FACTORS AFFECTING CHILD SURVIVAL IN KENYA

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DECLARATION

Except where it is indicated otherwise, this thesis is my own work carried out during my Ph.D Scholarship in the Graduate Program in Demography, Research School of Social Sciences, at the Australian National University from July 1992 to April 1996.

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DEDICATION

I dedicate this work to my wife, Ichalutu, and children, Amaja, Amoit, Amai and Ijaa.

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ABSTRACT

This study investigated some factors which affected child survival in Kenya. The study had three main objectives. First, to establish the effects of selected socioeconomic factors and proximate variables on infant and child mortality in Kenya. Second, to establish some of the mechanisms through which socioeconomic factors influenced infant and child mortality. Third, to identify the determinants of infant and child mortality in the two mortality regions: low- and high-mortality group of provinces; and to provide some insights into the differences in the levels of infant and child mortality between the two regions, using the case of Western and Central provinces.

This thesis was based on data from the 1988/89 Kenya Demographic and Health Survey (KDHS) and the information obtained from the author's field work in Western and Central provinces. The analytical model developed by Mosley and Chen (1984) was adopted to guide the study. Logistic regression was used to analyse effects of the explanatory variables on infant and child mortality.

The findings of the thesis showed that infant and child mortality varied according to socioeconomic status and proximate variables. Socioeconomic factors were shown to influence child survival through a complex web of pathways. Access to and use of health facilities, a toilet facility and piped drinking water were some of the mediating factors for most of the socioeconomic factors.

The determinants of infant mortality were the province of residence, survival status of the preceding child, preceding birth interval, household economic status, birth order, paternal education and possession of livestock. With respect to child mortality, the following factors had significant net effects: the province of residence, preceding birth interval, year of birth of the child, succeeding birth interval, ever-use

of modern contraception, household economic status and availability of a toilet facility.

Much of the differences in the levels of infant and child mortality between the low- and high-mortality regions were due to the differences in the structure of relationships between mortality and explanatory variables in the two regions. In the low-mortality region, the determinants of infant mortality were the survival status of the preceding sibling, preceding birth interval, birth order, household economic status and place of residence. In contrast in the high-mortality region, the determinants of infant mortality were the preceding birth interval, survival status of the preceding sibling, possession of livestock, paternal education, maternal education, household economic status and maternal age at birth.

In the low-mortality region, the determinants of child mortality were the preceding and succeeding birth intervals, maternal education and place of residence. In contrast in the high-mortality region, the determinants of child mortality were the preceding birth interval, year of birth of child, ever-use of modern contraception, succeeding birth interval and household economic status.

The results suggest that the differences in the levels of infant and child mortality between Western and Central provinces were due to the differences in the levels of social and economic development, accessibility and utilisation of health facilities, and climatic/ecological conditions in the two provinces.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Since independence in 1963, Kenya's policy initiatives and development programs have been concerned with the reduction of morbidity and mortality, particularly infant and child mortality. Consequently, an extensive public health infrastructure to provide both curative and preventive services (including family planning) has been established. Efforts have also been made to improve food security and distribution, provision of clean drinking water and adequate sanitation. Furthermore, a set of social and economic reforms intended to improve the average standards of living have been implemented since 1963 (Ministry of Planning and National Development (MPND), 1984: 143-165; 1989: 229-249). Although infant and child mortality rates have declined, they are still high, and wide regional variations exist (Ewbank *et al.*, 1986; Kichamu, 1986: 62-131; Venkatacharya, 1991: 29-37; National Council for Population and Development (NCPD), 1989: 58). This thesis sets out to examine the factors affecting infant and child mortality in Kenya.

Infant and child mortality rates are considered the most sensitive indicators of a nation's health status and socioeconomic development (Mahadevan *et al.*, 1985: 1; Blacker, 1991: 78; Hope, 1992: 151). Consequently, a study of infant and child mortality is relevant to various aspects of social, economic and health policy, planning and programming since high infant and child mortality rates are associated with poverty and deprivation (Mahadevan *et al.*, 1985: 1; Kent, 1991: 2). Infant and child mortality differentials can be indicative of the success of development programs undertaken to improve the well-being of a given people. For example, Caldwell and Ruzicka (1985: 187) observed that infant and child mortality differentials among strata of a given society provide an assessment of the extent of health problems and assist in the identification of the most vulnerable groups. Hence data on the levels and determinants of infant and child mortality are essential for planning, judicious resource allocation and implementation of development programs in any country.

Research on infant and child mortality in developing countries is important because infant and child mortality rates continue to be comparatively high, large variations exist and groups with the highest risk of mortality are numerically large (Behm, 1991: 7). In addition, a large proportion of deaths occurs during the first five years of life. It has been estimated that nearly half of all annual deaths that occurred in Kenya in the 1970s were deaths to children under age five (United Nations Economic Commission for Africa (UNECA), 1984: 113). Similarly, Kent (1991: 5) indicated that in the 1980s under-five deaths accounted for approximately one-third of all the deaths world-wide and in the developing countries they accounted for over half of all the deaths.

Furthermore, research on infant and child mortality is important because of the assumed relationship between fertility and mortality. Improvement in infant and child mortality rates may be necessary for triggering a decline in fertility (Chowdhury *et al.*, 1976: 258; Talyor *et al.*, 1976; Scrimshaw, 1978; Preston, 1978: 1-2; UN, 1984: 51; Okojie, 1991: 108-109; Barbieri, 1994: 27; Ohadike, 1995). The argument is that in conditions of high infant and child mortality parents usually opt for a larger family so that if some children die, they will still be able to achieve their desired family size, and when parents perceive that mortality is low they will adjust their fertility accordingly. For example, Ohadike (1995: 22-23) observed that the mortality decline during the 1960-93 period world-wide was negatively correlated with the level of synthetic fertility in 1993. He found a significant negative association between decline in fertility and decline in both infant and under-five mortality. Reduction in infant mortality has also been considered a necessary prerequisite for the acceptance of contraception (UN, 1972: 84; Mahadevan, 1979 cited in Mahadevan *et al.*, 1985: 1; Ross *et al.*, 1992: 7).

A fall in fertility can also bring about a reduction in infant and child mortality by reducing high order births which are usually subject to an elevated risk of mortality. With a total fertility rate of 5.4 in 1993, Kenya is one of the countries in sub-Saharan Africa with very high fertility (NCPD *et al.*, 1993: 8). As in other developing countries, the government of Kenya has been striving to improve the standard of living. However, this task is being complicated by high fertility that is sustaining rapid population growth. Therefore, a study such as this may generate information that can be used in the fertility reduction programs which are being implemented in Kenya.

1.2 Review of the literature: a global perspective

The mortality decline in different countries has been divided into three distinct categories also commonly known as models of mortality decline, according to the timing and tempo of the decline and the major factors accounting for the decline (Gwatkin, 1980: 616-637). The three models of mortality decline are the Western or Classic model, the Accelerated model and the Delayed or Contemporary model. The Western model seeks to describe the mortality decline in Western Europe, Australia and North America which began in the late 18th century and spanned a period of approximately 200 years. The western countries achieved a life expectancy at birth of about 70 years around the 1950s (Gwatkin, 1980: 616). The decline was largely due to improvements in socioeconomic conditions and was later accelerated by public health and medical advances and measures (Omran, 1971: 534).

The Accelerated model covers the mortality decline in Eastern and Southern Europe and Japan. In these countries the mortality decline started in the 19th century and was faster than in the case of the Western model. It was propelled by sanitary and medical advances as well as improvements in the socioeconomic conditions (Omran, 1971: 535). The Delayed or Contemporary model describes the relatively recent mortality decline in most of the developing countries. The decline in mortality occurred mainly as a result of the application of imported medical technology without concomitant improvements in the material conditions of life (Gwatkin, 1980: 616-617).

Generally, the decline began in the early 20th century and was more rapid after the Second World War (Omran, 1971: 536; Gwatkin, 1980: 616-617). Some scholars, notably Gwatkin (1980), Arriaga (1981), Ruzicka and Hansluwka (1982), argued that there was a deceleration in the rate of mortality decline in the developing countries in the late 1960s and early 1970s. The explanation for the deceleration lies in the relative contribution of socioeconomic development and application of imported medical technologies to the mortality decline in the developing countries. It has been argued that, when mortality levels are high, health and medical interventions are effective in reducing mortality but when mortality falls to relatively low levels, economic development, education and nutrition become crucial factors in determining further mortality decline (Hansluwka, 1978: 17; Caldwell, 1984: 104).

However, some recent studies on mortality decline in developing countries such as Sri Lanka, Kerala State in India, Costa Rica, and China indicate that political will, ideology and organisation played an important role in the mortality transition (Caldwell, 1989: 1-37). Mortality decline in Sri Lanka, Kerala State in India, Costa Rica and China has been attributed to other factors such as commitment to health as a social goal, equitable distribution of health and other welfare services, land tenure reforms, wide-spread mass participation in decision-making (especially in political processes), significant improvements in female educational attainment and autonomy (Rosero-Bixby, 1985: 129-137; Krishnan, 1985: 39-55; Rosenfield, 1985: 174-180; Caldwell, 1989: 1-49; Nag, 1990: 358-359).

The preceding discussion on the factors underlying mortality suggests that socioeconomic factors, environmental sanitation, and medical technology act in complementary ways to improve the mortality situation in developing countries. A certain level of socioeconomic development is necessary for health programs to become fully effective. There also appears to be a limit beyond which the effectiveness of health measures in reducing mortality declines. Once that stage is reached, any further gains in mortality reduction will depend on further improvements in socioeconomic conditions and positive changes in personal behaviour (Hansluwka, 1973: 283-300; Gwatkin, 1980: 617).

The literature shows that infant and child mortality have declined in both developed and developing countries. For example, UNICEF (1994: 82) indicates that infant mortality for the developed countries in 1960 was 36 per 1000 while that for the developing countries was 137. However, the corresponding rates in 1992 were 9 and 70, respectively. In 1960, the under-five mortality for the developed countries was estimated at 43 per 1000 while that for the developing countries was 216 per 1000. The 1960 under-five mortality estimates for sub-Saharan Africa and South Asia were 255 and 237 per 1000, respectively. The 1992 under-five mortality estimates for these regions show a considerable decline. The under-five estimates were 11 per 1000 for the developed countries, 104 for the developing countries, 181 for sub-Saharan Africa and 129 for South Asia (UNICEF, 1994: 82). These estimates show that the prospects of child survival in developing countries, though improving, are still poor.

Socioeconomic characteristics of the parents, such as levels of education, place of residence, region of residence and occupation, have been found to affect infant and child mortality (Caldwell, 1979: 408-413; Caldwell and McDonald, 1981: 75-76; Ewbank *et al.*, 1986: 48). Infant and child mortality have been found to be strongly and negatively associated with the level of education of the mother (Caldwell, 1979: 396). Since Caldwell's work on Nigeria, which indicated that mother's education had an independent effect on child survival, several other studies have found a positive association between mother's level of education and child survival. The results from the World Fertility Survey (WFS) showed that children of educated mothers had better survival chances than children of uneducated mothers (Hobcraft *et al.*, 1984: 197-221). Similar evidence has been obtained in other studies (Caldwell, 1989: 18-36; Mosley, 1989: 274; Cleland and van Ginneken, 1989: 80-92).

A review of the works of Cochrane *et al.* (1980) and the United Nations (1985) carried out by Cleland and van Ginneken (1989: 79-100) indicated that each year of increment in maternal education corresponds, on average, to a 7 to 9 per cent decline in childhood mortality. The inverse association between maternal education and infant and child mortality was found in all major regions of the developing countries. Like Rutstein (1984: 74), they showed that the effect of maternal education was greater on child mortality than on infant mortality.

Several mechanisms that mediate the effect of maternal education on infant and child mortality have been suggested. Sathar (1993: 234-236) reviewed some of the mechanisms. Caldwell (1979: 408-413, 1984: 108) suggested that education makes a mother less 'fatalistic' about illness as it promotes a stronger belief in modern medicine; it promotes hygienic practices and use of modern health facilities, and increases her ability to manipulate the world, including interacting with institutions and bureaucracies; and increases her intra-family power thereby allowing her to play a major role in decision-making and resource allocation which eventually may improve the health of her children. Similarly, Caldwell and McDonald (1981) argued that education of girls and women brings a new family system in which children and mothers are given a higher priority in terms of care and consumption than in the traditional society. Lindenbaum *et al.* (1985), based on their study in rural Bangladesh, argued that the only difference between educated and uneducated mothers was that educated mothers emphasised cleanliness, an attribute which they acquired while at school.

Ware (1984: 195-196) reported some studies conducted in Nepal which showed that educated mothers were better nourished (taller) than uneducated mothers because of the care they had been given by their parents when they themselves were children. In addition, educated women may be healthier because as girls they were spared the physical demands of domestic and agricultural work. Similar observations were made in a study among the middle class in Bangladesh (Lindendaum, 1990: 423-436). The height of the mother is one of the factors that has been reported to be closely associated with the birth weight of her children; taller women tend to bear heavier babies than do shorter women (Hytten and Leitch, 1971: 307-8; Dugdale *et al.* 1990: 25-

31). The height of the mother is determined in childhood and cannot be altered in adult women. Birth weight is the single most important factor affecting the chances of the new-born for survival and to experience healthy growth and development (WHO, 1980: 179-224 cited in Ward, 1993: 13; Das Gupta, 1990: 451).

Ware (1984) also argued that higher female education leads to women's better ability to make their own decisions and to understand the importance of hygiene and sanitation. Furthermore, she argued that education of the mother may also be a proxy for control of resources. Like Ware (1984), Das Gupta (1990: 456) observed that education improves the mother's basic child-care skills, and her domestic management of illness, and leads to better preventive care and use of medical services. She argued that maternal education improved child-care practices and that was one of the major pathways through which it helped to reduced child mortality in rural Punjab in India. Similarly, Cleland (1990: 400-420) argued that maternal education enhances knowledge about effective ways to prevent, recognise and treat childhood diseases, and according to him this is the main mechanism through which education of mothers influences child survival. He discounted the Lindendaum hypothesis on domestic cleanliness for lack of substantive empirical evidence.

LeVine (1980: 103) argued women's education as a part of the process of social change in developing countries, asserting that educated mothers tend to have well developed strategies for maximising the life chances of their children. Educated women are more likely to be aware of health problems, as well as to have greater access to improved sanitation and health facilities and services (LeVine *et al*, 1991). Mosley and Chen (1984: 29) suggested that better education of women and girls leads to a preference for modern health-care practices that improve children's survival.

Maternal education may also affect child survival through its influence on demographic factors such as age at first marriage and age at first birth, parity, and child spacing. Rutstein (1984: 74), in a cross-national study based on the World Fertility Survey (WFS), found a U-shaped pattern of association between child mortality and maternal age at birth. Educated women marry and start child bearing later, thus avoiding the high risk to child health associated with early pregnancies (Hobcraft, 1993: 161; World Bank, 1993: 42). They cease child bearing earlier, thus avoiding the elevated risks of infant and child mortality associated with advanced maternal age (Cleland and van Ginneken, 1989: 82). Educated women also tend to make greater use of contraception, hence lengthening the intervals between their births.

Analyses based on the Demographic and Health Survey (DHS) appear to support some of the above suggested mechanisms through which maternal education influences child survival (Hobcraft, 1993: 173). The results indicate that better educated women have better knowledge of Oral Therapy Sachets (ORS) and that they are more likely to use them for treatment of diarrhoea. They are more likely to use medical facilities for the treatment of diarrhoea episodes, fever, and coughs. Educated women are more likely to have initiated immunisation and even more likely to ensure that their children are fully immunised. They are also more likely to have received pre-natal care, to have been immunised with tetanus toxoid during pregnancy and to have their pregnancies attended by trained personnel. Better educated women also have fewer malnourished children.

A study in a rural village in Cameroon found that formally educated mothers were more attentive to the health of their children, noticed symptoms and identified illnesses more quickly than the uneducated mothers. They sought treatment for their children more often, especially biomedical treatment (Nyberg, 1993). Similarly, in Nepal educated mothers were more likely to use health facilities than uneducated mothers (Bhanu, 1994: 158). Therefore, as a consequence of their greater likelihood of using health services, of avoiding high-risk pregnancies and of experiencing fewer pregnancies, educated mothers are considerably less likely to die in childbirth and thereby orphan their children, with deleterious consequences.

However, evidence that is emerging from studies that controlled for the use of health services and maternal demographic factors (birth order, maternal age at birth, birth intervals) suggests that these factors do not explain much of the effect of maternal education on child survival. For example, using results from previous analyses carried out by Hobcraft *et al.* (1984, 1985) on the World Fertility Survey data, Cleland and van Ginneken (1989: 82-93) showed that the demographic factors did not account for much of the effect of maternal education on child survival. Barbieri (1990: 32), using the data drawn from the 1986 Senegal DHS, found that the use of health services and family formation patterns did not mediate much of the effect of maternal education on infant and child mortality in Senegal. Similarly, Bicego and Boerma (1991: 192), in a comparative study based on 17 countries that participated in the DHS program between 1986 and 1990, found that, with a few exceptions, birth order, maternal age at birth, and birth interval did not explain much of the effect of maternal education on child mortality and growth retardation.

A few studies have obtained results that show that in certain societies maternal education may not be significantly related to child survival. For example, Casterline *et al.* (1989: 25-29) showed that in Egypt maternal education was not significantly related to infant and child mortality with or without controls for a variety of other variables. Majumder (1989: 109-11) found that in Bangladesh maternal education was significantly related only to child mortality but not to infant mortality. He also showed that the effect of maternal education on child mortality was hardly reduced by controls for access to health services.

Streatfield *et al.* (1990: 453-455), in a small-scale study in Indonesia, found that educated women had greater awareness of correct immunisation schedules than did the less educated women, but the effect of maternal education disappeared when the mother had correct knowledge of vaccine functions. They concluded that it was possession of that specific knowledge rather than formal education *per se* that led a mother to ensure that her children received available vaccines. Gursoy (1992: 4), in a detailed small-scale study in a low-income area near Istanbul in Turkey, found that maternal education had little or no significant effect on infant mortality. Similarly, the analysis of the 1988 Uganda Demographic and Health Survey showed that maternal education had no significant effect on infant mortality (Ebong, 1993: 11).

Differentials in child survival in developing countries have also been found to be closely associated with paternal education. In fact some studies suggest that paternal education may be as important as or even more important than maternal education in determining infant and child mortality in some societies (Cochrane *et al.*, 1980; Caldwell and McDonald, 1981; Trussell and Hammerslough, 1983: 16; Aksit and Aksit, 1989: 571-572; Gursoy, 1992: 131-149; Toros and Kulu, 1988 cited in Gursoy, 1994: 183). Trussell and Hammerslough (1983: 16) showed that in Sri Lanka paternal education was more important in determining child mortality than was maternal education. Similarly, Martin *et al.* (1983: 422-425) found that paternal education was more important than maternal education in determining child mortality in Indonesia. In a recent study in a small area in Istanbul in Turkey, Gursoy (1992: 4) found that paternal education was the most important determinant of infant mortality and that maternal education was not significantly related to infant mortality.

Paternal education may influence child survival more through its role in determining household economic status than in directly affecting child-care skills. Thus, increased paternal education may increase access to health services, adequate food supply, better shelter or housing and sanitation facilities. Furthermore, educated fathers may initiate changes in the family's hygiene and food preparation practices that may have direct effect on child health and hence chances of survival.

Household economic status has been found to influence child survival (Jain, 1985: 422). It influences child survival, in principle, through access to goods and services that affect the health of children. Such goods and services include access to adequate calories and nutrients (food supply), access to health and medical services, clothing, good shelter and sanitary facilities. Household economic status is often measured in terms of household per capita income. Jain (1985: 422), Ruzicka and

Kane (1990: 333-334) and De Carvalho and Wood (1978: 417-419) observed that poverty had a positive effect on infant and child mortality. De Carvalho and Wood (1978: 417-419) indicate that in Brazil *per capita* income was inversely associated with child mortality and in particular infant mortality was sensitive to changes in *per capita* income.

Anker and Knowles (1980: 180-182) found a weak but a positive association between household annual *per capita* income and child survival to age three in Kenya. Children born in richer households have been found to experience a lower risk of death in childhood than children from poor households (Bhuiya, 1989: 67-68; Casterline *et al.* 1992: 245-260). However, the effect of household conditions as measured in terms of household income appears to differ with the age of the child. For example, Casterline *et al.* (1989: 25-30) show that in Egypt household income had no significant effect on infant mortality but had a statistically significant effect on child mortality. The effect remained statistically significant even in the multivariate analysis.

Mother's work status or occupation is also considered an important factor affecting infant and child mortality (Arriaga and Hobbs, 1982: 173; Hobcraft *et al.*, 1984: 196). The mother's work status determines the amount of time and care a mother can give to her child, and it may determine the amount of resources (income) available to the mother and as such her access to various goods and services. However, results obtained in studies conducted so far are mixed and appear to be inconclusive. Farah and Preston (1982: 372), in their study in the Sudan, found that children of working mothers experienced higher child mortality than children of housewives. They attributed the higher mortality among the children of working women to three possible factors: that children of working women were deprived of adequate child-care; that women's work was an indicator of economic hardships in the household, since in the Sudan full-time child bearing was a strongly sanctioned normative status of mothers; and that women who had lost a child were freed from child-care responsibilities and therefore were more likely to seek work.

working Nepalese mothers to the inadequacy of the time allocated to child-care and fatigue suffered by working mothers.

Residence in rural areas in developing countries has been associated with higher infant and child mortality risk than residence in urban areas (Gaisie, 1980: 24; Trussell and Hammerslough, 1983: 14-17; Caldwell and Ruzicka, 1985: 200; Jain, 1985: 416; Farah and Preston, 1982: 373: Pant, 1995: 130). Gaisie (1980: 24) argued that rural-urban mortality differentials in developing countries are attributable to distribution of health technology, sluggish economic growth, poverty, malnutrition, poor housing, unhealthy environment and low levels of education that disadvantaged rural populations. Urban areas usually contain the largest share of the country's well educated, high-income population and the best medical and health facilities.

Similarly, Behm and Vallin (1980: 29) observed that rural-urban mortality differentials were a reflection of the differences in socioeconomic standards of the populations in question, arguing that the place of residence *per se* did not explain mortality differentials. However, the effect of place of residence on child survival appears to differ from society to society. For example, Hull and Gubhaju (1986: 116) argued that, other things being equal, the place of residence was not significantly related to infant mortality in Indonesia. Although the place of residence had no significant net effects on infant mortality in Nepal, it was significantly related to child mortality even in the presence of the controls of maternal education, father's education, mother's work status and ever-use of modern contraception (Pant, 1995: 142)

Region of residence has been found to be associated with levels of infant and child mortality in many countries (Behm, 1980: 4-5; Gaisie, 1980: 18-19; Farah and Preston, 1982: 368; UN, 1985: 259-275; Jhamba, 1995: 109-156; Pant, 1995: 214-245). Regional mortality differentials may be due to the differences in parental social and economic characteristics, macro-economic conditions, availability and accessibility of health services and other basic welfare services. For example, De Carvalho and Wood

Many of the studies cited in Dwyer and Bruce (1988) suggest an inverse relationship between child health and female labour force participation, while some other studies suggest that, after controlling for family income, children are better fed and looked after in households where women are in paid employment outside the household. Also studies by Engle (1989: 179-200) and Tucker (1989: 161-177) and other similar studies cited in Leslie and Paolisso (1989) show mixed results. However, these studies did not explicitly focus on the association between female labour force participation and infant and child mortality but on the association between mother's work status and the nutritional status of her children. Similarly, using WFS data from 29 developing countries, Hobcraft *et al.* (1984: 202-203) found a higher risk of mortality among infants of mothers who worked as family workers or other compared to the infants of mothers who did not work in some countries.

Basu and Basu (1991: 96), using the 1981 census of India and another set of small-scale survey data, found a direct association between child mortality and female labour force participation. They found that the children whose mothers were working experienced higher child mortality than the children whose mothers were not working and attributed the higher mortality among the children whose mothers were working to the inability of working mothers to give adequate care to their children and to breastfeed them properly. However, their results have been contradicted by the results of the more recent study by Tulasidhar (1993) that was based on the same 1981 census data. Tulasidhar (1993: 184-189) found a statistically significant inverse relationship between child mortality and female labour force participation in India, thus lending support to other studies suggesting the favourable impact of maternal labour force participation on child survival. The difference in results obtained could be due to the fact that Basu and Basu used aggregated data, while Tulasidhar used disaggregated data and also used maternal education as a control variable.

Like Basu and Basu (1991), Pant (1995: 130-131) found higher risks of infant and child mortality among children of working mothers than children of non working mothers in Nepal. He attributed the elevated risks of infant and child death among

(1978: 417-419) argued that regional variations in infant and child mortality in Brazil were a reflection of regional differences in socioeconomic characteristics such as maternal education. The differences in infant and child mortality between the low and high-mortality regions in Nepal have been attributed mainly to the differences in parental social, economic and cultural characteristics (Pant, 1995: 245-247).

Regional variations in the level of mortality may also be due to the differences in ecological/climatic conditions which may influence the prevalence of infectious and parasitic diseases. Disease environment has been given as an alternative explanation for the regional variations in infant and child mortality in Tanzania (Hogan and Jiwani, 1973 cited in UN, 1985: 259), the Sudan (Farah and Preston, 1982: 368), Kenya (Anker and Knowles, 1980: 176-183; Mott, 1982: 19; Ominde, 1988: 110-117) and the United States of America (Preston and Haines, 1991: 109-116).

The age of the mother at child birth, her parity or the birth order of the child and intervals between births, and previous child loss have been found in the literature to be closely related to infant and child mortality (Hobcraft *et al.*, 1984; Da Vanzo, 1984: 313-315; Rutstein, 1984: 74; De Sweemer, 1984: 47-74; Cleland and Sathar, 1984: 408-413; Palloni and Tiende, 1986: 40-48; Gubhaju, 1984: 134). For example, Rutstein (1984: 74) in a cross-national comparative study based on the World Fertility Survey (WFS) data drawn from developing countries, found that the age of the mother, parity and child mortality relationship had a U-shaped pattern; mortality risks were highest among children born to very young mothers and those born to older mothers, and at the first and highest parities.

The higher risk of dying among children born to older mothers may be a result of a decline in the efficacy in the reproductive system with age and economic pressure in the family, while the excess risk at young maternal ages is partly due physical immaturity, lack of child-care skills and access to health care services (Da Vanzo *et al.*, 1983: 394; Pebley and Stupp, 1987: 42). Pebley and Stupp (1987: 43) are of the opinion that, irrespective of the age of the mother, first-born children may be at a greater risk of mortality because their mothers' reproductive system is in the process of adapting to pregnancy, or because their mothers are less likely to receive adequate pre-natal care and to know how to care for themselves during pregnancy.

Birth intervals have been found to be negatively associated with both infant and child mortality. Following previous investigations, Hobcraft *et al.*, (1984) found that one of the strongest and most persistent maternal differentials in infant and child mortality was in relation to the immediately preceding birth interval. Other studies conducted in India (De Sweemer, 1984: 47-74), Pakistan (Cleland and Sathar, 1984: 408-413), Malaysia (Da Vanzo, 1984: 308-316), Bangladesh (Al-Kadir, 1984: 32), Latin America (Palloni and Tiende, 1986: 40-48; Palloni, 1989: 164-166), Uganda (Ebong, 1993: 11-12), Tanzania (Bureau of Statistics, 1993: 76), Zimbabwe (Jhamba, 1995: 241-245) and Nepal (Pant, 1995) found a negative association between birth intervals and the risk of child death.

Several mechanisms have been suggested to explain the association between birth interval and child survival. De Sweemer (1984: 50), Palloni and Millman (1986: 216), Potter (1988: 447), and Boerma and Bicego (1992: 244-245) suggested that maternal depletion and sibling competition for maternal attention and other household resources are the possible mechanisms that link short birth intervals and poor child survival prospects. Short preceding birth intervals are likely to lead to the deterioration of the mother's capacity to adequately host a foetus and to facilitate its normal growth process. They are also likely to impair the mother's capacity to produce milk. Closely spaced births lead to increased sibling competition for scarce resources, including maternal care, among children in the household. Disease transmission among closely spaced siblings has been suggested as another mechanism linking short birth interval and poor survival prospects of the index child (Palloni and Millman, 1986; Koenig *et al.*, 1990: 250; Boerma and Bicego, 1992: 245-246).

As for the succeeding birth interval, a number of studies have found negative effects on the health of the first child resulting from the birth of the second child of the pair (Hobcraft *et al.*, 1983: 593-610; Palloni and Tiende, 1986: 40-48; Pebley and Stupp, 1987: 46). Three mechanisms are involved in this relationship. First, the occurrence of a conception shortly after a live birth curtails breastfeeding and thus does not allow for mature weaning. Second, competition among siblings for scarce resources in the household increases. Third, the mother's capacity to attend to the needs of older children during her pregnancy is likely to deteriorate (Abdel Aziz, 1988: 17; Palloni, 1989: 164-166).

However, a few studies suggest that in certain societies birth intervals might have no statistically significant effect on infant and child mortality or contradict the usual observed negative association between mortality risk and the preceding birth interval. For instance, a small-scale study in a rural area of Machakos district in Kenya found that children with shorter preceding or succeeding birth intervals did not experience a higher risk of mortality or growth retardation during the first two years of life than children with longer birth intervals (Boerma and van Vianen, 1984: 479-484). Similarly, Kim (1986: 192), in a study based on the 1974 Korean Fertility Survey data, obtained results that contradicted the usually observed negative association between mortality risk and the preceding birth interval. In the study, it was found that the mortality risk between ages one and five years for children with a preceding birth interval of more than three years was significantly greater than that of the children with preceding birth intervals of 2-3 years.

. Differentials in child survival have also been found to be closely associated with the survival status of the preceding child in a family. Several studies have documented the existence of a close correlation between the mortality risks of two successive births to a mother (Gubhaju, 1984: 134; Hull and Gubhaju, 1986: 109-118; Das Gupta, 1990: 451-453; Ebong, 1993: 12; Jhamba, 1995: 242-243). These studies suggest that children whose immediately preceding siblings are dead have a greater risk of mortality than the children whose older siblings are alive. For instance, in Nepal, the risk of infant and child mortality was substantially higher for the children with their immediately preceding sibling dead than among the children with their immediately preceding sibling alive (Gubhaju, 1984: 134).

The influence of the survival status of the preceding child on the mortality risk of the index child is explicable in terms of the existence or lack of sibling competition for maternal attention and household resources (Hobcraft, 1987: 10; Koenig *et al.*, 1990: 250). The increased risk of mortality of an index child preceded by a sibling who died could be due to shared common biological, social and even behavioural problems affecting the mothers of such children (Winikoff, 1983: 232; Hobcraft, 1987: 10).

The sex of the child has been reported in certain societies to be an important factor influencing mortality risk in infancy as well as between ages one and five years. In some countries, particularly in South East Asia and the Middle East, recent studies have documented excess female mortality in childhood as a reflection of the discriminatory attitude of parents towards female children (Chen *et al.*, 1981: 57-67; Das Gupta, 1987: 81-83; Majumder, 1989: 62-64). For example, Das Gupta in her study in rural Punjub found that, during the neonatal period, male mortality was higher than female mortality. However, between the ages of one and 24 months, when the majority of the deaths took place, mortality rates of girls were nearly twice as high as those of boys. She attributed the higher post-neonatal female mortality to behavioural factors.

Household environmental conditions proxied by amenities such as availability of clean drinking water, presence of toilet facilities and general environmental sanitation have been found to influence infant and child mortality. Poor water and sanitation have often been associated with high infant and child mortality. Agarwal and Ketiyer (1981: 545-550), in a study in India, reported that morbidity was higher among children who lived in poorly ventilated houses which had a source of water supply in the form of an open well, and where families defecated in the fields.

Da Vanzo *et al.* (1983: 396) in their study in Malaysia, indicated that the infant mortality of infants born into households with piped water was lower than the mortality of infants born into households where water was obtained from other sources such as wells, rivers or canals. In addition, they found that infants born in households with a toilet facility were significantly less likely to die throughout their first year of life than children born into households without a toilet facility (a difference of 42 per 1000). Access to toilet facilities has been one the factors that contributed to the decline in infant mortality in the Philippines (Martin *et al.*, 1983) and in Malaysia (Da Vanzo and Habicht, 1986; Peterson *et al.*, 1986). The presence of a toilet facility in the household was also found to have a negative effect on child mortality in Sri Lanka (Trussell and Hammerslough, 1983: 16). Similarly, access to piped water was found to be significantly related to child mortality in urban Brazil (Merrick, 1985: 12-18).

However, it is worthwhile to note that in some societies the household's source of drinking water and sanitation may not have a significant effect on child survival. For example, Haines and Avery (1982) indicated that sanitation variables had very little effect on infant mortality in Mexico, Puerto Rico and Costa Rica. Similarly, Jhamba (1995: 144-145) found a negative but weak association between a household's source of water supply, sanitation and under-five mortality in Zimbabwe.

Access to and use of maternal and child health services, both preventive and curative, directly influence child survival. Nag (1985: 67) indicated that the greater access and utilisation of health facilities in Kerala State, India, was the most important factor that placed Kerala in a better position in comparison with West Bengal in India. The 1985 United Nations comparative study of effects of socioeconomic factors on child mortality indicated that in Nigeria and Peru (the only two countries that had appropriate data on health care), both access to and utilisation of health services were positively related to child survival (UN, 1985: 281). Studies in Africa show that the use of health services was inversely associated with child mortality (Orubuloye and Caldwell, 1975: 263-267; Mbackè and van de Walle, 1992: 130-134; Ewbank, 1993: 64-72; Ewbank and Gribble, 1993; Becker *et al.*, 1993). For example, Ewbank and Gribble (1993) argued that the provision and utilisation of health services was one of the factors closely associated with the decline in infant and child mortality in sub-Saharan Africa.

In the recent past, a few studies have examined the effect of use of modern contraception on infant and child mortality. A study in rural Thailand indicated that the use of contraceptives, a proxy variable for use of health services, had a favourable effect on child survival (Frenzen and Hogan, 1982: 401). In Pakistan ever-use of contraception was found to have a positive effect on child survival but its effect was not statistically significant (Tauseef, 1992: 54). Ever-use of modern contraception was found to be negatively and significantly related to child mortality in Zimbabwe. Its effect was net of maternal education, age at first marriage, pre-natal care for that child, rural-urban residence and region of residence (Jhamba, 1995: 177-178). Similarly, in Nepal ever-use of modern contraception was associated with lower risks of infant and child mortality (Pant, 1995: 130-144).

Infant and child mortality differentials by various characteristics change over time (Preston, 1976). For example, Rosero-Bixby (1985) noted that in Costa Rica, differentials in infant and child mortality by maternal education decreased between 1965-69 and 1975-79 because public health programs improved access of poorly educated mothers to health facilities, thereby reducing their disadvantage. It has also been suggested that the relative importance of health measures and medical technological advances as determinants of mortality transition change over time. In line with the demographic transition theory, health measures and medical technology are more closely associated with mortality decline during the early stages of mortality transition when mortality is high. However, as mortality falls the relative importance of health and medical factors also falls but the importance of socioeconomic development, education and nutrition as determinants of mortality increases.

1.3 Review of infant and child mortality studies in Kenya

Several studies have been conducted on infant and child mortality in Kenya. The earliest estimates of infant mortality based on small-scale sample surveys conducted in various parts of the country for other purposes showed that between 1922 and 1933 infant mortality varied greatly between 100 and 400 per 1000 live births (Kuczynski, 1949). An estimate of 184 infant deaths per 1000 live births was obtained from the 1948 census data (Martin, 1953). Indirect estimates of infant and child mortality from the 1969 and 1979 Census have been made (Kibet, 1982; Kichamu, 1986; Adienge, 1987; Ottieno and Kichamu, 1986). Estimates of infant and child mortality have also been obtained from the 1977/78 Kenya Fertility Survey (Central Bureau of Statistics (CBS), 1981), Kenya Contraceptive Prevalence Survey (Ondimu, 1987) and Kenya Demographic and Health Surveys of 1988/89 and 1993 (NCPD, 1989; NCPD *et al.*, 1993).

Brass (1993: 74-76) and Brass and Jolly (1993: 25-48) investigated changes and differentials in child mortality on the basis of the 1977/78 Kenya Fertility Survey and the 1988/89 KDHS. Some preliminary estimates of infant and child mortality based on the 1989 census have also been made (MPND and UNICEF, 1992). These estimates show that infant and child mortality have been declining in Kenya since the 1950s, and that both infant and child mortality vary by socioeconomic strata. Infant mortality declined from 184 per 1000 live births in 1948 to about 60 in 1989, while child mortality dropped from 262 in 1948 to about 100 in 1989 (Brass and Jolly, 1993: 14), Life expectancy increased from 35 in 1948 to 59 years in 1989.

Maternal education, paternal education, region of residence, and household income have been identified as being closely related to infant and child mortality (Anker and Knowles, 1980; Kibet, 1982; Muganzi, 1984; UN, 1985; Mosley, 1989). Maternal education has been identified as a very important determinant of both infant and child mortality in Kenya. Infants and children of educated mothers have been found to have lower risks of death than those of uneducated mothers. Some scholars have attributed the observed mortality decline in Kenya to the increasing level of education, particularly education of mothers (Kibet, 1982; Mosley, 1989: 274). For instance, Mosley (1989: 274) argued that improvements in maternal education accounted for 86 per cent of the decline in child mortality between 1962 and 1979 and between the provinces of Kenya, and that the rest of decline was explained by improvements in household incomes.

Substantial regional variations in infant and child mortality exist in Kenya (Kibet, 1982; Kichamu, 1986; Ottieno and Kichamu, 1986: 417-423; Ewbank *et al.*, 1986: 42-44; NCPD, 1989: 58; Venkatacharya, 1991; NCPD *et al.*, 1993). Infant and child mortality has been found to be higher in Nyanza, Western and Coast provinces than in the other provinces. Regional differences in access to and utilisation of health services, levels of social and economic development, nutritional status and ecological conditions have been offered as possible explanations for the regional variation in infant and child mortality in Kenya (Anker and Knowles, 1980: 176-183; Mott, 1982: 19; Ominde, 1988: 110-117). For example, Anker and Knowles (1980: 182) indicated that the endemic presence of malaria, a proxy for disease prevalence, was significantly and negatively associated with life expectation at birth and child survival rates to age three. They found that children born to families residing in malarial areas had a lower (by about seven years) life expectation at birth than children born to families residing in areas where malaria was less common or non-existent.

Rural-urban residence differentials in infant and child mortality have been documented in several studies in Kenya; rural residence has been associated with slightly higher infant and child mortality than residence in urban areas (Muganzi, 1984: 41; Ewbank *et al.*, 1986: 52; Venkatacharya, 1991: 35). The analysis carried out by Ewbank *et al.* (1986: 52) showed that the rural-urban differentials in infant and child mortality disappeared in the presence of controls for a variety of factors. NCPD (1989: 57) indicated that although rural infant mortality was a slightly higher than urban infant mortality, rural and urban child mortality rates were more or less equal (34.2 and 34.3 for rural and urban areas, respectively). However, the analysis of Venkatacharya (1991: 34), which used the 1977/78 Kenya Fertility Survey data and the method suggested by Trussell and Preston (1982), indicated significant under-five mortality differentials by place of residence. His study found that under-five mortality in rural areas was higher than in large urban areas, even after controlling for maternal and paternal education, ethnicity and religion.

Differentials in early childhood and under-five mortality between ethnic groups have been documented in Kenya (Ubomba-Jaswa, 1989; Venkatacharya, 1991). For example, Venkatacharya (1991: 35) indicated that ethnicity was significantly associated with under-five mortality. His study indicated that children born to the Luo group had the highest mortality risks, followed by those of the Luhya group. Children of the Kikuyu had the lowest mortality risks. The effect of ethnicity was net of the effects of type of place of residence, maternal education, paternal education and religion.

Empirical evidence on the association between female labour force participation and child health in Kenya is scanty. The 1985 United Nations' cross-national study showed that child mortality was slightly lower among children of working mothers than among children of mothers in unpaid family work (UN, 1985: 161). Using the 1977/78 Kenya Fertility Survey, Ewbank *et al.* (1986: 50) found that mother's place of work since first marriage had no significant effect on child mortality after controlling for a variety of socioeconomic factors. They attributed the result to the conflicting influences of increased bottle feeding and use of health services by working mothers.

The effects of maternal factors such as current age of mother, marital status, and type of marriage have also been found to affect infant mortality in Kenya (Mott, 1982: 10-19; Muganzi, 1984: 78-91). Infant mortality and child mortality have also been found to be negatively associated with the length of breastfeeding (Muganzi, 1982: 78; Awino, 1989; Bankole and Olaleye, 1991: 1045-1071). Birth order and mother's age at birth have also been indicated to be related to infant and child mortality (Mott, 1982: 14-16; Rutstein, 1984: 29). Differentials in child survival have also been found to be closely associated with birth intervals (Muganzi, 1984: 78; Rutstein, 1984: 32). For example, using the 1977/78 Kenya Fertility Survey data, Muganzi, (1984: 78) indicated a positive association between inter-pregnancy interval and child survival during infancy. As indicated earlier, a small-scale study in a rural area of Machakos district in Kenya found that birth intervals had no significant effect on child health and mortality. The results obtained show that children with shorter preceding or succeeding birth intervals did not experience a higher risk of mortality or growth retardation during the first two years of life than the children with longer birth intervals (Boerma and van Vianen, 1984: 479-483).

Using the 1979 census, Ewbank *et al.* (1986: 45) found a small mortality differential by sex of the child; male children were found to have slightly higher infant and child mortality. Analysis of the 1977/78 Kenya Fertility Survey also indicated similar results (Mott, 1982: 15). Muganzi (1984: 78) found a weak association between sex of the child and infant mortality in Kenya; the effect of sex of the child on infant mortality was significant at the 10 per cent level. A recent review of child mortality differentials by sex in sub-Saharan Africa also indicated a weak association between sex of the child and infant mortality in Kenya and a number of other countries in the region (Gbenyon and Locoh, 1991: 233-247). However, the study did not find significant sex differences in child mortality at the 5 per cent level in Kenya.

1.4 Research problems and justifications

Although a number of studies on infant and child mortality have been carried out in Kenya, the determinants of infant and child mortality are still poorly understood. For example, is maternal education still significantly related to infant and child mortality after controlling for a number of other explanatory variables? Most of the previous studies focused on indirect estimation of infant and child mortality levels and differentials on the basis of the 1969 and 1979 census (Kibet, 1982; Kichamu, 1986: 62-131; Ottieno and Kichamu, 1986; Mosley, 1989). Similarly, most studies that carried out multivariate analyses used indirect measures of child mortality. For example, Kibet (1982) used an indirect estimate of the probability of dying by age two as the dependent variable in his district-level analysis of child mortality.

Anker and Knowles (1980) used life expectation at birth and survival status at age three, respectively, for their district-and household-level analyses. Data for their district level analysis were drawn from government publications and the district estimates of life expectation at birth were based on the 1969 census. Household-level analysis was based on a sample survey conducted in 1974 by the International Labour Organisation and the University of Nairobi. Venkatacharya (1991: 29-37) used the 1977/78 Kenya Fertility Survey data to examine some of the determinants of under-five mortality, using the methodology suggested by Trussell and Preston (1982). This thesis will relate infant and child mortality directly to the population exposed to the risk of mortality. Infant mortality will be based a cohort of live births. Similarly, child mortality will be based on a cohort of children who survived to age one. This avoids the problems caused by violations of some of the assumptions underlying the methodology suggested by Tressell and Preston (1982) method and the other methods of indirect estimation of infant and child mortality (Hill, 1989). The separation of analysis of infant mortality from that of child mortality is also important because the factors that affect infant mortality are bound to be different from those that affect child mortality.

In principle, socioeconomic factors such as maternal education influence infant and child mortality indirectly, that is through other factors (Mosley and Chen, 1984: 25-29). The mechanisms or pathways through which socioeconomic factors influence child survival in Kenya have not been identified. For example, the mortality advantage of maternal education and the role of maternal education in infant and child mortality decline have been highlighted by most studies conducted in Kenya (Anker and Knowles, 1980; Kibet, 1982; Muganzi, 1984; Kichamu, 1986; Mosley, 1989). However, the mechanisms through which maternal educations operates to influence child health and hence mortality in Kenya have not been identified and thus are poorly understood.

The development and improvement of policies and intervention programs that seek to reduce mortality require that the pathways of influence through which socioeconomic factors operate be understood. Mosley and Chen (1984) suggested that the variables mediating the effects of socioeconomic factors on child health and mortality are the most amenable to policy intervention. Thus, it is worthwhile to identify some of the mechanisms through which socioeconomic factors such as maternal education influence child survival in Kenya since such factors affect child survival mainly through variables directly related to child health.

, In spite of the fact that child survival has improved since 1948, infant and child mortality rates are still quite high in Western, Coast and Nyanza provinces. At the same time infant and child mortality rates have been comparatively low in Central province. For example, in 1979, infant mortality rates in Western, Coast and Nyanza provinces were 120, 101 and 133 per 1000 respectively, compared to 61 in Central province (Ottieno and Kichamu, 1986: 417-423). The determinants of provincial differentials in infant and child. mortality are poorly understood. Are the determinants of infant and child mortality in the high-mortality provinces the same as those in the low-mortality provinces? For example, does maternal education have the same effect on infant or child mortality in the high-mortality provinces as in the low-mortality provinces? To what extent do the socioeconomic and demographic characteristics of the populations in the different provinces account for the observed differences in the levels of infant and child mortality between the provinces? This thesis will address these issues with a view to contributing to a better understanding of why infant and child mortality are higher in certain provinces than in others.

As pointed out earlier, studies conducted in Nepal (Gubhaju, 1984: 134; Pant, 1995: 102-105), Bangladesh (Majumder, 1989: 132-178), Indonesia (Hull and Gubhaju, 1986: 109-118) and Uganda (Ebong, 1993: 12) indicate the existence of an intra-familial mortality relationship, that is a close correlation between the mortality of two close births to the same mother. These studies indicated that the mortality risk of the subsequent child was significantly higher when the preceding child had died than when it survived, and that the survival status of the preceding child was an important factor determining infant and child mortality. It is therefore worthwhile to investigate whether in the Kenyan context there is a close correlation between the mortality risk of two successive children born to the same mother in Kenya.

Kenya adopted the family planning program in 1967 to regulate fertility with a view to checking population growth and to improving maternal and child health (Ministry of Economic Planning and Development, 1967). Although family planning services have been officially promoted since then, the extent to which family planning services can explain child survival prospects is poorly understood. Past studies in Kenya have used information on family planning services to study fertility (Odile and McNicoll, 1987; Ngoju and Martin, 1991; Robinson, 1992: 445-457; Brass and Jolly, 1993; Brass, 1995), use or non-use of contraception (Ikamari, 1985), and unmet need for contraceptives (Westoff and Ochoa, 1991). If family planning services are associated at all with child survival, it is not clear whether the association is due to child spacing or to the use of other maternal and child health services being delivered in conjunction with family planning services, since contraceptive use is highly correlated with use of health services (Potter, 1988: 447-448; Tam, 1991: 1789). It should be noted that use of contraception is not a factor reducing infant and child mortality but a proxy variable to substitute for instance, spacing, for elimination of high order births, and use of primary health services (usually offered with family planning services).

A number of other mechanisms through which use of contraception influence child survival have been suggested. Chen *et al.* (1983: 203) suggested that contraception influences child survival through alteration in the distribution of births. Similarly, Trussell and Pebley (1984: 267) and Palloni and Pinto (1989: 363) argued that contraception reduces births with elevated risk of mortality through changing the age of mother, birth order and inter-pregnancy interval.

A review of the literature on the effects of birth intervals on infant and child mortality in Kenya has indicated contradictory results. Muganzi (1984: 78) indicated that the birth intervals, measured as the interval between two successive pregnancies, were significantly and negatively associated with infant mortality. Similarly, the bivariate analyses of Rutstein (1984: 32) showed that birth intervals were negatively associated with infant and child mortality in Kenya. However, Boerma and van Vianen (1984: 479-484) found that birth intervals (both preceding and succeeding) had no effect on infant and child mortality in a rural area of Kenya. Hence, due to the contradictory findings on the effects of birth intervals on infant and child mortality in Kenya, it is worthwhile to re-examine the effect of birth intervals on child survival in Kenya using the 1988/89 KDHS data, and to distinguish between the effects of preceding and succeeding birth interval and taking into account the effect of the survival status of the preceding birth on the mortality of the index child. Hence, in this thesis birth intervals will be measured as the interval that elapsed between two successive live births, that is the time in months that elapsed between the delivery of one live birth and the delivery of the next live birth.

The identification of factors that affect child survival in Kenya as well as in the low- and high-mortality provinces of the country is necessary for the development and improvement of policies and intervention programs that seek to enhance child survival. A clear understanding of the mechanisms through which socioeconomic factors influence child survival would greatly assist policy formulation and selection of appropriate intervention programs. Equally important is the identification of mothers whose children experience low survival rates. Once such mothers are identified, they can be targeted for special assistance. Furthermore, given the limited national resources, it is imperative that the effects on child survival of intervention programs such as family planning, which are being implemented in Kenya, be identified so that efficient allocation of the limited resources can be made. Thus, this thesis will examine some of these issues.

1.5 Objectives

This study seeks to identify some of the determinants of infant and child mortality in Kenya in general and in the low- and high-mortality regions of the country in particular. It also seeks to identify some of the mechanisms through which socioeconomic factors influence infant and child mortality. Furthermore, it investigates the relative roles of the differences in the levels of explanatory variables and the differences in the nature of relationships between mortality and explanatory variables in explaining variations in infant and child mortality between low- and high-mortality regions of Kenya.

Hence this study has a national and regional focus. Regional analysis encompasses a comparative study of infant and child mortality study by province of residence, and between the low- and high-mortality regions, and a comparative study between Western and Central provinces. Because of lack of data on breastfeeding, various forms of immunisation and other health variables for most of the children considered in this study, the effects of these variables on infant and child mortality were not examined in this study. However, where appropriate, references will be made to the possible effects on child survival of some of these factors.

More specifically, the study will investigate:

(i) the effect on infant and child mortality of a set of socioeconomic factors; namely maternal education, paternal education, household economic conditions, mother's work status, possession of livestock, province of residence, and type of place of residence;

(ii) the effect on infant and child mortality of maternal age at birth, birth intervals, and birth order of the child, survival status of the preceding child, and use of contraception

(iii) whether or not the effect, if any, of ever-use of modern contraception was mediated through birth intervals to influence infant and child mortality; and

(iv) the effect on infant and child mortality of household's source of drinking water and toilet facility.

Furthermore, the study seeks to identify:

(i) some of the mechanisms through which maternal education, paternal education, mother's work status, household economic status, province of residence and type of place of residence variables influence infant and child mortality;

(ii) some of the determinants of infant and child mortality in the low- and high-mortality regions of Kenya;

(iii) the relative roles of the differences in the values of explanatory variables and structure of relations between mortality and explanatory variables in explaining the difference in the levels of infant and child mortality between the low- and high-mortality regions of Kenya; and

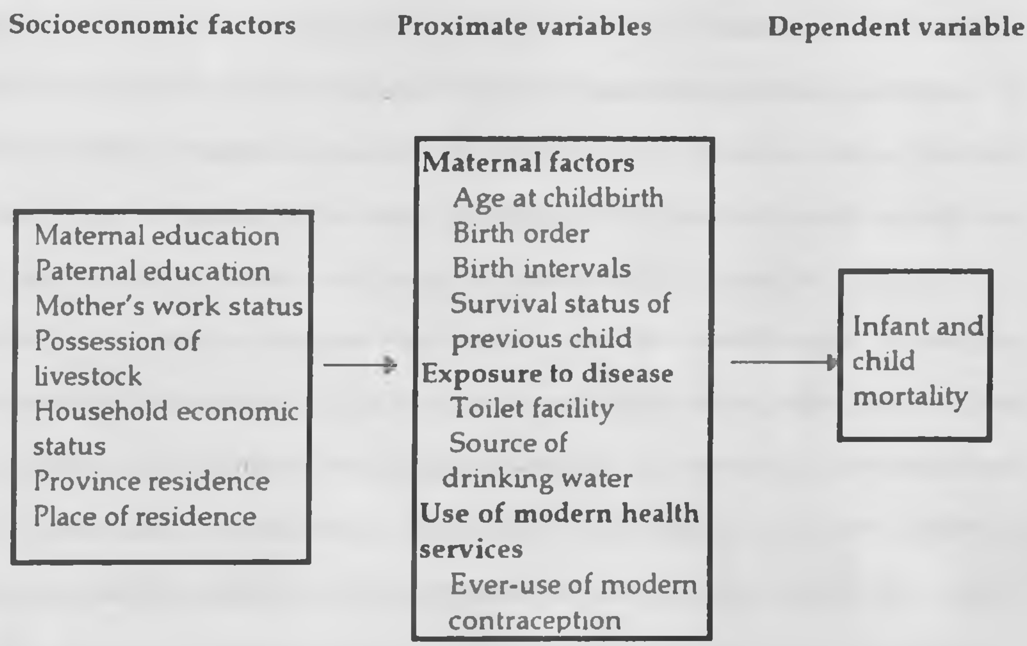
(iv) some of factors that could be associated with lower infant and child mortality in Central province relative to Western province.

1.6 Conceptual framework

Any attempt to investigate the effects of various variables on child survival requires the specification of a framework that incorporates all the relevant factors that directly or indirectly affect child health and mortality. A framework identifies causal linkages between different factors that affect child health and mortality. Furthermore, a framework assists in the understanding of factors that may cause a change in the mortality level in a given society. Several frameworks have been developed to link various factors to child health and mortality (Mosley and Chen, 1984: 25-45; Schultz, 1984: 215-234; Mahadevan, 1986; Venkatacharya, 1985: 237-250; Norren and Vianen, 1986; Cornia *et al.*, 1987: 35-41; Berman *et al.*, 1994: 205-215; Millard, 1994: 253-268). The most comprehensive and systematic framework is that developed by Mosley and Chen (1984: 25-45). Thus it has been the most popular and widely adopted model in studies of child survival. This study adopts this model because it incorporates both social and medical factors into a coherent analytical framework and provides a convenient and practical guide for studying child survival. Furthermore, it is flexible so that it can be modified to suit any particular situation.

Due to limitations of the data and methodological considerations, this study will focus only on a few socioeconomic factors, maternal factors, environmental contamination (exposure to disease) factors, and access and use of health services. The operational framework for this study is shown in Figure 1.1. However, where necessary and appropriate, reference will be made to some of the other components of the Mosley and Chen framework. For example, in explaining regional variations in infant and child mortality, reference will be made to regional differences in childhood nutritional status, ecological setting, availability and accessibility of health services.

Figure 1.1 **An operational framework for studying child survival**



Source: Adapted from Mosley and Chen (1984: 29)

As shown in Figure 1.1, the socioeconomic factors included in this study are province of residence, place of residence, maternal education, paternal education, mother's work status, possession of livestock, and household economic status. These factors are expected to affect child survival and their respective effects are mediated through intervening variables, some of which are included in the box denoting proximate variables.

Province of residence and place of residence are important because they indicate aspects of social and economic development that are not captured by the other socioeconomic factors included in this study. Province of residence also represents climatic and ecological conditions that influence the incidence of various diseases at the community level. Both province of residence and place of residence reflect differences in parental cultural attributes that influence utilisation of health services, child-care practices and reproductive behaviour (maternal factors). Infant and child mortality are expected to vary between the provinces and by place of residence.

Maternal education, paternal education, household economic status are each expected to be positively to associated with child survival. Possession of livestock is another socioeconomic factor used here to indicate household economic conditions. In addition to being a traditional indicator of wealth of a household in Kenya, livestock can be a source of income to the family as some of their products, such as milk and meat, can be sold to obtain cash money or can directly be used by members of a household to maintain or improve their nutrition and thus health status. Possession of livestock can be important for child survival particularly during infancy as livestock can be a source of nutritious food (milk). Livestock[1] as a source of nutritious food could be particularly crucial for the infants born to mothers who are not capable of producing enough breast milk or do no want to breastfeed or who cannot find time to breastfed regularly. Expectations are that household economic and possession of livestock are positively associated with child survival.

This study considered only a few proximate variables. Maternal factors comprise maternal age at birth, birth order, birth intervals, and survival status of the preceding child. Each of these maternal factors is expected to have a significant effect on child survival. Exposure to disease is represented by presence of a toilet facility in the household and source of drinking water. These two variables are expect to affect child survival.

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[1]The most commonly kept livestock in Kenya are cattle (cows, bulls, oxen, goats)

Although assessing the effect of ever-use of modern contraception on child survival is one of the objectives of this study, the variable is also used here as a crude proxy for access to and use of modern health facilities because of lack of more appropriate data for most of the live births covered in this study. The use of contraception as a proxy for use of health services and as evidence of modern attitude to life was found, for instance, in Wolfers and Scrimshaw (1975: 482). Pant (1995) used ever-use of contraception as a proxy for use of health services. It is assumed that a mother who had used a modern contraception method was more likely to use other health services, as family planning services in Kenya are integrated with other maternal and child health-care services. The expectation is that ever-use of modern contraception is positively associated with child survival.

1.7 Study organisation

The study is organised into nine chapters. Chapter One provided a brief discussion on the importance of the research on child survival in developing countries, the review of the literature, research problems and justifications, research objectives and the conceptual framework. Chapter Two provides background information on Kenya which is necessary for the understanding and the interpretation of the results. Chapter Three presents and discusses sources of data, evaluation of the quality of the 1988/89 KDHS data, methods of analysis and measurement of variables. The effects of proximate factors on infant and child mortality are examined and discussed in Chapter Four. The effects of socioeconomic factors on infant and child mortality are analysed in Chapter Five. Chapter Six is devoted to identification of some of the pathways through which the socioeconomic factors affected infant and child mortality, and establishing the determinants of infant and child mortality. Analyses of infant and child mortality in each mortality region are discussed in Chapter Seven. Further insights into variations in infant and child mortality between the mortality regions, and between the Western and Central provinces are discussed in Chapter Eight. Chapter Nine highlights the main findings and discusses some of the implications of the results.

CHAPTER TWO

SOCIOECONOMIC AND DEMOGRAPHIC CONTEXT

2.1 Introduction

In this chapter the main socioeconomic and demographic characteristics of Kenya are presented and discussed. The background information is necessary to aid the interpretation and to put in context the findings of this thesis. The chapter begins by a brief description of the geography and ecology, followed by a discussion of the demographic situation, and a description of some sectoral conditions and related policies.

2.2 Geographical setting

Kenya is located in East Africa and lies between longitudes 34^0 and 42^0 East and between latitudes of 4^0 21' North and 4^0 28' South. It is a medium-sized country with a land area of 528,647 square kilometres. It has common borders with Ethiopia and Sudan to the north, Somalia to the north east, Tanzania to the south, Uganda and Lake Victoria to the west. To the east, it has a coastline on the Indian Ocean.

The land rises gradually inland from the hot, humid coastal belt through the *Nyika* (dry bush country) to the savannah grasslands and to the highlands where rainfall is high. The Great Rift Valley runs from the northern part of the country to the south, varying in depth between 610 metres and 914 metres below the surface. On the western side of the Rift Valley, the land slopes down towards Lake Victoria - Africa's largest fresh water lake, and the Ugandan border.

The central part of the country is extremely mountainous, and the vast northern and eastern (North-eastern) province varies from semi-desert in the east, to the more rugged country west of Lake Victoria. The Lake Victoria basin in the west is mainly flat land which rises gradually towards Tanzania in the south.

Kenya may be divided into five major ecological/agricultural zones. These zones are: the Lake Victoria Basin, the Central rift and associated highlands, the northern, north-eastern, southern semi-arid and arid areas, the eastern plateau, and the coastal zone (Ominde, 1984: 1-5). The Lake Victoria Basin covers the Western and Nyanza provinces, and the western parts of the Rift Valley province. The elevation of this zone varies from 1,128 metres around Lake Victoria to over 1,524 metres along the Rift Valley. In this zone the annual rainfall varies from 1,016 to 1778 mm. Temperatures vary between 10^0 and 32^0 Celsius. This zone contains some of the most fertile lands in the country and a variety of food and cash crops can be grown, with low risk of crop failure. However, some areas surrounding the Lake are infested with tsetse fly and mosquitoes. Hence malaria is a common disease in this zone (MPND and UNICEF, 1992: 58).

The Central Rift and associated highlands zone covers the Central province, the eastern parts of the Rift Valley province and the western parts of the Eastern province. Altitude in this zone ranges from 1,829 metres at the floor of the Rift Valley to 5,182 metres at Mt. Kenya. The annual rainfall is between 762 mm and 1,524 mm, the temperatures average 17^0 Celsius and the risk of crop failure is low. The former "White Highlands"[1] fall within the zone. This zone contains rich volcanic soil and has very high agricultural potential. Due to high altitude, this zone is generally free from tsetse fly and mosquito infestation; hence malaria is not as common as in the Lake Basin or in the Coastal zone (Ominde, 1988: 110).

The northern, north-eastern and southern semi-arid and arid zone cover the entire North/Eastern province, north and southern parts of the Rift Valley province, and north-western parts of the Coast province. This is the largest geographical zone, and is characterised by a vast amount of agriculturally unproductive land. This zone covers about 83 per cent of Kenya's land. The annual rainfall is generally under 508

[1] These were highland areas that were settled by white settlers during the colonial rule in Kenya.

mm and the average temperature is 26^0 Celsius. This is a pastoral area and supports a dry bush vegetation.

The Eastern plateau zone is located in the south-eastern section of Kenya and extends from the eastern boundaries of the highland areas to within 66 km from the Coast. This zone has been, historically, highly susceptible to drought. Many areas suffer from tsetse fly infestation, and is noted for its grassland plains, sporadic wooded grasslands and semi-desert areas (Ominde, 1988: 4). Rainfall in the zone is scanty and unreliable, averaging between 508 and 762 mm annually. Agriculturally, this zone has low potential and the risk of crop failure is very high (MPND and UNICEF, 1992: 7).

The Coastal zone extends inland from the coastline on the Indian Ocean for about 64 km and is characterised by swampland and coral features. The Zone reaches an elevation of 137 metres. Agriculturally, this zone has both medium and low potential. Some areas receive an average of 900 mm of rainfall annually, and temperatures for the zone average 27^0 Celsius. This zone also suffers from tsetse fly and mosquito infestation (Ominde, 1988: 4; MPND and UNICEF; 1992: 58).

Climate is by and large determined by altitude. Areas above 1,524 metres experience a tropical climate with fairly high rainfall. Being on the equator, the country has no marked seasonal changes. For most parts of the country, there are two rainy seasons, the "long rains" (March to May) and the "short rains" (November to December). The highest rainfall has been recorded in areas with high altitude such as Kericho (in Rift Valley province) with average annual rainfall of 2,090 mm, Kakamega (in Western province) 2,021 mm and Kisii (in Nyanza province) with 2,171 mm. The Coastal strip and Mombasa have a hot, humid climate; the monsoon trade winds which blow from the Indian Ocean during most of the year keep the temperature from soaring above 33^0 Celsius, and falling lower than 20^0 Celsius.

Kenya is divided into eight large administrative areas called provinces. These are Nairobi, Rift Valley, Central, Eastern, North Eastern, Coast, Western and Nyanza.

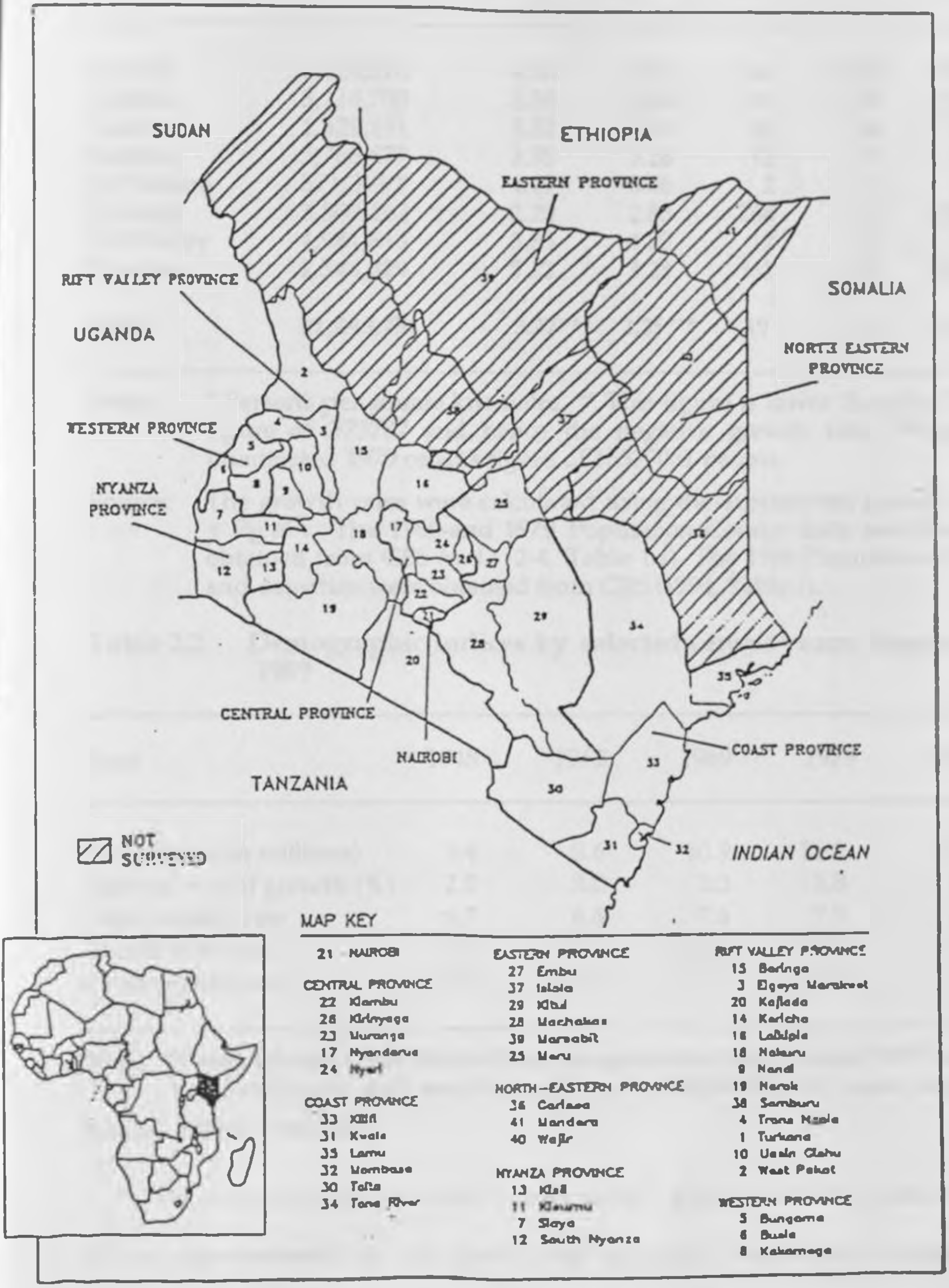
The provinces are divided into districts and the districts are divided into divisions. The smallest and lower administrative units are the locations and sublocations. Each of these units is headed by an administrator (a civil servant) who is answerable to the Office of the President through their immediate heads. This administrative structure was inherited from the colonial government at the time of independence in 1963. The present study will cover all the provinces except the North Eastern province. The 1988/89 KDHS, from which the main data used in this study are drawn, covered all the provinces except the North Eastern province. These are shown by the shaded areas in Figure 2.1.

2.3 Demographic setting and population policy

In 1948, Kenya's population was estimated at 5.4 million people and in 1969, the population had increased to 10.9 million. The 1979 census enumerated 15.3 million with an annual intercensal growth rate of 3.4 per cent between 1969 and 1979. In 1989 Kenya's population was enumerated at 21.4 million people, thus giving an intercensal annual growth rate of 3.3 per cent (Table 2.1). The population density for the nation as a whole is generally low but it has been rapidly increasing in the 1950's However, Nairobi, Western, Nyanza and Central provinces have very high population densities, while North Eastern, Coast and Rift Valley provinces have low population densities (Table 2.1).

Kenya has experienced a rapid decline in mortality during the last three decades (Brass and Jolly, 1993: 21). Table 2.2 shows a considerable decline in infant and under-five mortality and improvement in life expectancy at birth between 1948 and 1989. The crude death rate was estimated at 25 deaths per 1000 population in 1948; it was 17 in 1969 and 12 deaths per 1000 population in 1979. The life expectancy at birth was about 57 years in 1979 (Ewbank *et al.*, 1986: 36). The infant mortality rate (IMR) was 184 deaths per 1000 live births in 1948 but dropped to about 84 deaths per 1000 live births in 1979 and 74 in 1989.

Figure 2.1 Map of the Republic of Kenya: Administrative Units



Source: NCPD (1989: xxii)

Table 2.1 Population size, growth rates and density by province, Kenya, 1969-1989

Province	Population size 1989	Growth rate (% p.a.)		Density*		
		1969-79	1979-89	1969	1979	1989
Nairobi	1,324,570	4.86	4.70	746	1210	1910
Central	3,116,703	3.36	2.84	127	178	235
Coast	1,829,191	3.52	3.09	11	16	22
Eastern	3,768,677	3.55	3.26	12	17	24
N/Eastern	371,391**	4.19	-0.06	2	2	3
Nyanza	3,507,162	2.20	2.83	168	211	280
Rift Valley	4,981,613	3.83	4.30	12	19	27
Western	2,544,329	3.22	3.28	161	223	307
Total	**21,443,751**	**3.37*** **	**3.35*** **	**19**	**27**	**37**

Notes: * Persons per square kilometre. ** This figure is lower than the 1979 census figure of 373787 and hence the negative growth rate. ***Based on the unadjusted 1979 census figure of 15327061 people.

Source: The growth rates were calculated using the exponential growth formula, $P_t = P_0 e^{rt}$. The 1969-and 1979 Population Census data and densities were obtained from CBS (n.d.: 2-4, Table 1.1), The 1989 Population Census data and densities were obtained from CBS (1994, Table 1).

Table 2.2 Demographic indices by selected census years: Kenya, 1948-1989

Year	1948	1962	1969	1979	1989
Population (in millions)	5.4	8.6	10.9	16.1	21.4*
Natural rate of growth (%)	2.5	3.0	3.3	3.8	3.4*
Total fertility rate	6.7	6.8	7.6	7.9	6.7
Crude birth rate	50.0	50.0	50.0	52.0	---
Crude death rate	25.0	20.0	17.0	14.0	---

Note: * These estimates were obtained from the preliminary results from 1989 Census and the total fertility rate of 6.7 was obtained from the 1988/89 KDHS Country report.

Source: MPND (1989: 209).

The improvement in mortality observed in Tables 2.2 and 2.3 is one of the results of the improvements in the social and economic conditions coupled with the application of modern medical technology and public health measures. As indicated in Chapter One, since Independence in 1963, Kenya has been implementing various development programs aimed at improving the average standards of living and to reduce mortality particularly infant and child mortality. These include massive investment in the education sector and the development of an extensive public health infrastructure to provide both curative and preventive services (including family planning), and provision of clean drinking water (MPND, 1984: 143-165, 1989: 229-249).

Table 2.3 Trends in mortality in Kenya: 1948-89

Year	Infant mortality rate	Under-five mortality rate	Life expectation at birth (e^0) (both sex)	Crude death rate per 1000 population
1948	184	262	35	25
1962	146	211	44	20
1969	118	167	49	17
1979	84	150	54	12
1989	74	105	59	---

Source: Extracted from various census reports. The 1989 figures are from NCPD (1989).

Kenya's infant mortality rate of 74 deaths per 1000 live birth in 1989 compared favourably with the average world rate among low-income countries (excluding China and India), which in 1990 was estimated at 92 per 1,000 live births, but unfavourably with middle-income countries which had an average rate of 48 per 1000 in 1990. Kenya's under-five mortality rate of 105 in 1989 compares favourably with average under-five mortality rates both middle-income and low-income countries. In 1990 the average under-five mortality rate for low-income countries was 189 and 71 for middle-income income countries (MPND and UNICEF, 1992: 15). Within the Eastern African region, Kenya's mortality performance is quite remarkable. Its mortality rates (IMRs and CDRs) are far lower than the average mortality figures for the region and its life expectancy at birth figures are much higher than the average life expectancy figures for the region. Its mortality figures (IMRs and CDRs) are only greater than those of Reunion, Mauritius and Zimbabwe, and its life expectancy at birth figure for 1985-90 is only lower than those of Mauritius and Reunion (Table 2.4).

Table 2.4 **Kenya's mortality situation in comparison to other Eastern African countries: 1960-90**

Country	Infant mortality rate (IMR)		Life expectation at birth (e^0) (both sexes)		Crude death rate per 1000 population (CDR)	
	1960-65	1985-90	1960-65	1985-90	1960-65	1985-90
Kenya	118.0	72.0	45.9	57.9	21.4	11.4
Uganda	125.0	112.0	44.0	49.0	20.1	17.1
Burundi	149.0	129.0	42.0	45.5	22.1	19.4
Comoros	160.0	109.0	43.5	52.0	21.2	14.4
Ethiopia	170.0	159.0	37.0	40.0	26.8	23.5
Madagascar	211.0	130.0	41.7	51.5	22.9	15.3
Malawi	204.0	163.0	38.5	45.1	27.5	22.3
Mauritius	61.0	28.0	60.2	66.7	9.1	6.0
Tanzania	143.0	115.0	41.7	51.0	22.8	15.3
Somalia	170.0	143.0	37.0	43.1	26.9	22.3
Rwanda	142.0	132.0	43.0	46.5	21.4	18.8
Reunion	87.0	16.0	57.6	69.7	10.3	5.8
Mozambique	185.0	155.0	38.5	46.1	47.0	45.5
Zambia	130.0	86.0	42.8	48.6	21.4	15.9
Zimbabwe	106.0	67.0	46.5	56.8	19.3	11.0
Eastern Africa	156.0	115.0	40.7	48.8	23.7	16.9

Source: Extracted from UN (1993: Table A.18).

As pointed out in Chapter One, wide provincial differences in the levels of infant and child mortality exist in the country. Generally, mortality is high in the Nyanza, Western and Coast provinces (Table 2.5). Nairobi, Central, Rift Valley and Eastern provinces have low mortality. Table 2.5 shows that the high mortality provinces made higher gains in mortality than the low mortality provinces between 1969 and 1978. The 1988/89 KDHS indicates that infant and child mortality continued to be high in the Western, Nyanza, and the Coast provinces; and low in the Central, Eastern, Rift Valley, and Nairobi provinces (NCPD, 1989: 58).

Table 2.5 Trends in early childhood mortality and life expectation at birth by province: Kenya, 1960-79

Province	Infant mortality rate (IMR)		Child mortality $1000^{*}{}_2q_0$		Life expectation at birth (e^0) (both sexes)	
	1969	1979	1969	1979	1969	1979
Nairobi	75	72	92	88	56.4	57.1
Central	76	61	86	65	56.3	60.0
Rift Valley	89	85	101	101	53.4	54.1
Eastern	105	84	132	95	50.0	54.4
North Eastern	132	107	159	131	44.5	49.0
Coast	133	101	186	114	44.4	50.7
Western	131	120	166	145	44.8	46.9
Nyanza	165	133	203	163	39.0	44.3

Source: Ottieno and Kichamu (1986: 417-423).

Fertility level has been persistently high in Kenya, having increased from a crude birth rate of 50 per 1000 in 1948 to 52 per 1000 in 1979. The total fertility rate increased from the level of 6.7 children per woman in 1948 to 7.9 children per woman in 1979. However, from the 1989 KDHS, there are indications that fertility is on the decline having dropped to 6.7 children per woman in 1989 (NCPD, 1989: 19; Robinson, 1992: 446). The results from the 1993 KDHS show that fertility has dropped further to 5.4 children per woman (NCPD *et al.*, 1993: 8). A number of sub-national studies also indicate that a fertility transition is indeed taking place in Kenya. The decline has been largely attributed to increasing contraceptive practice (Robinson, 1992: 451; Brass *et al.*, 1995: 6).

However, this explanation ignores completely other equally important underlying factors such as government policies and development programmes (for example, massive investment in education and health sectors) which have transformed social and economic conditions in the country since Independence (Gaisie, 1995: 29). The explanation also ignores the effects of the economic reversal and the Structural Adjustment Programs (SAP) on the cost of children and in turn on fertility. The salient features of the SAP are the reduction on budgetary allocation to the social sectors (mainly health and education), relating prices to market levels, liberalising trade, adjusting exchange rates (mainly through devaluation of currency), and controlling the supply of money and credit (Cornia *et al.*, 1987; Adepoju, 1993: 3; Mwega and Kakuko, 1993: 27-39). For example, Mwega and Kakuko had the following to say about the effects of SAP on education and health sectors in Kenya:

> The direct effects of structural adjustment programmes in the education sector is reflected in a massive increase in school fees and other charges, a reduction in the quality of educational programmes, and an increase in the number of drop-outs from the school system. This skews access to education opportunities away from the poor, marginalises them and may eventually worsen social inequalities. Structural adjustment measures in the health sector have also adversely affected the poor, who can barely afford the fees needed to pay for services. The situation is aggravated by lack of drugs in government health institutions (Mwega and Kakubo, 1993: 39).

Provincial differences in the level of fertility in Kenya are quite marked. For instance, the 1988/89 KDHS data show that fertility was above the national average of 6.7 children per woman in the Western, Nyanza, Eastern and Rift Valley provinces and was below the national average in the Coast, Central and Nairobi provinces (Table 2.6). Western and Nyanza provinces have the highest fertility while Nairobi and Coast provinces have the lowest fertility rates.

Table 2.6 Fertility indices by province of residence: Kenya, 1988/89 KDHS

Province	Reported mean children ever born	Adjusted* mean children ever born	Mean family size	Total fertility rate**	Number of women aged 15-49 (Weighted)
Nairobi	2.25	3.07	3.58	4.60	554
Central	3.44	3.58	3.75	6.00	1281
Coast	4.35	3.58	5.60	5.50	720
Eastern	3.67	3.78	4.17	7.00	898
Nyanza	4.03	3.74	4.58	7.10	1265
Rift Valley	3.83	3.74	4.73	7.00	1100
Western	4.07	3.66	4.88	8.10	1027
Total	**3.67**	**3.67**	**4.88**	**6.70**	**7150**

Note: * Adjusted using the national age composition as a standard. ** Based on 0-4 years before the survey.
Source: Primary analysis of the 1988/89 KDHS data.

In terms of the distribution of population by race and ethnic group, about 98 per cent of the population are Africans and the rest are of Arab, European and Asiatic origins. The African population is composed of more than 42 ethnic groups, of which five dominate numerically. According to the 1979 census, the Kikuyu, who live mainly in the Central province, accounted for 21 per cent of the total population; the Luhya, who live mainly in the Western province, constituted 14 per cent; the Luo, who are concentrated mainly in Nyanza province, accounted for 13 per cent, the Kamba who live mainly in the Eastern province constituted 11 per cent and the Kalenjin, who live mainly in the Rift Valley province constituted about 10 per cent of the total population (CBS; 1988: 14). Each of these ethnic groups, by and large, inhabit their traditional land areas, although land resettlement schemes and land purchases are constantly altering the traditional ethnic boundaries. The non-African population resides mainly in urban centres and towns.

Since Independence, the Kenyan government has been concerned about the need to check the high population growth with a view to matching population size with the available resources. The high population growth has been viewed as a major obstacle to rapid economic development, social and family welfare. Consequently, in 1967 the Government adopted a population management policy whose main aim has been a reduction in the rate of population growth through fertility reduction (Ministry of Economic Planning and Development, 1967: 2-8). Since then this policy has been applied through the integrated maternal, child health and family planning (MCH/FP) program which is being implemented by a number of agencies (NCPD; 1984: 2).

The MCH component of the programme has been successful; by the early 1980s it had covered about 72 per cent of pregnant women and a nation-wide infrastructure for effective delivery of the services had been built (NCPD, 1984: 3). However, the family planning component has had only modest success; only 33 per cent of women of reproductive age are using contraception, and both fertility and population growth rates are still high though both are on the decline (NCPD *et al.*, 1993: 8; Brass and Jolly, 1993: 20).

2.4 Economic development

Since the attainment of Independence in 1963, Kenya has achieved substantial social and economic development. During the period 1964-73, the economy grew at a rate of 6.6 per cent per annum; between 1974 and 1980 the annual growth rate was 4.2 per cent and during the period 1980-1986 it was 3.4 per cent per annum (Mosley, 1992: 101). Although the annual growth rates of the economy as well as in each of the main sectors of the economy fluctuated (Table 2.7), the overall economic growth was quite impressive between 1964 and 1987. The children considered in this study were born between 1970 and 1987.

Table 2.7 Growth rates of Real Gross Domestic Product (GDP) and its components: Kenya, 1964-87

Year	Agriculture	Manufacture	Government services	Others	Total GDP
1964-71	4.2	8.2	9.8	6.9	6.5
1972	7.6	7.3	12.8	3.8	6.8
1973	4.4	14.4	6.3	1.0	4.1
1974	-0.2	5.9	6.8	4.0	3.1
1975	4.6	4.0	8.5	-0.01	3.1
1976	3.7	14.0	5.1	2.0	4.2
1977	9.5	16.0	5.1	6.1	8.2
1978	8.9	12.5	6.4	8.4	7.9
1979	-0.3	7.6	7.1	7.7	5.0
1980	0.9	5.2	5.6	5.2	3.9
1981	6.1	3.6	5.3	6.9	6.0
1982	11.2	2.2	3.8	1.4	4.8
1983	1.6	4.5	4.2	1.5	2.3
1984	-3.9	4.3	2.9	2.7	0.8
1985	3.7	4.5	4.2	1.5	4.8
1986	4.9	5.8	6.3	5.4	5.5
1987	3.8	5.7	5.7	4.9	4.8

Source: MPND (1989: 5, Table 1.1).

The performance of the Kenyan economy between 1950 and 1980 stood good comparison with any developing country. The level of investment was also high by international standards as well as compared with Sub-Saharan Africa as a whole (Table 2.8).

Table 2.8 Comparison of Kenya's economic performance with selected developing countries: 1950-86

a. Average Real GAP Growth Rates (percent per year)

Period	1950-59	1960-69	1970-75	1970-80	1975-80	1980-86
Taiwan	6.7	7.9	----	9.5	----	5.9
South Korea	3.3	6.9	----	5.9	----	5.1
Colombia	3.7	3.9	----	5.9	----	2.5
Mexico	11.3	6.1	----	5.2	----	2.0
Thailand	4.8	7.0	----	7.2	----	6.2
Kenya	6.1	5.9	10.0	----	5.9	3.4
Sub-Saharan Africa	----	4.9*	5.6	----	3.5	0.0

b. Investment as a ratio of GDP

Taiwan	----	----	----	----	31.2	----
South Korea	----	22.2	----	----	30.9	32.5
Colombia	----	15.9	----	----	24.8	18.0
Mexico	----	21.8	----	----	27.6	21.1
Thailand	----	20.1	----	----	26.8	21.3
Kenya	----	20.5	23.2	----	25.3	24.4
Sub-Saharan Africa	----	15.9	20.4	----	23.6	18.2

Note *1965-70 only.
Source: Mosley (1992: 100, Table 6.1).

By World Bank standards, Kenya is classified as a low-income country, with an average annual per capita income of US$390 in 1992. Within the country there are wide income disparities. Income and other forms of wealth are concentrated among a small section of the population, while the majority are living in poverty. For example, in rural areas where 80 per cent of the population live, it is estimated that the average annual income per capita is US$185, and that between 70 and 80 per cent of all households in 1991 had incomes below this figure (MPND and UNICEF, 1992: 2).

Wide disparities in income among the provinces are also evident in the data of the National Welfare Survey that was carried out in 1992 by the Central Bureau of Statistics among a representative sample of 11,568 households across the country (CBS, 1992: 44). Table 2.9 provides information on the distribution of households in relation to the mean household monthly income of Kenya shillings (Ksh.) 2308 (US $58). About 63 per cent of the households covered by the Survey had incomes below the national average. In Nyanza and Western province mean household incomes were largely below the national average, while in Nairobi province and urban areas of North/Eastern province over 50 per cent of the households had mean incomes that were above or equal to the national average. However, the sample size for the North Eastern province was too small to warrant any conclusive interpretation of the results. Other provinces that had more households below the national income were Central, Eastern, Rift Valley and Coast provinces in that order. The figure for Coast province is heavily influenced by urban household incomes, particularly in Mombasa (CBS, 1993: 44).

Table 2.9 Percentage distributions of households below/above mean national income: Kenya, 1992

Province	Below	Above or equal	Number of Households interviewed
Nairobi	49.2	50.8	1181
Central	65.2	34.8	1654
Coast	54.4	45.6	1489
Eastern	64.0	36.0	1435
North Eastern	40.0	60.0	32
Nyanza	74.6	25.4	1818
Rift Valley	60.7	39.3	2888
Western	71.4	28.6	1071
National	**62.7**	**37.3**	**11568**

Source: CBS (1993: 44).

A study carried out by the Central Bureau of Statistics 10 years earlier indicated that the gross average incomes in Central, Rift Valley and Eastern province were far above the national average. These figures suggest that the situation in these three provinces deteriorated over the decade. Coast, Western and Nyanza provinces, in that order, had gross average incomes that were below the national average (CBS, 1989: 50).

Kenya is primarily an agricultural country, with nearly 81 per cent of the population depending on agriculture for their livelihood. The agricultural sector accounts for 29 per cent of the Gross Domestic Product and is also the major source of raw materials for the growing agro-industrial sector. It remains by far the largest source of foreign exchange earnings (CBS, 1988: 19). The Kenyan Government, through various policies and measures, has been promoting small scale agriculture, as opposed to the large-scale commercial agriculture that was encouraged by the colonial government.

2.4.1 Health policies and strategy

Since 1963 the health sector has been accorded the requisite importance by the Kenya Government. Consequently, a number of policies, measures and strategies have been established to accelerate the development of health services. In an effort to make health services accessible to all people, the number of service delivery points (hospitals, health centres, dispensaries) have been increased and nearly all health services have been provided free of charge to the public in all government health institutions. However, from 1989 minimal fees have been being charged for certain health services in Government health institutions as a part of cost recovery measures being undertaken within the Structural Adjustment Program (MPND, 1989: 239).

Since Independence the health structure has developed from a very scanty to quite an elaborate infrastructure (Table 2.10). At Independence there were 56 government-run hospitals with another 92 being run by the missionaries and other agencies. As of 1993, there were 200 hospitals, 562 health centres, 1,947 dispensaries, 315 health clinics, 31 maternity homes and 40 nursing homes (Table 2.10). The majority of the health facilities are run by the government.

Table 2.10 Distribution of health facilities* by type and province: Kenya, 1993

Province	Hospital	Health centre**	Dispensary	Health clinic	Maternity home	Nursing home	Total
Nairobi	20	31	131	115	8	9	314
Central	35	66	248	9	8	3	367
Coast	23	54	220	62	2	3	366
Eastern	29	57	369	60	3	2	520
N/Eastern	6	10	35	5	0	0	56
Nyanza	18	93	198	12	6	8	335
Rift Valley	49	181	655	45	1	5	936
Western	20	70	91	7	3	10	201
Total	**200**	**562**	**1947**	**315**	**31**	**40**	**3095**

Note: * Includes both public and private facilities. ** includes 22 sub-health centres.
Source: Compiled from the Health Information system (of the Ministry of Health). Computer printout on the Number of Health Facilities by District, Type and Agency, 16 August 1993.

Over the same period the number of health personnel has increased. For instance, the number of doctors increased from 908 in 1963 to 3,000 in 1987, that is from a ratio of 8 doctors per 100,000 people in 1963 to 14 per 100,000 in 1987 (MPND, 1989: 236). Ratios of other health personnel increased over the same period (Table 2.11). Hospital beds and cots per 100,000 people increased from less than 110 in 1963 to 147 in 1987.

Table 2.11 Registered medical personnel per 100,000 population: Kenya, Selected years

Year	1964	1969	1974	1979	1983	1986	1987
Doctors	7.8	11.9	9.6	10.1	12.6	14.2	13.9
Dentists	0.3	0.5	0.7	0.9	1.5	2.1	2.2
Pharmacists	1.6	1.5	1.6	1.8	1.6	1.6	2.0
Registered Nurses	22.6	28.3	37.8	42.8	45.5	45.8	44.8
Enrolled Nurses	29.9	35.4	---	54.4	54.1	57.9	59.9
Clinical Officers	---	10.1	9.5	10.0	10.2	10.6	10.3
Public health Officers	---	---	0.8	1.5	1.8	2.1	2.2
Public Health Technicians	---	6.4	6.9	6.7	7.6	8.7	9.3

Source: MPND (1989: 19, Table 1.7).

Health services are delivered by the Ministry of Health, local government (municipalities, urban councils), private voluntary organisations, the private profit-making sector and traditional healers. However, the Ministry of Health provides most of the health care through its nation-wide infrastructure. In spite of the Government's efforts to make health care accessible to all people and to achieve the target of having good health for all by the year 2000, urban bias in allocation of health facilities and personnel exits in the country. For instance, over 75 per cent of the doctors, dentists, pharmacists and registered nurses are to be found in the urban areas where only 20 per cent of the population live (Ministry of Information and Broadcasting, 1993: 103-104).

In addition to the urban bias, there are marked disparities in the distribution of health facilities and manpower between the provinces. The problem of lack of access to health services is particularly serious in the provinces in the periphery, that is Nyanza, Western, Coast provinces and in some parts of the Rift Valley and North Eastern provinces. The problem is being exacerbated by rapid population growth, poor transport and communication networks and the Structural Adjustment Programs (SAP) being implemented since the early 1980s. As pointed out earlier, one of main tenets of the SAP is the reduction in the budgetary allocations to the social sectors, in particular the health and educational sectors.

In almost all the interviews that the author conducted in Central and Western provinces in 1993, complaints of frequent and often prolonged shortages of drugs and medical supplies and equipment in government health institutions were raised from time to time, even by the health personnel. Most of the interviewees said that the problem of shortages of medical supplies and lack of maintenance of medical equipment in government health institutions had become increasingly bad during the last five years or so. Some of the interviewees, including health personnel, strongly believed that infant and child mortality as well as adult mortality will certainly rise because of the inability of the public health system to provide adequate health services and because of increasing poverty.

The Panel of the Population Dynamics of Sub-Saharan Africa of the National Research Council's Committee on Population claimed that the effects of economic reversals on the population in Kenya were not clearly pronounced. The effects of poor economic conditions on child mortality were clearest for Ghana's rural areas and Nigeria's urban areas. A positive association was found between economic conditions and the odds of marrying for the first time in Botswana, Senegal, and Togo. In all countries except Kenya, a consistently positive relation was found between first births and economic variation; the same relationship was observed for second births only in Botswana, Ghana, and Uganda. Overall, Nigeria suffered the strongest across-the-board effects of economic reversal, while Kenya suffered the least. These differences may be in part due to Nigeria's dependence upon oil and the related oil shocks over the period compared to Kenya's more diversified economy (National Research Council, 1993: 167-170).

AIDS/HIV is another problem that is putting additional pressure on the already ailing public health system. One of the biggest challenges to the Ministry of Health and indeed to the whole country is to control the spread of AIDS. The spread of AIDS is threatening by itself to eradicate the gains recently made in reducing infant, child and adult mortality.

2.4.2 Water supply and sanitation

Provision of safe drinking water is one of the important aspects of preventive public health measures that the Kenya government has been implementing for some time now. The government, through the Ministry of Water Development, has formulated policies and measures to improve the quality and quantity of drinking water in the country.

In spite of that, the 1988/89 KDHS data suggest that accessibility to safe drinking water in Kenya was still low and that there was marked variability in availability of clean drinking water between provinces (Table 2.12). About 30 per cent of all the women interviewed indicated that their household obtained drinking water from a piped supply or a public tap. The people in Nairobi, Coast and Central provinces had better access to safe drinking water than those in other provinces. The majority of people, particularly in the rural areas where 80 per cent of the population lives, did not have access to safe drinking water. They depended on rivers, lakes, streams, ponds, bore holes and wells as sources of their drinking water.

Table 2.12 Percentage distribution of women interviewed by household main source of drinking water and by province: Kenya, 1988/89 KDHS

Province	Piped water in household	Public tap	Other sources*	No. of women (weighted)
Nairobi	57.7	38.1	4.2	554
Central	34.1	3.9	62.0	1120
Coast	24.1	32.7	42.8	498
Eastern	15.6	8.8	75.6	1269
Nyanza	7.6	9.2	83.2	1218
Rift valley	9.0	6.0	85.1	1517
Western	13.8	8.8	77.4	971
Total	**19.3**	**11.4**	**69.2**	**7150**

Note * Includes stream, river, lake, pond, spring, well, bore hole, rain, pond.

Source: Primary analysis of the 1988/89 KDHS data.

Similar results have been obtained in other national surveys. For example, the 1992 National Household Welfare Monitoring and Evaluation survey, found that 41 per cent of the households were disadvantaged and that Nyanza, Western and some parts of the Coast and Eastern provinces were worse off than other provinces (CBS, 1993: 48).

Adequate sanitation is an important requirement for the attainment of a healthy environment and the reduction of environment pollution. Like access to safe water, availability of sanitation facilities can contribute greatly to the achievement of sound environmental health care and thus, reduce morbidity and mortality (Gaisie, 1995: 10). Table 2.13 provides information on the proportion of households in Kenya by type of toilet facility used. These data indicate that 71 per cent of the households sampled had a pit latrine and that about 16 per cent of the households mostly in the Rift Valley, Coast, Eastern and Nyanza provinces had no toilet facility.

Table 2.13 Percentage distribution of households by type of toilet used and province: Kenya, 1992

Province	Pit latrine	VIP	Water closet	Flush	Bucket	None
Nairobi	46.5	1.5	21.7	27.4	2.9	-
Central	90.2	2.5	1.2	5.5	-	0.3
Coast	65.8	1.2	5.9	1.8	-	25.2
Eastern	71.9	3.4	0.9	2.1	0.1	21.6
North Eastern*	53.1	6.3	3.1	6.3	28.1	3.1
Nyanza	77.0	1.0	2.0	1.2	0.1	18.6
Rift valley	66.5	2.3	1.3	2.1	0.6	27.2
Western	87.0	0.4	2.8	3.9	0.3	5.5
Total	**71.4**	**1.9**	**4.6**	**5.7**	**0.6**	**15.7**

Note: * Urban areas only. VIP stands for pit latrine with improved ventilation.

Source: CBS (1993: 49).

2.4.3 Nutrition and food security policies

The importance of nutrition and food security has been recognised by the Kenyan government since the drawing of the first national development plan in 1963. Since then all the subsequent Development Plans have emphasised the need for the provision of adequate nutrition to the population. In 1981, the Government formulated a National Food policy which was adopted by Parliament as Sessional Paper No. 4 of 1981. The government has since implemented that policy with the objective of attaining self-sufficiency in food production through the provision of various incentives to farmers and avoidance of consumer subsidies (MPND, 1989: 23).

The National Nutritional Surveys that have been conducted in Kenya indicate a high prevalence of protein-calorie malnutrition, especially among children under age five. For example, the nutritional surveys carried out between 1977-1987 indicate that the level of stunting fluctuated between 28 and 24 per cent over the ten year period (Table 2.14).

Table 2.14 Comparison of mean height for age index and percent stunted in 1-4 year olds by year and province: Kenya

Province	1977 %	1977 Mean	1979 %	1979 Mean	1982 %	1982 Mean	1987 %	1987 Mean
Coast	14	96.3	40	92.9	39	92.2	40	91.2
Eastern	34	92.8	24	94.6	27	93.3	23	93.6
Central	26	93.6	21	94.5	24	94.0	15	94.6
Rift valley	25	94.0	24	94.2	22	94.9	17	95.2
Nyanza	21	94.7	34	93.6	33	93.4	32	93.4
Western	16	95.0	24	94.0	30	92.9	12	95.4
National	**24**	**94.1**	**27**	**94.5**	**28**	**93.7**	**22**	**94.2**

Note: Children with height for age median less than 90 per cent of the reference population (American children) were considered stunted. The measurements were in centimetres.

Source: CBS (1991a: 20).

The results of these surveys show that malnutrition continues to be prevalent in Coast, Nyanza and Eastern provinces. In Nyanza and Coast provinces the level of malnutrition remained almost constant between 1979 and 1987. Although in Table 2.14 shows that malnutrition was not a serious health problem in Western province, some of the small-scale studies conducted in Nyanza and Western provinces suggest that childhood malnutrition is a serious health problem in both provinces (Masimba, 1982: 11, cited in CBS, 1984: 76; Cohen and Odhiambo, 1989; Whyte and Karuiki, 1991: 172). In addition, some of the health workers the author interviewed in Western province in 1993 were of the opinion that malnutrition was a serious health problem and that childhood malnutrition was on the increase in the province.

2.4.4 Education development and policies

The Government has been committed to the provision of equal educational opportunities for all through the introduction of free primary education and the training of skilled and high-level manpower to meet the growing and changing demands of the economy. The government expenditure on the education sector has been quite substantial and has been increasing. The proportion of the total budget allocated to this sector rose from 10 per cent in 1964/65 to 20 per cent in 1985/86. The Government is spending, on average, 30 per cent of its recurrent expenditure on education. There has been a remarkable expansion in the education system during the last 25 years (Table 2.15). There has also been a notable growth in the number of enrolments, at schools, colleges and universities.

Table 2.15 Trends in education according to various institutions: Kenya, 1963-87 (Selected years)

	1963	1973	1983	1986	1987
Primary schools					
No. of schools	6058	6932	11966	13437	13849
Total Enrolment ('000)	892	1816	4324	4843	5031
Sex ratio (M/F)*	192	130	108	108	107
Secondary schools					
No. of schools	151	964	2230	2417	2592
Total Enrolment.	30120	174767	493710	458712	522261
Sex ratio	215	202	148	141	144
Teachers' Colleges**					
No. of Institutions	37	21	21	22	22
Total Enrolment	4119	8905	13657	15644	17817
National Polytechnics					
No. of Institutions	1	2	2	2	3
Total Enrolment	864	3721	5398	5313	5186
Institutes of Technology					
No. of institutions	--	1	4	16	16
Total enrolment	--	110	456	4694	4248
Government Universities***					
No. of institutions	1	1	1	4	4
Total Enrolment	571	5149	9233	10143	17538

Notes: *Boys per 100 girls, ** The drop in the number of colleges was to due to conversion of some of them to secondary schools.
*** These are public universities. There are three private universities in the country.

Source: MPND (1989: 21).

One important aspect of the education development has been the improvement in enrolments of girls, particularly in primary schools. The ratio of boys to girls in primary schools, which was 192: 100 in 1963, dropped to 107: 100 in 1987. Over the same period, the ratio for secondary schools dropped from 215: 100 to 144: 100. The pupil/teacher ratio also declined from 39: 1 to 34: 1 while the adult literacy rate has risen from 20 per cent to about 50 per cent over the last 25 years.

Despite the rapid advances in the educational sector, wide gender and provincial disparities in educational attainment still exist in Kenya. These disparities are evident in the 1989 Census data (Table 2.16).

Table 2.16 Percentage distribution of the population* aged 10 years and above by level of education, sex and province: Kenya, 1989

Province		None	Primary	Secondary	University	Total (N)
Nairobi						
	Males	5.6	45.8	44.5	4.5	567045
	Females	10.7	45.0	38.42	2.9	401784
	Both sexes	7.7	46.6	41.9	3.8	970329
Central						
	Males	9.4	66.8	23.1	0.7	1010511
	Females	21.1	59.0	17.6	0.3	1071587
	Both sexes	15.4	63.8	20.3	0.5	2082098
Coast						
	Males	27.1	53.7	18.4	0.7	613193
	Females	50.0	39.4	9.3	0.3	603878
	Both sexes	38.9	46.6	13.9	0.5	1217071
Eastern						
	Males	21.2	64.1	14.4	0.3	1149333
	Females	34.6	55.0	10.2	0.1	1276390
	Both sexes	28.2	59.4	12.2	0.2	2425723
N/Eastern						
	Males	76.7	16.9	6.1	0.2	127127
	Females	91.2	7.2	1.6	0.0	118674
	Both sexes	83.7	12.3	3.9	0.1	245801
Nyanza						
	Males	14.9	67.3	17.3	0.5	1035951
	Females	33.4	56.8	9.7	0.1	1187936
	Both sexes	24.8	66.8	13.3	0.3	2221887
Rift Valley						
	Males	23.8	58.6	17.0	0.5	1574156
	Females	38.4	51.2	10.3	0.2	1549588
	Both sexes	31.0	55.0	13.7	0.4	3123751
Western						
	Males	16.1	66.2	17.3	0.4	739709
	Females	30.8	57.6	11.5	0.1	853144
	Both sexes	23.9	61.6	14.2	0.3	1592853
Total						
	Males	**18.8**	**60.6**	**19.8**	**0.9**	**6819682**
	Females	**33.7**	**50.3**	**12.8**	**0.3**	**7064016**
	Both sexes	**26.4**	**56.8**	**16.2**	**0.6**	**14883698**

Note * Excludes persons who did not state their level of education.
Source: Calculated from Table 5 of the First Report of the 1989 Population Census (CBS, 1994).

Nairobi province has the highest concentration of well-educated people and also relatively modest gender differences in educational attainment. Nairobi province is followed by Central province. Western and Nyanza provinces have almost the same educational levels which are better than those for Rift Valley, Eastern, Coast and North Eastern. North Eastern and Coast provinces have the lowest education standards. The situation is particularly serious in North Eastern province where only about 16 per cent of the population aged at least 10 years are educated. The gender differences are particularly substantial in Coast province; 50 per cent of the female population aged at least 10 years have no formal education compared to 27 per cent of their male counterparts.

2.5 Conclusion

The preceding discussion indicates that Kenya has made impressive strides in social and economic development and that there are marked differences in the level of social and economic development, physical features, ecological conditions and demographic characteristics between the provinces. Nairobi, Central and some parts of Rift Valley, and Eastern provinces are economically more developed and are relatively malaria free compared with Nyanza, Western and Coast provinces. Fertility has also begun to decline. However, the overall population growth is still rapid.

Infant and child mortality has declined substantially during the last three decades. However, Western, Nyanza and Coast provinces are lagging behind in the mortality transition. Infant and child mortality appear to reflect the differences in the social and economic and ecological conditions between the provinces. For example, the more economically developed and relatively malaria-free Central province is likely to have lower infant and child mortality than the less developed and malaria-prone Western, Nyanza and Coast provinces.

CHAPTER THREE

DATA SOURCES AND METHODS OF ANALYSIS

3.1 Introduction

The purpose of this chapter is to discuss the sources of data, the quality of the main data used in this thesis and the methods of data analysis. In addition, this chapter presents the definitions of the variables used in the study. The chapter begins by discussing the sources of data, followed by an assessment of the quality of the main data used, methods of data analysis and then the definitions of the variables.

3.2 Sources of data

The main data source for this study is the 1988/89 Kenya Demographic and Health Survey (KDHS). The 1988/89 KDHS was conducted between December 1988 and May 1989 to collect data on fertility, family planning, and maternal and child health. It was carried out by the NCPD in collaboration with the Institute of Resource Development (IRD), Westinghouse (USA) as part of the world-wide DHS program. The Survey covered a national representative sample of 7,150 women aged 15-49 years and a sub-sample of 1,116 husbands of these women. The sampling methodology used and the sampling procedures are presented and discussed in the first report of the Survey (NCPD, 1989: 3-4).

The Survey provides a retrospective maternity history of the sampled women. Data were obtained on date of birth, the sex, survival status, and the current age or age at death of each live birth. These maternity histories constitute the data base for this study. A sub-set of data, hereafter referred to as the 'child file', where children are taken as the unit of analysis, was created by extracting data from the mother's birth history and joining them with her personal biosocial characteristics and health-care behaviour.

To assist in explaining regional variation in infant and child mortality additional information was collected from various sources during the author's field work conducted between July 1993 to December 1993. The information collected include provincial childhood nutritional indices, distribution of health facilities, educational attainment, child health-care practices (for example, immunisation coverage), health problems (for example, availability of drugs on a regular basis, transportation and communication network). These data were collected from unpublished and published government documents and through informal interviews with purposively selected informants. Informal interviews were held with a few local leaders, elders, teachers and health workers. Twenty such interviews were held in Western province and another twenty in Central province. In addition, four focus group discussion sessions were held in two villages in Nyeri district in Central province and another four in two villages in Busia District in Western province.

The selection of both Nyeri and Busia districts was based on the fact that the 1979 Census data showed that Nyeri district had the lowest infant mortality in Central province, while Busia had the highest infant mortality in Western province. In each district, two villages were selected for this purpose, one with a public health facility and near some administrative centre and the other without a health facility and without any administrative centre. In Busia district, Kocholya village has a public health centre and close by is Amagoro Divisional headquarters; Kotur village has no health facility and no administrative centre. In Nyeri district, Njoguini village has a public dispensary while Kanjora-B, has no health facility.

The selection of these villages was also based on the author's knowledge as well as logistic and other practical considerations, including the consent of the people to be involved in the discussions. In each village two focus group sessions were held, one for men and the other for women. They consisted of between eight and 12 participants, the majority of whom were in the reproductive ages 15-49 years. All the discussants were married and each had at least a child. The focus group sessions were conducted by the author assisted by one note-taker. In Busia district the discussions were conducted in Ateso and Kiswahili while in Nyeri district they were conducted in

Kiswahili and English[1]. All the sessions were recorded on cassette tapes. Although the information obtained during the discussions is not representative in a statistical sense, it is indicative of the life of the ordinary people in the two provinces. The themes used in the interviews and the focus group discussions are presented in appendix 3.1.

3.3 Quality of the 1988/89 KDHS data

During the planning and the implementation as well as the data processing phase of the KDHS, a number of measures were taken to ensure that data collected were of high quality (NCPD, 1989: 95-96):

(i) A selection of a nationally representative sample, that was administratively manageable, drawn from the National Sample Survey and Evaluation Programme (NASSEP) master sample maintained by the Central Bureau of Statistics.

(ii) The KDHS used three well-designed questionnaires: a household questionnaire, a women's questionnaire, and a husband's questionnaire. The first two were based on the DHS Programme's Model "B" for countries with low contraceptive prevalence rates, while the husband's questionnaire was based on similar questionnaires used in the DHS surveys in Ghana and Burundi. A two- day seminar was held to develop the questionnaires. The seminar was attended by demographers and health specialists drawn from the Population Studies and Research Institute of the University of Nairobi, the Central Bureau of Statistics, Community Health Department of the Medical School of the University of Nairobi, the Nairobi office of the United States Agency for International Development (USAID) and NCPD.

(iv) The three questionnaires were translated into eight major local languages. The quality of the translations as well as other aspects of the survey design was thoroughly pre-tested and the translations were modified on the basis of the results of the pre-test.

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[1]All the discussants in Nyeri district knew English and the interpreter that I had hired assisted me in taking notes and clarifying certain issues.

(v) The interviewers and field supervisors were carefully selected and were adequately trained. A total of 81 young interviewers, both male and female, were selected and trained for three weeks. Although they were centrally recruited, the interviewers were natives of areas where they were interviewing. Most of them had ordinary secondary ("O") level education, while a few had advanced secondary ("A") level. The training consisted of a combination of classroom lectures, demonstration interviews in front of the whole group, mock interviews in smaller groups, practice in interviewing in the local languages, a written examination, and during the final three days, field practice interviews in households around the training centre. The field editors and data-processing staff selected among those already trained were given special training in how to scrutinise questionnaires for accuracy, completeness, and consistency, while the supervisors were taught how to read maps and use household listing forms to find the selected households. The data entry and processing staff received further instructions in data processing from the IRD staff.

(vi) Each team of nine KDHS field staff, consisting of a supervisor, a field editor, four or five female interviewers and one male interviewer had a four-wheel drive-vehicle at their service. Field work was coordinated from the headquarters of NCPD. Most of the supervisory teams were accompanied at least initially by NCPD officers, who also made periodic supervisory field trips. The Central Bureau of Statistics full-time enumerators and supervisors also assisted in locating the selected sample points and households and, in certain areas, the District Statistical officers assisted in supervising the teams and providing logistical support. Desktop microcomputers were used for data processing. Data processing was done by five clerks, two data-entry supervisors and a control clerk. The country staff of the IRD were also available for any technical assistance required. The Integrated System for Survey Analysis (ISSA) program was used for data-entry and for resolving any inconsistencies detected during secondary machine editing (NCPD, 1989: 96).

Although the above-mentioned measures were undertaken during the planning and execution of the KDHS, it is possible that some errors were made by the survey staff and some respondents. Some of the common errors associated with survey data in developing countries, and indeed in Africa, are age misstatement; omissions of children ever born and dead, and non-response. Each of these will be examined in turn.

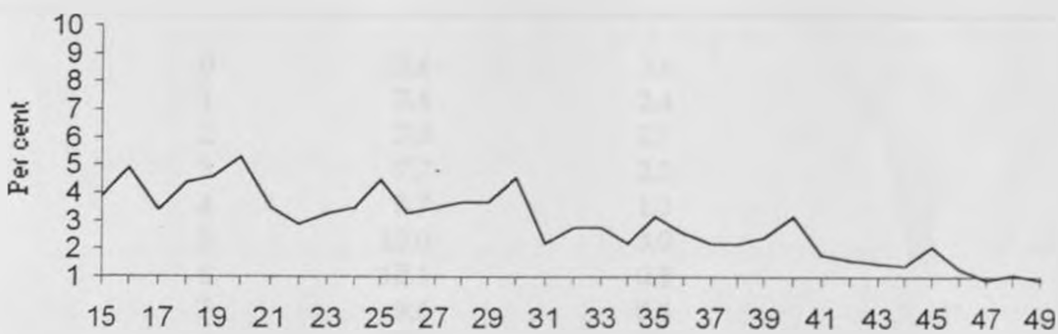
3.3.1 Age reporting among women

Poor reporting of the mother's age affects the results of the analysis of infant and child mortality based on this variable and any other variables computed on the basis of the reported age of mother. Maternal age at birth, which will be computed on the basis of the reported age of the mother, is one of the key variables in this study. Mothers who misreport their own age are also likely to misreport their maternity history. Thus, evidence of misreporting of the age of mother will erode the confidence in the rest of the 1988/89 KDHS data.

One common type of age error is age misstatement or misreporting arising from digital preference usually occurring at ages which end in 0 or 5. This is largely because some respondents do not know their exact ages and so round their ages at preferred digits. Age misreporting may result in a transfer of women into the wrong age group and may distort the expected pattern of the distribution of mean number of children ever born, mean number of children dead and the proportions of dead children by age of mother. Normally, when there are no such errors the mean number of children ever born, and the proportion of the dead children should increase with each succeeding age of mother. This is because older women have had more time in which to have children, and because children born further back in the past were exposed to the risks of mortality for longer duration and they might have been subject to higher mortality rates in the past. In addition, in the absence of a digital preference, there would be an even distribution of women at each terminal digit; about 10 per cent of the women would be in each terminal digit (Shryock and Siegel, 1971: 206).

In this study the extent of age misstatement, particularly age heaping, was examined by considering the percentage distribution of all women by their current single year of age and by calculating preference indexes for terminal digits using Myers' Blended Index. The distribution of all women interviewed in the 1988/89 KDHS according to their current single age is presented in Figure 3.1. Generally, the distribution of women does not provide evidence of serious age misreporting, although there appears to be slight age heaping at ages 20, 25, 30, 35, 40 and 45.

Figure 3.1 Percentage distribution of all women 15-49 years by current single year of age: Kenya, 1988/89 KDHS



The Myers' Blended Index entails determining the proportion of the total population reported at each terminal digit by changing the particular starting age for any 10-year age group. Thus, the method provides an index of preference for each terminal digit, representing the deviation from 10 per cent of the proportion of the total population reporting on the given digit. The method also provides a summary index of preference for all terminal digits. Theoretically, the method provides a summary index that can range from 0, representing no age heaping, to 90, if all ages were reported at a single digit (Shyrock and Siegel, 1971: 206-207).

Table 3.1 shows the indexes of the preference for terminal digits in the age range 20 to 49 for the women interviewed in the 1988/89 KDHS based on the Myers Blended Index. These results also provide evidence of modest preference for ages ending with digits zero and five and avoidance of digits ending with one, two, three and four. A summary index of 9.0 was obtained. Hence, these results do not indicate serious digital preference in the data.

Table 3.1 Percentage of women reported at each terminal digit according to Myers' Blended Index for ages 20-49: Kenya, 1988/89 KDHS

	Terminal digit	Percentage (%)	Deviation of the percentage from 10 % (ignore sign)
	0	13.6	3.6
	1	7.6	2.4
	2	7.3	2.7
	3	7.7	2.3
	4	8.7	1.3
	5	13.0	3.0
	6	10.1	0.1
	7	9.6	0.4
	8	10.8	0.8
	9	11.4	1.4
Total		100.0	18.0
Index	= 18/2 =	9.0	

Source: Primary analysis of the 1988/89 KDHS data.

Since this study focuses on infant and child mortality differentials, gross age misstatement can results in biased estimates based on maternal age groups. Gross age misstatement can occur if, for example, an interviewer systematically over or under estimates ages of mothers by five years. Gross misreporting can be detected by analysing the five-year distribution of respondents. When the data has no serious age misreporting, the proportions of women in successive age groups would be expected to decrease monotonically with increasing age under conditions of stable fertility, declining mortality and a closed population. The results presented in Table 3.2 do not provide evidence of gross misreporting of age of women. However, there was a slight over-reporting by women aged 25-29 years.

Table 3.2 Percentage distribution of women aged 15-49 years by five-year age groups: Kenya, 1988/89 KDHS

Age group	Percentage (%)	Number of of women
15-19	20.9	1497
20-24	18.5	1321
25-29	18.7	1334
30-34	13.7	981
35-39	12.6	898
40-44	9.4	674
45-49	6.2	445
Total	**100**	**7150**

Source: Primary analysis of the 1988/89 KDHS data.

3.3.2 Omission of births

Another error which distorts the expected distribution of children ever born and dead by age group of women is the tendency for older women to under-report their total number of children ever born and dead (Brass, 1980: 31). Consequently, older women (35+ years) often appear to have lower mean children ever born and dead than younger women. An associated problem is misplacement of date of birth or death. Omission of live-births may affect not only estimates of infant and child mortality but also may distort the effects of factors affecting infant and child mortality. For example, an omission of a live birth between two live births will increase the length of the birth interval between the two reported live births and reduce the birth order of the child born after the omitted live birth. Hence the effects of birth intervals and birth order on infant and child mortality will be distorted.

The tendency for older women to under-report some of their children is often attributed to the inability of older women to recall accurately the number of children who were born or who died in the distant past. In Kenya as well as in some other developing countries, cultural factors may also contribute to the omission of certain births and deaths, particularly by old mothers. It is not uncommon for some old people in Kenya to avoid counting their children because counting children is often associated with bad luck and may cause some of the children to die. Generally, people are reluctant to talk about the children who have died because no one wants to remember the sad event. In the 1988/89 KDHS a complete maternity history was sought from each mother. Consequently, a series of questions were asked in order to obtain an accurate maternity history. The interviewers were instructed to check on the accuracy and consistency of the answers given and to probe where necessary. In spite of all the measures undertaken, it is still possible that some mothers may have misreported their maternity history.

A simplified version of the P/F method suggested by Goldman and Hobcraft (1982: 15) and Hobcraft *et al.* (1982: 291) was used to assess the omissions in maternity history. In assessing the quality of maternity-history data and changes in fertility using the P/F ratio procedure, three main criteria have been suggested. Firstly, the P/F ratios would be close to unity in the absence of change in fertility and reporting errors; secondly, the P/F ratio would tend to decrease with increase in the age of women in the absence of omission of births. And finally, a pattern of P/F ratios that increases with the age of the women indicates a recent decline in fertility, if there are no errors (Brass and Coale, 1968: 90-91).

The P/F ratios based on cohort-period specific fertility rates are used as a diagnostic tool to assess data quality. Furthermore, the use of cohort-period fertility rates avoids the use of model age-specific fertility schedules required in the conventional method (Hobcraft *et al.*, 1982: 191-292). Hence, the cohort-period fertility method is used to detect omission of births or displacement of births in the 1988/89 KDHS data. The results are presented in Table 3.3.

Each diagonal in Table 3.3 shows period-specific information for different cohorts of women as they attained different five-years age groups. For example, in Panel A, the cohort-period fertility rate of 0.071 refers to the cohort of women aged 45-49 in 1988/89 when they were 15-19 years old. The cohort-period-fertility rate for this cohort of women when they were 45-49 years old, that is 0-4 years before the survey, is 0.064. Each row depicts information relating to different cohorts of women at the same age group. The cohort-period fertility rates shown in Panel A yield the cumulative cohort fertility rates at the end of each period (P values), and cumulative fertility rates within the periods (F values). The cumulative cohort fertility shown in Panel B is the mean parity that a woman achieved at the end of the period. For example, the cohort aged 15-19 during the 0-4 years before the survey had a mean parity of 0.281 at the time of the survey. The cohort aged 45-49 at the time of the survey had a mean parity of 7.6 and 7.3 five years earlier, when aged 40-45.

Panel B clearly depicts the expected fertility pattern: cumulative cohort fertility increased with the age of the women in all the cohorts of women. Even within each five-year period, cumulative fertility increased with the age of the women. If there were substantial omissions of births, a distorted pattern would have resulted. But it is not the case here. Panel B shows a gradual decline of fertility which began 10-14 years before the survey among the younger women; and during the most recent periods all the cohorts experienced a fertility decline. The period 15-19 years before the survey is characterised by an increase in fertility. Panel B also provides evidence of modest omission of births or displacement of births among oldest cohorts of women. For example, the cohort aged 40-45 at the time of the survey had achieved a mean parity of 1.6 by the age of 20-24, a value less than that for the younger cohorts, except for the cohort aged 20-24, at the time of the survey.

The cumulative fertility rates within the periods (Panel C) are the mean parities that a synthetic cohort of women would achieve at different ages if they were to experience the reported cohort fertility rates in a given period. The cumulative fertility rate for the age group 45-49 corresponds to the conventional total fertility rate of a period. The rate of 6.63 obtained here for this age group at the time of the survey is very close to the reported total fertility for Kenya of 6.7 children per woman in 1989 (NCPD, 1989: 18). The cumulative fertility rate for the most recent period up to age 40-45 equals 6.3 compared to corresponding values of 7.3 for the period 5-9 years before the survey. Panel C shows that the decline in period fertility is particularly evident among the older cohorts. For example, women aged 35-39 and 40-45 in 1988/89 had one child less in the 0-4 years before the survey compared to 5-9 years before the survey.

Table 3.3 Cohort-period fertility rates, cumulative cohort and period fertility rates: Kenya, 1988/89 KDHS

Age group	Number of women in the cohort	Years before 1988/89						
		0-4	5-9	10-14	15-19	20-24	25-29	30-34
A. Cohort-period fertility rate								
15-19	1497	0.054	0.061	0.096	0.102	0.091	0.104	0.071
20-24	1321	0.253	0.286	0.290	0.300	0.285	0.250	
25-29	1334	0.307	0.332	0.352	0.332	0.336		
30-34	981	0.269	0.310	0.330	0.306			
35-39	898	0.236	0.271	0.295				
40-44	674	0.144	0.203					
45-49	445	0.064						
B. Cumulative cohort-fertility at end of period (P)								
15-19		0.281	0.318	0.488	0.559	0.484	0.549	0.355
20-24		1.580	1.936	2.010	1.986	1.972	1.607	
25-29		3.472	3.672	3.745	3.634	3.285		
30-34		5.014	5.283	5.283	4.813			
35-39		6.474	6.639	6.290				
40-44		7.359	7.303					
45-49		7.622						
C. Cumulative cohort-fertility within periods (F)								
15-19		0.270	0.318	0.488	0.538	0.505	0.549	0.385
20-24		1.533	1.746	1.940	2.039	1.928	1.801	
25-29		3.069	3.408	3.699	3.700	3.607		
30-34		4.412	4.958	5.349	5.229			
35-39		5.591	6.314	6.825				
40-44		6.311	7.327					
45-49		6.630						

Source: Primary analysis of the 1988/89 KDHS data.

On the basis of the results presented in Table 3.3, the ratios of cohort to period cumulative fertility rates, that is the P/F ratios, as well as ratios of successive cumulative period fertility rates, (Fs), and successive cohort-period fertility (fs) have been calculated (Table 3.4). The P/F ratios have been calculated in two different ways as suggested by Hobcraft *et al.* (1982: 299): one set which includes common cells and the other which excludes common cells. Both sets of P/F ratios are presented in Table

3.4 as Panel A and B, respectively. For example, the P/F ratios (including the common cells) corresponding to the cohort 20-24 in the period 0-4 years before the survey is 1.031.

Table 3.4 P/F ratios and ratios of successive cumulative period fertility (Fs) and cohort-period fertility rates (fs): Kenya; 1988/89 KDHS

Age group	Years before 1988/89						
	0-4	5-9	10-14	15-19	20-24	25-29	30-34
A. P/F Ratios (including the common cells)							
15-19	0.042	0.998	1.040	1.039	0.959	0.999	0.923
20-24	1.031	1.109	1.036	0.974	1.023	0.892	
25-29	1.131	1.078	1.021	0.982	0.911		
30-34	1.137	1.068	0.988	0.921			
35-39	1.158	1.052	0.922				
40-45	1.166	0.997					
45-49	1.150						
B. P/F Ratios (excluding the common cells)							
20-24	1.031	1.109	1.036	0.974	1.023	0.892	
25-29	1.131	1.078	1.021	0.982	0.911		
30-34	1.137	1.068	0.988	0.921			
35-39	1.158	1.052	0.922				
40-45	1.166	0.997					
45-49	1.150						
C. Ratios of successive cumulative period fertility (Fs)							
15-19	1.167	1.556	1.102	0.935	1.089	0.700	
20-24	1.137	1.112	1.052	0.946	0.933		
25-29	1.109	1.087	1.000	0.976			
30-34	1.122	1.080	0.978				
35-39	1.128	1.082					
40-45	1.160						
D. Ratios of cohort -period rates at successive periods (fs)							
15-19	1.130	1.574	1.063	0.892	1.143	0.683	
20-24	1.130	1.014	1.034	0.950	0.877		
25-29	1.081	1.060	0.943	1.012			
30-34	1.152	1.065	0.927				
35-39	1.148	1.089					
40-45	1.410						

Source: Primary analysis of the 1988/89 KDHS data.

The results presented in Table 3.4 also provide evidence of fertility decline[2] during the 10 year period preceding the survey. They also provide evidence of misreporting of age or omission of some births among the oldest cohorts of women, particularly those aged 40-45 and 45-49 at the time of the survey. This could be a result of misdating of age rather than of omission of births since some of the women in these age groups also misstated their age as reflected by the slight age heaping at ages 35, 40 and 45 evident in Figure 3.3.

Furthermore, omissions of births among children ever born were examined by investigating the distribution of the mean of children ever born by the current age of the mother, classified in five-year age groups. The criteria suggested for this method is that in the absence of errors in the data and in the absence of fertility change in the past, the mean children ever born should increase with the age of the mother (Singh, 1987: 619-620). The results are presented in Table 3.5. The results are similar to those in Panel B of Table 3.3 relating to the 0-4 years before the survey. The mean parity increased with each succeeding age group of women, from a low of 0.28 for women aged 15-19 to a high of 7.62 for women aged 45-49 in 1988/89.

Table 3.5 Distribution of number of children ever born, children dead, mean parity and the proportion of children dead: Kenya, 1988/89 KDHS

Age of mother	Number of mothers	Number of children ever born	Number of children dead	Mean children ever born	Mean children dead	Proportion of children dead
15-19	1497	421	49	0.28	0.032	0.018
20-24	1321	2087	183	1.58	0.139	0.068
25-29	1334	4632	387	3.47	0.283	0.136
30-34	981	4919	513	5.01	0.527	0.185
35-39	898	5814	605	6.47	0.675	0.218
40-44	674	4960	563	7.36	0.834	0.203
45-49	445	3392	481	7.62	1.097	0.173
Total	**7150**	**26225**	**2773**	**3.67**	**0.389**	**0.106**

Source: Primary analysis of the 1988/89 KDHS data.

[2]Since the focus of this section is not fertility change in Kenya, no detailed discussion of the fertility decline is provided here.

This check does not provide evidence of omissions of births. It can therefore be concluded that the KDHS data does not suffer from serious omissions of children ever born.

3.3.3 Omission of dead children

Omission of dead children can be detected by examining the proportions of the children dead by age group of mother. Typically, in the absence of omission of dead children the proportion of children dead should increase with age of mother in a situation in which childhood mortality has not been increasing, because the children of the older mothers have had longer exposure to risk of dying and most likely had higher mortality risk than the children of the relatively younger mothers. However, this pattern may not hold for women aged 15-19 because their children, usually have a higher risk of death (Hobcraft *et al.* 1985: 369; Hobcraft, 1992: 8-9). Table 3.5 shows that the proportions of children dead by the age of the mother increased as expected up to the 35-39 age group and declined thereafter. It would appear that some of the women aged 40-45 and 45-49 under-reported some of their dead children since the proportions of children dead for these age groups were lower than for the age groups 35-39. A comparison of the child deaths per woman in the 1988/89 KDHS data with the 1977/78 Kenya Fertility Survey data on a cohort basis, also indicates that some older mothers under-reported some of their dead children in the KDHS data (Brass, 1993: 75).

3.3.4 'Heaping' of children's ages

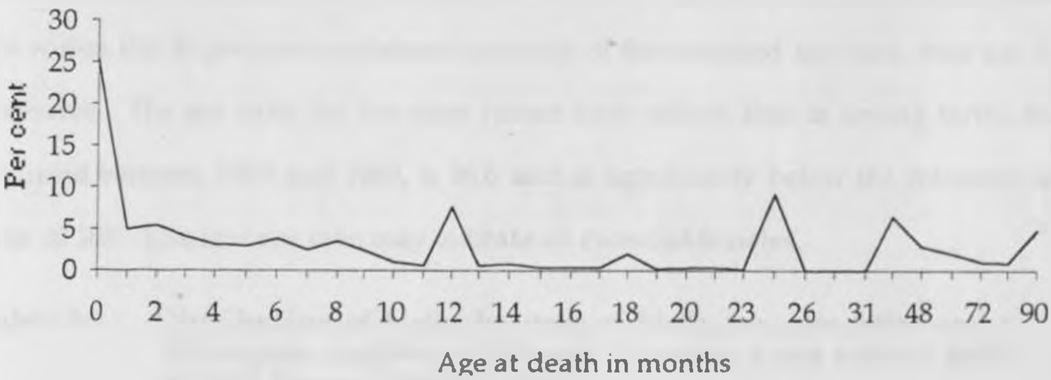
The use of birth histories in a population with a modest level of formal education introduces additional errors into the birth-history data. In the KDHS, women were not only asked to recall all the live births they had ever had, but also the date of births, the date of death and the age at death in months of each dead child. Due to the combination of no or modest formal education and of recall problems, children's age may have been misreported.

Therefore, in this study the extent of age heaping among children is assessed by investigating the percentage distribution of all living children by their current single year of age and the percentage distribution of all dead children by their age at death in months. Figure 3.2 does not show any significant age heaping. Some of the fluctuations could be due to the changes in fertility and to chance (random fluctuations). However, there appears to be some age heaping with respect to age at death. There is a marked concentration of deaths at 0 and small age heaping at 12, 24 and 36 months. Age heaping at age 0, 24 or 36 months poses no adverse effects for the analysis because age 0 falls within the age bracket for infant mortality and 24 and 36 months are in the age range for child mortality. However, age heaping at age 12 months poses a problem because it can affect the estimates of both infant and child mortality as age 12 months is the cut-off point for infant and child mortality.

Age heaping at ages 12, 24 and 36 months could be the result of some children dying either before or after that exact age. If a substantial number of children had died before 12 months and were reported as having died at age 12 months then the infant mortality rate derived from such data would be underestimated. Consequently, the child mortality rate would be overestimated. However, the estimation of the overall levels of infant and child mortality is not the primary focus of this study, as its main focus is differential mortality. As noted by Majumder (1989: 43), the effect of age heaping for the study of differential mortality can be expected to be negligible if the deaths are uniformly distributed among different sub-groups of the children selected for the study.

Figure 3.2 Percentage distribution of all living children by current age: Kenya, 1988/89 KDHS

Figure 3.3 Percentage distribution of all dead children by age at death: Kenya, 1988/89 KDHS



3.3.5 Sex ratios at birth

Another possible source of error in birth histories is sex selectivity in the recalling of live births. In societies which favour male children, women tend to remember and report their male children better than their female children (Singh, 1986: 639). The effect of this would be under-reporting of the total number of children ever born as well as a higher proportion of male children dead, since more male children usually die than female children. This sort of error in the data was examined by investigating the sex ratio at birth for all live births and by period (Brass, 1980: 40). In calculating sex ratios at birth, it is worthwhile to calculate a 95 per cent confidence interval for the sex ratios since the variation in the number of children affects the sex ratios obtained. A standard or reference sex ratio at birth of 103 was adopted as the true sex ratio in the population. It has been found that among African populations originating south of the Sahara the sex ratio at birth is close to 103 (UN, 1983: 77).

The following formula was used to calculate the 95 per cent confidence intervals (C.I.) for the observed sex ratios:

$$C.I. = p \pm 1.96\sqrt{p(1-p)/n},$$

where p is the proportion of the children in each group that were male;

and n is the total number of children in the group of interest (for instance total children born to mothers aged 15-19 years).

Higher sex ratios for live births that occurred between 1950 and 1959 and those born between 1960 and 1969 are evident in Table 3.6. However, since these sex ratios are within the 95 per cent confidence intervals of the standard sex ratio, they are not excessive. The sex ratio for the most recent birth cohort, that is among births that occurred between 1985 and 1989, is 96.6 and is significantly below the reference sex ratio of 103. This low sex ratio may indicate an excess of females.

Table 3.6 Distribution of births by year of birth, sex, sex ratios and a 95 percent confidence interval assuming a sex ratio at birth of 103: Kenya, 1988/89 KDHS

Year of birth	Males	Females	Total	Sex ratio *100	95 per cent confidence interval assuming a sex ratio at birth of 103
1950-54	11	9	20	122.2	40.5 - 265.6
1955-59	121	112	233	108.0	79.6 - 133.4
1960-64	562	543	1105	103.5	91.5 - 115.9
1965-69	1240	1120	2360	110.7	95.0 - 111.7
1970-74	2013	1999	4012	100.7	96.8 - 109.6
1975-79	2822	2739	5561	103.0	97.7 - 108.6
1980-84	3481	3418	6999	101.8	98.2 - 107.9
1985-89	2967	3070	6039	96.6	97.9 - 108.0*
Total	**13218**	**13010**	**26227**	**101.6**	**100.5 - 105.5**

Note: * The observed sex ratio is significantly lower than the standard sex ratio of 103.

Source: Primary analysis of the 1988/89 KDHS data.

Table 3.7 shows a higher sex ratio among the children reported by women currently aged 15-19 and 40-44. However, this sex ratio falls within the 95 per cent confidence interval for the standard sex ratio. Hence it can be concluded that they are not significantly higher than the reference ratio. However, the sex ratios among the children of mothers aged 20-24 and those aged 25-29 are significantly lower than the reference sex ratio.

Table 3.7 Distribution of births by current age of mother, sex, sex ratios and a 95 percent confidence interval assuming a sex ratio at birth of 103: Kenya, 1988/89 KDHS

Age of mother	Males	Females	Total	Sex ratio *100	95 percent confidence interval assuming a sex ratio at birth of 103
15-19	223	198	421	112.6	85.1 - 124.7
20-24	1048	1039	2087	100.9	102.9 - 103.1*
25-29	2262	2370	4632	95.4	97.2 - 109.1*
30-34	4920	2497	2423	103.1	97.4 - 108.9
35-39	2955	2814	5814	103.4	97.4 - 108.9
40-44	2561	2399	4960	106.7	97.8 - 108.4
45-49	1437	1475	3393	97.0	96.3 - 110.2
Total	**13218**	**13010**	**26227**	**101.6**	**100.5. - 105.5**

Note: * The observed sex ratio is significantly lower than the standard sex ratio of 103.

Source: Primary analysis of the 1988/89 KDHS data.

In conclusion, the preceding analysis indicates that the 1988/89 KDHS data does not suffer greatly from omissions of births. The data also does not suffer excessive age heaping. However, there is under-reporting of some dead children, particularly by mothers aged 40-49 years.

In order to reduce the possible biases that some of these problems can cause, the analysis of infant mortality was based on a cohort of single births that occurred between 1970 and 1987, because these were the births who had at least one year of exposure to the risk of dying at the time of the survey 1988/89. The analysis of child mortality was restricted to the children born between 1970 and 1983 who survived infancy, because these were the children who had experienced at least five years of exposure to the risk of dying at the time of the survey. The birth cohorts are used in order to have a sufficiently large number of observations to obtain robust results in the analysis.

Births that occurred before January 1970 were also excluded from the analysis in order to minimise problems of omission of dead children and misstatement of age often associated with births that occurred in the distant past. In addition, the reference period should be as near as possible to the survey time because some of the characteristics, particularly household characteristics, reported by the mother were those that were obtaining at the time of the survey. They might not be relevant to some of the children that were born in the distant past. For example, a piped water supply may have been connected to the household only recently after the birth of some of the children who may now be dead. In such a situation high mortality risk will be wrongly associated with piped water supply because the children in question died before the water supply was connected to their mothers' households.

3.4 Methods of data analysis

Since the dependent variable (child survival status) is dichotomous denoting whether or not a child failed to survive through a specified age bracket, the method of analysis used was logistic regression. This is an efficient way to introduce the necessary controls when the dependent variable is a dichotomous one and the explanatory variables are categorical as in the case of this study (Little, 1978: 23-25; Retherford and Choe, 1993: 119-150). The ratio of the probability that an event will occur, (ρ), to the probability that it will not occur, ($1-\rho$), is called the odds. A logit is the natural logarithm of the odds. Thus, a logistic regression model may be expressed as follows:

$$\text{Logit}(\rho) = \ln(\rho/(1-\rho)) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \ldots + \beta_n X_n + \varepsilon,$$

where ρ = the probability that the event will occur;

ln = the natural logarithm;

$1-\rho$ = the probability that the event will not occur;

α = a constant or the intercept of the model;

β_1 to β_n are logistic coefficients;

X_1 to X_n are dichotomous or interval explanatory variables, (categorical variables are expressed as a series of dichotomised variables); and

ε is a binomially distributed error term.

The dependent variable takes the value of unity if the child failed to survive through the specified age range and zero if the child survived. For infant and child mortality the age intervals are 0-11 and 12-59 completed months, respectively. Each explanatory variable has a reference or base category. The reference category was preferably the category with theoretically the lowest risk of mortality. For example, in the case of the source of drinking water, the reference is the 'piped-water supply' category. The logistic coefficient, (β_i), is interpreted as the difference in the predicted log odds of the outcome between those in the higher risk category and those in the reference category. The logistic coefficient, (βi), has to be exponentiated to obtain an estimate of the odds ratio associated with each category of the explanatory variable. The odds ratio of the reference category is unity. If the odds ratio of a given category is greater than 1.00, this indicates an increased likelihood of the risk of dying, and when the odds ratio is less than 1.00, it indicates a lower risk of dying compared to the reference category. A detailed description of logistic regression can be found in Hosmer and Lemershow (1989), Retherford and Choe (1993: 121-150), Norusis and Spss Inc. (1993: 1-30) and Kleinbaum (1994).

Weighting or not weighting data in regression modelling is a matter of choice. The statisticians consulted by the author on this issue strongly recommended non-use of weights in logistic models, arguing that it is not clear what happens in some statistical packages and hence in the model when weights are used. Skinner *et al.* (1989: 286) are of the opinion that unweighted model-inference is appropriate when the difference between the inclusion probabilities are a function only of known survey design variables such as stratum identifiers or size measures, and if these design variables are included as explanatory variables in the model and the model is correctly specified. They argue that even if the survey design variables are not included as explanatory variables in the model but a correct model of the selection mechanism is specified, then unweighted model-based inference is still appropriate. Because the emphasis in this study is on determining the influence of the explanatory variables and some of the pathways of their influence, for this it is the individual cases which are important and hence no weighting was done in the logistic models employed in this study.

The Generalised Linear Interactive Model, (*GLIM*), a software package developed by the Royal College of Statisticians, London, was used to fit the logistic models. Descriptions of *GLIM* procedure can be found in Healey (1988) Aitkin *et al.* (1989) and in Lindsey (1989). The statistic called scaled deviance, also known as the likelihood chi-square, (LRχ^2), together with the degrees of freedom of each variable was used to assess the significance of each explanatory variable. A t-test statistic will be computed and used to compare the significance of the estimates of the effect of each explanatory variable.

The Statistical Package for Social Sciences (SPSS) for UNIX Release 5.0 was also used to prepare data for use in GLIM and to carry out some analyses. For instance, the cross-tabs procedure will be used in the calculation of infant and child mortality rates. In Chapter Seven, the SPSS logistic regression procedure will be used to re-check the final logistic models fitted with GLIM. However, the GLIM type restrictions will be applied in the SPSS logistic regression procedure in order to obtain comparable results. SPSS procedures are also used in Chapter Eight.

3.5 Definitions of variables

(a) Survival status of the child

This is the main dependent variable and it measures whether or not the index child died during a specified age interval under consideration. This is conditional to the child's surviving to the beginning of the interval. As previously discussed, this variable will take the value of unity if the child failed to survive through the specified age range and zero if the child survived. For infant and child mortality the age intervals are 0-11 and 12-59 completed months, respectively.

(b) Province of residence

Province of residence (REG) refers to the usual province of residence. As pointed out in Chapter Two, this study will cover Nairobi, Central, Rift Valley, Eastern, Coast, Nyanza and Western provinces. This study did not cover North-Eastern province as it was not covered by the 1988/89 KDHS. Province of residence is a proxy for climatic and ecological conditions of each of the provinces as well as a proxy for other aspects of social and economic development, including health system, transport and communication networks that are not captured by the other socioeconomic factors included in this study.

(c) Place of residence

Type of place of residence (URB) refers to whether the usual place of residence was urban or rural. Type of place of residence of mother is often considered as a proxy for living conditions and also for access to such facilities as safe water, health services, and educational services (Arriaga and Hobbs, 1982; Hobcraft *et al.*, 1983).

(d) Index of household economic status

An index of household economic status (HSES) was constructed to serve as a proxy for household wealth and disposable income. Since no data were collected in the Survey on household income *per se*, a crude index of household economic status was constructed as suggested by Bicego and Boerma (1991: 182), using the data that DHS surveys collected with the intention of capturing variations in household wealth and disposable income. The index is constructed by using data on possession of a radio and television set (two points were assigned for a television set, and one for a radio if no television was owned). Then the type of main material used in floor construction of the dwelling house was considered (two points were assigned to a non-earth floor, otherwise zero). The third item related to possession of a motorised means of transportation (two points were assigned for either a car or tractor, and one for a motorcycle if no car or tractor was owned, otherwise zero).

This ranking resulted in an index ranging between 0 and 6 points, categorised into three groups: 0 to denote households with low economic status or poor households; 1-2 to denote households with medium economic status and 3-6 points to denote households with high economic status or richer households. According to this categorisation about 88 per cent of the members of the 1970-87 birth cohort were born in households with low to medium economic status and the rest were born in the relatively well-off households.

(e) Maternal education

Maternal education (MEDU) refers to the highest standard of formal learning attained by the mother. It is represented by a variable with three categories: no education; primary, and at least secondary education. This categorisation corresponds approximately to 0 years, 1-7, and 8+ years of education. The secondary and higher education categories were collapsed into 'at least secondary' because there were very few children whose mothers had higher education. Maternal education represents the knowledge and skills a mother acquires from her exposure to formal learning, increased autonomy in decision making inside and outside the household setting, and increased access to material resources through better employment and credit facilities.

(f) Husband's education

Paternal education (FADU) refers to the highest standard of formal learning attained by the husband. It has been given the same categories as maternal education. Since the unit of analysis is the child, it is not known whether the current husband is the biological father. He may be a foster father, but it is also possible that the current husband may have had no relationship at all with the child. This would be the case if the mother married after the death of the child. Hence, the education of the current husband is used as an approximation of paternal eduction.

(g) Mother's work status

Mother's work status (MOCW) refers to whether or not the mother was in some form of paid employment outside the household at the time of the survey. The mothers were not asked for how long they had worked or what type of work they did. Nor does the information collected include status of employment, for example employee, employer or own-account worker. Thus, it is not possible to group the mothers according to their employment status and occupations. Therefore, in this study mother's current work status will be taken to mean participation in paid work/employment. This is admittedly a narrow definition of economic activity because some women were likely to be self- employed, for example selling vegetables and fish, yet such women would be grouped together with housewives. A mother's work status is a proxy for her command of economic resources (income) and exposure to modern influences. This variable has only two categories: working or not working.

(h) Possession of livestock

Possession of livestock (LSTOK) refers to whether or not there were cattle, sheep or goats in the household at the time of the survey. No information was collected about the number or the specific type of livestock; nor was information collected about how long they had been reared. In addition to being a traditional indicator of wealth of a household, livestock can be a source of income to the family as they or some of their products such as milk and meat can be sold to obtain cash money or can directly be used by members of a household to maintain or improve their nutrition and thus health status.

(i) Maternal age at birth

This variable refers to the mother's age at birth (MAGE). It will be categorised as less than 20 years, 20-29 years, and at least 30 years. In the logistic regression, the 20-29 years category is the reference category. This variable is a proxy for the mother's physiological, mental, and emotional maturity. This variable also measures the mother's experience with child care.

(j) Birth order

This variable (BO) refers to the ordinal position in which the child was born in a family. This variable is coded as 1, 2-3, 4-5 and 6+. In the logistic regression, the birth order 2-3 is used as the reference category.

(k) Birth interval

Birth interval refers to the length of time, in months, between two successive live births. Two types of birth intervals are of interest in demography: preceding and succeeding birth intervals. The preceding birth interval refers to the interval before the birth of the child in question. Hence the effect of the preceding birth interval (PREBI) is considered in relation to the younger of the two children. Conversely, the succeeding birth interval refers to the interval after the birth of the child in question and its follower. Thus, the succeeding birth interval (SUCBI) is considered in relation to the older child of the pair.

(l) Survival status of the preceding child

The survival status of the preceding child (SURV) is a dichotomous variable, denoting whether the preceding child was alive or dead at age exact age one. This variable reflects family mortality environment.

(m) Ever -use of modern contraception

Ever-use of modern contraception (USE) refers to whether or not a mother had ever used a modern contraceptive method to space her children or to stop child bearing completely. This variable will be used as a crude proxy for access to and use of modern health services because of lack of more appropriate information for most of the children covered in this study. In the 1988/89 KDHS, data on use of modern health services such as ante-natal care are available for only children who were born between 1983 and 1989. In this study, it is assumed that a mother who had ever used a modern contraception method was more likely to use other health services as well, since family planning services in Kenya are integrated with other maternal and child health-care services. This variable is a dichotomous one.

(n) Household environmental conditions

In the analysis of the effects of household environmental conditions on infant and child mortality, two variables will be used: source of drinking water and type of toilet facility. The level of household exposure to diseases such as diarrhoea depends on the quality of household drinking water and whether or not the household has a toilet facility. A variable denoting household's source of drinking water (HWA) will be constructed from the mother's response to the question on the type of source of drinking water that her household uses. This variable has only two categories: piped water supply or other sources. In the logistic regression, the 'piped water' category will be reference.

A second variable denoting whether or not the household has a toilet facility (HTO) will be constructed from the mother's response to the question on the type of toilet facility that her household uses. This variable has two categories: Yes, if the household has a toilet facility or No, if the household does not have a toilet facility. A child is considered to be at higher risk if he or she lives in a household that has no toilet facility.

The socioeconomic variables and the variables representing household environmental conditions were characteristics prevailing at the time of the survey. They may or may not refer to the situation while the child was exposed to the risk of dying. The problem may be more severe for the variables representing household environmental conditions than for the socioeconomic variables. For example, the source of drinking-water supply and toilet facilities might have been recently upgraded such that some of the children born earlier classified as having better facilities might have been in reality exposed to poorer facilities. This could result in under-estimation of mortality risk associated with poorer facilities. Since they are the only variables available to consider, it is assumed, as in other studies (Muganzi, 1984, Trussell and Hammerslough, 1983), that these conditions did not change much during the period under review. These considerations will be borne in mind in the interpretation of the results.

CHAPTER FOUR

EFFECTS OF PROXIMATE VARIABLES ON INFANT AND CHILD MORTALITY

4.1 Introduction

This chapter examines the effects of selected proximate variables on infant and child mortality. As explained in Chapter One, proximate variables directly affect child health and socioeconomic variables must, in principle, operate through them to influence child survival. The proximate variables whose effects are examined are the maternal age at birth, birth order, birth interval, sex of the child, the survival status of the preceding child at age one, source of drinking water, availability of a toilet facility in the household, and ever-use of modern contraception. This chapter begins by a discussion of the analytical approach, followed by the presentation and discussion of the results.

4.2 Analytical approach

A two-stage analytical approach has been adopted in this chapter. First, direct estimates of infant and child mortality rates for each category of the proximate variable were obtained using a direct estimation method. As explained in Chapter Three, analysis of infant mortality was based on single births that occurred between 1970 and 1987, while analysis of child mortality was based on the children (singletons) born between 1970 and 1983 who survived infancy. These direct estimates of infant and child mortality rates were based on weighted number of cases. In the second stage of the analysis, the effects of each proximate variable were obtained by fitting logistic models, using unweighted data.

4.3 Effects of maternal factors

All births and children were considered in the following analyses of the effects of birth order and maternal age. The preliminary analysis revealed that sex of the child was not significantly, not even at the 10 per cent level, associated with either infant or child mortality. This was the case in both univariate and multivariate logistic regression models (Appendix 4.1). Hence sex of the child was excluded from the analysis in this study.

4.3.1 Maternal age at birth

The results presented in Table 4.1 show that maternal age at birth was closely associated with infant and child mortality in Kenya. Children of young mothers (< 20 years) and those of older mothers (30+ years) had higher infant mortality than children born to mothers in the prime reproductive ages, that is 20 to 29 years. Unlike in the case of infant mortality, it was only the children born to younger mothers that had higher child mortality than those born to mothers aged 20-29. The children born to mothers aged 30 years and above had lower child mortality than the children born to mothers aged 20-29. These results confirm previous findings on the association between maternal age at birth and infant and child mortality in Kenya (Mott, 1982: 20-23; Rutstein, 1984: 30).

Table 4.1 Infant and child mortality rates by maternal age at birth: Kenya, 1988/89 KDHS

Maternal age at birth	Infant mortality[a]	Child mortality[b]
< 20	67 (3940)	49 (2933)
20-29	54 (11240)	37 (7812)
30+	57 (5042)	26 (3124)
Total	57 (20222)	37 (13870)
χ^2	= 9.06, d.f. = 2, p < 0.01	χ^2 = 22.46, d.f. = 2, p < 0.001

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed live births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

The logistic regression results presented in Table 4.2 show that maternal age at birth had a significant effect on both infant and child mortality. Relative to children born to mothers aged 20-29 years, children born to mothers aged below 20 years and those born to mothers aged 30 and above had odds of dying in infancy 1.38 and 1.25 times higher. However, in the case of child mortality, it was only the odds of dying among children born to mothers aged below 20 years that were significantly greater than those of the children born to mothers aged 20-29 years.

Since maternal age and birth order are necessarily related in that birth order usually increases with age of the mother, birth order was taken into account. The results presented in Table 4.2 show that the strength of the effect of maternal age at birth on infant and child mortality was not altered when the birth order of the child was taken into account. This is indicated by the fact that virtually no change occurred in the $LR\chi^2$ values. However, there were moderate changes in the mortality risks represented by odds ratios. In the case of infant mortality, the odds ratio for children of younger mothers (< 20 years) increased from 1.38 to 1.51, while the odds ratio for the children of older mothers (30+ years) decreased from 1.25 to 0.92.

Similarly, the odds of child mortality for children of young mothers increased from 1.29 to 1.50, while odds of dying for children of older mothers decreased from 0.78 to 0.72 when the birth order was taken into account. This suggests that differences in the risk of child mortality by maternal age at birth were mainly due to physiological factors. Very young mothers may not have physiologically and emotionally matured enough to adequately manage a pregnancy (Pebley and Stupp, 1987: 43). They may also have poor child-care skills. In addition, they may be unable to obtain an adequate share of food and other household resources for their children, since they may have little influence on the allocation of household resources.

Higher birth orders are more likely to occur to older mothers (30+); and it has been suggested that the higher mortality risk among children born to older mothers may be a result of a decline in the efficacy in the reproductive system with age (Pebley and Stupp, 1987: 43). For example, advanced maternal age is often associated with a higher frequency of congenital anomalies. This may explain why the odds of dying during infancy among children born to younger mothers increased while the odds of dying among children born to such mothers were not significantly different from those of the children born to mothers in the prime reproductive ages when birth order was controlled.

Table 4.2 **Odds ratios and likelihood chi-square values indicating the effect of maternal age at birth on infant and child mortality, adjusted for birth order: Kenya, 1988/89 KDHS**

	Gross effect			Adjusted for birth order		
	Odds ratio	$LR\chi^2$	P	Odds ratio	$LR\chi^2$	P
Infant mortality (n= 18345)						
Maternal age at birth		19.96	< 0.001		19.36	< 0.001
< 20	1.38***			1.51***		
20-29	1.00			1.00		
30+	1.25**			0 92		
Child mortality (n = 12595)						
Maternal age at birth		12.57	< 0.001		13.69	< 0.001
< 20	1.38**			1.50**		
20-29	1.00			1.00		
30+	0.78			0.72*		

Notes: The $LR\chi^2$ values shown here are those associated with maternal age at birth only and not of all the variables in the model. ** Significant at $p < 0.01$, ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

Hence this study confirms the usual pattern of higher risks of infant and child mortality among children born to younger mothers. As discussed previously, the excess risk of death among children born to such mothers could be due to fact that the reproductive systems of such mothers are not fully developed. In addition, younger mothers may not be able to get adequate ante-natal care and to provide sufficient post-natal care due to lack of money, child-care skills and experience, which are associated with age.

4.3.2 Birth order

As in the case of maternal age, a U-shaped pattern has been found to characterise the association between birth order and infant and child mortality. Infant and child mortality is high at the first and highest birth orders (Hobcraft *et al.*, 1984; Rutstein, 1984: 74; Pebley and Stupp, 1987: 42). The results presented in Table 4.3 show birth order of the child was significantly associated with infant mortality but not with child mortality. First-born children and those of the sixth or higher birth orders had higher infant mortality than children of the second and third birth order or children of the fourth and fifth birth order. First-born children and those of the sixth or higher birth orders had similar infant mortality levels; their infant mortality was 22 and 20 per cent, respectively, higher than that of the children of the second and third birth order.

Table 4.3 Infant and child mortality rates by birth order: Kenya, 1988/89 KDHS

Birth order	Infant mortality[a]	Child mortality[b]
1	65 (3798)	41 (2652)
2-3	53 (6450)	35 (4629)
4-5	51 (4809)	41 (3430)
6+	64 (5166)	33 (3158)
Total	57 (20222)	37 (13870)
χ^2	**15.12, d.f. = 2, p < 0.001**	**χ^2 = 4.51, d.f. = 2 p> 0.05**

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed births and children.

Source: Primary analysis of the 1988/89 KDHS data.

Since birth order is closely associated with maternal age, in that higher birth orders usually occur among older mothers, the effect of maternal age at birth was controlled in the analysis. The results shown in Table 4.4 indicate that infant mortality rate declined with rising maternal age irrespective of birth order. Among children of younger mothers, the child mortality rate appeared to increase with the birth order.

But the small numbers of observations of higher birth orders make drawing any conclusion difficult. For the children of older mothers, child mortality rates were higher for the first born children and children of the fourth and fifth or higher birth orders than for the children of the second and third birth orders.

Table 4.4 Infant and child mortality rates by birth order and maternal age at birth: Kenya, 1988/89 KDHS

	Maternal age at birth							
	< 20		20-29		30+		Total	
	Infant mortality[a]							
Birth order								
1	68	(2469)	58	(1292)	27	(37)	65	(3798)
2-3	61	(1392)	51	(4770)	28	(288)	53	(6450)
4-5	129	(77)	52	(3709)	39	(1022)	51	(4809)
6+	333	(3)[c]	64	(1469)	64	(3694)	64	(5166)
Total	67	(3940)	54	(11240)	62	(1906)	57	(20222)
	Child mortality[b]							
Birth order								
1	43	(1764)	36	(861)	37	(27)	41	(2652)
2-3	57	(1104)	29	(3304)	14	(217)	35	(4629)
4-5	63	(64)	46	(2647)	24	(719)	41	(3430)
6+	---	(1)	45	(996)	27	(2160)	33	(3158)
Total	49	(2933)	38	(7812)	26	(3124)	37	(13870)

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. Weighted number of live births/children are in the parentheses, [c] One death occurred among the children in the category, --- No deaths occurred among the children in the category.

Source: Primary analysis of the 1988/89 KDHS data.

The results in Table 4.5 also show that birth order was significantly related to infant mortality but not to child mortality. The odds of dying in infancy among first-born children were no longer significantly different from those for the children of the second and third birth order once maternal age at birth was taken into account. This indicates that the excess infant mortality risk among first-born children was mainly due to the fact that they predominantly occurred to young mothers. The results show the effect of birth order on infant mortality persisted even when the influence of maternal age at birth was taken into account.

Table 4.5 **Odds ratios and likelihood chi-square values indicating the effect of birth order on infant and child mortality, adjusted for maternal age at birth: Kenya, 1988/89 KDHS**

	Gross effect			Adjusted for MAGE		
	Odds ratio	$LR\chi^2$	P	Odds ratio	$LR\chi^2$	P
Infant mortality (n = 18345)						
Birth order		29.57	< 0.001		28.97	< 0 001
1	1.21*			1 00		
2-3	1.00			1.00		
4-5	0.95			1.05		
6+	1.44***			1.67***		
Child mortality (n = 12595)						
Birth order		4.12	> 0 20		5.24	> 0.10
1	1.11			0.93		
2-3	1.00			1 00		
4-5	1.13			1.30*		
6+	0 87			1.18		

Notes: The $LR\chi^2$ shown here are those associated with birth order only. MAGE stands for maternal age at birth. * Significant at $p < 0.05$, ** Significant at $p < 0.01$, ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

4.3.3 Birth intervals

In this study the effects of the preceding and succeeding birth intervals are examined. Since two live births are involved in any given closed birth interval, the effect of the birth interval may relate to either the older or the younger child. Thus, the child for whom which the effect of the birth interval is being investigated must be specified. Where the focus is on the preceding birth interval, the effect on the immediately subsequent younger child is examined. The effect of the succeeding birth interval is related to the immediately preceding older child. In each case the child for whom the effect of the birth interval is considered is referred to as the index child.

In the multivariate analysis of the effects of the preceding birth interval on infant and child mortality, first-born children will be excluded because they have no logical preceding birth interval. In the analysis of the effects of the succeeding birth interval the last-born children would be excluded because their succeeding birth intervals were still open at the time of the survey. It is also important and helpful to use the survival status of the preceding child at age one as a control variable. Furthermore, the analysis of the effect of the succeeding birth interval was restricted to child mortality because of methodological difficulties associated with the use of succeeding birth intervals in infant mortality analysis.

(a) The preceding birth interval

In analysing the effect of the preceding birth interval, it is important to distinguish between cases where the intervals were short because the preceding child had died, and cases where the previous older child survived but the birth interval was still short. It has been argued that the effect of the preceding birth interval on the risk of mortality of the subsequent index child without the control of the survival status of the preceding child is likely to be biased (Pebley and Millman, 1986: 71-72; Boerma and Bicego, 1992: 245-246). The argument is that an early child death of the older child tends to shorten the interval between the births by abrupt curtailment of breastfeeding leading to an early resumption of ovulation.

In addition, because the couple may want to replace the dead child, there may be an early resumption of sexual intercourse. In such a situation it is very unlikely that the couple would want to use contraception, hence the mother is likely to become pregnant on resumption of sexual intercourse. The death of the index child could also be due to the same familial factors that caused the death of the elder sibling (Palloni and Millman, 1986: 317; Pebley and Stupp, 1987: 43-47).

The effect of the preceding birth interval was first analysed without controlling for the survival status of the preceding child at age one, and then with the control, to establish whether any relationship between the preceding birth interval and the mortality risk of the index child was influenced by the survival status of the preceding child. The results presented in Table 4.6 shows that the preceding birth interval was significantly and inversely associated with infant and child mortality. For example, infant mortality among children with a preceding birth interval of less than 24 months and those with a preceding birth interval of 24-35 months was 2.35 and 1.44 times, respectively, as high as that of the children born at least 36 months after the preceding birth.

Table 4.6 Infant and child mortality rates by the preceding birth interval: Kenya, 1988/89 KDHS

Birth interval (in months)	Infant mortality[a]	Child mortality[b]
< 24	80 (5789)	48 (4055)
24-35	49 (6320)	37 (4280)
36+	34 (4316)	19 (2878)
Total	56 (16425)	36 (11217)
χ^2	= 150.60, d.f. = 2 $p < 0.001$	χ^2 = 56.66, d.f. = 2 $p < 0.001$

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed live births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

When the infant and child mortality rates for the first-born children that were shown in Table 4.3 are compared with those presented in Table 4.6, it is clear that first-born children suffered higher infant and child mortality than subsequent children. However, subsequent children born within 24 months of the preceding live birth experienced higher infant and child mortality than first-born children. Infant and child mortality rates among such children were 23 and 17 per cent, respectively, higher than among first-born children. It was only the infant and child mortality among subsequent children born at least 24 months after the preceding live birth that were lower than those of the first-born children.

The logistic regression results presented in Table 4.7 show that the children born within 24 months of the preceding birth had odds of dying in infancy about 2.4 times higher than children who were born at least 36 months after the preceding live birth. A similar pattern is observed in relation to child mortality, though the odds of dying were slightly higher than in infancy (Table 4.8). The odds of infant and child mortality for first-born children were significantly higher than those for children with preceding birth intervals of at least 36 months but lower than those for children with preceding birth intervals of less than 24 months.

Table 4.7 Odds ratios and likelihood chi-square values indicating the effect of the preceding birth interval on infant mortality, adjusted for birth order and maternal age at birth: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for BO	Adjusted for MAGE	Adjusted for MAGE & BO
		All infants (n = 18345)		
$LR\chi^2$	115.68	113.50	117.00	106.86
d.f.	3	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
First birth	1.75**	(---)	1.66**	(---)
< 24	2.44***	2.43***	2.49***	2.38***
24-35	1.31**	1.31**	1.34**	1.29**
36+	1.00	1.00	1.00	1.00
		Second and higher order births[a] (n= 14951)		
$LR\chi^2$	114.70	113.50	115.60	106.10
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
< 24	2.44***	2.43***	2.48***	2.40***
24-35	1.31**	1.31**	1.33**	1.30**
36+	1.00	1.00	1.00	1.00

Notes: [a] Based on all live births that had a preceding birth interval (PBI), irrespective of whether they had a succeeding birth interval. (---) odds ratio were not calculated due to redundancy in the design matrix because first-order births are the same as first-born children. *Significant at $p < 0.05$, ** Significant at $p < 0.01$, *** Significant at $p < 0.001$. MAGE and BO stand for maternal age at birth and birth order, respectively.

Source: Primary analysis of the 1988/89 KDHS data

Tables 4.7 and 4.8 also show that the effects of the preceding birth interval on both infant and child mortality remained virtually unchanged when controls for maternal age at birth and birth order were each introduced. This indicates that, irrespective of birth order and maternal age, children born after a shorter birth interval were at greater risk of dying during infancy and between ages one and five years than children born at least 36 months after the preceding live birth.

Table 4.8 Odds ratios and likelihood chi-square values indicating the effect of the preceding birth interval on child mortality, adjusted for birth order and maternal age at birth: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for BO	Adjusted for MAGE	Adjusted for MAGE & BO
		All children (n = 12595)		
$LR\chi^2$	39.29	39.00	35.28	33.29
d.f.	3	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
First birth	2.10***	(----)	1.66**	(----)
< 24	2.55***	2.57***	2.44***	2.43***
24-35	1.85***	1.85***	1.79***	1.78***
36+	1.00	1.00	1.00	1.00
		Second and higher order births[a] (n = 10132)		
$LR\chi^2$	38.51	39.00	33.23	31.61
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
< 24	2.55***	2.57***	2.46***	2.38***
24-35	1.85***	1.85***	1.82***	1.76***
36+	1.00	1.00	1.00	1.00

Notes: [a] Based on unweighted number of children who had a preceding birth interval (PBI), irrespective of whether they had a succeeding birth interval. (----) odds ratio were not calculated due to redundancy in design matrix because first-order births are the same as first-born children. *Significant at p < 0.05, ** Significant at p < 0.01, *** Significant at p < 0.001. MAGE and BO stand for maternal age at birth and birth order, respectively.

Source: Primary analysis of the 1988/89 KDHS data.

At the beginning of this subsection, the need to control for the survival status of the immediately preceding child was stated. Therefore, the effect of the preceding birth interval has been re-analysed to take survival status of the preceding child into account. The results presented in Table 4.9 show that, among the two groups of children, infant and child mortality declined with increase in the preceding birth interval. The results also show that the risks of infant and child mortality were much higher at each birth interval among the children whose immediately preceding siblings were dead than the risks for the children whose preceding siblings were still alive. For example, the infant mortality rate for children whose preceding siblings were alive and with preceding birth intervals of less than 24 months was 67 per 1000, compared with 202 per 1000 among the children whose preceding siblings had died in infancy.

Table 4.9 Infant and child mortality rates by the preceding birth interval and the survival status of the preceding child: Kenya, 1988/89 KDHS

Birth interval (in months)	Infant mortality[a]	Child mortality[b]
	Preceding child was alive at age one	
Interval		
< 24	67 (5226)	47 (3722)
24-35	42 (6025)	34 (4098)
36+	31 (4165)	19 (2777)
Total	47 (15415)	35 (10597)
	Preceding child had died in infancy	
Interval		
< 24	202 (563)	59 (337)
24-35	190 (295)	104 (182)
36+	113 (151)	--- (101)
Total	185 (1009)	63 (620)

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are exposed live births for infant mortality and exposed children for child mortality. (---) no deaths occurred among the children in the category.

Source: Primary analysis of the 1988/89 KDHS data.

However, the pattern is much less clear with respect to child mortality among children whose preceding sibling died in infancy. The child mortality rate for children with a preceding birth interval of 24-35 months was greater than for the children with a preceding birth interval of less than 24 months. And no deaths occurred among the 101 children with a preceding birth interval of at least 36 months. But it is evident that the number of child deaths declined with the increase in the preceding birth interval for those whose preceding child was alive at age one.

A similar analysis was carried out by fitting logistic regression models. The results presented in Table 4.10 show that the effect of the preceding birth interval on infant and child mortality remained highly significant even after the survival status of the preceding child was taken into account. There was a slight attenuation in its effect on infant mortality but its effect on child mortality remained virtually unchanged when the survival status of the preceding child was taken into account.

Table 4.10 Odds ratios and likelihood chi-square values indicating the effect of the preceding birth interval on infant and child mortality, adjusted for survival status of the preceding child and ever-use of modern contraception: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for SPB	Adjusted for USE	Adjusted for SPB & USE
	Infant mortality (n = 14951)			
$LR\chi^2$	114 70	79 81	120 50	83.94
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0 001
Birth interval				
< 24	2.44***	2.16***	2.49***	2.20***
24-35	1.31**	1.29**	1.31**	1.29**
36+	1.00	1.00	1.00	1.00
	Child mortality (n = 10132)			
$LR\chi^2$	38.51	36.72	43 43	41.59
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
< 24	2.55***	2.51***	2.70***	2 66***
24-35	1.85***	1.85***	1.88***	1 88***
36+	1.00	1.00	1.00	1.00

Notes: Based on all live births that had a preceding birth interval (PBI), irrespective of whether they had a succeeding birth interval. *Significant at p < 0.05, ** Significant at p < 0.01, *** Significant at p < 0.001. SPB stands for survival status of the preceding sibling and USE for ever use of modern contraception.

Source: Primary analysis of the 1988/89 KDHS data.

The results indicate that, irrespective of the survival status of the preceding child, children born after short intervals were at a significantly greater risk of dying in infancy and between ages one and five years than the children who were born at least 36 months after the preceding birth. The effect of the preceding birth interval on infant and child mortality was strengthened when the control for the ever-use of modern contraception was introduced. While this means the preceding birth interval affected infant and child mortality independently of the ever-use of modern contraception, the strengthening of the differentials also suggests that children with shorter preceding birth intervals were likely to belong to mothers who had used modern contraception. This observation is supported by the information in Appendix 4.2.

A separate analysis was carried out among children who had both preceding and succeeding birth intervals in order to assess the effect of the preceding birth interval on child mortality when the succeeding birth interval was taken into account. The results shown in Table 4.11 indicate that child mortality was lowest among children that had both preceding and succeeding birth intervals of at least 36 months. Child mortality was highest among children with both preceding and succeeding birth intervals of less than 24 months. The effect of the preceding birth interval was stronger than that of the succeeding birth interval.

Table 4.11 Child mortality rates by the preceding and succeeding birth interval: Kenya, 1988/89 KDHS

	Succeeding birth interval (in months)			
	< 24	24-35	36+	Total
Preceding birth interval (in months)				
< 24	66 (1310)	40 (1473)	40 (1018)	**49** (3801)
24-35	54 (1266)	35 (1694)	25 (1016)	**39** (3975)
36+	32 (807)	17 (809)	14 (844)	**21** (2460)
Total	**53** (3383)	**33** (3976)	**27** (2877)	**38** (10236)

Notes: Based on children that survived to age one among those that were born between 1970 and 1983. The numbers in parentheses are the exposed children.
Source: Primary analysis of the 1988/89 KDHS data.

The results presented in Table 4.12 show that the effect of the preceding birth interval persisted even after the succeeding birth interval was controlled for. These results imply that effect of the preceding birth on child mortality was largely independent of the succeeding birth interval.

Table 4.12 Odds ratios and likelihood chi-square values indicating the effect of the preceding birth interval on child mortality, adjusted for the succeeding birth interval: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for SBI
$LR\chi^2$	28 15	27.82
d.f.	2	2
p	< 0.001	< 0.001
Preceding birth interval		
< 24	2.29***	2.28***
24-35	1 73**	1.77***
36+	1.00	1.00

Notes: The $LR\chi^2$ values shown here are those associated with the preceding birth interval only and not of all the variables in the model. Based on 9543 live births that had both preceding (PBI) and succeeding (SBI) birth interval. *Significant at p < 0.05, ** Significant at p < 0.01, *** Significant at p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

Although in the literature there appears to be uncertainty regarding the precise biological and behavioural mechanisms through which the preceding birth interval affects infant and child mortality, the results obtained in this subsection suggest that competition among siblings for household resources and disease transmission were not the main mechanisms through which the preceding birth interval influenced child survival. Had it been so, the mortality risk should have been higher at each preceding birth interval when the preceding sibling was alive than when it was dead, because the death of the preceding sibling should remove or at least reduce the competition among siblings for resources and parental attention in the household.

The cross-tabulation results obtained indicate that infant and child mortality rates were much higher at each preceding birth interval when the preceding siblings were dead than when they were alive. Furthermore, the results obtained from logistic regression show that the effect of the preceding birth interval on infant mortality persisted even after adjustment for the survival status of the preceding sibling and ever-use of modern contraception. Similarly, the risk of mortality was higher when the preceding sibling had died in infancy than when it was alive. Therefore these results suggest that shared biological or physiological factors affecting the children with short preceding birth intervals were more important than sibling competition and disease transmission in the link between the preceding birth interval and child survival.

It appears maternal depletion was the main mechanism that linked the preceding birth intervals and child survival. In a situation where another child is born after a short interval, the mother may not have fully restored her nutritional reserves or fully recovered from trauma associated with the preceding pregnancy and child delivery. As a result such a mother may not be physiologically or emotionally prepared for another child. This may adversely affect the index child; the child might suffer intrauterine growth retardation and may cause premature delivery or low birth weight, all of which are closely associated with elevated risks of infant and child death. A pregnant mother with short birth intervals still has very young children; she may not be able to attend ante-natal care services at all or may attend much later in the pregnancy than might otherwise be the case (Boerma and Bicego, 1992: 244). Furthermore, a mother with poor health and nutritional status and short birth intervals may not be able to produce adequate breast milk for the infant (Pebley and Millman, 1986).

The suggestion of maternal depletion is also supported by Boerma and Bicego (1992: 245-246) who observed that if mortality risks between two successive children are correlated because of shared family problems, the effects of birth intervals on child survival would be reduced by controlling for the preceding child death. On the other hand, they argued that, if sibling competition is important, the potential effects of sibling competition and disease transmission are removed by the death of the preceding child, thus controlling for the survival status of the preceding child would be expected to increase the effect of birth interval on child survival. Finally, they argued that if the net effect of controlling for the survival status of the preceding child is a reduction of the effect of the birth interval, the implication is that shared family problems would be stronger than sibling competition and disease transmission.

The results in this subsection show that longer preceding birth intervals enhanced the chances of child survival. Shorter preceding birth intervals were associated with poor child survival prospects. The results also show that the effect of the preceding birth interval on infant and child mortality persisted even after maternal age at birth, birth order, the survival status of the preceding child, and ever-use of contraception were individually or simultaneously taken into account. Its effect on child mortality persisted even when the succeeding birth interval was taken into account. These findings are consistent with other studies which have found a positive association between birth intervals and child survival (Hobcraft *et al.*, 1983: 593-610; Muganzi, 1984: 78; Cleland and Sathar, 1984: 406-414; Palloni and Tiende, 1986: 40-48; Palloni, 1989: 164-166; Boerma and Bicego, 1992: 243-256). Thus, increasing the preceding birth interval to at least 24 months can bring about significant improvements in the survival prospects of Kenyan children.

(b) The succeeding birth interval

The use of subsequent birth interval in child survival analysis particularly during infancy is fraught with methodological difficulties. An early death of the index child may shorten the succeeding birth interval creating an association between short succeeding birth interval and the mortality risk of the index child. Similarly, the early arrival of a subsequent child is likely to adversely affect the survival chances of the index child.

It has been suggested that the problem of reverse causality, that is the effect of the early death of the index child on the succeeding birth interval, can be overcome by restricting the analysis to that group of children who were alive at the time of the conception of the next child (Wolfers and Scrimshaw, 1975: 483; Hobcraft *et al.*, 1985: 365-373; Cleland and Sathar, 1984: 414). However, this separation is not practicable for analysis of infant mortality since it is unlikely for another birth to occur within 12 months after the birth of the index child. In addition, the use of succeeding birth intervals may also lead to truncation effects in the analysis, as the children with closed succeeding birth intervals are more likely to have been born further in the past. In this thesis, truncation effects have generally been avoided by specifying periods for the analysis which exclude incomplete exposure to the risk of dying. Therefore, the analysis of the effect of the succeeding birth interval will be restricted to child mortality, that is between ages one and five years.

The results presented in Table 4.13 show that the succeeding birth interval was significantly and negatively associated with child mortality. The child mortality rate among children with a succeeding birth interval of less than 24 months was 51 per 1000 compared with 26 per 1000 among the children with succeeding birth intervals of at least 36 months. Child mortality among children with a succeeding birth interval of 24-35 months was 42 per cent higher than that of the children with a succeeding birth interval of at least 36 months.

Among the 13870 children included for the analysis of child mortality, there were 1079 with open succeeding birth intervals (last-born children at the time of the survey). Between ages one and five years only 24 deaths occurred among these children, giving a child mortality rate of 22 per 1000. This rate is significantly lower than that of all the children with closed succeeding birth intervals. This could be because last-born children receive the best possible attention from their parents by virtue of their position in the family and perhaps more importantly because they have no younger siblings.

Table 4.13 Child mortality rates by the succeeding birth interval: Kenya, 1988/89 KDHS

Birth interval (in months)	All children	Children alive at the conception of the next child
	Child mortality	Child mortality
Interval		
< 24	51 (4249)	49 (4234)
24-35	37 (4914)	23 (4845)
36+	26 (3628)	5 (3550)
Total	39 (12791)	26 (12629)
χ^2	36.13, d.f. = 2, p< 0.001	χ^2 = 518.23, d.f. =2, p < 0.001

Notes: Based on weighted cases of children that had a succeeding birth interval, irrespective of whether they had a preceding birth interval. The numbers in the parentheses are the exposed children.

Source: Primary analysis of the 1988/89 KDHS data.

It is evident from Table 4.13 that a much stronger effect of the succeeding birth interval exists when, to overcome the problem of reverse causality, children who died before the conception of the next child are removed from analysis. For example, the exclusion of 78 births in Table 4.13 reduced child mortality from 26 to 5 (at the interval 36+ months). However, it is possible to argue that an inverse bias has been introduced because the longer the birth interval becomes, the less likely it is that a child will die in the remaining period before it reaches age five. Furthermore, excluding deaths that occurred before the next conception of the next child would reduce the total number of deaths for the analysis of child mortality and this might adversely affect the robustness of the results. It seems safest to include all cases in the multivariate analysis, whether or not the child died before the conception of the next child.

The results of logistic regression analysis presented in Table 4.14 show that shorter succeeding birth intervals were associated with higher risk of child mortality than longer succeeding birth intervals. Relative to children with succeeding birth interval of at least 36 months, children with succeeding birth intervals of less than 24 months had 1.61 times higher odds of dying. Unlike the case of preceding birth interval, the odds ratio for children with succeeding intervals of 24-35 months was not significantly different from that of the children with succeeding intervals of at least 36 months. The results also show that last-born children had more or less the same prospects of survival as the children with succeeding birth intervals of at least 36 months.

Table 4.14 **Odds ratios and likelihood chi-square values indicating the effect of the succeeding birth interval on child mortality, adjusted for birth order and maternal age at birth: Kenya, 1988/89 KDHS**

Explanatory variable	Gross effect	Adjusted for BO	Adjusted for MAGE	Net effect[a]
		All children (n= 12595)		
$LR\chi^2$	27.51	26.45	24.26	24.87
d.f.	3	3	3	3
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
Last birth	0.64	0.66	0.70	0.70
< 24	1.61***	1.61***	1.62***	1.63***
24-35	1.15	1.15	1.15	1.15
36+	1.00	1.00	1.00	1.00
		Second and higher order births (n= 11637)[b]		
$LR\chi^2$	17.23	17.40	17.51	17.98
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
< 24	1.61***	1.61***	1.62***	1.63***
24-35	1.15	1.15	1.15	1.15
36+	1.00	1.00	1.00	1.00

Notes: The $LR\chi^2$ values shown here are those associated with the succeeding birth interval only and not of all the variables in the model. [a] Net of the influence of birth order of the child (BO) and maternal age (MAGE). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. [b] Based on unweighted number of children had a succeeding birth interval whether or not they had a preceding birth interval.

Source: Primary analysis of the 1988/89 KDHS data.

In order to establish whether the preceding birth interval and the survival status of the preceding child had a significant impact on the effect of the succeeding birth interval, a separate analysis was carried out using children who had both birth intervals. In addition, control was introduced for ever-use of modern contraception. Child mortality rates by both preceding and succeeding birth intervals have already been presented in Table 4.11. The results presented in Table 4.15 show that controlling for the preceding birth interval and survival status of the preceding child had almost no effect on the strength of the association between the succeeding birth interval and the mortality risk of the index child between ages one and five years. However, controlling for ever-use of modern contraception slightly increased the effect of the succeeding birth interval. In general, these results show that the effect of the succeeding birth interval on child mortality was independent of the preceding birth interval, the survival status of the preceding child and ever-use of modern contraception. Thus, increasing the subsequent birth interval to at least 24 months could lead to significant improvements in the survival chances of Kenyan children.

Table 4.15 Odds ratios and likelihood chi-square values indicating the effect of the succeeding birth interval on child mortality, adjusted for the preceding birth interval, survival status of the preceding child and ever-use of modern contraception: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for PBI	Adjusted for SPB	Adjusted for USE
$LR\chi^2$	21.56	21.22	21.41	24.08
d.f.	3	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Birth interval				
< 24	1.66***	1.62***	1.66***	1.72***
24-35	0.99	0 96	0.96	1.00
36+	1.00	1.00	1.00	1.00

Notes: The $LR\chi^2$ values shown here are those associated with the succeeding birth interval only and not with all the variables in the model. Based on 9243 children who had both birth intervals. *Significant at p < 0.05, **Significant at p < 0.01, ***Significant at p < 0.001. PBI stands for the preceding birth interval, SPB for survival of the preceding child and USE stands for ever-use of modern contraception.

Source: Primary analysis of the 1988/89 KDHS data.

The excess risk of child mortality among children with shorter succeeding birth intervals may be due to several factors, acting separately or in combination. First, the occurrence of a new conception shortly after a live birth may lead to abrupt curtailment of breastfeeding and hence early weaning. Second, short succeeding birth intervals may increase competition among siblings for scarce resources in the household and parental care. Third, short succeeding birth interval may lead to a deterioration of the mother's capacity to attend to needs of the older children during her pregnancy and the subsequent lactation period (Palloni, 1989: 164-166).

In summary, the findings in this subsection show that succeeding birth intervals shorter than 24 months were associated with greater child mortality risk compared to succeeding birth intervals of at least 24 months. The risk of child mortality among children with succeeding birth intervals of 24-35 months was not significantly different from that of children with succeeding birth intervals of at least 36 months. The results also show that the effect of the succeeding birth interval persisted even when maternal age at birth, birth order, preceding birth interval, the survival status of the preceding child and ever-use of modern contraception were taken into account. In general, these findings are consistent with those of other studies which found negative effects on the health of first child resulting from the birth of the second child soon after (De Sweemer, 1984: 63-71; Palloni, 1989: 164-166; Cleland and Sathar, 1984: 414-416; Boerma and Bicego, 1992: 243-256).

4.3.4 Survival status of the preceding child

In many of the studies cited in Chapter One of this thesis, survival status of the preceding child was found to be closely associated with the mortality risk of the subsequent child. Survival chances were almost invariably lower when the preceding sibling died in infancy than when it was alive. Hence this subsection aims to establish whether such intra-familial mortality relationships also exist in Kenyan families.

Analysis in this subsection is based on the children who had at least one preceding sibling, unless indicated otherwise. The results presented in Table 4.9 showed infant and child mortality rates were substantially greater when the immediately preceding siblings had died in infancy than when they had survived infancy. Infant mortality among children whose immediately preceding sibling had died in infancy was 294 per cent higher than among the children whose immediately preceding sibling survived infancy, and child mortality was only 74 per cent higher.

The results shown in Table 4.16 confirm that the survival status of the immediately preceding sibling was significantly related to both infant and child mortality. Children whose immediately preceding siblings had died in infancy were at a significantly greater risk of dying in infancy and between ages one and five years than those children whose immediately preceding sibling survived infancy. In gross terms, a child whose preceding sibling had died in infancy was 4.51 times more likely to die in infancy and if such a child survived infancy it was 1.54 times more likely to die between ages one and five years as a child whose preceding sibling survived infancy.

The results obtained after controlling for the preceding birth interval, birth order and maternal age at birth are also presented in Table 4.16. The effect of the survival status of the preceding sibling on infant and child mortality was slightly reduced when the preceding birth interval was taken into account. In fact, its effect on child mortality was no longer significant at the 5 per cent level, though the odds of dying among children whose preceding sibling had died in infancy were still 40 per cent higher than those for the children whose preceding sibling had survived infancy. This suggests that survival status of the preceding sibling was itself an important determinant of infant mortality.

These results suggest that the excess risk of mortality among the children preceded by a sibling who died in infancy could be due to shared physiological problems affecting the mother and shared social and physical environment (Winikoff, 1983: 232; De Sweemer, 1984: 56-59; Boerma and Bicego, 1992: 245-246). These could include problems such as poor nutritional reserves among the mothers of such children resulting in low-birth-weight babies and impaired lactation, poor parenting, social as well as economic deprivation, and higher incidence of environmental contamination.

Table 4.16 **Odds ratios and likelihood chi-square values indicating the effect of the survival status of the preceding child on infant and child mortality, adjusted birth order, preceding birth interval and maternal age at birth: Kenya, 1988/89 KDHS**

	Gross effect	Adjusted for BO	Adjusted for PBI	Adjusted for MAGE	Net effect[a]
			Infant mortality		
$LR\chi^2$	223.60	216.90	188.60	219 70	179.70
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Survival status of the preceding child					
Alive	1.00	1 00	1.00	1.00	1.00
Dead	4.53***	4.43***	4 00***	4.47***	3.88***
			Child mortality		
$LR\chi^2$	4.58	4.88	2.78	3.79	2 44
d.f.	1	1	1	1	1
p	< 0.05	< 0.05	> 0.05	> 0.05	> 0.10
Survival status of the preceding child					
Alive	1 00	1.00	1.00	1.00	1.00
Dead	1.54*	1.57*	1.40*	1 49*	1.37

Notes: The $LR\chi^2$ values shown here are those associated with the survival status of the sibling only and not with the variables in the model. Based on live births that had a preceding sibling irrespective of whether they had a subsequent birth interval.
[a] Net of the influence of birth order of the child (BO), maternal age at birth (MAGE) and preceding birth interval (PBI). * p < 0.05, ** p < 0.01, *** p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

Overall, these results confirm that the survival status of the preceding child was significantly related to the mortality risk of the index child. The risk of death was greater when the preceding sibling was dead than when it was alive. The risk was greater during infancy than between ages one and five years. Furthermore, the results show that its effect on infant mortality continued to be highly significant even after the preceding birth interval, maternal age at birth and birth order of the child were taken into account. Hull and Gubhaju (1986: 109-118) found similar results in Indonesia.

4.4 Effect of ever-use of modern contraception

The use of family planning has been associated with better prospects of child survival (Frenzen and Hogan, 1982; Hobcraft, 1992; Pant, 1995). Similarly, in this study ever-use of modern contraception is expected to be associated with lower infant and child mortality. The results presented in Table 4.17 show that the use of modern family planning services had a beneficial effect on the survival of Kenyan children as well. Both infant and child mortality was lower among children whose mothers had used modern contraception. For example, child mortality among children whose mothers had ever-used modern contraception was 24 per 1000 compared with 44 per 1000 among the children whose mothers had never used modern contraception.

Table 4.17 Infant and child mortality rates by ever-use of modern contraception: Kenya, 1988/89 KDHS

	Infant mortality[a]	Child mortality[b]
Ever-use of modern contraception		
Yes	44 (6603)	24 (4757)
No	64 (13619)	44 (9113)
Total	60 (20222)	37 (13870)
χ^2	**31.69, d.f. = 1, p < 0.001**	**χ^2 = 36.83, d.f. = 1, p <0.001**

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed births and children.

Source: Primary analysis of the 1988/89 KDHS data.

Similarly, Model I of Tables 4.18 and 4.19 show that ever-use of modern contraception was significantly related to infant and child mortality. Children whose mothers never used modern contraception were 54 per cent more likely to die in infancy and those who survived infancy were 41 per cent more likely to die between ages one and five years. The results indicate that the effect of ever-use of modern contraception was slightly stronger on child mortality than on infant mortality and that the removal of the first born children from the model did not significantly alter its effect. Similar results were obtained in rural Thailand (Frenzen and Hogan, 1982: 401), in Nepal (Pant, 1995) and in Zimbabwe (Jhamba, 1995).

Since the use of modern contraception may be influenced by the age of mother and family size and also since use of modern contraception may affect maternal age at birth and family size, both maternal age at birth and birth order of the child were taken into account in Models 11 to IV in Table 4.18. These results indicate that the effect of ever-use of modern contraception on infant and child mortality was independent of maternal age at birth and birth order of the child.

It has been suggested that birth intervals are one of the mechanisms through which use of contraception may influence child survival (Frenzen and Hogan, 1982: 401; Chen *et al.*, 1983: 203; Trussell and Pebley, 1984: 267; Palloni and Pinto, 1989: 363). There is, therefore, a need to take birth intervals into account. The preceding birth interval was taken into account for infant mortality, while for child mortality both preceding and succeeding birth intervals were taken into account.

The results obtained show that ever-use of modern contraception influenced infant and child mortality independently of the birth intervals (Model VIII of Table 4.18 and Model VIII and IX of Table 4.19). Furthermore, the results presented in Appendix 4.2 show that ever-use of modern contraception was actually associated with shorter birth intervals. Maternal age was also controlled and that made no difference. A study in Nepal found that the effect of ever-use of modern contraception on infant and child mortality was independent of the birth interval (Pant, 1995). These results suggest that the effect of ever-use of modern contraception on child survival in Kenya cannot be explained in terms of the length of birth intervals or any other shifts in reproductive behaviour associated with the use of effective contraception. The most plausible explanation of how the use of modern contraception influences child survival is that it enhances the use of maternal and child services being delivered in conjunction with family planning services. For example, a study in Peru indicates that use of modern family planning services increased the use of modern maternal-and child-care services (Tam, 1991: 1789).

Table 4.18 Odds ratios and likelihood chi-square values indicating the effect of ever-use of contraception on infant mortality, adjusted for maternal age at birth, birth order and preceding birth interval: Kenya, 1988/89 KDHS

	Gross effect Model I	Adjusted for MAGE Model II	Adjusted for BO Model III	Adjusted for BO & MAGE Model IV
		All births (n = 18345)		
$LR\chi^2$	40.64	38.03	39.64	39.23
d.f.	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001
Ever-use of modern contraception				
Yes	1.00	1.00	1.00	1.00
No	1.54***	1.52***	1.53***	1.52***

Second and higher order births (n= 14595)

	Gross effect Model V	Adjusted for MAGE Model VI	Adjusted for BO Model VII	Adjusted for PBI Model VIII	Adjusted for BO MAGE & PBI Model IX
$LR\chi^2$	21.50	19.89	20.80	27.22	25.14
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ever-use of modern contraception					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.41***	1.52***	1.41***	1.48***	1.46***

Notes: The $LR\chi^2$ values shown here are those associated with ever-use of modern contraception and not with all the variables in the model. MAGE, BO and PBI stand for maternal age at birth, birth order of the child, and the preceding birth interval, respectively.

Source: Primary analysis of the 1988/89 KDHS data.

Table 4.19 Odds ratios and likelihood chi-square values indicating the effect of ever use of modern contraception on child mortality, adjusted for maternal age at birth, birth order, preceding and succeding birth intervals: Kenya, 1988/89 KDHS

	Gross effect Model I	Adjusted for MAGE Model II	Adjusted for BO Model III	Adjusted for BO & MAGE Model IV
		All births (n =12595)		
$LR\chi^2$	33.35	33.08	33.51	32.86
d.f.	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001
Ever-use of modern contraception				
Yes	1.00	1.00	1.00	1.00
No	1.82***	1.82***	1.83***	1.82***

Second and higher order births (n= 9234)

	Gross effect Model V	Adjusted for MAGE Model VI	Adjusted for BO Model VII	Adjusted for PBI Model VIII	Adjusted for SUCBI Model IX	Adjusted for BO, MAGE, PBI & SUCBI Model X
$LR\chi^2$	28 01	27.75	28.02	32.13	30.54	33 71
d.f.	1	1	1	1	1	1
p	< 0.001	< 0 001	< 0.001	< 0.001	< 0.001	< 0.001
Ever use of modern contraception						
Yes	1.00	1.00	1.00	1.00	1.00	1.00
No	1.89***	1.89***	1.98***	1.99***	1.95***	2.03***

Notes: The $LR\chi^2$ values shown here are those associated with ever-use of modern contraception and not with all the variables in the model. BO, MAGE, PBI and SUCBI stand for birth order, maternal age at birth, the preceding and succeeding birth interval, respectively. *** p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

4.5 Effects of household environmental conditions

In the Mosley-Chen (1984: 27) model household environment contamination variables are one of the five sets of proximate variables through which socioeconomic factors operate to influence child survival. Household environmental conditions determine the extent to which a child is exposed to disease. Only two aspects of exposure to disease are examined in this study: source of drinking water and whether the household had a toilet facility. Access to and use of safe water and adequate sanitation in the form of a toilet facility are expected to be associated with lower risks of infant and child mortality. Dirty or contaminated drinking water and lack of a toilet facility may cause diarrhoeal and parasitic diseases, which are among the major killers of children in the developing countries (UNICEF, 1988). Access to and use of safe water and adequate sanitation reduce the exposure to such diseases.

4.5.1 Availability of toilet facility

The results presented in Table 4.20 show that infant and child mortality varied significantly according to whether the household had a toilet facility. Lower infant and child mortality rates were associated with the presence of a toilet facility in the household, while excess infant and child mortality rates were associated with lack of a toilet facility.

Table 4.20 Infant and child mortality rates by availability of a toilet facility: Kenya, 1988/89 KDHS

	Infant mortality[a]	Child mortality[b]
Availability of a toilet facility		
Yes	52 (16874)	32 (11623)
No	83 (3327)	67 (2234)
Total	57 (20201)	37 (13856)
χ^2	**44.02, d.f. = 1, p < 0.001**	**χ^2 = 56.17, d.f. = 1, p < 0.001**

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed births and children.

Source: Primary analysis of the 1988/89 KDHS data.

Infant and children mortality rates were also obtained by re-classifying births according to whether their households had a toilet facility and by source of drinking water. Table 4.21 shows that the highest infant and child mortality rates were for children from households that had neither access to piped water supply nor a toilet facility. The lowest infant and child mortality rates were for children from households that had both piped water supply and a toilet facility. The results also indicate that the presence of a toilet facility in the household was more important than the household's source of drinking water. Children from households that had no toilet facility but had access to piped water had greater infant and child mortality than the children from the households that had a toilet facility but drew their drinking water from other sources.

Table 4.21 Infant and child mortality rates by availability of a toilet facility and source of drinking water: Kenya, 1988/89 KDHS

	Source of drinking water					
	Piped water supply		Other sources drinking water		Total	
			Infant mortality[a]			
Toilet facility						
Yes	**45**	(4730)	**55**	(12134)	**52**	(16864)
No	**77**	(246)	**83**	(3081)	**83**	(3327)
Total	**46**	(4976)	**61**	(15215)	**57**	(20191)
			Child mortality[b]			
Toilet facility						
Yes	**23**	(3223)	**35**	(8392)	**31**	(11615)
No	**43**	(161)	**69**	(2073)	**67**	(2234)
Total	**24**	(3384)	**41**	(10465)	**37**	(13849)

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed births for infant mortality and children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data

The results of logistic regression analysis shown in Table 4.22 confirm that presence of the toilet facility in the household was significant related to infant and child mortality. Children from households which did not have a toilet facility were at a greater risk of mortality than the children from households that had a toilet facility. They had odds of infant mortality 1.62 times higher than the children from households which had a toilet facility, while odds of child mortality were almost twice as high as those for the children from households that had a toilet facility. The effect was greater after than during infancy. Infants spend much of their time crawling on the ground, putting everything in their mouth. Though they themselves do not use toilet facilities, they are handled by people who do so. As the child matures and begin to walk and run around the household, the child is increasingly being exposed to the hazards associated with lack of adequate sanitation in the household.

The effect of the presence of a toilet facility in the household on infant and child mortality was slightly attenuated when the household's source of drinking water was taken into account. This suggests that the effect of presence of toilet facility on infant and child mortality was mainly independent of the influence of the household's source of drinking water. These results are consistent with those found in the Philippines (Martin *et al.*, 1983) and Malaysia (Da Vanzo *et al.*, 1986; Peterson *et al.*, 1986).

Table 4.22 Odds ratios and likelihood chi-square values indicating the effect of availability of a toilet facility on infant and child mortality, adjusted for source of drinking water: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for HWA
Infant mortality (n = 18345)		
$LR\chi^2$	37.07	31.81
d.f.	1	1
p	< 0.001	< 0.001
Toilet facility		
Yes	1.00	1.00
No	1.62***	1.56***
Child mortality (n= 12595)		
$LR\chi^2$	31.99	27.82
d.f.	1	1
p	< 0.001	< 0.001
Toilet facility		
Yes	1.00	1.00
No	1.94***	1.86***

Notes: The $LR\chi^2$ values shown here are those associated with existence of a toilet facility in the household and not with all the variables in the model. HWA stands for source of drinking water. ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data

4.5.2 Source of drinking water

The results presented in Table 4.23 show that both infant and child mortality were significantly associated with household source of drinking water. Lower infant and child mortality was found in households that had access to piped drinking water than in households that drew drinking water from other sources. For example, infant mortality among children from households that obtained their drinking water from 'other' sources was 64 per 1000 compared with 35 per 1000 among the children from households that had access to piped drinking water.

Table 4.23 Infant and child mortality rates by source of drinking water: Kenya, 1988/89 KDHS

	Infant mortality[a]	Child mortality[b]
Source of drinking water		
Piped	35 (6603)	24 (3384)
Other	64 (13619)	42 (10468)
Total	57 (20222)	37 (13857)
χ^2	15.30, d.f. = 1, $p < 0.001$	χ^2, = 23.46, d.f. = 1 $p < 0.001$

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children that survived to age one among those that were born between 1970 and 1983. Both were weighted cases. The numbers in the parentheses are the exposed live births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

The logistic regression results presented in Table 4.24 show that access to piped water was positively associated with child survival. Relative to children from households which had such access, children from households which did not have access to safe drinking water had 1.26 times higher odds of dying in infancy. Between ages one and five years, the odds were 1.38 higher than for the children from households which had access to safe drinking water. The effect of source of drinking water on both infant and child mortality was reduced when availability of toilet facility in the household was taken into account. This suggests that only part of the effect of source of drinking water on infant and child mortality was independent of the influence of the existence of a toilet facility.

Table 4.24 Odds ratios and likelihood chi-square values indicating the effect of source of drinking water on infant and child mortality, adjusted for availability of a toilet facility: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for HTO
Infant mortality (n= 18345)		
$LR\chi^2$	12.06	6.79
d.f.	1	1
p	< 0.001	< 0.02
Source of drinking water		
Piped	1.00	1.00
Other	1.26***	1.20**
Child mortality (n = 12595)		
$LR\chi^2$	9.36	5.19
d.f.	1	1
p	< 0.01	< 0 02
Source of drinking water		
Piped	1.00	1.00
Other	1.38**	1.27*

Notes: The $LR\chi^2$ values shown are those associated with the source of drinking water and not for all the variables in the model. Based on all live births. HTO stands for toilet facility. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

The results obtained in this subsection indicate that both the presence of a toilet facility in the household and water supply were strongly and negatively associated with infant and child mortality. These results are in contrast with those found in Mexico, Puerto Rico and Costa Rica (Haines and Avery, 1982) and in Zimbabwe (Jhamba, 1995). The mortality risk associated with access to piped water should be treated with caution. This is because in the recent past the Government of Kenya and a number of non-governmental agencies have been improving the coverage of piped water supply in the country. It is therefore possible that some of the children from the households which in 1988/89 had a piped water supply died long before such water supply was connected to their households or neighbourhoods.

4.6 Net effects of proximate variables

Tables 4.25 and 4.26 review the net effects of proximate variables that had significant net effects on infant and child mortality, respectively. The year of birth of child was added into the analysis in order to control for mortality trend. The results presented in Table 4.24 indicate that survival of the preceding child, preceding birth interval, birth order, ever-use of modern contraception and toilet facility had significant net effects on child mortality. Maternal age at birth, source of drinking water and year of birth of the child had insignificant net effects on infant mortality.

The results presented in Table 4.25 show that preceding birth interval, ever-use of contraception, succeeding birth interval, toilet facility, and maternal age had significant net effects on child mortality. However, when the year of birth was included in the analysis, maternal age at birth was no longer significantly related to child mortality. This means that maternal age at birth increased over the period under review. The year of birth of the child had a significant net effect on child mortality, indicating that significant improvements in child mortality occurred between 1970 and 1983 and that the proximate variables included in the model could not explain most of the improvement (Table 4.26).

Table 4.25 Logit linear model of proximate variables affecting infant mortality: Kenya, 1988/89 KDHS

	Logs odds	$LR\chi^2$	P	Odds ratio
Survival status of preceding sibling		171.85	< 0.001	
Alive	0.000			1.00
dead	1.326(14.4)**			3.77
Preceding birth interval		84.76	< 0.001	
< 19	0.795(8.01)***			2.21
24-35	0.259(2.30)*			1.30
36+	0.000			1.00
Birth order		22.14	< 0.001	
2-3	0.000			1.00
4-5	-0.045(-0.50)			1.00
6+	0.323(3.97)***			1.38
Ever use[a]		14.28	< 0.001	
Yes	0.000			1.00
No	0.295(3.73)***			1.34
Toilet facility		5.87	< 0.05	
Yes	0.000			1.00
No	0.224(2.30)*			1.25
Constant	= -3.6874, standard error = 0.1129			

Notes: [a] Stands for ever use of modern contraception. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. Overall $LR\chi^2$ for the multivariate model = 350.22 (Obtained from subtracting the total reduction in the overall $LR\chi^2$ due to the Model (6419.68) from the null model $LR\chi^2$ (6769.9)), @ 7 d.f., $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

Table 4.26 Logit linear model of proximate variables affecting child mortality: Kenya, 1988/89 KDHS

	Logs odds	$LR\chi^2$	P	Odds ratio
Preceding birth interval		33.25	< 0 001	
< 19	0.905(5.37)***			2.47
24-35	0.605(3.50)***			1.83
36+	0.000			1.00
Year of birth		25.44	< 0.001	
1970-74	0.703(4.89)***			2.02
1975-79	0.465(3.35)***			1.59
1980-83	0.000			1.00
Succeeding birth interval		22.78	< 0.001	
< 19	0.519(3.70)***			1.68
24-35	-0.021(-0.14)			0.98
36+	0.000			1.00
Ever use[a]		26.12	< 0.001	
Yes	0.000			1.00
No	0.642(4.91)***			1.90
Toilet facility		5.87	< 0.05	
Yes	0.000			1.00
No	0.502(3.78)***			1.65
Constant	= -4.9851, standard error = 0.2277			

Notes: [a] Stands for ever-use of modern contraception. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. Overall $LR\chi^2$ for the multivariate model = 121.95 (Obtained from subtracting the total reduction in the overall $LR\chi^2$ due to the Model (2882.05) from the null model $LR\chi^2$ (3004)), @ 8 d.f., $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

4.7 Conclusion

The risk of infant and child death was found to be highest among children born to mothers aged under 20 years, lowest among the children born to mothers in the prime reproductive age (20-29) and slightly increased thereafter. However, in the case of infant mortality, maternal age lost its statistical significance in the multivariate analysis that incorporated all the other proximate variables (Table 4.25). In the case of child mortality, maternal age was no longer significantly related to child mortality when year of birth was included in analysis.

Birth order was found to be significantly related to infant mortality but not to child mortality. The risk of infant mortality was found to be higher at extreme birth orders, but after controlling for maternal age the risk of infant mortality increased with birth order. Thus these results indicate that the elevated risk of infant death among the first order births was due to the fact that the majority, (65 per cent), were born to younger mothers (less than 20 years).

The analysis demonstrated the effects of birth interval on infant and child mortality. Short preceding birth intervals were associated with higher risk of dying during infancy and between ages one and five years in contrast to longer preceding birth intervals. Similarly, short succeeding birth intervals were associated with higher risk of child mortality in contrast with longer succeeding birth intervals. The results showed that the effect of the preceding birth interval on infant and child mortality was by and large independent of all the proximate variables considered in this study. Similarly, the effect of the succeeding birth interval on child mortality was mainly independent of all other proximate variables.

This analysis established the existence of the tendency of infant and child deaths to cluster in certain Kenyan families. Infants whose preceding siblings had died in infancy experienced a significantly greater risk of infant death than infants whose preceding siblings had survived infancy. The survival status of the preceding child was an important determinant of infant mortality with or without controls for preceding birth intervals, maternal age, birth order, ever use of modern contraception, household environmental conditions. The survival status of the preceding child was weakly associated with the mortality risk of the next child between ages one and five years but its effect was no longer significant in the multivariate analysis. The results obtained imply that shared physiological, social, economic as well as environmental problems relating to mothers of children whose siblings had died in infancy were more important than sibling competition and disease transmission in the link between the survival status of the preceding child and the mortality risk of the next child.

Ever-use of modern contraception was found to be significantly related to infant and child mortality. Children whose mothers had never used contraception were at significantly greater risk of dying during infancy and between ages one and five years than children whose mothers had used contraception. The results obtained do not provide evidence that ever-use of modern contraception influenced infant and child mortality through birth intervals. A plausible explanation for this association is that ever-use of contraception appears to operate through the use of other maternal and child services delivered in Kenya in conjunction with family planning services. The child care health seeking behaviour of mothers that drove them to the clinics could also apply to their contraceptive behaviour.

Infant and child mortality was found to vary significantly according to whether or not the household had piped water and also according to whether the household had a toilet facility. Both infant and child mortality rates were lower for children from households that had access to piped water or a toilet facility compared to children from households that did not have access to piped water or a toilet facility. However, the effect of type of source of water was no longer significant once all the other proximate variables considered in this study were taken into account (Tables 4.25 and 4.26). Finally, year of birth of the child was found to have a significant net effect on child mortality, indicating that a decline in child mortality had taken place between 1970 and 1983 and that most of this decline cannot be explained by the effect of the proximate variables considered in this study.

The effects of proximate variables presented in this chapter are not net of the influence of the socioeconomic factors examined in this thesis. Therefore, further analysis of the effects of these proximate variables is presented in Chapter Six where socioeconomic factors were also incorporated in multivariate analysis of infant and child mortality.

CHAPTER FIVE

EFFECTS OF SOCIOECONOMIC FACTORS ON INFANT AND CHILD MORTALITY

5.1 Introduction

This chapter has two main purposes. The first is to examine the effect of province of residence, place of residence, maternal education, paternal education, household economic status, possession of livestock and mother's participation in paid employment on infant and child mortality. The second is to investigate the extent to which their respective effects are altered when the other socioeconomic factors are introduced as controls. The chapter begins by providing a short discussion of the analytical approach and then presents the results.

5.2 Analytical approach

As in the previous chapter, a two-stage analytical approach was adopted in this chapter. First, estimates of infant and child mortality rates for each category of the socioeconomic factors were obtained using a direct estimation method. Second, the effects of each socioeconomic factor were obtained by fitting logistic models.

5.3 Results

5.3.1 Province of residence

There was marked variation in infant and child mortality between provinces of Kenya. Residence in Nyanza, Western and Coast provinces was associated with an elevated risk of infant and child mortality. Infant mortality rates in the Coast, Nyanza and Western provinces were respectively 86, 60 and 16 per cent higher than the national average of 57 per 1000. The rest of the provinces had infant mortality below the national average. Central and Rift Valley provinces had the lowest infant mortality. Similarly, child mortality rates were highest for the Coast, Western and Nyanza provinces which were 143, 76 and 54 per cent, respectively, in excess of the national average. Like infant mortality, child mortality in the Central, Rift Valley, Eastern and Nairobi provinces was below the national level. The estimated level for Nairobi was only 16 per cent below the national average, while the estimates for Eastern, Central and Rift Valley provinces were 32, 51 and 70 per cent, respectively, lower than the national average. The logistic regression results presented in Table 5.2 also indicate pronounced differences in infant and child mortality between the provinces. Several earlier studies carried out in Kenya found similar provincial differences in the level of infant and child mortality (Anker and Knowles, 1980: 176-183; Mott, 1982: 19; Kibet, 1982; Ewbank *et al.*, 1986: 42-47; Kichamu, 1986).

Table 5.1 Infant and child mortality rates by province of residence: Kenya, 1988/89 KDHS

Province	Infant mortality[a]	Child mortality[b]
Central	36 (2957)	11 (2121)
Rift Valley	36 (4651)	18 (3284)
Nairobi	42 (983)	31 (640)
Eastern	46 (3590)	25 (2469)
Western	66 (2941)	65 (1945)
Nyanza	91 (3719)	57 (2487)
Coast	106 (1382)	90 (924)
Total	**57 (20222)**	**37 (13870)**
χ^2	**202.43, d.f. = 6, $p < 0.001$**	**χ^2 = 220.33, d.f. = 6, $p < 0.001$**

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

The extent to which the effect of province of residence on infant and child mortality was altered by the other socioeconomic factors was investigated next. The effect of the province of residence on infant and child mortality was not significantly altered when the other socioeconomic factors were taken into account, either individually or simultaneously. Nor was the provincial pattern of infant and child mortality altered. However, there were slight increases in the odds of both infant and child mortality among children in Nairobi province relative to those for the children in Central province when place of residence, household economic status, and maternal education were each taken into account. This suggests that higher economic status households and better educated mothers were more likely to be found in Nairobi province, which contains the national capital than Central province. Nairobi province has the highest proportion of women with at least secondary education (See Table 2.16 of Chapter Two).

These results therefore suggest that the province of residence reflects conditions which are quite separate from the differences attributable to parental social and economic characteristics. Ecological conditions creating specific disease environment, differences in accessibility and availability of health and medical services, and differences in the levels of social and economic development (for instance, transport and communication networks) are likely to be among the main factors contributing to the differences in the level of infant and child mortality between the provinces.

Western, Nyanza and Coast province are located near large water masses and are prone to malaria due to their ecological conditions (Chapter Two). The availability of health and medical services in these three provinces is poor compared to Central or Nairobi province. Central, Rift Valley and Eastern provinces are mainly highland provinces, and as such suffer less from malaria (Ominde, 1988: 110-117). For historical and geographical reasons, these latter provinces are economically more developed, have better transport and communication networks, and have better access to health and other basic services. Furthermore, Coast, Nyanza and to some extent Western province[1] have lower child nutritional standards than the other provinces.

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[1] As was mentioned in Chapter Two, a cross-section of people interviewed by the author in Western province suggested that child malnutrition in the province was worse than the 1988 Nutrition Survey figures indicated and that the situation was deteriorating as result of the introduction of cash crops (sugar cane, tea, tobacco and coffee) in the area in the 1970s, a shortage of arable land, and structural adjustment programs being implemented in the country since the 1980s. Adoption of life styles and diets associated with modernity also contributes to inadequate diet.

Table 5.2 Odds ratios and likelihood chi-square values indicating the effect of the province of residence on infant and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for URB	Adjusted for HSES	Adjusted for MEDU	Adjusted for PADU	Net effect[a]
Infant mortality (n = 18345)						
$LR\chi^2$	223.90	228.50	207.30	194.30	213.80	175.00
d.f.	6	6	6	6	6	6
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Province						
Central	1.00	1.00	1.00	1.00	1.00	1.00
Nairobi	1.01	1.39**	1.29	1.13	1.13	1.29
Coast	2.81***	3.02***	2.73***	2.41***	2.57***	2.22***
Eastern	1.25	1.23	1.22	1.19	1.20	1.16
Nyanza	2.54***	2.61***	2.43***	2.41***	2.55***	2.35***
R.Valley	0.73**	0.73**	.0.69**	0.68**	0.70**	0.66**
Western	1.72***	1.73***	1.63***	1.68***	1.74***	1.64***
Child mortality (n = 12595)						
$LR\chi^2$	129.10	129.30	123 30	123.40	131.40	113.50
d.f.	6	6	6	6	6	6
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Province						
Central	1.00	1.00	1.00	1.00	1.00	1.00
Nairobi	2.22**	2.47***	2.97***	2.60***	2.48***	2.54***
Coast	3.61***	3.70***	3.46***	3.05***	3.18***	2.69***
Eastern	1.82**	1.81**	1.77**	1.72**	1.76**	1 68**
Nyanza	3.87***	3.91***	3 67***	3.66***	3 89***	3.48***
R Valley	1.08	1.09	1.02	1.01	1.04	0.95
Western	4.02***	4.03***	3.78***	3.92***	4 14***	3.78***

Notes: The $LR\chi^2$ values shown here are those associated with the province of residence only and not of all the variables in the model. [a] Net of the influence of maternal education (MEDU), paternal education (PADU), place of residence (URB), Household economic status (HSES), mother's work status (MOCW) and possession of livestock (LSTOK). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS.

5.3.2 Place of residence

Infant and child mortality has been found to vary according to the place of residence. Rural residence in developing countries has been associated with higher risks of infant and child mortality than residence in urban areas (Gaisie, 1980: 24; Caldwell and Ruzicka, 1985: 200; Hull and Gubhaju, 1986: 116). Rural-urban mortality differentials have been seen as reflecting the differences in social and economic conditions between rural and urban areas of a given country (Behm and Vallin, 1980:29). In Kenya, as in other developing countries, urban areas usually have the largest share of the country's well-educated, high-income population and the best medical and health facilities (Ewbank *et al.*, 1986: 52; Good, 1987 cited in Phillips, 1990: 123). Thus, urban areas of Kenya would be expected to have lower infant and child mortality.

The results presented in Table 5.3 show that although infant mortality was moderately higher in rural than urban areas, the difference was not statistically significant. Similarly, the rural child mortality rate was almost at par with the rate for urban areas.

Table 5.3 Infant and child mortality rates by place of residence: Kenya, 1988/89 KDHS

Type of place of residence	Infant mortality[a]	Child mortality[b]
Rural	58 (17961)	37 (12437)
Urban	52 (2261)	36 (1433)
Total	57 (20222)	37 (13870)
χ^2	1.60, d.f. = 1 p > 0.20	χ^2 = 0.027, d.f. = 1 p > 0.70

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

However, the logistic regression results show that place of residence had a weak but statistically significant gross effect on infant mortality (Table 5.4). Rural residence was associated with a much greater risk of infant mortality compared to urban residence. In gross terms, the odds of dying of rural children in infancy were 1.21 times higher than those of their counterparts in urban areas.

Place of residence emerged as a stronger determinant of infant mortality when the province of residence was taken into account. This indicates that place of residence affected infant mortality independently of the influence of province of residence. However, the effect of place of residence on infant mortality was no longer statistically significant once parental education or household economic status were each taken into account. These results suggest that the differences in the survival chances during infancy of a child in an urban setting was more a function of the education of its parents and the socioeconomic status of their households than of urban residence *per se*. Thus what appears to be an urban-rural difference is actually mediated by the socioeconomic status of the family: the concentration of better off, and better educated in urban areas.

Table 5.4 Odds ratios and likelihood chi-square values indicating the effect of place of residence on infant and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for REG	Adjusted for PADU	Adjusted for HSES	Adjusted for MEDU	Net effect[a]
			Infant mortality (n= 18345)			
$LR\chi^2$	5.24	9.87	0.66	0.35	0.05	0.76
d.f.	1	1	1	1	1	1
p	< 0.05	< 0.02	> 0.30	> 0.50	> 0.80	> 0.30
Place of residence						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	1.21*	1.39*	1.07	0.94	1.02	1.10
			Child mortality (n= 12595)			
$LR\chi^2$	0.22	0.46	1.52	7.57	4.26	2.08
d.f.	1	1	1	1	1	1
p	> 0.50	> 0.30	> 0.20	< 0.02	< 0.05	> 0.10
Place of residence						
Urban	1.00	1.00	1.00	1.00	1.00	1.00
Rural	0.94	1.11	0.85	0.68*	0.76*	0.78

Notes: The $LR\chi^2$ values shown here are those associated with the place of residence only and not of all the variables in the model. [a] Net of the influence of province of residence (REG), maternal education (MEDU), paternal education (PADU), household economic status (HSES), mother's work status (MOCW) and possession of livestock (LSTOK). * $p < 0.05$, ** $p < 0.01$.

Source: Primary analysis of the 1988/89 KDHS data.

Place of residence had no statistically significant gross effect on child mortality. However, it had a significant effect on child mortality when controls for HSES and MEDU were introduced. But the net effect after controlling for province of residence, father's education, household economic status and mother's education was not statistically significant. This suggests that the risk of child mortality was about the same among children born to parents with similar socioeconomic characteristics, whether they lived in rural or urban areas.

Since the ecological, socioeconomic and cultural environment of a mother's childhood place of residence or birth place influences her general health and well-being and contributes to the formation of beliefs, skills and practices that are important during her reproductive life, further analysis has been performed by re-classifying all births and children by their mother's childhood place of residence (until the age of 12 years) and current place of residence (Table 5.5).

Table 5.5 Infant and child mortality rates by mother's childhood residence or birth place and place of residence: Kenya, 1988/89 KDHS

	Current place of residence					
	Rural		Urban			
	Infant mortality[a]					
Childhood residence					Total	
Rural	57	(16562)	55	(1569)	57	(18131)
Urban	65	(1394)	43	(690)	58	(2084)
Total	58	(17956)	52	(2259)	57	(20215)
	Child mortality[b]					
Childhood residence						
Rural	36	(11560)	38	(987)	36	(12547)
Urban	53	(873)	33	(445)	46	(1318)
Total	37	(12433)	36	(1432)	37	(13865)

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

One of the marked features of Table 5.5 is that the highest infant and child mortality was among children whose mothers lived in urban areas during their childhood but had rural residence at the time of the survey. The question to ask is why they left the urban environment for life in the rural village. Unfortunately, this information was not sought from such mothers. Some probably migrated as children with their parents or relatives on retirement or loss of a job. Others probably migrated because of marriage. In any case, they appear to have been least able to adjust to the living conditions in the rural areas and take adequate care of their children.

The results shown in Table 5.6 also suggest that urban residence was beneficial only to the children born to mothers of urban origin and currently living in urban settings. Compared to these children, those born to mothers of rural origin and currently living in urban areas had excess infant and child mortality of 12 and 5 per 1000, respectively. Before drawing conclusions from the results in Table 5.6 as to the likely mechanisms through which the mothers' change of childhood residence may affect the survival of their children, it has to be remembered that the Survey recorded residence of the mothers at the time of the interview, not at the time of their children's birth. Thus mothers who moved from rural areas and were recorded as urban residents in the Survey may have had all or some of their children while still living in the village. Hence, such children were exposed to the risk of mortality associated with the rural rather than the urban environment where the mothers were recorded as being residents.

Another limitation of the data on which the analysis is based and which complicates the interpretation of the results is that no information is available about why some of the women moved from the place of their childhood residence: marriage may be one such reasons; another may that young educated women looked for better jobs in the urban area by educated young woman. Some of the women who moved from rural to urban areas may have done so recently, and their adjustment to the life in the town and their knowledge and use of the urban infrastructure, in particular health services, may have been limited.

The only significant difference either for gross effects or net effects was for infant mortality among children of women of urban origin currently living in rural areas (Table 5.6). Although controls for maternal education and household economic status strengthened the effect of childhood visa vis current residence on child mortality, the net effect remained not significant.

Table 5.6 Odds ratios and likelihood chi-square values indicating the effect of childhood and current place of residence on infant and child mortality: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for MEDU	Adjusted for HSES	Net effect[a]
		Infant mortality (n= 18345)		
$LR\chi^2$	13.26	9.50	6.34	6.01
d.f.	3	3	3	3
p	< 0.01	< 0.05	>0.05	> 0 10
Childhood-current residence				
Rural-Rural	1.37	1.15	1.05	1.31
Rural-Urban	1.22	1.18	1.17	1.32
Urban-Rural	1 86**	1.58*	1.45	1.62*
Urban-Urban	1 00	1.00	1.00	1.00
		Child mortality (n= 12595)		
$LR\chi^2$	2.67	7.33	9.21	2.65
d.f.	3	3	3	3
p	> 0.30	> 0.10	< 0.05	> 0.30
Childhood-current residence				
Rural-Rural	0.97	0.76	0 70	0.78
Rural-Urban	1.08	1 04	1 03	1.01
Urban-Rural	1.30	1.06	0.95	0.92
Urban-Urban	1.00	1.00	1.00	1.00

Notes: The $LR\chi^2$ values shown here are those associated with the childhood-current place of residence only and not of all the variables in the model. [a] Net of the influence of province of residence (REG), mother's work status (MOCW), household economic status (HSES), paternal education (PADU) and possession of livestock (LSTOK) and maternal education (MEDU), * p < 0.05, ** p < 0.01.

Source: Primary analysis of the 1988/89 KDHS data.

5.3.3 Maternal education

Maternal education has been found almost invariably to be the most important socioeconomic determinant of infant and child mortality: children of educated mothers have better survival chances than children of uneducated mothers (Caldwell, 1979:

408-413; Caldwell, 1989: 16-38; Cochrane *et al.*, 1980). This finding is confirmed by the results presented in Table 5.7. Both infant and child mortality rates declined with the level of maternal education. The child mortality rate for children of uneducated mothers was twice as great as that for the children of mothers with at least secondary education.

Table 5.7 Infant and child mortality rates by maternal education: Kenya, 1988/89 KDHS

Level of education	Infant mortality[a]		Child mortality[b]	
None	70	(7679)	50	(5741)
Primary	52	(10172)	29	(6782)
Secondary	40	(2348)	23	(1328)
Total	**57**	**(20199)**	**37**	**(13851)**
	$\chi^2 = 40.26$, d.f. = 2 $p < 0.001$		$\chi^2 = 42.24$, d.f. = 2, $p < 0.001$	

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

Since educated women tend to marry educated men, a bivariate analysis of infant and child mortality according to paternal and maternal education was carried out in order to examine whether or not the association observed in Table 5.7 was a result of better educated women marrying better educated men. The results in Table 5.8 indicate that, irrespective of the level of paternal education, infant and child mortality declined with the level of maternal education.

Paternal education apparently had only marginal impact on the association between maternal education and infant and child mortality. Its impact was only clear when the mother was uneducated and the father had at least primary education. Both infant and child mortality estimates were high when both parents were uneducated, followed by the other categories in which the mother was not educated. If the few educated fathers who married women with at least secondary education are ignored, the lowest infant and child mortality rates were among children with both parents having at least secondary education.

Table 5.8 Infant and child mortality rates by maternal education and paternal education: Kenya, 1988/89 KDHS

	Paternal education			
	None	Primary	Secondary	
		Infant mortality[a]		
Maternal education				Total
None	77 (2940)	65 (4042)	67 (448)	70 (7484)
Primary	64 (1331)	48 (5880)	55 (2475)	52 (9686)
Secondary	18 (55)*	45 (467)	39 (1644)	40 (2166)
Total	73 (4380)	55 (10389)	51 (4567)	58 (19336)
		Child mortality[b]		
Maternal education				
None	59 (2285)	46 (3023)	45 (2950)	51 (5603)
Primary	52 (919)	25 (4055)	29 (1589)	29 (6561)
Secondary	27 (36)*	24 (288)	25 (921)	25 (1245)
Total	56 (3241)	33 (7366)	29 (2802)	38 (13409)

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. *The estimate is unreliable because only one death occurred among the births in this category. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

Children born to mothers that had at least secondary education had more or less the same child mortality rate irrespective of the father's educational level. If both parents had at least primary education, their children experienced similarly low child mortality. The influence of maternal education was stronger on child mortality than on infant mortality. These results indicate that the influence of maternal education was greater than that of paternal education. Hence, the negative association between maternal education and both infant and child mortality observed in Table 5.7 is unlikely to be simply the economic consequence of better educated women marrying better educated men with more resources as a result of their education. The results in Table 5.10 further confirm the strong positive association between maternal education and child survival.

In order to examine whether or not the place of residence had any statistically significant impact on the maternal education-child survival relationship, the analysis in Table 5.9 was carried out. The results show that children born to uneducated rural mothers had lower infant and child mortality than children born to uneducated urban mothers. During infancy, residence in urban areas was beneficial only for the children born to educated mothers, and was particularly beneficial to children born to mothers with at least secondary education. This may be because mothers with at least secondary education were capable of partaking in the benefits associated with urban residence, such as increased access to health services, credit facilities, better job opportunities and safe drinking water.

Table 5.9 Infant and child mortality rates by maternal education and place of residence: Kenya, 1988/89 KDHS

	Place of residence		
	Urban	Rural	
	Infant mortality[a]		
Maternal education			Total
None	99 (481)	68 (7198)	70 (7679)
Primary	47 (1022)	52 (9150)	52 (10172)
Secondary	27 (758)	47 (1590)	40 (2348)
Total	52 (2260)	58 (17939)	57 (20199)
	Child mortality[b]		
Maternal education			
None	58 (346)	50 (5395)	50 (5741)
Primary	42 (629)	28 (6153)	29 (6782)
Secondary	13 (457)	28 (871)	23 (1328)
Total	36 (1432)	37 (12419)	37 (13851)

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

Children born to rural mothers with primary education had a lower child mortality rate than children born to urban women with primary education. In addition, in rural areas children born to mothers with primary education and those born to mothers with at least secondary education had the same child mortality rate of 28 deaths per 1000. This means that the beneficial effect of increased maternal education beyond the primary level was not apparent in the survival of rural children of ages one to five years. These results suggest that the inverse association between maternal education and infant and child mortality was stronger in the urban than in the rural areas.

Table 5.10 Odds ratios and likelihood chi-square values indicating the effect of maternal education on infant and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for URB	Adjusted for REG	Adjusted for HSES	Adjusted for MOCW	Adjusted for PADU	Net effect[a]
				Infant mortality (n = 18345)			
$LR\chi^2$	77.76	72.57	48.16	39.64	59.60	36.26	8.07
d.f.	2	2	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01
Maternal education							
None	2.40***	2.38***	2.12***	1.93***	2.14***	2.02***	1.44*
Primary	1.59***	1.59***	1.57***	1.39**	1.44***	1.46***	1.23
Secondary	1.00	1.00	1.00	1.00	1.00	1.00	1.00
				Child mortality (n = 12595)			
$LR\chi^2$	37.55	41.58	31.91	18.16	27.83	22.86	9.21
d.f.	2	2	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01
Maternal education							
None	2.86***	3.17***	2.82***	2.22***	2.50***	2.69***	2.02**
Primary	1.93**	2.10***	1.99**	1.64**	1.71**	1.95**	1.65*
Secondary	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Notes: The $LR\chi^2$ values shown here are those associated with maternal education only and not of all the variables in the model. [a] Net of the influence of province of residence (REG), mother's work status (MOCW), household economic status (HSES), paternal education (PADU) and possession of livestock (LSTOK)[2] and place of residence (URB). * $p < 0.05$, ** $p < 0.01$, *** at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

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[2] Athough the effect of controlling for possession of livestock is not shown in the table, this variable was included in the net effects model.

The extent to which maternal education operated through the other six socioeconomic factors to influence child survival was also examined. The effect of maternal education on infant mortality was only marginally reduced in the presence of the variable distinguishing rural-urban residence and slightly increased in the case of child mortality. This indicates that neither rural nor urban residence had any statistically significant effect on the association between maternal education and child mortality. The effect of maternal education on both infant and child mortality did not depend on rural or urban residence. Conversely, it was the effect of rural-urban residence on infant and child mortality that depended upon maternal education. It should be recalled here that in Section 5.3.2, it was found that the effect of rural-urban residence on infant mortality disappeared once maternal education was taken into account. And in the case of child mortality, the effect of rural-urban residence became statistically significant only when controls for maternal education were introduced, indicating that it was the maternal education that suppressed the otherwise higher urban child mortality.

The effect of maternal education on infant and child mortality was slightly reduced when the province of residence was taken into account. However, large reductions in its effect on infant and child mortality occurred when household economic status and paternal education were each taken into account. These results indicate that better educated mothers were likely to belong to households of high economic status and also that they were more likely to marry better-educated men compared with their uneducated counterparts (Appendices 5.1 and 5.2). These results show that a modest part of the gross effect of maternal education on infant and child mortality was due to the better economic conditions of households to which educated mothers belonged and to the ability of the educated women to attract and marry educated men. Hence these results provide evidence that maternal education influenced child survival through selective marriage.

Participation in the modern labour market is one of the possible avenues through which maternal education can influence child survival. Education facilitates a woman's labour force participation, since formal education is one of the requirements for obtaining a paid job in the modern sector in most societies. As it is evident in Appendix 5.3, educated women were more likely to be in paid employment than their uneducated counterparts. Furthermore, increased education may lead to increased potential return for work. As noted in Section 5.3.6, though a working mother may have little time for child care, she may be able to contribute to family economic resources, which in turn might impact favourably on the health of her children. To examine the effect of this possible avenue, mother's current work status was added to the model. The results in Table 5.10 indicate that the effect of maternal education on both infant and child mortality was reduced. This suggests that educated women were likely to be in paid employment, and that maternal education moderately enhanced child survival through its effect on the mother's employment status.

The effect of maternal education on both infant and child mortality remained statistically significant even after all the other six socioeconomic factors were simultaneously controlled for. However, its effects were substantially reduced (last column of Table 5.10), more in the case of infant than in child mortality. For example, the odds of dying in infancy among the infants of mothers with primary education was no longer significantly different from those of the infants born to mothers with at least secondary education. Thus, it can be concluded that a substantial part of the gross effect of maternal education on both infant and child mortality was due to the influence of the other six socioeconomic factors.

5.3.4 Paternal education

As in the case of maternal education, paternal education was significantly associated with both infant and child mortality (Table 5.11). Fathers having primary and secondary education resulted in equally substantial reductions in infant and child mortality compared to those children born to fathers with no education. The results already presented in Table 5.8 suggest that the observed association between paternal education and infant and child mortality was, in part, due to educated men being able to marry educated women.

Table 5.11 Infant and child mortality rates by paternal education: Kenya, 1988/89 KDHS

Level of education	Infant mortality[a]		Child mortality[b]	
None	73	(4382)	56	(3242)
Primary	55	(10397)	33	(7372)
Secondary	51	(4572)	29	(2805)
Total	58	(19351)	38	(13419)
χ^2	= 22.69, d.f. = 2, $p < 0.001$		χ^2 = 37.68, d.f. = 2, $p < 0.001$	

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 and who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

As in the case of maternal education, the effect of the place of residence on the association between paternal education and infant and child mortality was also examined. Table 5.12 indicates that, in both rural and urban areas, children born to uneducated fathers had the highest infant and child mortality rate. In rural areas children born to fathers with primary education and those born to fathers with at least secondary education had the same infant mortality rate and almost the same child mortality rate. However, in the urban areas children born to fathers with at least secondary education had substantially lower infant and child mortality rates than children born to fathers with primary education.

Table 5.12 Infant and child mortality rates by paternal education and place of residence: Kenya, 1988/89 KDHS

	Place of residence		
	Urban	Rural	
	Infant mortality[a]		
Paternal education			Total
None	74 (286)	72 (4096)	73 (4382)
Primary	61 (756)	54 (9641)	55 (10397)
Secondary	39 (1036)	54 (3536)	51 (4572)
Total	51 (2078)	58 (17273)	58 (19351)
	Child mortality[b]		
Paternal education			
None	57 (203)	56 (3039)	56 (3242)
Primary	47 (499)	32 (6873)	33 (7372)
Secondary	27 (632)	30 (2172)	29 (2804)
Total	39 (1334)	38 (12084)	38 (13418)

Notes: [a] Per 100 live births that occurred between 1970 and 1987.. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The total numbers of live births are in the parentheses. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

The results of logistic regression analysis presented in Table 5.13 confirm that paternal education was negatively and significantly related to both infant and child mortality. In gross terms, the odds of infant mortality for children born to uneducated fathers and those born to fathers with primary education were 95 and 40 per cent higher, respectively, than those for children whose fathers had at least secondary education. The odds of child mortality for children whose fathers had no education were 84 per cent higher than those for children whose fathers had at least secondary education. The odds of child mortality for children whose fathers had primary education were not significantly different at the 5 per cent level from those of the children whose fathers had at least secondary education.

The results in Table 5.13 also show that the place of residence and province of residence had no significant effect on the paternal education-child mortality relationship. The effect of paternal education on both infant and child mortality was substantially reduced in the presence of either household economic status or maternal education variables in the model. When maternal education was taken into account, the odds of dying in infancy among children whose fathers had primary education were no longer significantly different from those of the children whose fathers had at least secondary education. In the case of child mortality, the odds for the children whose fathers had no education and children whose fathers had primary level of education were no longer significantly different from those of children born to fathers with at least secondary education.

These results suggest that better-off households were more likely to be occupied by better-educated men who were likely to marry better-educated women. It can therefore be concluded that the positive association between paternal education and child survival was partly due to this selective marriage. The large difference between the gross effect and net effect of paternal education on infant and child mortality suggests that a substantial part of the gross effect was due to the influences of the other socioeconomic factors. Although paternal education had an overall significant net effect on child mortality, the differences in the odds of child mortality by paternal education were not statistically significant.

Table 5.13 **Odds ratios and likelihood chi-square values showing the effect of paternal education on infant and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS**

	Gross effect	Adjusted for URB	Adjusted for REG	Adjusted for HSES	Adjusted for MEDU	Net effect[a]
			Infant mortality (n = 18345)			
$LR\chi^2$	55.03	50.45	44.96	25.77	13.00	8.58
d.f.	2	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.02
Paternal education						
None	1.95***	1.92***	1.86***	1.60***	1.42***	1.36**
Primary	1.40***	1.38***	1.44***	1.22*	1.13	1.15
Secondary	1.00	1.00	1.00	1.00	1.00	1.00
			Child mortality (n = 12595)			
$LR\chi^2$	23.57	24.87	25.94	11.97	8.88	9.25
d.f.	2	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01
Paternal education						
None	1.84***	1.91***	1.97***	1.44**	1.26	1.28
Primary	1.20	1.24	1.25	0.99	0.91	0.90
Secondary	1.00	1.00	1.00	1.00	1.00	1.00

Notes: The $LR\chi^2$ values shown here are those associated with paternal education only and not all the variables in the model. [a] Net of the influence of province of residence (REG), mother's work status (MOCW), household economic status (HSES), maternal education (MEDU), paternal education (PADU), possession of livestock (LSTOK) and place of residence (URB). *Significant at $p < 0.05$, ** Significant at $p < 0.01$, *** Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

5.3.5 Household economic status

Infant and child mortality levels were significantly and negatively associated with household economic status. Infant and child mortality among children from households of low economic status were almost twice as high as that of the children from households of high economic status (Table 5.14).

Table 5.14 Infant and child mortality rates by household economic status: Kenya, 1988/89 KDHS

Household economic status	Infant mortality[a]		Child mortality[b]	
Low	72	(7629)	49	(5313)
Medium	54	(8129)	34	(5527)
High	38	(4435)	22	(3018)
Total	57	(20193)	37	(13858)
	$\chi^2 = 65.58$ d.f. = 2, $p < 0.001$		$\chi^2 = 41.74$, d.f. = 2, $p < 0.001$	

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 KDHS data.

The results of logistic regression analysis presented in Table 5.15 reveal again that both infant and child mortality were significantly and negatively associated with household economic status. The results show that the effect of household economic status on infant and child mortality was independent of place of residence and province of residence. However, both paternal and maternal education moderately reduced the effect of household economic status on both infant and child mortality. For instance, when maternal education was added to the model, the odds of infant mortality of children from households of low economic status decreased from 1.97 to 1.68, while the odds of child mortality decreased from 2.13 to 1.68 compared to those of the children from the relatively well-off households. This suggests that households of high economic status were likely to have educated parents, which is a partial reason why household economic status was inversely associated with the risk of infant and child mortality.

Table 5.15 Odds ratios and likelihood chi-square values showing the effect of household economic status on infant and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for URB	Adjusted for REG	Adjusted for PADU	Adjusted for MEDU	Net effect[a]
			Infant mortality (n = 18345)			
$LR\chi^2$	66.43	61.53	49.83	37.16	16.29	12.21
d.f.	2	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01
Household economic status						
High	1.00	1.00	1.00	1.00	1.00	1.00
Medium	1.42***	1.44***	1.42***	1.30**	1.23*	1.21
Low	1.97***	2.01***	1.86***	1.71***	1.68***	1.41**
			Child mortality (n = 12595)			
$LR\chi^2$	35.67	43.01	29.92	24.06	16.29	11.63
d.f.	2	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01
Household economic status						
High	1.00	1.00	1.00	1.00	1.00	1.00
Medium	1.46*	1.68**	1.57**	1.38*	1.23	1.33
Low	2.13***	2.48***	2.12***	1.94***	1.68***	1.68***

Notes: The $LR\chi^2$ values shown here are those associated with household economic status only and not of all the variables in the model. [a] Net of the influence of province of residence (REG), mother's work status (MOCW), maternal education (MEDU), paternal education (PADU), place of residence (URB) and possession of livestock (LSTOK). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

Although its effect was substantially reduced, household economic status had statistically significant net effects on both infant and child mortality. The substantial reduction in the gross effects of household economic status on both infant and child mortality suggests that a large part of its effect was due to the influence of the other socioeconomic variables, particularly maternal education.

5.3.6 Mother's current work status

Mother's current work status was significantly related to both infant and child mortality. Children whose mothers were at the time of the Survey in some form of paid employment experienced lower infant and child mortality than the children whose mothers were not in any form of paid employment (Table 5.16). The infant mortality rate among the children whose mothers were not in paid employment was 41 per cent higher than that of the children whose mothers were working, while child mortality among children of non-working mothers was about 70 per cent higher than of the children of working mothers.

Table 5.16 Infant and child mortality by mother's work status: Kenya, 1988/89 KDHS

Mother's work status	Infant mortality[a]	Child mortality[b]
Working	42 (2094)	23 (1472)
Not working	59 (17925)	39 (12243)
Total	57 (19979)	37 (13717)
χ^2	**10.28, d.f. = 1, p < 0.001**	**χ^2 = 11.24,d.f. = 1, p < 0.001**

Notes: The figures do not add up to the total numbers of births or children because some mothers did not state their current paid work status. [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 data.

The results of logistic regression analysis presented in Table 5.17 also show that children of non-working mothers were at a significantly greater risk of infant and child mortality than the children of working mothers. Children of non-working mothers had odds of infant mortality 1.8 times higher than those of the children whose mothers were in paid work. Children who survived infancy had odds of child mortality 1.9 times higher than those for children whose mothers were in paid work. These results indicate that the negative aspects of women's participation in paid employment previously discussed appear to be outweighed by the benefits.

Hence, in the Kenyan context, mother's participation in paid employment appears to enhance child survival, bearing in mind that employment refers to the time of the survey rather than the time the child was born. These results are consistent with analysis of the 1977/78 Kenya Fertility Survey (UN, 1985: 161) and also are in agreement with other studies which have found a positive association between child survival and female labour force participation (Tulasidhar, 1993: 184-189; Kumar, 1977 cited in Dwyer and Bruce (1988).

Table 5.17 Odds ratios and likelihood chi-square values showing the effect of mother's work status on infant and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for URB	Adjusted for REG	Adjusted for MEDU	Adjusted for PADU	Net effect[a]
			Infant mortality (n= 18345)			
$LR\chi^2$	26.18	22.05	16.10	8.02	13.98	2.43
d.f.	1	1	1	1	1	
p	< 0.001	< 0.001	< 0.001	< 0.01	< 0.01	> 0.10
Mother's working status						
Working	1.00	1.00	1.00	1.00	1.00	1.00
No	1.80***	1.75***	1.62***	1.42**	1.57***	1.23
			Child mortality (n= 12595)			
$LR\chi^2$	13.45	15.50	11.30	3.74	8.72	1.99
d.f.	1	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	> 0.05	< 0.01	> 0.10
Working	1.00	1.00	1.00	1.00	1.00	1.00
No	1.89***	2.02***	1.83**	1.45	1.71**	1.33

Notes: The $LR\chi^2$ values shown here are those associated with mother's work status only and not of all the variables in the model. [a] Net of the influence of province of residence (REG), maternal education (MEDU), place of residence (URB), paternal education (PADU), Household economic status (HSES) and possession of livestock (LSTOK). **Significant at p < 0.01, ***Significant at p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

The effects of mother's work status on both infant and child mortality were significantly reduced when maternal education was taken into account. In the case of child mortality, the risk among children of mothers who were not in paid employment was no longer significantly greater than that of the children whose mothers were in paid employment. The inverse association between mother's labour force participation and infant and child mortality was mainly due to the effect of maternal education. Better-educated women were more likely to be in paid employment than the less educated or uneducated women (Appendix 5.3). However, mother's work status was no longer significantly related either to infant or to child mortality in the multivariate model that incorporated all six socioeconomic factors (last column of Table 5.17). This means that almost all the gross effects of mother's work status on both infant and child mortality can be adequately explained by the other socioeconomic factors, particularly maternal education.

5.3.7 Possession of livestock

The possession of livestock was negatively associated with infant mortality (Table 5.18). Infant mortality among the children from households that did not keep livestock was about 42 per cent higher than that of the children from households that kept livestock.

Table 5.18 Infant and child mortality rates by possession of livestock: Kenya, 1988/89 KDHS

Possession of livestock	Infant mortality[a]	Child mortality[b]
Yes	52 (15415)	36 (10622)
No	74 (4786)	42 (3237)
Total	**57 (20201)**	**37 (13859)**
χ^2	29.12, d.f. = 1, $p < 0.001$	χ^2 = 2.40, d.f. = 1, $p > 0.10$

Notes: [a] Per 1000 live births that occurred between 1970 and 1987. [b] Per 1000 children born between 1970 and 1983 who survived to age one. The numbers in the parentheses are the exposed births for infant mortality and exposed children for child mortality.

Source: Primary analysis of the 1988/89 data.

The results obtained by fitting logistic regression models also indicate that possession of livestock was significantly related only to infant mortality (Table 5.19). Infants from households that did not have livestock had the odds of dying in infancy 1.44 times higher than the infants from households that kept livestock. The results indicate that the effect of possession of livestock on infant mortality increased when the place of residence was taken into account. This suggests that households classified as urban were less likely than rural households to keep livestock.

The effect of possession of livestock on infant mortality was moderately reduced when the province of residence was taken into account. The odds of dying in infancy among children from households that did not keep livestock were reduced from 1.4 to 1.3 when the province of residence was taken into account. This suggests that the province of residence captured some of the pathways through which possession of livestock influenced infant mortality. The results of the multivariate model indicate that the effect of possession of livestock on infant mortality was, by and large, independent of all other socioeconomic factors, since its effect remained highly statistically significant even after all other socioeconomic factors were taken into account.

Table 5.19 Odds ratios and likelihood chi-square values indicating the effect of possession of livestock on infant mortality and child mortality, adjusted for other socioeconomic factors: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for URB	Adjusted for HSES	Adjusted for REG	Adjusted for MEDU	Net effect[a]
			Infant mortality (n = 18345)			
$LR\chi^2$	28.80	39.53	28.60	14.20	29.59	14.68
d.f	1	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Possession of livestock						
Yes	1.00	1.00	1.00	1.00	1.00	1.00
No	1.44***	1.57***	1.44***	1.32***	1.45***	1.32***
			Child mortality (n = 12595)			
$LR\chi^2$	1.28	1.98	0.01	1.98	1.61	0.01
d.f.	1	1	1	1	1	1
p	> 0.20	> 0.10	> 0.90	> 0.10	> 0.10	> 0.90
Possession of livestock						
Yes	1.00	1.00	1.00	1.00	1.00	1.00
No	1.13	1.12	1.01	1.16	1.14	0.99

Notes: The $LR\chi^2$ values shown here are those associated with possession of livestock only and not of all the variables in the model. [a] Net of the influence of province of residence (REG), maternal education (MEDU), place of residence (URB), paternal education (PADU), household economic status (HSES) and mother's work status (MOCW). ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

The results in Table 5.19 confirm that whether or not the household possessed livestock had no significant association with child mortality. In all the alternative models fitted the effect of possession of livestock on child mortality was not significant.

5.4 Further analysis of effects of socioeconomic factors

The preceding section of this chapter examined the effects of each of the socioeconomic factors on both infant and child mortality, controlling for the other socioeconomic factors. In this section, parsimonious models of socioeconomic determinants of infant and child mortality are presented. As in the preceding section the analysis of infant mortality was based on 18345 live births, whereas the analysis of child mortality was based on 12595 children who survived to age one. The results for infant mortality are presented in Table 5.20 while those for child mortality are presented in Table 5.21. Table 5.20 shows that the socioeconomic determinants of infant mortality were province of residence, household economic status, possession of livestock, maternal education and paternal education in that order. Mother's current work status and place of residence had no significant net effects on infant mortality and thus were excluded in the model.

With respect to child mortality, except for possession of livestock, place of residence and mother's work status, all socioeconomic factors were significantly related to child mortality. In order of significance, the determinants of child mortality were province of residence, household economic status, maternal education and paternal education (Table 5.21). Although the overall net effect of paternal education was significant, the risk of child death, as represented by odds ratios, for children of uneducated fathers was not significantly different from that for the children of fathers with at least secondary education. Nor was the risk of child death for children of fathers with primary education significantly different from that of the children of fathers with at least secondary education.

Table 5.20 Logistic regression coefficients and associated statistics of the socioeconomic factors significantly related to infant mortality: Kenya, 1988/89 KDHS

	Log odds	$LR\chi^2$	d.f.	P	Odds ratio
Province		177.15	6	< 0.001	
Central	0.00				1.00
Nairobi	0.16(0.93)				1.17
Coast	0.79(6.38)***				2.20
Eastern	0.16(1.22)				1.17
Nyanza	0.85(7.92)***				2.34
R. Valley	-0.41(-2.89)**				0.66
Western	0.49(4.20)***				1.63
Household economic status		15.91	2	< 0.01	
High	0.00				1.00
Medium	0.22(2.22)*				1.25
Low	0.39(3.81)***				1.48
Possession of livestock		13.56	1	< 0.001	
Yes	0.00				1.00
No	0.26(3.72)***				1.30
Maternal education		10.46	2	< 0.02	
Secondary	0.00				1.00
Primary	0.26(1.94)				1.30
None	0.43(2.95)**				1.54
Paternal education		9.05	2	< 0.02	
Secondary	0.00				1.00
Primary	0.15(1.57)				1.16
None	0.32(2.91)**				1.38
Constant	= -3.9032, standard error = 0.1511				

Notes: *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. Based on 18345 infants born between 1970 and 1987. The figures in the parentheses are the t-statistic values.

Source: Primary analysis of the 1988/89 KDHS data.

Table 5.21 Logistic regression coefficients and associated statistics of the socioeconomic factors significantly related to child mortality: Kenya, 1988/89 KDHS

	Log odds[a]	LRχ^2	d.f.	P	Odds ratio
Province		122.34	6	< 0.001	
Central	0.00				1.00
Nairobi	1.11(4.33)***				3.04
Coast	1.05(4.89)***				2.86
Eastern	0.53(2.35)**				1.70
Nyanza	1.27(6.71)***				3.56
R. Valley	-0.04(-0.17)				0.96
Western	1.35(7.00)***				3.86
Household economic status		11.44	2	< 0.02	
High	0.00				1.00
Medium	0.27(1.72)				1.31
Low	0.50(3.14)**				1.64
Maternal education		10.87	2	< 0.01	
Secondary	0.00				1.00
Primary	0.55(2.34)*				1.73
None	0.76(3.05)**				2.14
Paternal education		9.38	2	< 0.01	
Secondary	0.000				1.00
Primary	-0.10(-0.72)				0.90
None	0.25(1.52)				1.28

Constant = -5.0290, standard error = 0.2731

Notes: *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. Analysis based on 12595 born between 1970 and 1983 who survived infancy. The figures in the parentheses are the t- statistic values.

Source: Primary analysis of the 1988/89 KDHS data.

5.5 Conclusion

In this chapter the effects of province of residence, place of residence, maternal education, mother's current work status, paternal education, possession of livestock and household economic status on infant and child mortality were examined in some detail. All these socioeconomic factors were found to have significant gross effects on infant mortality. Except for possession of livestock they also had significant gross effects on child mortality. However, the effects of mother's work status and place of residence on infant mortality were no longer statistically significant once other socioeconomic factors were taken into account.

The results obtained indicate substantial provincial differences in infant and child mortality. Among the socioeconomic factors considered, province of residence emerged as the most important factor determining both infant and child mortality. Low risks of infant and child mortality were associated with residence in the more economically developed, high altitude and almost malaria free provinces (Central, Rift Valley, Eastern and Nairobi[3]). A high risk of infant and child mortality was associated with residence in the less economically developed, low-altitude and malaria-prone province (Coast, Nyanza and Western). The results suggest that the provincial differentials in infant and child mortality were largely independent of the socioeconomic factors examined in this study.

Both maternal and paternal education were strongly and negatively associated with infant and child mortality. However, the influence of maternal education was greater than that of paternal education. Furthermore, the effect of maternal education was greater on child mortality than on infant mortality. In contrast, the effect of paternal education was stronger on infant mortality than on child mortality. The results indicated that paternal education that positively associated with child survival in part because of selective marriage, in the sense that educated women were more likely to marry better-educated men. Furthermore, the results showed that maternal education influenced child survival through its effect on incomes or wealth as represented by household economic status. Educated mothers were more likely to be paid employment. Better- educated women were likely to have high-salary jobs and thus were likely to have access to financial resources with which to purchase a wide range of goods and services to maintain and improve the health of their children.

Similarly, paternal education influenced child survival through household income/wealth because better-educated men were more likely to have high-salary jobs and to engage in a wide range of income-generating activities.

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[3]At its level of socioeconomic development, Nairobi province should have lower mortality than Central province. The higher mortality in Nairobi than Central province could be due to the problems associated with urban poverty and the fact that a large section of the population in Nairobi live in slum settlements with appalling housing and sanitary conditions.

Household income/wealth as proxied by the household economic status variable was positively associated with child survival. Its effects on both infant and child mortality remained significant even after all the other socioeconomic factors were taken into account. However, its effects were reduced when either maternal or paternal education was taken into account, indicating that educated parents were more likely to belong to households of high economic status. Yet a significant part of its effects on child survival was independent of the influence of maternal and paternal education.

Possession of livestock was found to be significantly related to infant mortality but not to child mortality. Infants from households that did not keep livestock were at a significantly greater risk of dying. than infants from households that kept livestock. These differentials persisted even after all other socioeconomic factors were taken into account. Unlike in the case of infant mortality, possession of livestock had no significant effect on child mortality. Its effects remained not significant in all the alternative models fitted.

Mother's current work status had significant effects on both infant and child mortality. Children of non-working mothers were at a significantly greater risk of dying in infancy and between ages one and five years the children of working mothers. Its gross effects were mainly due to the influence of education; educated mothers were more likely to be in paid employment than the uneducated mothers. Its effect on child mortality was no longer significant when maternal education was controlled for. And its effect on infant mortality was no longer significant once all other socioeconomic factors were taken into account.

CHAPTER SIX

SOCIOECONOMIC FACTORS AND PROXIMATE VARIABLES: A SEARCH FOR PATHWAYS OF INFLUENCE

6.1 Introduction

This chapter has two aims. The first is to investigate the extent to which the socioeconomic factors influenced infant and child mortality through the proximate variables included in this study. The second is to identify key factors that influence infant and child mortality in the country. The chapter has been divided into three parts. The first investigates the extent to which the proximate variables mediated the effects of the socioeconomic factors on infant and child mortality. The second part of the chapter is devoted to assessing the changes, if any, in the respective effects of the socioeconomic factors on infant and child mortality when the proximate and other socioeconomic factors are taken into account. The third part seeks to identify key factors that had significant net influence on infant and child mortality in the country.

Although in the review of the literature presented in Chapter One, some of the associations between the socioeconomic factors and proximate variables were discussed, it is important to investigate these relationships in the Kenyan context. This is because an understanding of these associations is necessary in the interpretation of the results on the pathways of influence. These are also investigated in this chapter. The results of this investigation are presented in Appendices 6.25 to 6.32.

6.2 Analytical approach

As in the previous chapters, the significance of the effect of any explanatory variable will be assessed in terms of reduction in the value of the likelihood ratio chi-square ($LR\chi^2$) along with the corresponding probability level (p). Any change that might occur to the effect of a given explanatory variable when another variable is added into the logit model can be assessed in terms of the size of the reduction in

$LR\chi^2$ value, from that particular explanatory variable and its log odds or coefficients and standard errors. The reduction in $LR\chi^2$ value due to the addition of a particular explanatory variable is computed from the difference in the $LR\chi^2$ values of the two models, one which does and another which does not include that variable.

If the socioeconomic factors influenced infant or child mortality through the proximate variables, there would be considerable attenuation in the size of their respective effects, as represented by $LR\chi^2$ values and in parameter estimates (coefficients)[1], when these proximate variables are added into the model. However, if no attenuation occurs in the size of the $LR\chi^2$ and the coefficients of a given socioeconomic factor, then the factor in question did not influence infant or child mortality through that particular proximate variable.

The statistical significance of the differences between the parameter estimates (coefficients) of the controlled models and the gross effects model is examined in terms of their respective standard errors. As an illustration if in the gross effects model a parameter estimate, say P_1, has a standard error, S_1, and the estimate, P_2, of the same parameter in the controlled model has a standard error, S_2, then the square root of the sum of the squares of S_1 and S_2 is the standard error of the difference between P_1 and P_2. The significance of the difference in the estimates obtained under the controlled models and those of the gross effects model can then be compared using the normal t-test statistical procedure.

If the difference between the two estimates is statistically significant, then the socioeconomic factor in question significantly influenced infant or child mortality through the proximate variable that was taken into account. However, if the difference is not significant but the estimates in the controlled model were lower than those in the gross effect model, then not much of the effect of the socioeconomic factor was mediated by the proximate variable. And if the estimates in the controlled model are greater than those in the gross effect model, then the socioeconomic factor

[1] The parameter coefficients were exponentiated to obtain the odds ratios shown in all the tables in this chapter.

influenced infant or child mortality independently of the proximate variable in question. The same interpretation would be given if the estimates obtained under the controlled model were more or less the same as those in the gross model.

When all births were included in the analysis, the controls for maternal factors (MATF) included maternal age and birth order only; and the proximate variables (PROX) included all the proximate variables except the birth interval variables and the survival status of the preceding child at age one. However, when analyses were based on the second and higher order births all the maternal factors, that is maternal age at birth, birth order, birth interval variables and the survival status of the preceding child at age one were included. In the case of infant mortality, the succeeding birth interval was not included in the analysis because of methodological difficulties already discussed in Chapter Four in Section 4.3.3.

Furthermore, the associations between the socioeconomic factors and the proximate variables will be investigated, using cross-tabulations. Pearson chi-square (χ^2) values will be used to assess whether the associations are statistically significant and Cramer 's V values will be used to assess the strength of the associations. Cramer's V statistic is based on the χ^2 and measures the strength of the relationship between dependent and independent variables (Norusis and Spss Inc., 1990: 132-133). If it is close to zero the relationship is weak; if it is close to one the relationship is strong. These investigations will be based on all the births that occurred between 1970 and 1987.

6.3 The effects of socioeconomic factors after adjusting for proximate variables

The results[2] in this subsection relate to the effects of each of the socioeconomic factors on infant and child mortality when the proximate variables were taken into account. Detailed results relating to the effect of each of the socioeconomic factors

[2] As in the previous chapters, logistic regression models were fitted using unaggregated data since the version of GLIM used could handle all the cases.

when each or a combination of the proximate variables was taken into account are presented in Appendices 6.1 to 6.24.

No analyses on the effect of the type of place of residence and possession of livestock on child mortality are carried out in this chapter because these two factors had no significant gross effect on child mortality. Similarly, since type of place of residence had no significant gross effect on infant mortality among second and higher order births, no further analysis is presented on this variable.

6.3.1 Province of residence

In Table 6.1 are the estimates of the effect of the province of residence on infant mortality, obtained under various alternative models. The results indicate that the effect of the province of residence was slightly reduced when each set of the proximate variables was taken into account. As is evident in Model V, the provincial differentials in infant mortality were not substantially altered even when all the proximate variables were taken into account. The odds of infant mortality were slightly reduced in all provinces except for Nairobi province, where they slightly increased.

A test of significance of difference in the parameter estimates obtained in the gross effect model and those obtained in each of the controlled models shows that none of the differences was significant at the 5 per cent level. This indicates that not much of the effect of the province of residence on infant mortality was mediated through the proximate variables. It can therefore be concluded that the province of residence influenced infant mortality by and large independently of the proximate variables considered here.

Table 6.1 Odds ratios and likelihood chi-square values indicating the effect of province of residence on infant mortality, adjusted for proximate variables, Kenya: 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 18345)		
$LR\chi^2$ [a]	223.90	208.00	201.40	214.50	187.10
d.f.	6	6	6	6	6
p	< 0.001	< 0.001	<0.001	< 0.001	< 0.001
Province					
Central	1.00	1.00	1.00	1.00	1.00
Nairobi	1.01	1.20	1.03	1.04	1.20
Coast	2.80***	2.75***	2.61***	2.77***	2.57***
Eastern	1.25	1.16	1.17	1.24	1.12
Nyanza	2.54***	2.28***	2.32***	2.46***	2.09***
Rift Valley	0.73**	0.64**	0.67**	0.71**	0.61***
Western	1.72***	1.61***	1.58***	1.68***	1.49**
Model $LR\chi^2$	223.90	251.80	242.00	263.60	299.20
Model d.f.	6	8	7	11	14
Constant	-3.19(0.09)	-3.38(0.11)	-3.38(0.10)	-3.38(0.10)	-3.63(0.12)
			Second and higher order births (n = 14951)		
$LR\chi^2$ [a]	195.20	189.10	180.90	149.6	139.10
d.f.	6	6	6	6	6
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Province					
Central	1.00	1.00	1.00	1.00	1.00
Nairobi	1.01	1.21	1.02	1.09	1.26
Coast	2.64***	2.72***	2.50***	2.35***	2.32***
Eastern	1.14	1.09	1.09	1.12	1.05
Nyanza	2.54***	2.35***	2.38***	2.30***	2.05***
Rift Valley	0.62**	0.57**	0.59**	0.62**	0.56***
Western	1.71***	1.62***	1.61***	1.60***	1.46**
Model $LR\chi^2$	195.20	208.60	202.40	481.30	495.70
Model d.f.	6	8	7	14	17
Constant	-3.17(0.10)	-3.37(0.12)	-3.27(0.10)	-3.86(0.14)	-4.08(0.15)

Notes: [a] The $LR\chi^2$ values associated with province of residence only while Model $LR\chi^2$ values are due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

The results of analysis of variation of child mortality by province of residence after adjusted for the effects of the proximate variables are presented in Table 6.2. As in the case of infant mortality, a moderate attenuation in the provincial differences in child mortality is evident when access to safe drinking water and toilet facility or ever-use of modern contraception were taken into account. Again, Nairobi province is the only exception; the odds slightly increased. As can be seen in Model IV, provincial variation in child mortality remained virtually unchanged when maternal factors were taken into account. This indicates that the provincial variation in child mortality was independent of maternal factors. As seen in Appendices 6.25 to 6.29, the associations between maternal factors and the province of residence were statistically significant, though they were very weak.

Again, as in the case of infant mortality, the provincial variation in child mortality was not substantially altered when all the proximate variables were taken into account (Model V). Except for the children in Nairobi province, where the odds of dying slightly increased relative to those of the children in Central province, whereas in all other provinces controlling for the effects of all the proximate variables reduced the risk of child mortality. Some of the underlying factors appear to be access to safe drinking water and toilet facility, and access to and use of health facilities (Models II and III).

Nairobi, Coast, and Central provinces had better access to safe drinking water. Nyanza, Rift Valley and Western provinces had comparatively poor access to safe drinking water (Appendices 6.30 and 6.32). Nairobi, Central, Western and Eastern provinces had better access to toilet facilities. Coast and Nyanza provinces had poor access to toilet facilities. However, these associations, though significant, were not very strong. The results in Appendix 6.31 show significant but weak associations between ever-use of modern contraception and province of residence. Ever-use of modern contraception was highest in Nairobi and Central provinces and lowest in Nyanza and Western provinces.

Table 6.2 Odds ratios and likelihood chi-square values indicating the effect of province of residence on child mortality, adjusted for proximate variables, Kenya: 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 12595)		
$LR\chi^2$ [a]	129.10	122.10	112.10	125.50	111.00
d.f.	6	6	6	6	6
p	< 0.001	< 0.001	< 0.001	< 0 001	< 0.001
Province					
Central	1.00	1.00	1.00	1.00	1.00
Nairobi	2.22**	2.73***	2.31**	2.14**	2.65***
Coast	3.61***	3.14***	3.23***	3.52***	2.89***
Eastern	1.81**	1.61*	1.66*	1.82**	1.53*
Nyanza	3.87***	3.42***	3.39***	3.75***	2.94***
Rift Valley	1.09	0.91	0.97	1.06	0.81
Western	4.02***	3.75***	3.36***	3.96***	2.94***
Model $LR\chi^2$	129.10	153.30	145.50	143.30	178.70
Model d.f.	6	8	7	11	14
Constant	-4.15(0.16)	-4.15(0.16)	-4.37(0.18)	-4 23(0.18)	-4.60(0.21)
			Second and higher order births (n = 9243)		
$LR\chi^2$ [a]	88.32	84.53	76.01	85.74	74.01
d.f.	6	6	6	6	6
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Province					
Central	1.00	1.00	1.00	1.00	1.00
Nairobi	2.02*	2 41**	2.14**	2.06**	2.39***
Coast	2.84***	3 14***	2 52***	2.79***	2.08**
Eastern	1.47	1.32	1.32	1 53	1.25
Nyanza	3 48***	2.97***	3.00***	3.37***	2.54***
Rift Valley	1.04	0.84	0.91	0.99	0.73
Western	3 49***	3.18***	3.05***	3 50***	2.82***
Model $LR\chi^2$	88 32	107.10	104.00	149.0	183.8
Model d.f.	6	8	7	16	19
Constant	-3.99(0.18)	-4.18(0.21)	-4.25(0.19	-4.86(0.26)	-5.28(0.28)

Notes: [a] The $LR\chi^2$ values associated with province of residence while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

6.3.2 Maternal education

The estimates of the effect of maternal education on infant mortality, obtained from different models, are presented in Table 6.3. Moderate attenuation in the effect of maternal education occurred when the source of drinking water and toilet facility, and ever-use of contraception were taken into account (compare Models II and III to Model I). This indicates that a modest part of the effect of maternal education on infant mortality was mediated by these three proximate variables. These results are supported by the findings that educated mothers were likely to have access to piped water supply, a toilet facility, and to have access and use health facilities as represented by ever-use of modern contraception (Appendices 6.29 and 6.30).

Similarly, the effect of maternal education on infant mortality was reduced when maternal factors were taken into account. The reduction was greater among infants of the second and higher birth order. This is because more proximate variables were taken into account in the analysis of second and higher order births than when all the infants were considered. The detailed results given in Model VI of Appendix 6.18 do not provide evidence that maternal education influenced infant mortality through birth intervals. They show that the effect of maternal education on infant mortality was increased rather than decreased when the preceding birth interval was taken into account.

The results show that maternal education was negatively associated with birth intervals (Appendices 6.27 and 6.28). This could be because mothers with at least secondary education marry late and because of this they would like to have their desired number of children as quickly as possible so as to avoid the elevated risks of maternal, infant and child mortality associated with child bearing at an advanced age. In addition, they may want to avoid other social and economic problems associated with child bearing and child care at an advanced age. For example, the compulsory retirement age for civil servants in Kenya is 55 years; so most educated and working mothers would want to have all their children educated long before they attain the compulsory retirement age.

Furthermore, an inverse relationship exists between maternal education and mean duration of breastfeeding, postpartum amenorrhoea and postpartum abstinence in Kenya (NCPD, 1989: 15-16). Breastfeeding and postpartum abstinence are usually positively associated with birth intervals. Breastfeeding through assisting to delay ovulation, lengthens the birth interval. Similarly, postpartum abstinence lengthens the birth interval through preventing conception from taking place.

As seen in Model V of Table 6.3, the differences in the odds of infant mortality by maternal education categories persisted even after all the proximate variables were taken into account. A statistical test showed that none of all the parameter estimates of the effects of maternal education on infant mortality obtained in each of the controlled models was significantly different at the 5 per cent level from those in the gross effect model (Model I of Table 6.3). These results show that the birth order, maternal age at birth, birth intervals and survival status of the previous child were not the link between maternal education and child mortality. However, the fact that the effect of maternal education was moderately attenuated when access to piped water, toilet facility and ever-use of contraception were taken into account shows that these were some of the mechanisms through which maternal education influenced infant mortality.

Table 6.3 **Odds ratios and likelihood chi-square values indicating the effect of maternal education on infant mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS**

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 18345)		
$LR\chi^2$ [a]	77.76	52.63	54.21	66.92	34.23
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Maternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1.59***	1.51***	1.49**	1.51**	1.36*
None	2.40***	2.14***	2.13***	2.28***	1.87***
Model $LR\chi^2$	77.76	96.50	94.90	115.80	146.4
Model df	2	4	3	7	10
Constant	-3.33(0.11)	-3.39(0.12)	-3 45(0.11)	-3.99(0.16)	-3.59(0 13)
			Second and higher order births (n = 14951)		
$LR\chi^2$ [a]	59.43	45.76	44.61	38.76	24.00
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Maternal education					
Secondary+	1.00	1.00	1.00	1.00	1.00
Primary	1.66***	1.59***	1.58**	1.52**	1.42*
None	2.47***	2.29***	2.27***	2.15***	1.88***
Model $LR\chi^2$	59.43	65.30	66.10	370.50	380.60
Model df	2	4	3	10	12
Constant	-3.41(0.14)	-3.45(0.14)	-3.48(0.14)	-3.99(0.17)	-4.11(0.17)

Notes: [a] The $LR\chi^2$ values associated with maternal education while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors. Secondary+ stands for at least secondary education.

Source: Primary analysis of the 1988/89 KDHS data.

Table 6.4 presents the estimates of the effect of maternal education on child mortality. As in the case of infant mortality, the effect of maternal education was moderately attenuated when the household's source of drinking water, toilet facility, and ever-use of modern contraception were each taken into account (Models II and III compared to Model I of Table 6.4). Maternal education apparently influenced child mortality, albeit moderately, through access to safe drinking water, a toilet facility and access to and use of health services as represented by ever-use of modern contraception. As pointed out earlier, educated women were more likely than uneducated women to have access to piped drinking water, to have a toilet facility in their households and to use health facilities. Furthermore, with respect to access and use of health facilities, educated women are more likely to be listened to by health personnel, and they are more capable of demanding their attention (Caldwell, 1984: 108).

No evidence supports the hypothesis that maternal education operated through maternal factors to influence child mortality (Table 6.4). Virtually no change occurred in the effect of maternal education on child mortality when maternal factors were taken into account (Model IV compared to Model I). As in the case of infant mortality, the detailed results showed in Appendix 6.19 provide no evidence that maternal education influenced child mortality through the birth intervals. These results are consistent with those obtained by Cleland and van Ginneken (1989: 83) and Hobcraft, (1993: 163) but inconsistent with those found in Mexico (Bodadilla *et al.*, 1990: 28).

The effect of maternal education on child mortality was substantially reduced when all the proximate factors were taken into account (Model V). The $LR\chi^2$ value associated with the effect of maternal education on child mortality among children of the second and higher birth orders was reduced from 21.0 to 6.8. In addition, the odds of child mortality for children of uneducated mothers were not significantly different at the 5 per cent level from those for children of mothers with at least secondary education[3]. These results indicate that a combination of proximate factors presented here explains most of the difference in survival levels between ages one and five years. Hence, it can be concluded that access to safe drinking water, a toilet facility, and access to and use of health facilities were some of factors underlying the positive association between maternal education and child survival.

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[3]A similar result was obtained when the reference category was changed to 'no education' since it had a larger number of cases than in the 'least secondary education' category.

Table 6.4 Odds ratios and likelihood chi-square values indicating the effect of maternal education on child mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 12595)		
$LR\chi^2$ [a]	37.55	21.32	21.60	41.93	15.93
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.01	< 0.001	< 0.05
Maternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1.93**	1.77**	1.71**	1.96**	1.66*
None	2.86**	2.37***	2.33***	3.06***	2.18***
Model $LR\chi^2$	37.55	58.70	55.00	59.8	83.60
Model d.f.	2	4	4	7	10
Constant	-4.04(0.21)	-4.12(0.21)	-4.21(0.21)	-4.15(0.22)	-4.36(0 22)
			Second and higher order births (n = 9243)		
$LR\chi^2$ [a]	21.02	11.83	10.32	22.01	6.76
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.01	< 0.001	< 0.05
Maternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1.52	1.41	1.32	1.55	1.27
None	2.30**	1.93*	1.80*	2.39**	1.65
Model $LR\chi^2$	21.02	34.40	38.30	85.2	114 80
Model d.f.	2	3	4	10	15
Constant	-3.82(0.25)	-3.92(0.26)	-4.01(0.26)	-4.67(0.30)	-5.01(0 32)

Notes: [a] The $LR\chi^2$ values associated with maternal education while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

6.3.3 Paternal education

The effect of paternal education was moderately attenuated when the household's source of drinking water and whether it had a toilet facility were taken into account (Model II of Table 6.5). However, the effect of paternal education on infant mortality that was mediated through these proximate variables was not statistically significant because the estimates (coefficients) of effects of paternal education were not significantly different at the 5 per cent level from those in the corresponding gross model (Model I).

Similarly, the effect of paternal education on infant mortality was moderately reduced when ever-use of modern contraception was taken into account (Model III of Table 6.5). Again, none of the estimates obtained under Model III was significantly different from those in the corresponding gross effects model. It can therefore be argued that not much of the effect of paternal education on infant and child mortality was mediated through access to and use of health services as represented by ever-use of modern contraception or access to and use of piped drinking water and toilet facility. However, the effect of paternal education was moderately attenuated when all maternal factors were taken into account. The survival status of the preceding child was the main underlying factor (Appendix 6.13). Hence, these results suggest that a small proportion of the effect of paternal education was mediated by maternal factors (Compare Model IV to Model I of Table 6.5).

The effect of paternal education on infant mortality was only moderately reduced when all the proximate variables were taken into account. Although the $LR\chi^2$ values show a comparatively large attenuation in its effect on infant mortality, the odds ratios shown in Model V were not significantly different at the 5 per cent level from those in the corresponding gross effects model. Hence, it can be concluded that these results do not provide sufficient evidence of a substantial effect of paternal education on infant mortality being mediated through the proximate variables considered here.

Table 6.5 Odds ratios and likelihood chi-square values indicating the effect of paternal education on infant mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
		All births (n = 18345)			
$LR\chi^{2}$[a]	55.03	35.31	38.28	48.48	24.22
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Paternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1.40***	1.32***	1.32**	1.36**	1.23*
None	1.95***	1.74**	1.77***	1.90***	1.60***
Model $LR\chi^2$	55.03	88.20	78.90	97.40	136 50
Model df	2	4	3	7	10
Constant	-3.09(0.07)	-3.184(0.08)	-3.26(0.08)	-3.25(0 09)	-3 46(0 10)
		Second and higher order births (n = 14951)			
$LR\chi^{2}$[a]	45.14	34.11	33 89	38.68	18.49
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Paternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1 49***	1.43***	1.42**	1 39**	1.30*
None	2.01***	1.87***	1.86***	1.81***	1.62***
Model $LR\chi^2$	45.14	53.60	55.40	364.40	375.50
Model df	2	4	3	10	13
Constant	-3 16(0.08)	-3.24(0.10)	-3.28(0.09)	-3 81(0 12)	-3.46(0.10)

Notes: [a] The $LR\chi^2$ values associated with paternal education while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

As in the case of infant mortality, the effect of paternal education on child mortality was reduced when the household's source of drinking water, existence of a toilet facility in the household, and ever-use of modern contraception were each taken into account (Compare Model II and Model III to Model I of Table 6.6). This indicates that a modest effect of paternal education was mediated by access to safe drinking water, a toilet facility, and health facilities.

Unlike the case of infant mortality, the effect of paternal education on child mortality was slightly increased when maternal factors were taken into account (Model IV). This implies that paternal education influenced child mortality independently of the maternal factors. However, the effect of paternal education, as represented by $LR\chi^2$, was substantially reduced when all the proximate variables were taken into account. Similarly, the odds ratios were reduced, although they were not significantly different from those in the corresponding gross effects model. This indicates that a modest effect of paternal education on child mortality was mediated through the proximate variables.

However, access to piped drinking water, toilet facility and ever-use of modern contraception were some of the underlying factors. It is clear from the Appendices 6.30 to 6.32 that households in which husbands were educated were likely to have access to piped drinking water, toilet facility and health facilities. Since education is the main pre-requisite for employment in the modern sector, educated men are likely to be employed and to have high incomes which can enable them to have houses with piped water and toilets, and to have access to a wide range of health facilities and services.

Table 6.6 **Odds ratios and likelihood chi-square values indicating the effect of paternal education on child mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS**

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 18345)		
$LR\chi^2$ [a]	23.57	12.29	14.18	27.01	10.27
d.f.	2	2	2	2	2
p	< 0.001	< 0. 001	< 0.001	< 0.001	< 0 01
Paternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1.19	1.08	1.17	1.23	1.03
None	1.84**	1.53**	1.55**	1.96***	1.45*
Model $LR\chi^2$	23.57	49.70	47.60	44.90	78.30
Model df	2	4	3	7	15
Constant	-3.52(0.11)	-3.67(0.12)	-3.77(0.12)	-3.64(0.13)	-3.97(0.15)
			Second and higher order births (n = 14951)		
$LR\chi^2$ [a]	16.19	8.99	8 76	18.39	6 46
d.f.	2	2	2	2	2
p	< 0.001	< 0. 02	< 0.02	< 0.001	< 0 05
Paternal education					
Secondary	1.00	1.00	1.00	1.00	1.00
Primary	1.32	1.22	1.17	1.38	1.16
None	1.89***	1.63**	1.58**	2.02***	1.51*
Model $LR\chi^2$	16.19	31.50	27.80	81.00	114.60
Model d.f.	2	4	3	11	14
Constant	-3.56(0.14)	-3 71(0 16)	-3.83(0.18)	-4.49(0.23)	-4 87(0.25)

Notes: [a] The $LR\chi^2$ values associated with paternal education while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data

6.3.4 Household economic status

The effect of household economic status on infant mortality was moderately diminished when household's source of drinking water and whether it had a toilet facility were taken into account (compare Models II with Model I of Table 6.7). A moderate attenuation in the odds of infant mortality for children from households of low or medium economic status relative to those of children from households of high economic status is also evident. A similar pattern is observed in relation to child mortality (Table 6.8). These results indicate that access to safe drinking water and toilet facility were some of the mechanisms that link household economic status and child survival. However, the differences in the estimates of the effect of household economic status on both infant and child mortality obtained in the gross effects models and those in the corresponding controlled models were not statistically significant (Models II and I of Tables 6.7 and 6.8). This therefore indicates that not much of the effect of household economic status on both infant and child mortality was mediated through these two variables.

The effect of household economic status on both infant and child mortality was moderately decreased when ever-use of modern contraception was taken into account (Model III of Table 6.7 and 6.8). Similarly, the effect of household economic status on infant mortality was attenuated when maternal factors were controlled for (Model IV of Table 6.7). Thus ever-use of contraception was one of the underlying factors. The results in appendices 6.30 to 6.32 show a positive association between ever-use of modern contraception and household economic status.

However, the effect of household economic status on child mortality remained virtually unchanged when maternal factors were taken into account, indicating that household economic status influenced child mortality independently of the maternal factors. The effect of household economic status on both infant and child mortality was only moderately reduced when all the proximate variables were taken into account (compare Model V to Model I of Tables 6.7 and 6.8). However, the parameter estimates were not significantly different at the 5 per cent level from those in the corresponding gross effects model. In spite of the lack of statistical significance in the difference between the two estimates, the fact that the odds ratios were moderately decreased when all the proximate variables were taken into account indicates that some effect of the household economic status on infant and child mortality was mediated through these proximate variables, particularly through access to safe drinking water, toilet facility, and access to and use of health facilities as represented by ever-use of modern contraception.

Table 6.7 Odds ratios and likelihood chi-square values indicating the effect of household economic status on infant mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 18345)		
$LR\chi^{2}$ [a]	66.43	37.96	44.54	61.78	27.71
d.f.	2	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.05
Household economic status					
High	1.00	1.00	1.00	1.00	1.00
Medium	1.42***	1.35***	1.52***	1.38***	1.27*
Low	1.97***	1.76***	1.77***	1.92***	1.62**
Model $LR\chi^2$	66.43	81.80	85.20	109.70	147.50
Model d.f.	2	4	3	7	10
Constant	-3.15(0.07)	-3.18(0.08)	-3.30(0.08)	-3.34(0.09)	-3.47(0.10)
			Second and higher order births (n = 14951)		
$LR\chi^{2}$ [a]	59.13	42.51	44.58	45.13	27.92
d.f.	2	2	2	2	1
p	< 0.001	< 0.001	< 0.001	< 0.001	<0.001
Household economic status					
High	1.00	1.00	1.00	1.00	1.00
Medium	1.49***	1.49**	1.46***	1.45***	1.40**
Low	2.09***	1.98***	1.95***	1.93***	1.78***
Model $LR\chi^2$	59.13	62.00	66.00	377.30	496.90
Model d.f.	2	4	3	9	16
Constant	-3.23(0.09)	-3.25(0.09)	-3 33(0.09)	-3.91(0.13)	-3 99(0.14)

Notes: [a] The $LR\chi^2$ values associated with household economic status while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of 1988/89 KDHS data.

Table 6.8 Odds ratios and likelihood chi-square values indicating the effect of household economic status on child mortality, adjusted for proximate variables, Kenya: 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF& HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 12595)		
$LR\chi^2$ [a]	35.67	16.07	20.84	34.84	10.62
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01
Household economic status					
High	1.00	1.00	1.00	1.00	1.00
Medium	1.46**	1.33	1.32	1.45**	1.24
Low	2.12***	1.75***	1.81***	2.11***	1.58**
Model $LR\chi^2$	35.67	53.30	54.20	48.30	78.3
Model d.f.	2	4	3	7	10
Constant	-3.72(0.12)	-3.78(0.13)	-3.94(0.13)	-3.84(0.14)	-4.16(0.10)
			Second and higher order births (n = 9234)		
$LR\chi^2$ [a]	27.09	14.13	16.01	28.50	9.59
d.f.	2	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001	<0.01
Household economic status					
High	1.00	1.00	1.00	1.00	1.00
Medium	1.30*	1.21	1.18	1.34	1.16
Low	2.04***	1.74***	1.72***	2.21***	1.59**
Model $LR\chi^2$	27.09	36.70	44.00	81.60	119.40
Model d.f.	2	3	3	9	14
Constant	-3.64(0.14)	-3.70(0.15)	-3.89(0.16)	-4.54(0.23)	-4.86(0.25)

Notes: [a] $LR\chi^2$ values associated with household economic status while Model $LR\chi^2$ are values due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

6.3.6 Mother's current work status

Mother's work status had significant gross effects on infant and child mortality (Model I of Tables 6.9 and 6.10). Children of non-working mothers were at significantly higher risk of infant and child mortality than the children of working mothers. The effect of mother's work status on infant and child mortality was reduced when both household's source of drinking water and whether it had a toilet facility were taken into account. A similar reduction in the effect on infant and child mortality occurred when ever-use of modern contraception was taken into account. However, in the case of child mortality, the effect of mother's work status was no longer significant at the 5 per cent level among children of second and higher birth order (Model III and IV of Table 6.10). Mothers who were in paid work were more likely than non-working mothers to have access to piped water supply, a toilet facility and health services (Appendices 6.30 to 6.32).

Similarly, part of the effect of mother's work status on infant mortality was mediated through some of the maternal factors, particularly the survival status of the preceding child, as indicated by the attenuation of its effect on infant mortality when the maternal factors were taken into account (Model IV of Table 6.9). However, the effect of mother's work status on child mortality remained virtually unchanged when maternal factors were added to the model (Model IV of Table 6.10). This indicates that mother's work status influenced child mortality independently of maternal factors.

However, the effect of mother's work status on infant and child mortality was substantially reduced when all the proximate variables were taken into account. In the case of child mortality, its effect was no longer statistically significant at the 5 per cent level. Hence, it can be argued that the effect of mother's work status on infant mortality was partly mediated through these proximate variables. However, its effect on child mortality was mediated mainly through access to safe drinking water and a toilet facility and access to health services.

Table 6.9 Odds ratios and likelihood chi-square values indicating the effect of mother's work status on infant mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 18345)		
$LR\chi^{2a}$	26.18	15.88	16.38	20.36	8.86
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01
Mother's work status					
Working	1.00	1.00	1.00	1.00	1.00
No	1.80***	1.61***	1.61***	1.69***	1.44**
Model $LR\chi^2$	26.19	59.70	57.00	69.30	121.00
Model d.f.	1	3	2	6	9
Constant	-3.28(0.12)	-3.34(0.12)	-3.44(0.12)	-3.43(0.12)	-3.60(0.13)
			Second and higher order births (n = 14951)		
$LR\chi^{2a}$	17.07	11.11	11.44	10.03	5.02
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.01	< 0.05
Mother's work status					
Working	1.00	1.00	1.00	1.00	1.00
No	1.69***	1.56***	1.56***	1.52***	1.36*
Model $LR\chi^2$	17.07	30.60	32.90	341.70	361.60
Model d.f.	1	3	2	9	12
Constant	-3.24(0.13)	-3.30(0.14)	-3.37(0.13)	-3.89(0.16)	-4.02(0.17)

Notes: [a] $LR\chi^2$ values associated with mother's work status while Model $LR\chi^2$ are values due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Table 6.10 Odds ratios and likelihood chi-square values indicating the effect of mother's work status on child mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
			All births (n = 12595)		
$LR\chi^2$ [a]	13.45	6.53	7.31	12.41	3.95
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	<0.001	> 0.05
Mother's work status					
Working	1.00	1.00	1.00	1.00	1.00
No	1.89***	1.59*	1.62**	1.85***	1.45
Model $LR\chi^2$	13.45	44.00	40.70	25.90	71.60
Model d.f.	1	3	2	6	9
Constant	-3.83(0.18)	-3.92(0.18)	-4.08(0.18)	-3.93(0.19)	-4.20(0.20)
			Second and higher births (n = 9234)		
$LR\chi^2$ [a]	4.76	1.81	1.77	4.21	0.58
d.f.	1	1	1	1	1
p	< 0.05	> 0.10	> 0.20	< 0.05	> 0.20
Mother's work status					
Working	1.00	1.00	1.00	1.00	1.00
No	1.55*	1.33	1.32	1.52*	1.18
Model $LR\chi^2$	4.76	24.30	29.80	67.40	110.40
Model d.f.	1	3	2	11	14
Constant	-3.63(0.21)	-3.73(0.21)	-3.91(0.22)	-4.47(0.27)	-4.87(0.29)

Notes: [a] $LR\chi^2$ values associated with mother's work status while Model $LR\chi^2$ are values due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

6.3.6 Possession of livestock

As indicated earlier, no further analysis was carried out on the effect of possession of livestock on child mortality since it had no statistically significant gross effect on child mortality. Hence, the analysis presented here relates only to the effect of possession of livestock on infant mortality. The estimates obtained from various models are presented in Table 6.11. The results show that when all the births were considered, the effect of possession of livestock on infant mortality was strengthened instead of being decreased in all the alternative models fitted. Among second and higher order births the effect of possession of livestock was only slightly attenuated when maternal factors were taken into account. It appears that the effect of possession of livestock on infant mortality was independent of household's environmental conditions, ever-use of modern contraception, and maternal factors. In fact, its effect was independent of all the proximate variables considered here (Model V of Table 6.11).

Table 6.11 Odds ratios and likelihood chi-square values indicating the effect of possession of livestock on infant mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
All births (n = 18345)					
$LR\chi^2$ [a]	28.80	38.46	33.21	31.39	40.71
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Possession of livestock					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.44***	1.54***	1.48***	1.47***	1.57***
Model $LR\chi^2$	28.80	82.30	73.90	79.60	152.90
Model d.f.	1	3	2	6	9
Constant	-2.84(0.04)	-3.13(0.07)	-3.16(0.07)	-3.08(0.04)	-3.51(0.09)
Second and higher order births (n = 14951)					
$LR\chi^2$ [a]	25.68	32.71	28.43	20.79	25.40
d.f.	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Possession of livestock					
Yes	1.00	1.00	1.00	1.00	1.00
No	1.47***	1.57***	1.51***	1.43***	1.50***
Model $LR\chi^2$	25.68	52.80	49.90	352.50	382.00
Model d.f.	1	3	2	9	12
Constant	-2.86(0.04)	-3.12(0.07)	-3.11(0.07)	-3.63(0.11)	-3.98(0.13)

Notes: [a] $LR\chi^2$ values associated with possession of livestock while Model $LR\chi^2$ are values due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

6.3.7 Place of residence

Since place of residence had no statistically significant gross effect on infant mortality among infants of the second and higher order births, the results presented here are limited to all infants. Similarly, no further analysis is presented here on the effect of place of residence on child mortality. It had no significant gross effect on child mortality.

The estimates of the effects of place of residence on infant mortality obtained under different models are presented in Table 6.12. Place of residence was no longer significantly related to infant mortality once the household's source of drinking water and toilet facility were taken into account. The odds of infant mortality of rural children were no longer significantly greater than those of urban children. This indicates that the infant survival advantage of urban children over rural children completely disappeared when household's source of drinking water and whether it had a toilet facility were taken into account. Households in urban areas were more likely than those in rural areas to have access to safe drinking water (Appendices 6.30 and 6.32). Hence, it can be concluded that the observed gross effect of place of residence on infant mortality was a function of household environmental conditions and that whether an infant lived in an urban or rural areas was not important in determining infant mortality.

Table 6.12 Odds ratios and likelihood chi-square values indicating the effect of place of residence on infant mortality, adjusted for proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HTF & HWA (Model II)	Adjusted for USE (Model III)	Adjusted for MATF (Model IV)	Adjusted for PROX (Model V)
		All births (n = 18345)			
$LR\chi^2$ [a]	5.24	0.00	1.47	3.21	0.16
d.f.	1	1	1	1	1
p	< 0.05	> 0.95	> 0.20	> 0.05	> 0.50
Place of residence					
Urban	1.00	1.00	1.00	1.00	1.00
Rural	1.21*	1.00	1.11	1.17	0.96
Model $LR\chi^2$	5.24	43.90	42.10	51.30	112.3
Model d.f.	1	3	2	6	9
Constant	-2.90(0.08)	-2.95(0.08)	-3.12(0.09)	-3.08(0.09)	-3.29(0.10)

Notes: [a] The $LR\chi^2$ values associated with place of residence only while Model $LR\chi^2$ are the values due to all variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility, USE for ever-use of modern contraception, MATF for maternal factors and PROX stands for all the proximate variables. The numbers in the parentheses are the standard errors.
Source: Primary analysis of the 1988/89 KDHS data.

6.4 Net effects of socioeconomic factors

The manner in which the effects of various explanatory variables considered singly are mediated through other explanatory variables and proximate determinants of mortality was investigated in the Chapter Five and the preceding Section 6.3. It is now time to integrate all these partial investigations and explanations into single analytical models, one each for infant and child mortality. The results are presented in Model IV of Table 6.13 for infant mortality and Model IV of Table 6.14 for child mortality. Tables 6.13 and 6.14 also present the effects of each of the socioeconomic factors when either other socioeconomic factors (SOCIO) or all proximate variables (PROX) were taken into account.

A greater proportion of the respective effects of the socioeconomic factors such as maternal education, paternal education, household economic status, possession of livestock and mother's current work status on infant mortality was mediated through the other socioeconomic factors in the model than through the proximate variables (compare Model I and II and Model I and III of Table 6.13). The only exception is the province of residence where its effect on infant mortality was reduced more by proximate variables than socioeconomic factors.

Mother's current work status was no longer significantly related to infant mortality once the other socioeconomic factors were taken into account. The analysis in Chapter Five showed that most of the gross effect of mother's current work status on infant mortality was due to the influence of maternal education. Educated mothers were likely to be in paid employment since education was and is still a requisite for employment, particularly in the public sector.

The effects of maternal education, paternal education and mother's status on infant mortality were no longer significant at the 5 per cent level when both other socioeconomic factors and proximate variables were taken into account (Table 6.13). It is important to note that the elimination of the statistically significant effect of maternal and paternal education occurred only when the other socioeconomic variables and the proximate variables were taken into account, implying that the explanations of the effect will be multi-factorial.

Model IV also shows that the respective net effects on infant mortality of province of residence, household economic status and possession of livestock were still significant at the 5 per cent level, though they were considerably reduced. Except for Nairobi province, where infant mortality slightly increased, the provincial differentials in infant mortality were moderately reduced when all the explanatory variables were included in the model (Model IV). This indicates that the provincial differences in infant mortality were mainly independent of the explanatory variables included in this study.

Table 6.13 Odds ratios and likelihood chi-square values indicating the effects of socioeconomic factors on infant mortality, adjusted for other socioeconomic factors and all proximate variables: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for SOCIO (Model II)	Adjusted for PROX (Model III)	Adjusted for SOCIO & PROX (Model IV)
Province	(195.90)***	(159.20)***	(139.10)***	(123.60)***
Central	1.00	1.00	1.00	1.00
Nairobi	1.01	1.23	1.26	1.29
Coast	2.64***	2.07***	2.32***	1.97***
Eastern	1.14	1.07	1.05	1.05
Nyanza	2.54***	2.34***	2.06***	2.08***
R.Valley	0.62***	0.56***	0.56***	0.56***
Western	1.71***	1.62***	1.46**	1.49**
Maternal education	(59.43)***	(6.32)*	(24.00)***	(3.43)
Secondary	1.00	1.00	1.00	1.00
Primary	1.66***	1.25	1.42*	1.17
None	2.47***	1.46*	1.88***	1.33
Paternal education	(45.14)***	(8.37)**	(18.49)***	(5.62)
Secondary	1.00	1.00	1.00	1.00
Primary	1.49***	1.23	1.30**	1.19
None	2.30***	1.43**	1.62***	1.35*
Household status	(59.13)***	(14.35)**	(27.92)***	(11.81)**
High	1.00	1.00	1.00	1.00
Medium	1.49***	1.32*	1.40***	1.33*
Low	2.09***	1.54**	1.78***	1.53**
Possession of livestock	(25.68)***	(11.73)***	(25.56)***	(8.57)**
Yes	1.00	1.00	1.00	1.00
No	1.47***	1.32***	1.50***	1.27**
Work status	(17.07)***	(1.03)	(4.98)*	(0.41)
Yes	1.00	1.00	1.00	1.00
No	1.69***	1.16	1.36*	1.10

Notes: SOCIO included province of residence, household economic status, maternal education, paternal education, possession of livestock and mother's work status only. PROX stands for maternal age at birth, birth order, toilet facility, source of drinking water, preceding birth interval and ever-use of modern contraception. The numbers in the parentheses are the $LR\chi^2$ values for each socioeconomic factor. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. Analysis was based on 14951 live births.

Source: Primary analysis of the 1988/89 KDHS data.

As in the case of infant mortality, a greater proportion of the respective effects of maternal education, paternal education, household economic status and mother's work status on child mortality was mediated through the socioeconomic factors than through the proximate variables (compare Model II and Model III with Model I of Table 6.14). Again, the only exception is province of residence where the effect on child mortality was reduced more by proximate than socioeconomic factors. The respective effects of maternal education and mother's work status on child mortality were no longer significant at the 5 per cent level when the other socioeconomic factors were taken into account. In Chapter Five it was found that educated mothers were more likely than uneducated mothers to marry educated men, to belong to households of high economic status. Educated mothers were more likely than uneducated mothers to be in paid employment. It was found that most of the observed effect of mother's work status on child mortality was due mother's education.

Model IV of Table 6.14 shows that, except for effect of the province of residence, the respective effects of maternal education, paternal education, household economic status and mother's status on child mortality was no longer significant at the 5 per cent level. The effect of the province of residence on child mortality was moderately reduced when all the explanatory factors were taken into account. As in the case of infant mortality, Nairobi province was the only exception; the difference in child mortality between Nairobi and Central province was slightly increased. These results imply that the explanatory variables included in this study can adequately explain the respective effects of maternal education, paternal education, household economic status and mother's work status on child mortality. However, the provincial differentials in child mortality were, by and large, independent of the explanatory variables included here.

Table 6.14 **Odds ratios and likelihood chi-square values indicating the effects of socioeconomic factors on child mortality, adjusted for other socioeconomic factors and all proximate variables: Kenya, 1988/89 KDHS**

Explanatory variables	Gross effect (Model I)	Adjusted for SOCIO[a] (Model II)	Adjusted for PROX (Model III)	Adjusted for SOCIO & PROX (Model IV)
Province	(88.32)***	(85.38)***	(74.01)***	(77.67)***
Central	1.00	1.00	1.00	1.00
Nairobi	2.04***	2.71***	2.39***	2.65*
Coast	2.84***	2.22***	2.11**	1.77**
Eastern	1.47	1.34	1.25	1.24
Nyanza	3.48***	3.19***	2.54***	2.61***
R Valley	1.04	0.91	0.73	0.71
Western	3.49***	3.31***	2.82***	2.91***
Maternal education	(21.02)***	(4.28)	(6.76)*	(2.93)
Secondary	1.00	1.00	1.00	1.00
Primary	1.52	·1.24	1.27	1.16
None	2.30**	1.56	1.65	1.42
Paternal education	(16.19)***	(6.20)*	(6.46)*	(5.36)
Secondary	1.00	1.00	1.00	1.00
Primary	1.32	1.07	1.16	1.09
None	1.89***	1.46*	1.51*	1.45
Household status	(27.09)***	(9.38)**	(9.59)**	(4.28)
High	1.00	1.00	1.00	1.00
Medium	1.30***	1.16	1.16	1.14
Low	2.04***	1.58**	1.59*	1.41
Work status	(4.76)*	(0.24)	(0.58)	(0.00)
Yes	1.00	1.00	1.00	1.00
No	1.55*	1.13	1.18	1.03

Notes: [a] SOCIO included province of residence, maternal education, paternal education, household economic status and mother's work status only. PROX included maternal age at birth, birth order, toilet facility, source of drinking water, preceding birth interval, succeeding birth interval and ever-use of modern contraception. The numbers in the parentheses are the LRχ^2 value for each socioeconomic factor. *Significant at $p < 0.05$. **Significant at $p < 0.01$, ***Significant at $p < 0.001$. Analysis was based on 9234 second order births who survived infancy.

Source: Primary analysis of the 1988/89 KDHS data.

6.5 Final parsimonious models

In this subsection the relative importance of key determinants of the level of infant and child mortality is established through fitting parsimonious logit models. Year of birth was included in these analyses in order to control for any trend in infant and child mortality. The results of analysis of infant mortality are presented in Table 6.15 and those for child mortality in Table 6.16.

The province of residence emerged as the most important factor influencing both infant and child mortality in Kenya (Tables 6.15 and 6.16). Residence in Coast, Western and Nyanza provinces was consistently associated with higher risks of infant and child mortality than residence in Central, Nairobi and Rift Valley provinces. These results are consistent with results previous studies (Mott, 1979: 25; Muganzi, 1984: 76-111; Ewbank *et al.*, 1986: 42-47; Kichamu, 1986: 62-130).

The survival status of the preceding child was the second most significant factor affecting infant mortality, but it had an insignificant effect on child mortality in the final model. Children of mothers whose previous child had died in infancy were at a significantly greater risk of infant mortality; they were three times as likely to die in infancy as the children born to mothers without such a history. These results show a strong intra-family mortality correlation during infancy among successive births. Therefore, a mother who had lost her previous child in infancy was likely to lose her next child in infancy as well. These results are in agreement with other studies which have found an intra-family mortality relationship in infancy (Gubhaju, 1984: 134; Hull and Gubhaju, 1986: 109-118; Majumder, 1989: 132-178; Ebong, 1993: 12).

Tables 6.15 and 6.16 show that birth intervals were significantly and negatively associated with both infant and child mortality. A preceding birth interval of less than 36 months was associated with significantly higher infant and child mortality risks than birth intervals of at least 36 months. The effect of a badly spaced subsequent birth also had a devastating effect on the survival of the older child between ages one and five years; when the subsequent birth occurred before the first child's second birthday, the first child's risk of child mortality was increased by 75 per cent compared to the children born at least 36 months before their younger brothers and sisters. These results show that a subsequent birth interval of less than 24 months had serious negative effects on the survival chances of both children, with the younger of the pair suffering the heavier impact, as reflected by the higher odds of dying among children with shorter preceding birth intervals than for similar succeeding birth intervals.

Table 6.15 Parsimonious logit linear model[4] of the factors affecting infant mortality: Kenya, 1988/89 KDHS

Explanatory variable	Log odds	$LR\chi^2$	d.f.	P	Odds ratio	Number of cases
Province of residence		132.15	6	< 0.001		
Central	0.00				1.00	2743
Nairobi	0.26(1.29)				1.30	989
Coast	0.71(5.22)***				2.03	1542
Eastern	0.09(0.60)				1.09	1976
Nyanza	0.79(6.69)***				2.20	2897
Rift Valley	-0.53(-3.17)**				0.59	2346
Western	0.43(3.36)***				1.54	2458
Survival status of preceding child		124.80	1	< 0.001		
Alive	0.00				1.00	13988
Dead	1.13(12.02)***				3.09	983
Preceding birth interval		88.42	2	< 0.001		
< 24	0.82(8.23)***				2.27	5406
24-35	0.28(2.62)**				1.32	5720
36+	0.00				1.00	3125
Household economic status		21.02	1	< 0.001		
High	0.00				1.00	3380
Medium	0.35(3.05)**				1.42	5855
Low	0.51(4.44)***				1.67	5716
Birth order		14.51	2	< 0.001		
2-3	0.00				1.00	5946
4-5	-0.10(-1.10)				0.90	4384
6+	0.23(2.72)*				1.26	4621
Paternal education		12.76	2	< 0.01		
None	0.42(3.53)**				1.52	3410
Primary	0.26(2.41)**				1.30	8067
Secondary+	0.00				1.00	3474
Possession of livestock		7.76	1	< 0.01		
Yes	0.00				1.00	11672
No	0.23(2.82)**				1.26	3602
Constant	= -4.400, standard error = 0.1719					

Notes: Based on 14951 second and higher order births. Model $LR\chi^2$ = 535.78, 16 d.f. p < 0.001. ***Significant at p < 0.001, **Significant at p < 0.01, *Significant at p < 0.05. The numbers in the parentheses are t-statistics. Secondary+ stands for at least secondary education.

Source: Primary analysis of the 1988/89 KDHS data.

[4]When model fitting was carried out using the automatic forward stepwise procedure of the logistic program of the SPSS for Unix Release 5.0, maternal education, mother's work status, type of place of residence, source of drinking water, toilet facility, maternal age at birth and use of modern contraception were automatically excluded, as they failed the test of inclusion..

Table 6.16 Parsimonious logit linear model[5] of the factors affecting child mortality: Kenya, 1988/89 KDHS

Explanatory variable	Log odds	$LR\chi^2$	d.f.	P	Odds ratio	Number of cases
Province of residence		74.28	6	< 0.001		
Central	0.00				1.00	1773
Nairobi	0.95(3.18)**				2.59	552
Coast	0.69(2.82)**				2.00	925
Eastern	0.24(0.28)				1.27	1255
Nyanza	0.99(4.72)***				2.69	1730
R.Valley	-0.26(-0.96)				0.77	1499
Western	1.05(4.96)***				2.85	1509
Preceding birth interval		32.59	2	< 0.001		
< 24	0.90(5.25)***				2.46	3513
24-35	0.60(3.46)***				1.82	3557
36+	0.00				1.00	2136
Year of birth of the child		23.88	2	< 0.001		
1970-74	0.68(4.76)***				1.97	2404
1975-79	0.44(3.16)**				1.55	3535
1980-83	0.00				1.00	3304
Succeeding birth interval		22.95	2	< 0.001		
< 24	0.53(4.70)***				1.70	3123
24-35	-0.01(-0.03)				0.99	3557
36+	0.00				1.00	2563
Ever-use of contraception		10.33	1	< 0.01		
Yes	0.00				1.00	3383
No	0.43(3.16)**				1.55	5860
Household economic status		9.25	1	< 0.01		
High	0.00				1.00	2034
Medium	0.25(1.37)				1.28	3636
Low	0.50(2.81)**				1.65	3573
Toilet facility		7.78	1	< 0.01		
Yes	0.00				1.00	7855
No	0.42(2.85)**				1.52	1388
Constant	= -5.5207, standard error = 0.3094.					

Notes: Based on 9243 second and higher order births. *Significant at $p < 0.05$, **Signifant at $p < 0.01$, ***Significant at $p < 0.001$. The numbers in the parentheses are the t-statistics values. Model $LR\chi^2 = 196.82$, 18 d.f., $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

[5] An exact version of this model was obtained when model fitting was performed using forward stepwise procedure of the logistic regression program of the SPSS for Unix Release 5.0. A re-check of the model was found necessary because of the unusual result with respect to the net effect of maternal education. Maternal education has been invariably found to be a strong determinant of child survival. However, in this multivariate analysis, its net effect was not statistically significant.

The effects of the birth intervals were not controlled for the possible confounding effect of breast feeding because information on breast feeding was not available for most of the children included this study[6]. It is desirable to control for breast feeding because it affects both child survival and birth interval. However, a recent study based on 17 DHS surveys (data for 17 developing countries) shows that breast feeding has an insignificant impact on the effect of preceding birth interval on child survival (Boerma and Bicego, 1992: 235-248). Similar results have been found elsewhere. For example, in Latin America, Palloni and Millman (1986: 46) showed that controlling for breast feeding had little effect on the strength of the association between birth intervals and infant mortality.

Birth order was significantly related to infant mortality but not to child mortality. Infants of sixth or higher birth order experienced greater mortality risk than those of second to fifth birth orders. The results obtained in Chapter Four show that first-born infants and infants of sixth or higher birth order experienced higher mortality risks than those of the second and third birth order. The results also show that the higher mortality among first-born infants was due to the fact that the majority (65 per cent) were born to mothers under age 20 years, whose children usually experience higher mortality risk.

Household economic status, possession of livestock and paternal education were each significantly related to infant mortality in the final parsimonious model. Similarly, household economic status was significant related to child mortality. Children from poor households were at a significant risk of infant and child mortality. Similarly, children from households that did not keep livestock and whose parents were uneducated were more likely to die in infancy and between ages one and five years than children from better off households or households that had livestock and children born to educated parents.

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[6]Data on breast feeding were available only for live births that occurred between 1983 and 1989, but to avoid trunction effects this analysis excluded most of these births.

Both paternal and maternal education were strongly associated with infant and child mortality in the gross effects model and in the models in which socioeconomic factors were considered without the proximate variables. In the final parsimonious models, only paternal education was significantly associated with infant mortality but not with child mortality. Maternal education was no longer significantly associated with either infant or child mortality. This suggests that most of the mechanisms through which maternal education influenced infant and child mortality were captured by some of the variables included in the final models. Similarly, these results imply that most of the mechanisms through which paternal education influenced child mortality were captured by the factors included in the model.

In a multivariate model without the year of birth of the child, paternal education and maternal age at birth were significantly related to child mortality. However, they were not significantly related to child mortality when the year of birth of the child was included in the model. It can be concluded that the apparent effect of paternal education was due to its increasing prevalence over time, and that of mother's age at birth was also increasing over time. As in the case of infant mortality, the statistical significance of the effect of maternal education on child mortality disappears in the final model[7], which suggests that the mechanisms through which it influenced child mortality were adequately captured by some of the variables included in the model.

Ever-use of modern contraception was the fifth most significant determinant of child mortality. Children whose mothers had never used contraception had odds of dying between ages one and five years 1.5 times higher than those of the children whose mothers had used contraception. Ever-use of contraception was also related to infant mortality in both the gross effects model and the model that included only proximate variables (Table 4.18). These results provide empirical evidence that the use of modern contraception has a beneficial effect on child survival. This result implies

[7] The effect of maternal education on child mortality was also insignificant in a model in which year of birth was not included.

that improvements in child survival prospects in Kenya could be achieved if most women of the reproductive age were to use family planning services.

Having a toilet facility was significantly associated with child mortality but not with infant mortality in the final model. Children from households that did not have a toilet facility experienced a greater risk of child mortality than the children from households that had a toilet facility. In the gross effects models and in models in which only proximate variables were considered, the toilet facility variable was significantly related to both infant and child mortality (Table 4.21). These results imply that significant improvements in child survival prospects would be achieved if most households were to have toilets.

The year of birth of the child was significantly associated with child mortality. Children who were born between 1980 and 1983 were at a significantly lower risk of child mortality than the children who were born in the 1970s. Relative to children born between 1980 and 1983, children born between 1970 and 1974 and those born between 1975 and 1979 had respective odds of child mortality 1.94 and 1.5 times higher. These results indicate a significant improvement in child mortality during the period under review, net of the effects of the socioeconomic explanatory and proximate variables examined in this study. The improvement in child survival could be due to the improving coverage of immunisation, improvements in childhood nutritional status, and improving quality of public and private health services, including malaria and diarrhoeal diseases control programs.

6.6 Conclusion

The chapter has demonstrated that most of the socioeconomic factors considered in this study influenced child survival through a complex web of pathways. The effects of each of the socioeconomic factors that were mediated by the proximate variables were not statistically significant at the 5 per cent level. It is nevertheless likely that a larger sample would have detected more statistically significant differences between estimates of the effects of these socioeconomic factors obtained in controlled models and those in the corresponding gross effects models, even if the differences remained relatively small in size (Gray, 1995: Personal communication).

However, the study identified access to safe drinking water, a toilet facility, and access to and use of health services as mediating some of the gross effects of maternal education, paternal education, household economic status, mother's work status and province of residence on infant and child mortality. Similarly, the study confirmed that the rural infant mortality was slightly higher than urban simply because rural areas were disadvantaged in terms of access to piped water, adequate sanitation and access to and use of health services. Educated mothers, working mothers, mothers whose husbands were educated and mothers resident in urban areas were likely to use health services such as contraception and to belong to households having access to piped water and a toilet facility. The results suggest that the socioeconomic factors influenced child mortality independently of the maternal factors.

Maternal education, paternal education, mother's work status, and place of residence were no longer significantly related to infant mortality when the controls for all the other explanatory variables were introduced. Similarly, all the socioeconomic factors other than the province of residence were no longer significantly related to child mortality once all other explanatory variables were controlled for. It can be concluded that the pathways through which maternal education, paternal education, mother's work status and type of place of residence influenced child survival were adequately captured in this study. The pathways through which possession of livestock influenced infant survival were not evident in this study. Similarly, the major pathways through which the variables embedded in the province of residence variable influenced both infant and child mortality were not captured in this study.

The results obtained showed that the data did not fully support the Mosley and Chen framework. Most of the socioeconomic factors had large effects net of the proximate variables. This is more true of infant mortality than child mortality. Furthermore, in the case of infant mortality some socioeconomic factors had significant net effects even after all the explanatory variables had been taken into account. This suggests that some socioeconomic factors may be having a direct effect on the child's health and thus its risk of dying.

The last part of the chapter showed that the factors that had statistically significant net effects on infant mortality were province of residence, survival status of the preceding child at age one, the length of the preceding birth interval, household economic status, birth order, paternal education and possession of livestock in that order. The factors that had statistically significant net effects on child mortality were province of residence, the length of the preceding and succeeding birth intervals, year of birth of the child, ever-use of modern contraception, and toilet facility.

CHAPTER SEVEN

REGIONAL VARIATIONS IN INFANT AND CHILD MORTALITY

7.1 Introduction

This chapter seeks to establish the extent to which key factors such as maternal education or birth intervals are significant independent predictors of infant and child mortality in the two mortality regions into which the country has been divided for the purpose of this study. Hence it seeks to clarify the relative importance of the key variables as determinants of the level of infant and child mortality in each mortality region. This exercise was carried out by fitting parsimonious logit models.

The chapter has been divided into two parts. The first part examines infant and child mortality differentials according to the selected factors in the low- (LMR) and high-mortality region (HMR). The second part is devoted to establishing the factors that have a statistically significant net effect on infant and child mortality in each mortality region.

7.2 Analytical approach

Ideally, regional analysis of the determinants of infant and child mortality should be performed at the provincial or district level in order to capture some of the salient socioeconomic as well as cultural factors that may be unique to each province or district. However, the numbers of exposed children born between 1970 and 1987 used for the analysis of infant mortality and those born between 1970 and 1983 and who survived infancy used for analysis of child mortality in each of the provinces covered by the 1988/89 KDHS are not large enough to permit unbiased results to be obtained from multivariate analysis.

On the basis of the results presented in Table 5.1 of Chapter Five, the provinces were grouped into two broad mortality groups: the low-mortality (LMR) and high-mortality region (HMR). This was done in order to retain a sufficiently large number of observations in each region. The LMR consists of all the provinces that had infant and child mortality rates below the average national rates. This group comprises Rift Valley, Central, Nairobi and Eastern provinces. The HMR consists of all the provinces that had both infant and child mortality rates that were above the national average rates. This group is composed of Western, Nyanza and Coast provinces. As explained in Chapter Two, the LMR comprises provinces that are socially and economically more developed than the provinces of the HMR. Essentially, the comparison is between the more and the less developed group of provinces.

In fitting final multivariate logit models, the forward selection procedure was used. In this procedure, the explanatory variable that contributed the largest reduction in the scaled deviance was entered first. In the next steps, the remaining variables were entered one by one according to their contribution to the reduction in the scaled deviance. This process was repeated until all the explanatory variables that made significant reductions in the scaled deviance were exhausted[1]. The parsimonious logit models were restricted to second and higher order births because of the inclusion of birth-interval variables. Before parsimonious logit models are discussed, infant and child mortality differentials in the two mortality regions are presented

7.3 Infant and child mortality differentials

7.3.1 Differentials by socioeconomic factors

The mortality rates presented in Tables 7.1 and 7.2 relate to socioeconomic differentials in infant and child mortality, respectively in the two mortality regions. Infant mortality in the HMR was 2.1 times as high in the LMR. The child mortality rate in the HMR was 3.5 times as high as in the LMR. Generally, the socioeconomic differentials in infant and child mortality were more pronounced in the HMR than in the LMR. The largest differentials were in respect of parental education, especially

[1] A 5 or lower per cent level was the criterion for inclusion.

paternal education. Infant mortality was significantly and negatively associated with maternal and paternal education in the HMR only. Maternal and paternal education were significantly associated with child mortality in both mortality region. These differences in the effects of parental education in the two mortality regions may have been due to the influence of community variables such as access to health services and average level of education. Provinces in the LMR had higher levels of education than those in the HMR (Table 2.16). Typically, any individual should experience better health in a community where education level is high. This results partly from the fact that a better-educated community will want and be able to afford (and obtain through political process) better public health, water and sanitation facilities, and partly because better educated individuals and their families will be healthy (O'Hara, 1980: 39).

Infant mortality in both mortality regions was significantly and negatively associated with household economic status. On the basis of the magnitudes of the χ^2 and mortality differentials, the association between household economic status and infant mortality was stronger in the HMR than the LMR. Household economic status was negatively and significantly associated with child mortality in the HMR only. Similarly, possession of livestock was significantly and negatively associated with infant mortality in both mortality regions. On the basis of the size of the χ^2 and the differences in infant mortality levels between the children from households that kept and did not keep livestock, the association was stronger in the HMR than in the LMR. In contrast, possession of livestock was not significantly associated with child mortality in both mortality region.

Table 7.1 Infant mortality rates according to socioeconomic variables and mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR IMR (a)	LMR IMR (b)	Mortality ratio (a)/(b)
Maternal education			
None	**105** (3455)	**41** (4225)	2.56
Primary	**71** (3708)	**41** (6464)	1.73
Secondary	57 (869)	**30** (1479)	1.90
χ^2	= 35.72, d.f. = 2, p < 0.001	χ^2 = 4.12, d.f. = 2, p > 0.10	
Paternal education			
None	**113** (1797)	**45** (2585)	2.51
Primary	**83** (4127)	**36** (6270)	2.30
Secondary	**60** (1189)	**44** (1479)	1.36
χ^2	= 34.36, d.f. = 2, p < 0.001	χ^2 = 5.12, d.f. = 2, p > 0.05	
Mother's current work			
No	**85** (7366)	**40** (10558)	2.13
Working	**65** (627)	**33** (1476)	1.97
χ^2	= 3.35, d.f. = 1, p > 0.05	χ^2 = 2.08, d.f. = 1, p > 0.10	
Household economic status			
Low	**107** (3327)	**45** (4302)	2.38
Medium	**74** (3271)	**41** (4858)	1.80
High	**55** (1422)	**30** (3012)	1.83
χ^2	= 44.17, d.f. = 2, p < 0.001	χ^2 = 12.03, d.f. =2, p < 0.001	
Possession of livestock			
No	**105** (2070)	**50** (2716)	2.10
Yes	**77** (5960)	**37** (9455)	2.08
χ^2	= 14.52, d.f. = 1, p < 0.001	χ^2 = 9.56, d.f. = 1, p < 0.01	
Type of place of residence			
Rural	**86** (7112)	**40** (10848)	2.15
Urban	**68** (929)	**40** (1332)	1.70
χ^2	= 3.74, d.f. = 1, p > 0.05	χ^2 = 0.01, d.f. = 1, p > 0.95	
Total	**84** (8042)*	**40**(12180)*	2.10

Notes: The rates are per 1000 live births that occurred between 1970 and 1987. * Some of the cases in the brackets do not add up to this total because of missing cases. Multiple births were excluded in both cohorts. The numbers in the parentheses are the weighted number of exposed births.

Source: Primary analysis of the 1988/89 KDHS data.

Table 7.2 Child mortality rates according to socioeconomic variables and mortality regions: Kenya, 1988/89 KDHS

Explanatory variable	HMR	LMR	
	CMR (a)	CMR (b)	Mortality ratio (a)/(b)
Maternal education			
None	85 (2464)	24 (3277)	3.54
Primary	51 (2413)	17 (4369)	3.00
Secondary	40 (471)	14 (857)	2.86
χ^2	= 28.72, d.f. = 2, p < 0.001	χ^2 = 6.31, d.f. = 2, p < 0.05	
Paternal education			
None	102 (1251)	28 (1991)	3.64
Primary	60 (2847)	16 (4524)	3.75
Secondary	43 (1189)	20 (1615)	2.15
χ^2	= 36.3,1 d.f. = 2, p < 0.001	χ^2 = 9.17, d.f. = 2, p < 0.02	
Mother's current work			
No	69 (4895)	20 (7349)	3.45
Working	34 (434)	18 (1039)	1.89
χ^2	= 9.26, d.f. = 1, p < 0.01	χ^2 = 0.11, d.f. = 1, p > 0.70	
Household economic status			
Low	88 (2265)	21 (3048)	4.19
Medium	55 (2129)	20 (3398)	2.75
High	37 (956)	16 (2062)	2.31
χ^2	= 35.42, d.f. = 2, p < 0.001	χ^2 = 1.38, d.f. = 2, p > 0.20	
Possession of livestock			
No	73 (1379)	19 (1858)	3.84
Yes	63 (3971)	19 (6652)	3.32
χ^2	= 1.54, d.f. = 1, p > 0.20	χ^2 = 0.03, d.f. = 1, p > 0.70	
Type of place of residence			
Rural	68 (4768)	18 (7181)	3.78
Urban	49 (588)	27 (1332)	1.81
χ^2	= 3.10, d.f. = 1, p > 0.05	χ^2 = 2.95, d.f. = 1, p > 0.05	
Total	66 (5356)*	19 (8513)*	3.47

Notes: The rates are per 1000 children born between 1970 and 1983 who survived infancy. *Some of the cases in the brackets do not add up to this total because of missing cases. Multiple births were excluded in the cohorts. The numbers in the parentheses are the weighted number of exposed children.

Source: Primary analysis of the KDHS 1988/89 data.

Mother's work status was not significantly associated with infant mortality rates in both mortality region, although in both mortality regions infant mortality rates were slightly lower among children whose mothers were currently in paid work. However, mother's work status was significantly associated with child mortality in the HMR but not in the LMR. In the HMR, the child mortality rate among children whose mothers were in paid work was lower than that of the children whose mothers were not in paid work. At the population level, that is when all weighted exposed births were considered in the analysis, place of residence was not significantly associated with infant and child mortality in both mortality region.

7.3.2 Differentials by proximate variables

Tables 7.3 and 7.4 set out respective infant and child mortality differentials according to the selected proximate variables. In the LMR, the survival status was significantly associated with infant and child mortality. Children whose preceding sibling had died in infancy experienced a higher risk of infant and child mortality than the children whose preceding sibling survived infancy. In contrast, in the HMR, survival status of the preceding sibling at age one was significantly associated with infant mortality only. As in the case of the LMR, children whose preceding sibling had died in infancy experienced greater risk of dying in infancy than children whose preceding sibling survived infancy.

The length of the preceding birth interval was significantly and negatively associated with both infant and child mortality in both mortality regions. Infant mortality differentials with respect to the preceding birth interval were somewhat larger in the HMR than in the LMR. For example, in the HMR, the infant mortality rate among children with a preceding birth interval of less than 24 months was 2.4 times as high as the rate among children with a preceding birth interval of at least 36 months. In the LMR the corresponding rate was 2.2 times as high. However, child mortality differentials to respect with the preceding birth interval were larger in the LMR than in the HMR.

Table 7.3 Infant mortality rates according to proximate variables and mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR IMR (a)	LMR IMR (b)	Mortality ratio (a)/(b)
Survival of preceding child			
Dead	216 (577)	144 (433)	1.50
Alive	71 (6043)	32 (9372)	2.22
χ^2	= 108.49, d.f. = 1, p < 0.001	χ^2 = 89.45, d.f. = 1, p < 0.001	
Preceding birth interval			
< 24	121 (2422)	50 (3367)	2.42
24-35	70 (3038)	35 (3831)	2.00
36+	50 (1706)	23 (2607)	2.17
χ^2	= 75.85, d.f. = 2, p < 0.001	χ^2 = 31.11, d.f. = 2, p < 0.001	
Maternal age at birth			
< 19	93 (1655)	49 (2286)	1.90
20-29	80 (4433)	37 (6807)	2.16
30+	86 (1954)	38 (3088)	2.26
χ^2	= 2.70, d.f. = 2, p > 0.10	χ^2 = 6.07, d.f. = 2, p < 0.05	
Birth order			
1	86 (1422)	51 (2375)	1.69
2-3	81 (2449)	35 (1422)	2.31
4-5	77 (1916)	33 (2893)	2.33
6+	92 (2254)	43 (2912)	2.14
χ^2	= 3.48, d.f. = 3, p > 0.10	χ^2 = 14.60, d.f. = 3, p < 0.01	
Source of drinking water			
Other	87 (6438)	42 (8782)	2.07
Piped	74 (1595)	33 (3381)	2.24
χ^2	= 4.80, d.f. =1, p < 0.05	χ^2 = 2.83, d.f. =1, p > 0.05	
Toilet facility			
None	116 (1633)	51 (1694)	2.27
Available	76 (6405)	38 (10469)	2.00
χ^2	= 24.65, d.f. = 1, p < 0.001	χ^2 = 6.68, d.f. = 1, p < 0.01	
Ever-use of contraception			
Never	94 (5950)	40 (4512)	2.35
Yes	57 (2092)	39 (7669)	1.46
χ^2	= 29.75, d.f. = 1, p < 0.001	χ^2 = 0.18, d.f. = 1, p > 0.70	
Total	84 (8042)*	40 (12180)*	2.10

Notes: The rates are per 1000 live births that occurred between 1970 and 1987. * Some of the cases in the parentheses do not add up to this total because of missing cases. Multiple births were excluded in both cohorts. The numbers in the parentheses are the weighted number of exposed births.

Source: Primary analysis of KDHS 1988/89 data.

Table 7.4 Child mortality rates according to proximate variables and mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR CMR (a)	LMR CMR (b)	Mortality ratio (a)/(b)
Survival of preceding child			
Dead	74 (323)	49 (297)	1.51
Alive	63 (4048)	18 (9372)	3.50
χ^2	= 0.58, d.f. = 1, p > 0.30	χ^2 = 10.46, d.f. = 1, p < 0.001	
Preceding birth interval			
< 24	84 (1612)	25 (2447)	3.36
24-35	60 (1660)	23 (2619)	2.61
36+	41 (1099)	5 (1780)	8.20
χ^2	= 21.03, d.f. = 2, p < 0.001	χ^2 = 30.49, d.f. = 2, p < 0.001	
Succeeding birth interval			
< 24	89 (1684)	26 (2565)	3.42
24-35	64 (3779)	20 (3028)	3.20
36+	46 (1398)	14 (2230)	3.28
χ^2	= 23.26, d.f. = 2, p < 0.001	χ^2 = 30.49, d.f. = 2, p < 0.001	
Maternal age at birth			
< 20	78 (1216)	28 (1718)	2.78
20-29	65 (3005)	18 (4808)	3.61
30+	42 (1136)	16 (1988)	2.63
χ^2	= 14.97, d.f. = 2, p < 0.001	χ^2 = 7.32, d.f. = 2, p < 0.05	
Birth order			
1	75 (985)	20 (1667)	3.75
2-3	60 (1721)	20 (2909)	3.00
4-5	74 (1302)	22 (2128)	3.36
6+	59 (1329)	14 (1809)	4.21
χ^2	= 4.51, d.f. = 3, p > 0.20	χ^2 = 3.80, d.f. = 3, p > 0.20	
Source of drinking water			
Other	72 (4311)	20 (6157)	3.60
Piped	40 (1039)	17 (2345)	2.35
χ^2	= 15.79, d.f. = 1, p < 0.001	χ^2 = 0.79, d.f. = 1, p > 0.30	
Toilet facility			
None	115 (1050)	24 (1183)	4.79
Available	54 (4305)	19 (7317)	2.84
χ^2	= 45.45, d.f. = 1, p < 0.001	χ^2 = 1.73, d.f. = 1, p > 0.10	
Ever use of contraception			
Never	77 (3869)	20 (5244)	3.85
Yes	36 (1487)	19 (3269)	1.89
χ^2	= 32.12, d.f. = 1, p < 0.001	χ^2 = 0.13, d.f. = 1, p > 0.70	
Total	66 (5356)*	19 (8513)*	3.47

Notes: The rates are per 1000 children born between 1970 and 1983 who survived infancy. * Some of the categories do not add up to this total because of some missing cases. Multiple births were excluded in both cohorts. The numbers in the parentheses are the weighted number of exposed children.

Source: Primary analysis of the 1988/89 KDHS data.

Similarly, the succeeding birth interval was significantly and negatively associated with child mortality in both mortality regions. As with preceding birth interval, child mortality differentials according to the length of the succeeding birth interval were larger in the LMR than in the HMR. In the LMR, child mortality among children with a succeeding birth interval of less than 24 months was almost twice as high as that of the children with succeeding birth intervals of at least 36 months. The corresponding rate in the HMR was 1.9 times as high.

Maternal age at birth was significantly associated with infant mortality only in the LMR. However, it was significantly associated with child mortality in both mortality regions. In both mortality regions, infant mortality display the usual pattern: high at younger and older maternal ages and low at the prime reproductive age of 20-29. In contrast, in both mortality regions, child mortality is highest at younger maternal ages, and lowest at older maternal ages, with the mortality of the children born to mothers in the prime reproductive ages of 20-29 being in between. The observed lower child mortality at older maternal age could be due to the fact that mothers who gave birth at older age and whose infants survived infancy gave their children the best child care possible for fear that if the children died they would not be able to replace them since they were advanced in age. Furthermore, those who had given birth before were experienced at child rearing.

Birth order was significantly associated with infant mortality in the LMR only. In the LMR, infant mortality was highest among first-born children, higher among children of sixth or higher birth order and lowest among the children of the second to fifth birth order. Birth order was not significantly associated with child mortality in either mortality region.

Infant mortality in both mortality regions varied significantly according to whether the household had a toilet facility. Children from households that had no toilet facility had a higher infant mortality rate than the children from households that had a toilet. However, the gap was smaller in the LMR than in the HMR. Similarly, child mortality varied significantly according to whether the household had a toilet facility only in the HMR. The child mortality rate for the children from households that did not have a toilet facility was almost five times as high as that for the children from households without toilets in the LMR.

The results in Tables 7.3 and 7.4 also show that both infant and child mortality varied significantly according to whether the household had a safe source of drinking water in the HMR but not in the LMR. In the HMR, both infant and child mortality rates were significantly higher for the children from households that did have access to piped water supply than for the children from households that had access to piped water supply.

Ever-use of modern contraception was significantly associated with both infant and child mortality in the HMR but not in the LMR. In the HMR the difference between the infant mortality rates among children of mothers who had used contraception and that of the children whose mothers had never used contraception was 37 per thousand live births. In the case of child mortality, the difference was 41 per thousand children who survived to age one.

In conclusion, both infant and child mortality differentials by the selected socioeconomic and proximate variables were generally larger in the HMR than in the LMR. This indicates that both infant and child mortality rates in the HMR were generally more closely associated with socioeconomic and demographic characteristics of the parents and household environmental conditions than they were in the LMR. However, the bivariate associations are not net of possible confounding effects of other explanatory variables. Hence the next subsection will examine their net effect by multivariate analysis.

7.4. Multivariate analysis of infant and child mortality

This subsection presents parsimonious models of the determinants of infant and child mortality in each of the two mortality regions. In order to establish the determinants of infant and child mortality in each mortality region, the same set of explanatory variables as those in the national level analysis are included in the subsequent analysis.

7.4.1 Infant mortality

The results obtained by fitting parsimonious logit models are presented in Table 7.5 for infant mortality in the LMR and in Table 7.6 for the HMR. In the LMR, the survival status of the preceding child, the preceding birth interval, birth order, household's economic state and place of residence had significant net effects on infant mortality. In the HMR, on the other hand, the variables that had significant net effects on infant mortality were the preceding birth interval, survival status of the preceding child, paternal education, maternal education, household's economic status and possession of livestock and maternal age at birth. Rural children in the LMR were less likely to die in infancy than their urban counterparts. This suggests that living conditions in the rural areas of the LMR were better than those in the urban areas of the LMR.

Although maternal education was significantly related to infant mortality in the HMR, the odds of dying in infancy among infants born to uneducated or less educated mothers were not significantly greater at the 5 per cent level than among children born to mothers with at least secondary education. The net effect of paternal education on infant mortality was slightly greater than that of maternal education. The fact that parental education was not significantly related to infant mortality in the LMR suggests that its role diminishes in conditions of low to moderate mortality.

Possession of livestock was significantly related to infant mortality in the HMR but not in the LMR. This may be due to the fact that most of the households in the LMR had livestock and those that did not have livestock had adequate access to the

Table 7.5 Parsimonious logit linear model of factors affecting infant mortality in the LMR: Kenya, 1988/89 KDHS

Explanatory variables	Log odds	$LR\chi^2$	d.f.	P	Odds ratio	No. of cases
Survival of preceding sibling at age one		63.80	1	< 0.001		
Alive	0.00				1.00	7712
Dead	1.53(9.09)***				4.62	342
Preceding birth interval		15.19	2	< 0.001		
< 24	0.59(3.62)***				1.80	2875
24-35	0.25(1.48)				1.28	3095
36+	0.00				1.00	2084
Birth order		16.62	2	< 0.001		
6+	0.49(3.51)***				1.63	2353
4-5	-0.05(-0.31)				0.95	2382
2-3	0.00				1.00	3320
Household economic status		11.12	1	< 0.01		
High	0.00				1.00	2142
Medium	0.42(2.58)**				1.52	3226
Low	0.58(3.24)**				1.79	2686
Place of residence		6.46	1	< 0.02		
Urban	0.00				1.00	1288
Rural	-0.46(-2.62)**				0.63	6766

Constant = -3.8825 standard error = 0.2095

Notes: Based on 8054 second and higher order births. Model $LR\chi^2$ = 118.43, 8 d.f., p < 0.001. The numbers in the parentheses are t-statistics. *Significant at p < 0.05, ** Significant at p < 0.01, ***Significant at p < 0.001.

Source: Primary analysis of the 1988/89 KDHS.

products of livestock (for example milk) both by buying from the neighbours or from commercial outlets. For example, in Nyeri district in Central province, where the author spent about two months among villagers in Tetu division, almost every household had a hybrid dairy cow, and the villagers who did not have milk in their households could easily buy it from their neighbours or from retail outlets. There were also other sources of income, for example, selling coffee or tea and or *waru* (Irish potatoes).

Table 7.6 Parsimonious logit linear model of factors affecting infant mortality in the HMR: Kenya, 1988/89 KDHS

Explanatory variable	Log odds	$LR\chi^2$	d.f.	P	Odds ratio	No. of cases
Preceding birth interval		76.29	2	< 0.001		
< 24	0.95(7.44)***				2.58	2531
24-35	0.30(2.15)*				1.35	2625
36+	0.00				1.00	1741
Survival of previous birth at age one		70.78	1	< 0.001		
Alive	0.00				1.00	5516
Dead	1.00(9.01)***				2.72	621
Possession of livestock		9.52	1	< 0.01		
Yes	0.00				1.00	4985
No	0.29(3.10)**				1.34	1912
Paternal education		8.31	2	< 0.02		
None	0.46(2.83)**				1.58	1720
Primary	0.32(2.22)*				1.38	3614
Secondary	0.00				1.00	1563
Maternal education		6.20	2	< 0.05		
None	0.38(1.64)				1.46	3256
Primary	0.15(0.69)				1.17	3028
Secondary	0.00				1.00	613
Household economic status		7.24	1	< 0.05		
High	0.00				1.00	1238
Medium	0.24(1.61)				1.27	2629
Low	0.36(2.59)**				1.48	3030
Maternal age at birth		6.01	2	< 0.05		
< 20	0.24(1.72)				1.27	684
30+	0.21(2.13)*				1.23	2053
20-29	0.00				1.00	4160

Constant = -4.0432, standard error = 0.2381

Notes: Based on 6897 second and higher order births. Model $LR\chi^2 = 248.50$, 9 d.f., $p < 0.001$. N is the number of cases in each category. The numbers in the parentheses are t-statistics. *Significant at $p < 0.05$, ** Significant at $p < 0.01$, ***Significant at $p < 0.001$.

Source: Primary analysis of the 1988/89 KDHS data.

In contrast, it was not so easy to obtain milk in households in the Western province. Most households did not have hybrid dairy cows, and they could not afford to purchase milk from commercial outlets. For example, in Amagoro Division, the local livestock development officer and some of my informants told me that there were very few households in the area that had high hybrid cattle (cows) and that Busia district was a net importer of milk.

Survival status of the preceding child at age one, the preceding birth interval and household economic status were each significantly related to infant mortality in each mortality region. The net effect of the survival status of the preceding child at age one on infant mortality of was stronger in the LMR than in the HMR. Similarly, household economic status had a stronger net effect on infant mortality in the LMR than in the HMR. However, the preceding birth interval had stronger net effects on infant mortality in the HMR than in the LMR.

7.4.2 Child mortality

The results obtained by fitting parsimonious logit models on child mortality in the LMR are presented in Table 7.7. The determinants of child mortality in the LMR were the preceding birth interval, the succeeding birth interval, maternal education and place of residence. The effect of the preceding birth interval was greater than that of the succeeding birth interval. The children with preceding birth intervals of less than 24 months were 2.7 times more likely to die than their counterparts with preceding birth intervals of at least 36 months, while those with preceding birth intervals of 24-35 months were 2.3 times more likely to die. Similarly, the odds of child mortality among children with a succeeding birth interval of less than 24 months were twice as high as the odds among children with a succeeding birth interval of at least 36 months, while the odds of dying among children with succeeding birth intervals of 24-35 months were not significantly different from the odds among children with succeeding birth intervals of at least 36 or more months.

Unlike in the case of infant mortality in the LMR, maternal education was a significant determinant of child mortality. Children of more educated mothers had better chances of survival than children born to less educated or uneducated mothers.

Relative to the children whose mothers had at least secondary education, children born to uneducated mothers and those born to mothers with primary education had odds of child mortality 3.5 times and 2.6 times higher, respectively.

As in the case of infant mortality, place of residence had a statistically significant net effect on child mortality in the LMR. Rural children were less likely to die than urban children; the odds of child mortality among rural children were about half of those of urban children. This result suggests that in the LMR the conditions that prevailed in the rural areas were more conducive to child survival than those that prevailed in the urban areas.

Table 7.7 Parsimonious logit linear model of factors affecting child mortality in the LMR: Kenya, 1988/89 KDHS

Explanatory variable	Log odds	$LR\chi^2$	d.f.	P	Odds ratio	No. of cases
Preceding birth interval		12.39	2	< 0.01		
< 24	0.96(3.06)**				2.61	1949
24-35	0.84(2.63)**				2.31	1949
36+	0.00				1.00	1190
Succeeding birth interval		10.07	3	< 0.001		
< 24	0.69(2.73)**				1.99	1725
24-35	0.13(0.47)				1.14	1964
36+	0.00				1.00	1390
Maternal education		8.87	2	< 0.02		
None	1.24(2.54)**				3.46	2027
Primary	0.94(1.97)*				2.56	2592
Secondary	0.00				1.00	460
Place of residence		8.14	1	< 0.01		
Urban	0.00				1.00	691
Rural	-0.76(-3.04)**				0.47	4388
Constant = -5.2486, standard error = 0.5593						

Notes: Based on 5079 second and higher order births. Model $LR\chi^2$ = 40.88, 9 d.f., p < 0.001. N is the number of cases in each category. The numbers in the parentheses are t-statistics. *Significant at p < 0.05, ** Significant at p < 0.01, ***Significant at p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

The determinants of child mortality in the HMR are presented in Table 7.8. Except for the preceding and suceeding birth intervals, the factors that had statistically significant net effects on child mortality in the HMR were slightly different from those in the LMR. In the HMR, they included the preceding birth interval, year of birth, ever-use of contraception, the household economic status and succeeding birth interval in that order. When household economic status was not included in the equation, household source of drinking water and availability of a toilet facility had significant net effects on child mortality. However, when the household economic status was included neither source of drinking water nor availability of a toilet facility had statistically significant net effects, and both were therefore excluded in the final model.

The effects, as measured by odds ratios, of the preceding and succeeding birth intervals on child mortality were slightly stronger in the LMR than in the HMR. In both mortality regions the preceding birth interval exerted a greater influence than the succeeding birth interval. The fact that year of birth had a statistically significant net effect on child mortality in the HMR but not in the LMR indicates that there was a substantial improvement in child mortality in the HMR during the period under review that was net of the influence of the factors included in the model. In contrast, the improvements in child mortality in LMR could be accounted for by the factors included in the model.

The results indicate that in the HMR there was significant variation in access to and use of health services, as proxied by ever-use of modern contraception, and that significant reductions in child mortality can be achieved in the HMR by improving access to and encouraging use of these services. Ever-use of modern contraception was not significantly related to child mortality in the LMR in the final logit model.

Table 7.8 **Parsimonious logit linear model of factors affecting child mortality in the HMR: Kenya, 1988/89 KDHS**

Explanatory variables	Log odds	$LR\chi^2$	d.f.	P	Odds ratio	No. of cases
Preceding birth interval		20.26	2	< 0.001		
< 24	0.84(4.21)***				2.32	1573
24-35	0.47(2.26)*				1.60	1645
36+	0.00				1.00	946
Year of birth		17.18	2	< 0.001		
1970-74	0.71(4.06)***				2.03	1085
1975-79	0.44(2.53)**				1.55	1589
1980-83	0.00				1.00	1490
Ever use of contraception		15.39	1	< 0.001		
Yes	0.00				1.00	1130
No	0.71(3.66)***				2.03	3043
Household economic status		13.82	1	< 0.001		
High	0.00				1.00	731
Medium	0.28(1.16)				1.32	1587
Low	0.69(2.94)**				1.99	1846
Succeeding birth interval		12.62	2	< 0.01		
< 24	0.43(2.54)**				1.54	1398
24-35	-0.10(0.55)				0.90	1593
36+	0.00				1.00	1173
Constant	= -4.8606, standard error = 0.3362					

Notes: Based on 4164 second and higher order births. Model $LR\chi^2$ =70.53, 7 d.f., p < 0.001. N is the number of cases in each category. The number in the parentheses are the t -statistics values. *Significant at p < 0.05, ** Significant at p < 0.01, ***Significant at p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

7.5 Conclusion

The results obtained in this chapter showed that there were larger infant and child mortality differentials in the HMR than in the LMR. The largest differentials were in relation to parental education. Both maternal and paternal education were significantly and negatively associated with infant and child mortality in the HMR. In contrast, in the LMR, neither maternal nor paternal education was significantly associated with infant mortality. However, in the LMR both maternal and paternal education were rather weakly associated with child mortality. One of the unexpected findings was the that children of mothers with at least secondary education in the HMR had higher infant and child mortality than the children of uneducated mothers in the LMR. For example, the child mortality rate for the children of mothers with at least secondary education in the HMR was almost twice that for the children of uneducated mothers in the LMR.

In the population of the children of the second and higher birth orders, the factors that had significant net effect on infant and child mortality in the LMR and HMR were slightly different. In the LMR, the survival status of the preceding sibling, the length of the preceding birth interval, birth order, household economic status and place of residence had significant net effects on infant mortality. In contrast, in the HMR, the preceding birth interval, the survival status of the preceding sibling, possession of livestock, paternal education, maternal education, household economic status and maternal age at birth had statistically significant net effects on infant mortality. The results obtained suggest that the survival status of the preceding child at age one had a stronger effect in the LMR than in the HMR. However, the preceding birth interval had a slightly stronger effect in the HMR than in the LMR.

In the LMR, the preceding and succeeding birth intervals, maternal education and type of place of residence had significant net effect on child mortality. In the HMR, on the other hand, the length of the preceding birth interval, year of birth, ever-use of modern contraception, succeeding birth interval and household economic status had significant net effects on child mortality.

CHAPTER EIGHT

INSIGHTS INTO REGIONAL VARIATION IN INFANT AND CHILD MORTALITY

8.1 Introduction

This chapter aims to provide some insights into regional variations in infant and child mortality in Kenya. A comparative discussion of infant and child mortality differentials and determinants in the low-and high-mortality regions was presented in Chapter Seven. This chapter further extends that discussion by investigating some of the reasons for the observed mortality differentials between the two mortality regions.

The chapter is divided into two parts. The first part seeks to answer the following questions: (1) Were the differences in the mortality rates between the two regions due to the differences in the levels of the explanatory variables?, or (2) Were they due to the differences in the structure of relationships between mortality and the explanatory variables in the two regions? Such analyses help to explain some of the causes of the high infant and child mortality rates in the high-mortality region. These two objectives will be achieved through analysis of data drawn from the 1988/89 KDHS data. The analysis of infant mortality was based on the single births that occurred between 1970 and 1987, while analysis of child mortality was based on single births that survived infancy among those that occurred between 1970 and 1983. The second part of this chapter provides further insights into causes of differentials in mortality through the use of supplementary information obtained from various sources, including field work carried out by the author in Western and Central provinces in 1993.

8.2 Analytical approach

To achieve the objectives of the first part of this chapter, an analytical approach used in a similar study in Malaysia in 1986 (Peterson *et al.*, 1986: 10-12) was adopted. This approach uses logistic regression to decompose the effects of explanatory variables. Decomposition techniques have been used to analyse areal and temporal changes in infant and child mortality. Preston (1976, 1980) used these procedures to study the effect of social and economic development on mortality decline in developing countries since World War II. Da Vanzo and Habicht (1986: 144-154) used a similar approach to study factors accounting for the decline in infant mortality between 1941 and 1975 in Malaysia. Similarly, Kintner (1994: 117-132) used a regression decomposition procedure to study the decline in infant mortality between 1871 and 1925 in Germany. The analytical approach adopted for this study and the associated computations are explained in some detail in what follows.

First, a comparison of the levels or values, using means, of each of the explanatory variables of infant and child mortality between the two mortality regions[1] was carried out. In order to obtain the means of variables, all the explanatory variables except for maternal and paternal education were converted into dichotomous variables and recoded as shown below:

Mother's work status: working or not working
(working = 1, not working = 0)

Household economic status: high or low (high = 1, low = 0)

Maternal age at birth: ≥ 20 or < 20 years (≥ 20 = 1, < 20 = 0)

Birth order: 2-3 or ≥ 4 (2-3 =1, ≥ 4 =0)

Preceding birth interval: ≥ 36 months or < 36 months
(≥ 36 months = 1, < 36 months = 0)

Succeeding birth interval: ≥ 36 months or < 36 months
(≥ 36 months = 1, < 36 months = 0)

Second, the structure of the relationship between each explanatory variable and infant and child mortality in each mortality region was established. The structure of relationship is indicated by the logit coefficient and the associated standard error for the explanatory variable in question. A test of significance for the difference between the logit coefficients of each explanatory variable in the two mortality regions was

[1]As in the previous chapter the low-mortality and high-mortality regions are abbreviated as LMR and HMR, respectively.

carried out in order to assess whether they were significantly different. The logit coefficients were then used to assess the relative roles of differences in the levels of the explanatory variables and the differences in the structure of relationship in explaining the difference in the levels of infant and child mortality in the two mortality regions.

Using the logit coefficients, infant and child mortality rates in both regions were then predicted in two different ways. First, they were predicted using the logit coefficients and the values of explanatory variables, (X_i), for each region. For example, the predicted infant mortality for the HMR, using the coefficients for the HMR, (β_iHMR), and the values of explanatory variables for the HMR, (X_iHMR), was obtained by taking the average of the probabilities of dying in infancy for each live birth, (P_i), using the following formula: $P_i = 1/(1+e^{-(\beta_i HMR * X_i HMR)})$. The average predicted infant mortality rate obtained in this way is equivalent to the observed infant mortality rate for the HMR. This procedure was repeated for the LMR. Second, expected infant and child mortality probabilities were also obtained by applying the logit coefficients of one region to the values of the explanatory variables of the other region. The logit coefficients of the HMR, (β_iHMR), were applied to values of explanatory variables for the LMR, (X_iLMR), and vice versa.

As an illustration, to predict infant mortality for the HMR using the coefficients for the HMR and the values of explanatory variables for the LMR, the probability of dying for each live birth was obtained by using the following formula: $P_i = 1/(1+e^{-(\beta_i HMR * X_i LMR)})$. The mean of these predicted probabilities was then compared with the observed infant mortality rate in the LMR in order to assess the role of differences in the structure of relationship between mortality and the explanatory variables in explaining the higher mortality rate in the HMR.

This procedure was repeated by applying the logit coefficients of the LMR to the observed values of explanatory variables for the HMR. The difference between the observed infant mortality rate for a given region and the predicted infant mortality rate obtained by applying the coefficients of the other region to the observed values of explanatory variables of that region was the share attributable to the structure of relationship (Preston, 1980: 304-313; Da Vanzo and Habicht, 1986: 147; Peterson *et al.*, 1986: 12). The difference in both infant mortality or child mortality rates between the two regions that is attributable to the differences in the levels of values of the explanatory variables was assessed by comparing the estimates for each region obtained in the two different ways.

Third, an assessment was carried out of the contribution of each of the explanatory variables to the difference in infant and child mortality due to the differences in the observed values of the explanatory variables in the two mortality regions. The basic question being addressed here is: Other things being equal, how much lower or higher would infant or child mortality be in the HMR if it had, for example, the same level of maternal education as the LMR over the same period? This question was asked for each of the other explanatory variables. For each mortality region, the change implied by one unit change in each explanatory variable, (X_i), was computed, when all the other variables were held constant at their mean value for the region. Each of these derivatives, ($\partial P/\partial X_i = \beta_i P(1-P)$), was then multiplied by the observed difference between the means of the given explanatory variable in the HMR and the LMR (Da Vanzo and Habicht, 1986: 147; Peterson *et al.*, 1986: 12).

As an illustration, to answer the question of how much lower infant mortality rate in the HMR would be if it had the same mean value of maternal education as the LMR, the following computation was carried out:

$$\text{Change in IMR} = \beta_{MEDU} * IMR_0(1-IMR_0) * (MEDU_1 - MEDU_0) * 1000,$$

where β_{MEDU} = logit coefficient of maternal education in HMR region,

IMR_0 = the average IMR in the HMR,

$MEDU_1$ = the mean value of the maternal education in the LMR region, and

$MEDU_0$ = the mean value of maternal education in the HMR region.

8.3 Infant mortality

8.3.1 Differences in the levels of explanatory variables

The means of the explanatory variables for infant mortality by mortality region are presented in Table 8.1. Except for paternal education and the length of the preceding birth interval, the means of all other explanatory variables were significantly different between the two mortality regions. The average values of all the explanatory variables in the LMR were greater than those in the HMR. Thus, differences in the levels of the remaining 11 explanatory variables are expected to account for some of the variation in infant mortality between the two mortality regions. The greatest differences in the mean values were in relation to ever-use of modern contraception , availability of a toilet facility and household economic status.

Table 8.1 Means of explanatory variables for infant mortality by mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR (n = 6866)	LMR (n = 8039)	Significance of difference in means (t-statistic)
Maternal education (Years)	3.08	3.92	-2.70*
Paternal education (Years)	10.13	10.18	-0.35
Urban residence (D)	0.15	0.16	-2.21*
Household economic status (D)	0.18	0.27	-13.04***
Possession of livestock (D)	0.72	0.79	-9.94***
Working mother (D)	0.08	0.12	-7.71***
Ever-use of contraception (D)	0.26	0.44	-22.22***
Birth order (D)	0.38	0.41	-6.68***
Maternal age at birth (D)	0.90	0.92	-5.22***
Survival of preceding child (D)	0.91	0.96	-11.78***
Preceding birth interval (D)	0.25	0.26	-1.39
Piped drinking water (D)	0.28	0.34	-8.21***
Toilet facility (D)	0.80	0.89	-15.04***
Infant mortality	0.086	0.037	12.58***

Notes: D denotes dichotomous variable. LMR = Low mortality region and HMR = High mortality region. ***$p < 0.001$, ** $p < 0.01$, * $p < 0.05$. All the calculations were based on second and higher order births.

Source: Primary analysis of the 1988/89 KDHS data.

8.3.2 Effects of explanatory variables

The results presented in Table 8.2 show the effect of controlling for explanatory variables on the differences in the levels of infant mortality between the two mortality regions. Model I shows that the risk of infant death in the HMR was significantly greater than that for that infants in the LMR; the infant in the HMR had odds of dying in infancy 2.4 times higher than that in the LMR. The constant of Model I was -3.25 which implied that infant mortality rate for the LMR was 37.3 per 1000 live births[2] and that for the HMR was about 86.5 per 1000. These rates are equivalent to those shown in the last row of Table 8.1. The difference in infant mortality between the two regions was not substantially reduced in any of the alternative models shown in Table 8.2. Even in Model VI, which includes all the explanatory variables, the odds ratio was reduced from 2.4 to 2.0. These results suggest that the differences in the levels of explanatory variables included in this analysis do not explain much of the difference in the levels of infant mortality between the two mortality regions.

Table 8.2 Odds ratios and likelihood chi-square values indicating the effects of controlling for explanatory variables on infant mortality differential between the two mortality regions: Kenya, 1988/89 KDHS

Explanatory variable	Model I	Model II	Model III	Model IV	Model V	Model VI
$LR\chi^2$	159.4	121.5	153.4	122.5	143.9	90.7
d.f.	1	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mortality region						
LMR	1.0	1.0	1.0	1.0	1.0	1.0
HMR	2.4(8.60)***	2.2(10.7)***	2.4(11.8)***	2.2(10.6)***	2.4(11.6)***	2.0(9.2)***

Notes: Model I = Mortality region indicator variable only, Model II = Model 1 plus all socioeconomic variables, Model III = Model 1 plus household environment variables, Model IV = Model 1 plus maternal variables, Model V = Model 1 plus ever-use of modern contraception, and Model VI = Model 1 plus all the other models. t-statistics are shown in the parentheses. LMR = Low mortality region and HMR = High mortality region. All models were based on second and higher order births. *** Significant at $p < 0.001$. The $LR\chi^2$ values shown here are those associated with the mortality region indicator variable.

Source: Primary analysis of the KDHS data.

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[2] The IMR for LMR was obtained by using the formular: $1/(1 + e^{-(-3.25)}) * 1000$.

8.3.3 Structural relationships

Despite the fact that the results in the preceding section suggest that the explanatory variables considered here do not explain much of the difference in the levels of infant mortality between the two mortality regions, there may still be structural differences in the effects of these variables in the two mortality regions. The structure of relationship between explanatory variables and infant mortality in the two mortality regions is presented in Table 8.3.

Table 8.3 Logit coefficients of explanatory variables of infant mortality by mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR Coefficients	LMR Coefficients	Significance of difference in coefficients in the two regions (t-statistic)[3]
Maternal education (years)	-0.0707(-4.42)***	-0.0403(-2.01)*	-1.18
Paternal education (years)	-0.0008(3.81)***	-0.0022(-0.69)	-0.78
Urban residence (D)	-0.0307(-0.20)	0.5123(2.40)**	-2.05*
Household economic status (D)	-0.2079(-1.36)	-0.3533(-2.06)	-0.63
Possession of livestock (D)	-0.3401(-3.56)***	-0.1216(-0.81)	1.22
Mother's work status (D)	0.1351(0.69)	-0.3295(-1.42)	-1.53
Ever-use of contraception[a] (D)	-0.1274(-1.10)	0.1257(0.99)	1.47
Birth order (D)	-0.0729(-0.70)	-0.1764(-1.29)	0.60
Maternal age at birth (D)	-0.2161(-1.43)	-0.0012(0.01)	-0.78
Survival of preceding child (D)	-1.0945(-9.83)***	-1.5822(-9.48)***	-2.43*
Preceding birth interval (D)	-0.6317(-5.23)***	-0.4365(-2.83)**	0.99
Piped water supply (D)	-0.1066(-0.12)	-0.1533(-0.74)	-0.19
Toilet facility (D)	-0.0796(-0.74)	0.2818(1.36)	-1.55
Constant (Intercept)	-0.5138(-2.55)**	-1.6166(-4.68)**	-2.76**

Notes: D denotes dichotomous variable. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. LMR = Low mortality region and HMR = High mortality region. All the calculations were based on second and higher order births. [a] refers to ever-use of modern contraception. The numbers in parentheses are the t-statistics.

Source: Primary analysis of the 1988/89 KDHS data.

[3] This was tested through using the method explained in Chapter Six.

Maternal education had a significant negative effect on infant mortality in both mortality regions but the difference in its effect in the two mortality regions was not significant. Paternal education and possession of livestock had significant negative effects on infant mortality in the HMR but each had an insignificant negative effect on infant mortality in the LMR. High household economic status had a significant negative effect on infant mortality in the LMR. Although its effect was also negative in the HMR, it was not significant. Mother's work in paid employment, ever-use of modern contraception, having a toilet facility and piped water had no significant effect on infant mortality in either mortality region.

These results show that, except for urban residence and survival of the preceding sibling, the effects of all the other explanatory variables were not significantly different in the two mortality regions (Table 8.3). Urban residence had a significant positive effect on infant mortality in LMR but had an insignificant negative effect on infant mortality in the HMR. Survival of the preceding child had a greater negative effect on infant mortality in the LMR than in the HMR. The overall effect (intercept) was also significantly larger in the HMR than in the LMR. Hence, when all the explanatory variables were set to zero, infant mortality rate in the HMR remained significantly greater than that in the LMR.

8.3.4 Explanatory variables versus structural relationships

The observed infant mortality rates for HMR and LMR were 86 and 37 infants deaths per 1000 live births, respectively (Table 8.1), and thus the difference in infant mortality rates between the two regions was 49 infant deaths per 1000. The equivalent infant mortality rates were obtained when the coefficients for the mortality regions were applied to their respective values of explanatory variables (Table 8.4). However, when the coefficients of the LMR were applied to the values of the explanatory variables of the HMR the average predicted infant mortality rate for the HMR was 44 deaths per 1000 instead of the observed 86 deaths per 1000. This gives a difference of 42 infant deaths per 1000. This means that the differences in the structure of relationship between explanatory variables and infant mortality in the two regions accounted for 42 infant deaths per 1000 out of the total observed difference of 49 deaths per 1000. The infant mortality for the LMR increased from 37 to 70 deaths per 1000 when the coefficients of the HMR were applied to the values of explanatory variables of the LMR. This results in a difference of 33 deaths per 1000 which are attributable to the differences in the structure of relationship between explanatory variables and infant mortality in the two regions.

These results suggest that about 38 deaths[4] per 1000 out of the total difference of 49 infant deaths per 1000, between the two mortality regions, were due to the differences in the structural relationship. And the rest, that is 11 infant deaths per 1000 out of the 49 infant deaths per 1000, were due to the differences in the values of the explanatory variables between the two regions. These results suggest that a major part of the difference in the levels of infant mortality between the two mortality region was due to the differences in the structural relationship.

Table 8.4 Predicted infant mortality rates using one region's coefficients and the values of explanatory variables of the other region: Kenya, 1988/89 KDHS

	Predicted using values of explanatory variables from:		Estimated change in IMR due to changes in the values of explanatory variables
	HMR	LMR	
Predicted IMR using HMR coefficients	86	70	16
Predicted IMR using LMR coefficients	44	37	7
Estimated difference in IMR due to differences in the structure of relationship	42	33	

Notes: LMR = Low mortality region and HMR = High mortality region. All the calculations were based on second and higher order births.

Source: Primary analysis of the 1988/89 KDHS data.

[4] Obtained by taking the average of 42 and 33 deaths per 1000.

Table 8.5 shows the changes that would occur in the infant mortality rate of the HMR if the HMR had the same values of explanatory variables as the LMR and vice versa. The lower mean values of maternal education, survival of the preceding child at exact age one, possession of livestock, ever-use of modern contraception and household economic status contributed to the higher IMR in the HMR. For instance, if the HMR had the same average level of maternal education as the LMR over the 1970-87 period, its infant mortality would be 4.7 deaths per 1000 lower. If the HMR had the same proportion of the preceding children surviving to at least age one as in the LMR, its infant mortality would have been lower by 4.3 deaths per 1000. The other variables, except for paternal education and mother's work status, would each make a small contribution to the higher infant mortality in the HMR.

The results presented in Table 8.5 also show how the infant mortality rate in the LMR would be affected if the region had the same values of the explanatory variables as the HMR. The changes in infant mortality in the LMR are considerably smaller than the corresponding changes in the HMR. This may be due simply to the fact that infant mortality was lower in the LMR. If the LMR had the same mean value for maternal education as the HMR, its infant mortality would be higher by 1.2 deaths per 1000. If the LMR had the same proportion of the immediately preceding children surviving to at least age one as the HMR, its infant mortality would be higher by 2.8 deaths per 1000. If the LMR had the same values for household economic status, its infant mortality would be higher by 1.1 deaths per 1000. Each of the other variables would bring about very small changes in the level of infant mortality in the LMR. Hence, it can be concluded that the higher proportion of preceding children surviving to age one, the higher average level of maternal education, and the higher proportion of well-to-do households contributed most to the lower infant mortality in the LMR.

Table 8.5 **Changes that would occur in infant mortality rate in each region if each region had the same mean value of each explanatory variable as the other region: Kenya, 1988/89 KDHS**

Explanatory variables	HMR Mean value	LMR Mean value	HMR logit coefficient	LMR logit coefficient	Change in IMR if HMR had the same mean value of this variable as LMR	Change in IMR if LMR had the same mean value of this variable as HMR
Maternal education (years)	3.08	3.92	-0.0707	-0.0403	-4.67	+1.21
Paternal education (years)	10.13	10.18	0.0008	-0.0022	+0.00	+0.00
Urban residence (D)	0.15	0.16	-0.0307	0.5123	-0.02	-0.18
Household economic status (D)	0.18	0.27	-0.2079	-0.3533	-1.47	+1.13
Possession of livestock (D)	0.72	0.79	-0.3401	-0.1216	-1.87	+0.30
Working mother (D)	0.08	0.12	0.1351	-0.3295	+0.42	+0.47
Ever-use of contraception[a] (D)	0.26	0.44	-0.1274	0.1257	-1.82	-0.81
Birth order (D)	0.38	0.41	-0.0729	-0.1764	-0.17	+0.19
Maternal age at birth (D)	0.90	0.92	-0.2161	0.0012	-0.34	-0.00
Survival of preceding child (D)	0.91	0.96	-1.0945	-1.5822	-4.30	+2.83
Preceding birth interval (D)	0.25	0.26	-0.6317	-0.4365	-0.50	+0.15
Piped supply water (D)	0.28	0.34	-0.1066	-0.1533	-0.50	+0.33
Toilet facility (D)	0.80	0.89	-0.0796	0.2818	-0.56	-0.90
Constant (Intercept)	-0.5133	-1.6166				
Dependent variable (IMR)	0.086	0.037				

Notes: + increase in IMR, - decrease in IMR. D denotes dichotomous variable. LMR = Low mortality region and HMR = High mortality region. [a] refers to ever-use of modern contraception. All the calculations were based on second and higher order births.

Source: Primary analysis of the 1988/89 KDHS data.

8.4 Child mortality

8.4.1 Differences in the levels of explanatory variables

The means of explanatory variables for child mortality, with some differences due to the different time frame, and the inclusion of the additional variable for succeeding birth interval are shown in Table 8.6. As in the case of infant mortality, the average values of all the explanatory variables for LMR were higher than those for the HMR. Except for the birth intervals and urban residence, the means of all the other explanatory variables were significantly higher in the low mortality region.

Table 8.6 Means of explanatory variables for child mortality by mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR (n = 4145)	LMR (n = 5071)	Significance of difference in means (t-statistic)
Maternal education (years)	2.82	3.50	-10.19***
Paternal education (years)	9.62	10.15	-2.57**
Urban residence (D)	0.13	0.14	-0.25
Household economic status (D)	0.17	0.26	-9.65***
Possession of livestock (D)	0.73	0.80	-8.19***
Working mother (D)	0.08	0.11	-5.27***
Ever-use of contraception (D)	0.26	0.44	-16.87***
Birth order (D)	0.42	0.45	-2.74*
Maternal age at birth (D)	0.88	0.90	-3.62**
Survival of preceding child (D)	0.92	0.96	-7.11***
Preceding birth interval (D)	0.22	0.23	-1.14
Succeeding birth interval (D)	0.28	0.27	1.07
Piped water supply (D)	0.26	0.32	-6.07***
Toilet facility (D)	0.80	0.89	-11.04***
Child mortality	0.058	0.022	8.87***

Notes: D denotes dichotomous variable. LMR = Low mortality region and HMR = High mortality region. ***$p < 0.001$, ** $p < 0.01$, * $p < 0.05$. All the calculations were based on second and higher order births.

Source: Primary analysis of the 1988/89 KDHS data.

The greatest differences were in relation to the proportion of children with mothers who had ever-used modern contraception, the proportion of children belonging to households with a toilet facility, the average level of maternal education, and the proportion of children belonging to households of high economic status. Thus, the differences between these explanatory variables are expected to account for a sizeable proportion of the difference in child mortality between the two regions.

8.4.2 Effects of explanatory variables

The results presented in Table 8.7 show that the risk of child mortality in the HMR 2.7 times higher than in the LMR. This difference was not significantly altered in any of the alternative models shown in Table 8.7. For example, the difference in the child mortality between the two regions, as measured by the odds ratios, was reduced from 2.7 to 2.3 when all the explanatory variables were taken into account (compare Model VI to Model 1). Hence, the differences in the values of explanatory variables considered in this study do not account for much of the difference in the level of child mortality between the two mortality regions.

Table 8.7 Odds ratios indicating the effects of controlling for explanatory variables on child mortality differential between the two mortality regions: Kenya, 1988/89 KDHS

Explanatory variable	Model I	Model II	Model III	Model IV	Model V	Model VI
$LR\chi^2$	84.0	71.0	74.3	79.3	69.2	55.4
d.f.	1	1	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mortality region						
LMR	1.0	1.0	1.0	1.0	1.0	1.0
HMR	2.7(8.6)***	2.5(7.9)***	2.6(8.1)***	2.7(8.4)***	2.5(7.8)***	2.3(7.1)***

Notes: Model I = Mortality region indicator variable only, Model II = Model 1 plus all socioeconomic variables, Model III = Model 1 plus household environment variables, Model IV = Model 1 plus maternal variables, Model V = Model 1 plus ever-use of modern contraception, and Model VI = Model 1 plus all the other models. t-statistics are in the parentheses. LMR = Low mortality region and HMR = High mortality region. *** Significant at $p < 0.001$. The numbers shown in parentheses are the t- statistic values. All models were based on second and higher order births.

Source: Primary analysis of the KDHS data.

8.4.3 Structural relationships

The results relating to the structure of relationship between the explanatory variables and child mortality are shown in Table 8.8. Except for the ever-use of modern contraception, the effects of all the other explanatory variables on child mortality were not significantly different in the two mortality regions. Ever-use of modern contraception had a significant negative effect in the HMR but an insignificant negative effect in the LMR.

Piped drinking water and toilet facility had significant negative effects in the HMR but each had an insignificant negative effect in the LMR. The length of the preceding birth interval had a significant negative effect in each mortality region. However, its effect was much greater in the LMR than in the HMR. Maternal age at birth and urban residence had significant positive effects in the LMR but had an insignificant positive effect in the HMR. Maternal education had a significant effect in the LMR but insignificant negative effect in the HMR. The survival status of the preceding child was insignificantly associated with child mortality in both mortality regions. All the other explanatory variables had insignificant effects on child mortality in both mortality regions. Furthermore, the intercepts were not significantly different between the two mortality regions, (t = -0.49), which means that when all the explanatory variables were set to zero, child mortality rates in the two mortality regions would not be significantly different. Hence, these differences in the structural relationships as well as the differences in the levels of the explanatory variables are expected to account for some of the variation of child mortality.

Table 8.8 Logit coefficients of explanatory variables of child mortality by mortality region: Kenya, 1988/89 KDHS

Explanatory variable	HMR Coefficients	LMR Coefficients	Significance of difference in coefficients in the two regions (t-statistic)
Maternal education (years)	-0.0411(-1.61)	-0.0709(-2.10)*	-0.71
Paternal education (years)	-0.0006(-0.17)	-0.0005(-0.10)	0.02
Urban residence (D)	0.2091(0.87)	0.7799(2.37)**	1.41
Household economic status (D)	-0.2795(-1.14)	-0.0425(-0.16)	0.66
Possession of livestock (D)	-0.0590(-0.38)	0.0709(0.28)	0.44
Mother's work status (D)	0.2476(0.84)	-0.3297(-0.89)	-1.22
Ever-use of contraception[a] (D)	-0.6215(-3.17)***	-0.0313(-0.15)	2.06*
Birth order: 2-3 (D)	-0.1092(-0.70)	-0.0480(-0.22)	0.23
Maternal age at birth (D)	-0.3395(-1.60)	-0.5349(-1.85)	-0.55
Survival of preceding child (D)	0.1708(0.68)	-0.5665(-1.58)	-1.68
Preceding birth interval (D)	-0.6315(-3.29)***	-0.8498(-2.84)**	-0.61
Succeeding birth interval (D)	-0.2134(-1.36)	-0.4274(-1.77)	-0.74
Piped drinking water (D)	-0.4034(-2.09)*	-0.1283(-0.50)	-1.65
Toilet facility (D)	-0.3123(-1.96)*	-0.3711(1.32)	-0.18
Intercept (constant)	-1.8275(-5.30)***	-2.1397(-3.98)***	-0.49

Notes: D denotes dichotomous variable. *** $p < 0.001$, ** $p < 0.01$ * $p < 0.05$. LMR = Low mortality region and HMR = High mortality region. All the calculations were based on second and higher order births. [a] refers to ever-use of modern contraception. The numbers in the parentheses are the t-statistics.

Source: Primary analysis of the 1988/89 KDHS data.

8.4.4 Explanatory variables versus structural relationships

The results relating to the relative roles of the differences in the levels of the explanatory variables and the differences in the structure of relationship of child mortality between the two regions are presented in Table 8.9. The observed child mortality rates for the HMR and LMR were 58 and 22 deaths per 1000, respectively (Table 8.5), and thus the difference in the observed level of child mortality between the two regions was 36 deaths per 1000. The level of child mortality in the HMR was reduced from 58 to 26 per 1000 when the coefficients of the LMR were applied to the values of explanatory variables of the HMR, resulting in a difference of 32 deaths per 1000. Hence the differences in the structure of relationships accounted for 32 child deaths per 1000 of the total observed difference of 36 child deaths per 1000. The level of child mortality for the LMR was raised from 22 to 49 deaths per 1000 when the coefficients of the HMR were applied to the values of variables of the LMR, giving a difference of 27 child deaths. The 27 child deaths per 1000 are attributable to the differences in the structure of relations.

These results show that average of 28.5 child deaths per 1000 of the 36 child deaths per 1000 were due to the difference in the structure of relations in the two mortality regions. And the rest of the difference, that is an average of 8 child deaths per 1000, were due to the differences in the values of the explanatory variables in the two mortality regions. Thus, these results show that a major part of the observed difference in child mortality between the HMR and LMR was due to the differences in the structure of relationships in the two mortality regions.

Table 8.9 Predicted child mortality rates using one region's coefficients and the values of explanatory variables of the other region: Kenya, 1988/89 KDHS

	Predicted using values of explanatory variables from:		Estimated change in CMR due to changes in the values of explanatory variables
	HMR	LMR	
Predicted CMR using HMR coefficients	58	49	9
Predicted CMR using LMR coefficients	26	22	4
Estimated difference in CMR due to differences in the structure of relationship	32	27	

Notes: LMR = Low mortality region and HMR = High mortality region. All the calculations were based on second and higher order births.

Source: Primary analysis of the 1988/89 KDHS data.

Table 8.10 displays the changes that would occur in child mortality in the HMR if the region had the same values of explanatory variables as the LMR. As explained earlier, the changes were calculated assuming that the values of all other variables were held constant. The results suggest that the lower mean values of maternal education, ever-use of modern contraception, access to piped water and a toilet facility and proportion of high economic status households contributed to the higher child mortality in the HMR. The most important variable was ever-use of modern contraception, the proxy for access to and use of modern health services. If the HMR had the same level of ever-use of modern contraception as the LMR, its child mortality would be 5.8 deaths per 1000 children lower. If the HMR had the same average level of maternal education or the same proportion of children belonging to households with a toilet facility as the LMR, its child mortality rate would be lower by 1.5 deaths per 1000 children.

If the HMR had the same mean value for access to piped water supply and household economic status as the LMR, its child mortality rate would be lower by 1.3 and 1.4 deaths per 1000, respectively. If the values of each of the remaining explanatory variables were the same as those in the LMR, the child mortality rate in the HMR would virtually remain unchanged. The last column of Table 8.10 shows how the child mortality rate in the LMR would differ if the LMR had the same values of the explanatory variables as the HMR. Because child mortality was low, changes in the levels of the explanatory variables would not contribute much. It was only maternal education that would have increased the level of child mortality by 1.1 deaths per 1000 if the LMR had the same level of maternal education as the HMR.

Table 8.10 Changes that would occur in child mortality rate in each region if each region had the same mean value of each explanatory variable as the other region: Kenya, 1988/89 KDHS

Explanatory variables	HMR	LMR	HMR	LMR	Change in CMR if HMR had the same mean value of this variable as LMR	Change in CMR if LMR had the same mean value of this variable as HMR
	Mean value	Mean value	logit coefficient	logit coefficient		
Maternal education (years)	2.82	3.50	-0.0411	-0.0709	-1.53	+1.05
Paternal education (years)	9.62	10.15	-0.0006	-0.0005	-0.02	+0.01
Urban residence (D)	0.13	0.14	0.2091	0.7799	+0.11	-0.17
Household economic status (D)	0.17	0.26	-0.2795	-0.0425	-1.38	+0.08
Possession of livestock (D)	0.73	0.80	-0.0590	0.0709	-0.09	+0.18
Working mother (D)	0.08	0.11	0.2476	-0.3297	+0.41	+0.22
Ever-use of contraception[a] (D)	0.26	0.44	-0.6215	-0.0313	-5.79	+0.12
Birth order (D)	0.42	0.45	-0.1092	-0.048	-0.18	+0.03
Maternal age at birth (D)	0.88	0.90	-0.3395	-0.5349	-0.37	+0.23
Survival of preceding child (D)	0.92	0.96	0.1708	-0.5665	+0.37	+0.49
Preceding birth interval (D)	0.22	0.23	-0.6315	-0.8498	-0.35	+0.30
Succeeding birth interval (D)	0.28	0.27	-0.2134	-0.4274	-0.12	+0.09
Piped water supply (D)	0.26	0.32	-0.4034	-0.1283	-1.33	-0.17
Toilet facility (D)	0.80	0.89	-0.3123	-0.3711	-1.54	+0.73
Constant (Intercept)	-1.827	-2.139				
Dependent variable (CMR)	0.058	0.022				

Notes: + increase in CMR, - decrease in CMR. D denotes dichotomous variable. LMR = Low mortality region and HMR = High mortality region. [a] refers to ever-use of modern contraception. All the calculations were based on second and higher order births.

Source: Primary analysis of the 1988/89 KDHS data.

8.5 Further insights

This section provides further insights into the regional variations in infant and child mortality by focusing on only two provinces, namely Western and Central provinces. The primary focus in this section is on factors that have not been considered in the analyses so far and which could be associated with the observed higher mortality in the HMR and lower mortality in the LMR. Part of the information used in this section was gathered through informal discussions and interviews that the author held with a cross-section of purposively selected informants in Western and Central provinces and the four focus group discussion sessions that were held in two villages in Tetu Division of Nyeri District in Central province and in Amagoro Division of Busia District in Western province. The chosen districts are exemplary of the social and economic contexts in which ordinary mothers and their children live in each of the two provinces. As was pointed out in Chapter Three, the information obtained from the interviews and focus group discussion sessions is not representative in the statistical sense.

8.5.1 Main features of the two provinces

A description of the Central province and Western province was presented in Chapter Two. During the 1970s both provinces experienced similarly high levels of fertility. The total fertility rate estimates, based on the 1977/78 Kenya Fertility Survey for Central and Western provinces, were 8.6 and 8.2 respectively compared to the national figure of 8.2 children per woman (CBS, 1980: 101). However, the estimates based on the 1988/89 KDHS show that Central province had lower fertility than Western province. The total fertility rate estimates for the 1984-89 period for Central and Western provinces were 6.0 and 8.1 respectively and the average mean number of children ever born to women aged 40-49 was estimated at 7.3 and 8.2 for Central and Western provinces respectively. The results from the 1993 KDHS indicate that fertility has continued to decline in both provinces (NCPD *et al.*, 1994: 25).

A higher percentage of women in the reproductive age (15-49) in Central province were educated than their counterparts in Western province (Table 8.11). In

Central province, Nyeri and Kiambu districts had the lowest percentages of uneducated women aged 15-49 and Kirinyaga district has the highest percentage of uneducated women. Nyeri district also had the highest percentage of women with at least secondary education. In Western province, Busia district has the highest percentage of uneducated women and lowest percentage of women with at least secondary education. Busia district is followed by Kakamega district.

Table 8.11 Percentage distribution of women aged 15-49 by level of education, province and district: Kenya, 1979 Census

Province/district	None	Primary	Secondary or higher	Number of women
Central province	**28.0**	**52.2**	**19.8**	**468,311**
Kiambu	26.8	51.3	21.9	140,569
Kirinyaga	40.1	45.0	15.9	58,936
Muranga	29.4	54.4	16.2	127,216
Nyandarua	36.1	51.5	13.3	44,646
Nyeri	22.6	55.2	22.2	96,944
Western Province	**44.7**	**43.7**	**11.6**	**399,665**
Bungoma	38.3	48.8	12.9	105,746
Busia	58.5	34.6	6.8	72,113
Kakamega	43.3	44.3	12.5	221,806

Source: Calculated from the 1979 Population Census, Special Tables, No.18.

The welfare of a household is influenced by the economic status of its members, particularly the head of the household. Household incomes, consumption and expenditure patterns to a great extent depend on the economic status of the head of the household. The distribution of the households in both Central and Western provinces by economic status (activity) of the head of the household (Table 8.12) gives a rough indication of the main economic activities in the two provinces. The information was obtained from a nation-wide welfare survey that was conducted by the Central Bureau of Statistics in 1992. From the results it is clear that the major activity of the household heads and, consequently, households in the two provinces was farming, particularly food/subsistence farming. A slightly higher percentage of the households in Western province than in Central province were engaged in food/subsistence farming. Although in both provinces only a small percentage of the household heads were engaged in cash crop farming, there is a substantial difference in the cash crops grown in the two provinces. In Central province the common cash crops are coffee, tea and pyrethrum, and these are the main foreign-exchange earners in Kenya, while in Western province the main cash crops are sugar cane and cotton. Western province is essentially a subsistence economy.

Table 8.12 Percentage distribution of households in Central and Western provinces by economic status of household head: Kenya, 1992

Economic status	Central province	Western province
Export oriented	3.1	0.7
Cash crop	8.6	5.9
Food/subsistence farming	40.6	56.8
Working in public sector	10.3	15.3
Working private sector	22.1	16.0
Casual worker	9.0	0.7
Unemployed	3.6	2.4
Other*	1.7	2.2
Total number of households	1654.0	1071.0

Note: * includes pastoralists, student and the 'not stated' categories.
Source: CBS (1993: 39 Table 3.4).

In addition, animal husbandry in Central Province, backed by strong co-operative societies and unions, is more advanced than is the case in Western province where traditional African Zebu cattle dominate. Due to its richness in agriculture, highland climate and proximity to Nairobi, early white settlers were attracted to Central province; they introduced improved agricultural practices, started coffee and tea production in the province, established health and educational institutions, and put in place good road networks in the early part of this century. Since Independence in 1963 these facilities have been improved and increased in number due to the economic and political importance of Central province.

For example, during the field work in the Tetu Division of Nyeri district, the author observed that almost every household had at least one hybrid cow, a coffee or tea farm, and a small vegetable garden. Davison (1989: 10-11) made a similar observation about animal husbandry in the neighbouring district of Kirinyaga:

> In addition to tea and coffee production, there is some dairy farming. Most families keep at least one or two cows in addition to sheep and goats.

The 1992 Welfare Survey indicated that 71 per cent of the households in Western province had incomes that were below the mean national income. The corresponding figure for Central province was 65 per cent (CBS, 1993: 44-45). Though a small percentage of women in both provinces were in paid employment, the percentage of women in Central province who were currently in paid employment was twice that of women in Western province. Furthermore, though in both provinces only a small percentage of households had piped water supply and electricity, households in Central provinces were more likely to have such amenities than those in Western province (Table 8.13).

Table 8.13 Percentages of women aged 15-49 with selected socioeconomic characteristics and province: Kenya, 1988/89 KDHS

Characteristic	Central province	Western province
Are literate	83.7	68.9
Have no education	12.9	25.5
Have primary education	60.3	54.3
Have at least secondary education	26.8	20.0
Live in households with electricity	11.5	6.6
Live in households with a car	8.9	4.9
Live in households with a radio	71.8	63.7
Live in households with piped water	38.2	22.6
Live in households with a toilet facility[a]	99.6	90.0
Live in a permanent house (owned)	46.0	25.5
Currently in paid employment	16.8	8.3
Total number of women	1120	971

Note: [a] Flush, bucket, pit latrine

Source: Primary analysis of the 1988/89 KDHS data.

Provision of piped water, electricity and public utilities such as roads usually fall in the purview of either central or local government departments. However, in the case of electricity and water, individual rural households have to pay the cost of connecting these facilities to their households from the main distribution lines or points and to pay their consumption bills regularly. Therefore, the percentage of households with these facilities also reflects the relative ability of the community members to pay for those services.

After my field work in both Central and Western provinces, and observing and interviewing a cross-section of people, and having the information contained in Tables 8.11 to 8.13, the overall impression of the economic situation of women in Western province is that the majority and consequently their families, were at the minimum limit of existence and had to struggle daily to meet the basic needs of their families. The situation, according to most of the informants, was deteriorating as a result of the stringent structural adjustment programmes (SAP) being implemented in the country. The burden of adjustment programmes was falling disproportionately on the children under five, pregnant and breastfeeding mothers. In contrast, most of the households and families in Central province appeared to be economically better off and were striving to improve their standards of living. According to the informants, the SAP has not had serious adverse effects on the welfare of families in Central province because of the robustness and diversified nature of its economy and the fact that most people in the province were wealthy by Kenyan standards.

8.5.2 Some characteristics of women and children in Western and Central provinces

In the previous chapters a variety of risk factors for children have been identified. This subsection then examines the differences in the distribution of the births that occurred between 1970 and 1987 births in the two provinces by the selected risk factors. Table 8.14 shows that significant differences in the distribution of the births in the two provinces by the socioeconomic strata. A significantly higher percentage of children were born to educated mothers, non-working mothers, and into low-status households in Western than Central province. Similarly, in Western than Central province a significantly higher percentage of the children were born into households that did not have access to safe drinking water and into households that did not have a toilet facility.

These results indicate a significantly larger percentage of the births in Western than Central province were in the high risk category for each of the socioeconomic and household environment risk factors considered (Table 8.14). In the case of paternal education, the percentage distribution of the births to uneducated fathers in Central province was significantly greater than the corresponding percentage in Western province.

Table 8.14 Percentage distribution of the births that occurred between 1970 and 1987 in Western and Central provinces by socioeconomic and household environmental risk factors: Kenya, 1988/89 KDHS

Explanatory variable	Central province	Western province	Significance of difference in percentages (t-statistic values)
Maternal education			
None	22.9	38.1	-12.8***
Primary	61.4	49.5	9.3***
Secondary	15.7	12.4	3.5*
Paternal education[a]			
None	19.5	15.8	3.5***
Primary	53.8	58.8	-3.8**
Secondary	26.7	25.3	1.2
Mother's employment			
Yes	17.8	8.6	10.55***
No	82.2	91.4	-10.55***
Place of residence			
Rural	95.0	93.9	1.85
Urban	5.0	6.1	-1.85
Household economic status			
High	25.4	14.8	10.19***
Low	74.6	85.2	-10.19***
Possession of livestock			
Yes	75.7	79.7	3.7***
No	24.3	20.3	-3.7***
Household source of drinking water			
Piped	36.3	17.2	16.7***
Other	63.7	82.8	-16.7***
Household toilet facility			
Latrine or other	99.6	84.4	18.8***
None	0.4	15.6	-18.8***
Total number of births	3017	3035	

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. [a] Based on 2818 children in Central province and 3005 children in Westen province

Source: Primary analysis of the 1988/89 KDHS data.

Table 8.15 presents the percentage distribution of the children according to maternal factors. The percentage of the births to young mothers (< 20 years) was significantly greater in Western than Central province. A slightly higher percentage of births occurred to mothers aged 35 or more in Central than Western province. The analysis presented in Chapter Four showed that children of younger mothers experienced much excess infant and child mortality than children of mothers in the reproductive age (20-29 years). The results in Table 8.15 indicate that there were no statistically significant differences between the provinces in the average length of the preceding birth intervals.

Table 8.15 Percentage of the distribution of the births that occurred between 1970 and 1987 in Western and Central provinces by selected maternal factors: Kenya, 1988/89 KDHS

Explanatory variable	Central province	Western province	Significance of difference in percentages (t-statistic values)
Maternal age at birth (years)			
< 20	17.1	18.1	-1.0
20-29	57.4	55.5	1.7
30+	25.5	26.4	-0.9
Preceding birth interval			
< 24 months	20.7	21.8	-0.9
24-35 months	47.8	47.9	0.1
36+ months	31.5	30.3	0.9
Birth order			
1	19.0	16.9	2.1*
2-3	32.2	29.6	2.2*
4-5	24.8	23.9	0.7
6+	24.0	29.6	-4.9***
Use of modern contraception			
Yes	50.3	26.3	19.2***
No	49.7	73.7	-19.2***

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Source: Primary analysis of the 1988/89 KDHS data.

The percentage of second and third order births was higher in Central than Western province. However, the percentage of births of sixth or higher order was significantly greater in Western than Central province. These results, therefore, suggest that a higher percentage of children in Western than Central province were exposed to higher infant and child mortality risk because of higher birth order. Furthermore, a larger percentage of children in Western than Central province were born to mothers who had never used modern contraception.

During my field work in Busia and Nyeri districts, the issue of family planning services and other health services was raised often in the interviews that I conducted. In Western province most of the informants said that family planning services were not easily available. They argued that men were being overlooked since family planning was integrated with maternal and child care services in government clinics, the major provider of health services in the province. Furthermore, they said that, there were very few community based family planning programs and workers in the province to promote family planning at the village level. For example, there was only one community health worker at Kochyolia Health Centre, and she was to cover several villages. There was no community health worker at Kotur village. Neither did the villages have a Village Health Committee (VHC) or any such organisation to deal with health issues in the village. The village did not have any women's development group.

Some of the women in the focus group discussions in Kotur and Kocholya villages said that their husbands did not accept contraception and objected to discussing the subject. Most of the women were fearful of the side effects of the contraceptives. Only two women among the 12 women who took part in the discussions said they had used contraceptive pills in the past. The two women used the pills when they visited their husbands in Nairobi city.

Men who took part in the focus group discussions in Kocholya village were divided on the issue of approval of modern contraception. About half of the participants said they supported modern contraception and also allowed their wives to use it but expressed fear of side effects. They cited economic burdens of a large family size as their main reason for wanting to limit family size. The other half were strongly opposed to it, arguing that it might make their wives unfaithful to them and also fearing that their wives might become infertile as a result of the side effects. Despite the fact that family planning services were available at the local health centre, none of the participants (both male and female) had ever used modern contraception. A nurse at the health centre said that local people were generally not interested in modern contraception.

The men who took part in the focus group discussions held at Kotur village said that they had very little information about modern contraception and had never tried condoms or discussed them or other contraceptives with their wives. The majority suggested that fertility regulation and contraception were essentially women's issues because 'they are the ones who get pregnant and who know when they can get pregnant'.

In all the focus group discussions conducted in Nyeri district both men and women were unanimous about their approval of and the need for family planning. The women said that their husbands did not object to their use of modern contraception and they often discussed welfare issues including family planning and child spacing. They said that there were several community health workers, either employed by the Family Planning Association of Kenya or the Ministry of Health. Community health workers provided pills, condoms and creams, and related information and education materials, and referred to clinics clients with side effects or who wanted sterilisation or Norplant. Most villages had VHCs to discuss health issues, including family planning, and to seek ways and means of improving the health status of the villagers.

In addition, most women said that they belonged to women's development groups and that they often discussed family planning in their meetings. Most of the community health workers I talked to in Tetu Division confirmed most of the views that were expressed in the focus group discussions. Those views are attested by the fact that use of modern contraception was lower in Western than Central province. For example, about 35 per cent of the 1120 mothers interviewed in 1988/89 KDHS in

Central province had used modern contraception as against only 18 per cent of the 971 women in Western province. These results are consistent with those of previous studies (CBS, 1984; NCPD, 1989: 37). Furthermore, the information presented in Appendix 8.1 supports the views expressed by the participants regarding family planning in the two provinces.

8.5.3 Maternal and child care

This subsection examines the differences, if any, in the level of access to and use of maternal and child care services in the two provinces. The care that a mother received during pregnancy and at the time of delivery is important for the survival and well-being of the new baby and herself. Maternity care before delivery (ante-natal care) includes periodic visits to the health clinic for check-up of the pregnancy, immunisation of the expectant mother against tetanus, receiving advice on appropriate diet, treatment of any complications associated with the pregnancy, as well as having a medically supervised delivery. The health of the newly born child and its mother immediately before and after delivery, to a great extent, is determined by the skill of the birth attendant, the sanitary conditions of the place of delivery, and the hygienic procedures followed during delivery.

Maternity care after delivery (post-natal care) includes both preventive and curative medical care. Post-natal care for mothers includes examination of her nutritional status, treatment for anaemia, and advice on diet, child care, breastfeeding, weaning and family planning. The major preventive care is the immunisation of the children against major childhood diseases (TB, diphtheria, poliomyelitis, whooping cough, and measles). Curative care involves the detection of illness, the selection of the type of treatment the child receives, the timing of seeking treatment, and the effectiveness of the selected treatment.

During the 1988/89 KDHS respondents who had given birth in the five years preceding the interview were asked if they had consulted anyone for ante-natal care before birth. They were asked the place where the delivery took place, if anyone had assisted them with the delivery of that child and, if so, they were asked who provided the care. In cases where the maternity care was received from more than one provider, the most qualified provider was recorded by the interviewer (NCPD, 1989: 59). In addition, mothers were asked if they had received an injection of tetanus toxoid before birth to prevent the baby from getting tetanus. The responses received in relation to this question undoubtedly depended largely on the mother's ability to distinguish between tetanus toxoid vaccination and the other injections she might have received during that particular pregnancy. Despite this drawback, the percentage of women immunised against tetanus infection in each of two provinces provides a rough indicator of the extent to which children in the two provinces were protected against neonatal tetanus infection.

(a) Tetanus toxoid immunisation coverage

For most of the births that occurred between 1983 and 1989 in Central and Western provinces mothers had received tetanus toxoid immunisation and ante-natal care from medical personnel during the pregnancy (Table 8.16). There was no significant difference in the uptake of the tetanus toxoid immunisation between the expectant mothers in the two provinces. However, significant differences are observed in relation to the ante-natal care providers. In Central province, for 53.3 per cent of the births mothers had consulted a doctor and only 16.3 per cent had seen a trained nurse or a midwife, whereas in Western province for 12.6 per cent of the births the mothers had consulted a doctor and for 60 per cent of the births mothers had seen a trained nurses or a midwife.

In addition, in Western province for about 2.4 per cent of the births, the mothers obtained ante-natal care from a traditional birth attendant, while in Central province a negligible per cent (0.4) had seen a traditional birth attendant for ante-natal care. In Central province for 29 per cent of the births the mothers did not consult anybody for ante-natal care, compared to about 25 per cent in Western province. The large percentage of the births in each province whose mothers did not consult anybody for ante-natal care suggests that the reporting of the tetanus toxoid vaccination was exaggerated in both provinces. It is also possible that the respondents did not associate injection of tetanus toxoid with ante-natal care.

Table 8.16 Percentage distribution of live births that occurred between 1983 and 1989 by whether the mother received tetanus toxoid immunisation and ante-natal check-up provider: Kenya, 1988/89 KDHS

Ante-natal care /provider	Central province	Western province	Significance of difference in the percentages (t- statistics)
Received tetanus toxoid vaccine	89.9	88.5	0.8
Received antenatal care from:			
(a) Doctor	53.3	12.6	20.0***
(b) Trained nurse	16.3	60.1	-20.4**
(c) TBA	0.4	2.4	3.7**
(d) Other	1.0	0.5	1.3
(e) No one	29.0	24.4	2.8*
Total number of children	969	1132	

Source: Primary analysis of the 1988/89 KDHS data.

The information obtained from informal interviews held with some health personnel and the focus group discussions with women in both Nyeri and Busia districts suggest that some mothers felf that they did not need ante-natal care because they thought that clinic-based ante-natal care was meant for women who were having their first pregnancy, or women who had experienced problems with their previous pregnancies, and those whose physiological development (stature) do not permit a normal delivery. For instance, during one of the focus group discussion sessions at Kocholya village, a mother of eight children had the following to say:

> I did not go to any clinic for my children [pregnancies]. I did not experience any problem with my first child [pregnancy]. I did not have any problem with the other seven children [pregnancies]. I did not see or have any reason for wasting my time and money to go to the clinic. But my neighbour, Atiang'a[5], had to go to the clinic during her second pregnancy because she nearly died during her first delivery which took place at home.

In contrast, in Njoguini Health Centre in Tetu Division of Nyeri District, a story was narrated to me of a mother who did not visit the clinic for ante-natal care during

[5] This is an alias. Hence the confidentially of the identity of the person referred to is not violated.

her pregnancy because she thought it was not necessary since she had no apparent health problem. She had no problems with her previous pregnancies. However, during the sixth month of her third pregnancy she felt sick and then decided to go to the health centre for treatment. She was referred to Nyeri Provincial Hospital where she was diagnosed as anaemic and subsequently put on a special diet. Two months later she had a normal delivery in one of the maternity homes in the Division.

(b) Delivery place and service provider

As mentioned earlier, the sanitary conditions of the place of delivery and the skill of the birth attendant as well as the hygienic procedures followed during child birth affect the survival chances of both the mother and her new baby. The risk of maternal and infant death during and immediately after delivery is particularly great when the delivery is not adequately attended to. The responses to the questions on the place of delivery and who provided assistance that were asked during the 1988/89 KDHS are presented in Table 8.17.

Table 8.17 Percentage of total births delivered between 1983-89 according to type of place of delivery, service provider, and province: Kenya, 1988/89 KDHS

Place of delivery /provider	Central Province	Western Province	Significance of difference in the percentages (t-statistics)
Place of delivery			
Delivered in hospital	69.2	32.5	16.8***
Delivered in a clinic	4.9	1.6	4.3***
Delivered at home	24.9	65.4	-18.5***
Assistance at delivery			
Delivered by a doctor	35.1	6.2	16.6***
Delivered by trained nurse	39.0	28.8	4.9***
Delivered by TBA	6.0	11.1	-4.1***
Delivered by relative/other	12.0	21.4	-4.7***
Delivered on her own	5.7	31.5	-14.8***
Total number of children	969	1132	

Note: *** $p < 0.001$, ** $p < 0.01$ and * $p < 0.01$.

Source: Primary analysis of the 1988/89 KDHS data.

About 75 per cent of the births that occurred in Central province took place in a health institution; that is they were delivered by a doctor or a trained nurse. The rest were delivered at home, with 6.0 per cent delivered by traditional birth attendants (TBA), 12 per cent by a relative or some other person and 5.7 per cent were unattended. In contrast in the Western province only 35 per cent were delivered under medical supervision; the rest were delivered at home and most of them were unattended to. Thus most of the deliveries in Central province took place in health institutions while in Western province the majority took place at home and were unattended.

These findings are confirmed by the discussions with the health personnel and other informants in the two provinces. Most informants said that because of the high level of awareness of the importance of ante-natal care, most expectant mothers in Central province were highly motivated to make use of modern maternal and child health care services and that they were able to pay for the services. A wide variety of health facilities, including maternity clinics and nursing homes, was generally available and accessible to the majority of the expectant mothers in the province. In addition, some expectant mothers in Kiambu district could easily obtain maternity services in Nairobi city.

In contrast, the informants in Western province were of the opinion that modern maternal and child health care services, just like other modern health services, were either not available or were not accessible to the majority of the population. Hence most of the child deliveries took place at home unattended. Several of the participants at the focus group discussion sessions held at Kotur and Kocholya villages of Busia district discussed the problems they encountered in seeking maternity and other health services. The problems included lack of ambulances, lack of quick public transport, lack of maternity clinics in the neighbourhood, lack of trained traditional birth attendants, long travel distance to nearest maternity clinic, and impassable rural access roads during the rain season. Some of them narrated their personal experiences. Mary's experience is typical of the experiences that I was told. Mary, aged about 28, a mother of three and a Form II school leaver, described her experience as follows:

> It was a Friday evening in July 1984. I suddenly felt a sharp pain here (pointing at her abdomen) and earlier in the day I had a funny feeling. There was something wrong with my body but I did not know what exactly it was. I realised my time to deliver was about. I sent for my husband from my father-in-law's house where he had been drinking most of the day. Despite his apparently drunken state, my husband rode with me slowly on his bicycle to Amukura Mission Hospital (about 10 km away) but about one kilometre away from the hospital, I gave birth to Asere. My mother-in-law who had followed us on foot was my birth attendant. Apparently, my mother-in-law was prepared for this task. She had even carried a razor blade with her. My husband left me and my mother in-law in the bush and went to call for a vehicle from the hospital but it was out of order. So he had to take me on his bicycle to the hospital. I spent three days in the hospital because they were not sure about Asere's and my own health.

One of the other stories narrated to me was about a mother who delivered on a Sunday afternoon at a bus stop at Kocholya market while awaiting public transport to Bungoma District Hospital to which she had been referred by a nurse at Kocholya Health Centre because there were no maternity facilities. Her baby died soon after delivery and she was given a lift by the local priest to Busia District Hospital where she was hospitalised for about two weeks.

Jensen and Juma (1989: 245-246) obtained similar responses when they interviewed women in two sublocations in Webuye Division in Bungoma district in Western province. For example, the women in Makuselwa sublocation gave the following comments unanimously: -

> Women cannot reach hospitals easily because of poor roads and lack of transport and long distance. Expectant mothers, lactating mothers and young children don't go to clinics because the two hospitals, Misikhu and Lugulu are too far and expensive. Therefore, children die sometimes due to lack of urgent medical attention (p.245).

The women in Muchi sublocation commented as follows: -

> Several women die at childbirth in this sublocation. Last year, about 20 women died at childbirth. During the rainy season, Muchi is cut off from the rest of Bungoma due to very poor access roads. Pregnant women do not go to Webuye clinic which is the only health

> centre available and it is very far, about 20-30 km. Women's diseases and complications are not detected. Children die in big numbers, and they are not taken for clinic-immunisation etc. Last year, about 100-150 children died from malnutrition, measles, malaria, cough and typhoid (p.246).

In Tetu division of Nyeri district I was told of experiences relating to urgent maternity help but the women involved almost invariably obtained appropriate assistance either from a retired midwife or some other such person in the community, or transport was quickly sought for and they were sent to Nyeri Provincial Hospital or some other private maternity home which operated for 24 hours a day. For example, within Tetu Division of Nyeri district there were four maternity/nursing homes and two hospitals with maternity wards (at the time of field work in September 1993). Public transport was not a big problem since a fairly large number of public service vehicles, particularly mini-buses called '*Matatus*', served most of the roads and the road network in the Division was good. In addition, some of the villagers owned vehicles some of which could be used in case of an emergency, particularly at night.

All this information strongly indicates that maternity services were and are not as accessible to the majority of the expectant mothers in the Western province as they are in the Central province. The field work information about the availability of health services is confirmed by the information obtained from the Ministry Health and presented in Table 8.18. This problem in Western province was complicated and exacerbated by poor road infrastructure and networks, inadequate public transport, high travel costs, long distance to nearest health facility and poverty. For example, in Amagoro Division of Busia district there was no maternity or nursing home. Most of the rural access roads in the area were not serviced by any public transport and most of them were impassable during the rain season. Because of poverty, hardly any vehicles were owned by the local villagers. The few people from the area who owned cars worked in urban areas such as Nairobi and they occasionally visited their countryside homes; their cars were not usually available to the villagers.

Table 8.18 Number of maternity homes and hospitals with maternity wards in Western and Central provinces: Kenya, 1993

Province/district	Maternity homes	Hospitals	Total
Central Province	**8**	**35**	**43**
Nyeri	6	7	13
Kirinyaga	1	2	3
Muranga	0	10	10
Nyandarua	0	4	4
Kiambu	1	12	13
Western province	**3**	**19**	**22**
Busia	0	5	5
Bungoma	0	6	6
Kakamega	3	8	11

Source: Compiled from the Ministry of Health (Kenya) records on the number of health facilities by district and type.

(c) Child immunisation coverage

Immunisation against the major childhood diseases (TB, diphtheria, poliomyelitis, whooping cough and measles) can greatly enhance child survival. This subsection examines the extent to which children under five years in Central and Western provinces are immunised, using the information obtained from the 1988/89 KDHS. However, this analysis is restricted only to living children aged 12-23 months whose health cards were seen by the interviewers.

Child immunisation coverage was higher in Central than Western province. The largest difference in immunisation coverage was in relation to the measles vaccine; 94 per cent of the children aged 12-23 months had received the vaccine in Central province compared to only 66 per cent in Western province (Table 6.19). About 88 per cent of the children in Central province were fully immunised against the six major childhood diseases while in Western province only 56 per cent of the children were fully immunised. The immunisation coverage levels among children in Central province were higher than the national average levels. However, the level of immunisation among children in Western province was lower than the national average level for each of the vaccines and the overall level of full immunisation.

Table 8.19 Percentage of the children aged 12-23 months with health cards seen by interviewer who had been immunised in Western and Central provinces: Kenya, 1988/89 KDHS

Vaccine	Central province	Western province	National
BCG	95.6	95.5	96.7
DPT 1	100.0	98.3	98.9
DPT 2	99.4	90.8	96.1
DPT 3+	98.2	80.6	90.7
Polio 1	100.0	97.4	99.3
Polio 2	100.0	86.5	95.8
Polio 3+	97.9	78.7	92.4
Measles	93.6	66.2	78.0
All vaccines*	87.7	56.5	72.8
Total number of children	203	189	1315

Notes: * BCG, at least 3 doses of DPT and polio, and measles vaccine.

Source: Primary analysis of the 1988/89 KDHS data.

Nearly all the women in the focus group discussion sessions in Kotur village appeared to be aware of the importance of immunisation but argued that the long distance to the nearest health facility, frequent shortages of the relevant vaccines and the heavy domestic workloads they shoulder discourage them from having their children immunised. Some complained that some vaccines made their children sick. So they said most of their children were not immunised. The men who took part in the focus group discussions confirmed the views expressed by the women.

Although Kocholya village had a health centre the situation was not any different there. During the focus group discussion sessions which were held just a few metres away from the health centre, the participants complained of having been turned away several times with their children from the health centre because of the frequent shortage of vaccines, drugs and other medical supplies. According to them, most of the villagers had been discouraged as a result and hardly ever went there for child immunisation or for treatment. Furthermore, the health centre did not have a maternity wing or ward. They said that they had nobody to complain to since no VHC had been established, and the health centre was managed by the District Health

Management Team based at the District Headquarters at Busia Township, about 30 kilometres away.

According to the local village Headman, *Loka alipo,* the VHC had not been formed because the local people felt it was irrelevant since public health facilities and services were administered by the Ministry of Health. However, all the men denied that they had ever been requested to form a VHC. Later in my discussions with some of the staff of the health centre, the complaints of the villagers were confirmed. The staff pointed out that the health centre had no electricity and therefore could not store a large number of vaccines. Also, because their transport vehicle was often out of order, it was very difficult to replenish the vaccines and other medical supplies on a regular basis. 'In addition, we are given according to what is available at the medical stores at Busia Township', they said.

(d) Childhood morbidity and treatment

This subsection examines prevalence of diarrhoea, fever/malaria and whooping cough among children under five years in the two provinces. The data were obtained from the 1988/89 KDHS. The respondents were asked about the occurrence of these three illnesses among their children aged under five years in the four weeks preceding the interview and the treatment provided for the children experiencing these illnesses. The accuracy of the morbidity data obtained obviously depended on the mother's understanding of these terms (diarrhoea, fever and whooping cough) and her ability to recall when the episode of the illness occurred among her children under age five. In addition, the KDHS survey was carried out during the dry season, when the prevalence of these illnesses would generally be lower than during the wet season.

Diarrhoea was slightly more prevalent among the children in Western than Central province (Table 8.20). However, fever and whooping cough were more frequently reported among the children in Central than Western province. Except for the results pertaining to fever, the other morbidity results are consistent with the out-patient records for 1984 (Table 8.21). These data clearly show that malaria and diarrhoea were more prevalent in Western than Central province, and diseases of the respiratory system were more prevalent in Central province, presumably because of its higher altitude.

Table 8.20 Percentage of children under five years who had diarrhoea, fever and whooping cough in Western and Central provinces: Kenya, 1988/89 KDHS

Illness	Central Province	Western Province
Had diarrhoea recently (0-2 weeks)	11.0	22.2
Had fever recently (0-4 weeks)	54.1	44.9
Had whooping cough (0-4 weeks)	11.5	6.6
Total number of children	785	845

Note: The figures in parentheses indicate weeks preceding the Survey.

Source: Primary analysis of the 1988/89 KDHS data.

Morbidity statistics, such as those provided in Table 8.20, are filtered, that is, only those who seek treatment are reported. Reported morbidity thus represents treatment of disease rather than its prevalence. It is possible, for example, that fever is as prevalent or more prevalent in Western than Central province, but unless the sufferers are treated in hospital or clinic they will not appear in the morbidity statistics. Morbidity statistics, such as those in the 1988/89 KDHS data, could be reflectng differing levels of perception of illness itself or its severity, rather than prevalence of equivalent symptoms.

Table 8.21 Percentage distribution of out-patients by major illnesses (new cases) in Western and Central provinces: Kenya, 1984

Illness	Central province	Western province	National
Malaria	11.5	35.3	25.4
Diseases of the respiratory system	28.5	18.8	19.4
Diarrhoeal diseases	4.8	5.8	6.6
Diseases of the skin	5.7	5.7	6.2
Intestinal worms	6.4	4.2	5.4
Other	43.10	30.2	37.0
Total number of new cases	**4,712,969**	**4,436,478**	**28,745,182**

Source: Central Bureau of Statistics (1991b: 197, Table 186a).

Home management of illness by mothers in both provinces is examined in relation to how they responded when diarrhoea attacked some of their children. Correct home management of diarrhoea entails using Oral Rehydration Sachets (ORS) or a home-made solution of sugar, salt and water, increasing fluids in the diet of the child and continuing to feed the child. The child should be taken to the clinic or hospital quickly if it is not responding to home treatment. During the 1988/89 KDHS mothers who reported that their children had experienced episodes of diarrhoea during the 24 hours to two weeks preceding the survey were asked whether or not the child was taken to hospital or clinic, and whether ORS or a home-made solution of sugar, salt and water was used for treatment, whether more or less fluids were given to the child. The responses to these questions are summarised in Table 8.22.

These results show that mothers in Central province knew how to manage diarrhoea better than mothers in Western province. Mothers in Western province were less likely to take the child suffering from diarrhoea to hospital or clinic than the mothers in Central province. Similarly, they were less likely to treat the disease with ORS, or with a home-made solution of sugar, salt and water, Further more, they were less likely to give the child more fluids to prevent the child from dehydration.

Table 8.22 Percentage of children sick with diarrhoea according to type of treatment given by province: Kenya, 1988/89 KDHS

Action taken	Central province	Western province
Treated with Oral Rehydration Sachets	19.8	16.3
Taken to hospital/clinic for treatment	33.0	27.0
Given solution of sugar, salt and water	71.8	52.6
Given more fluids	66.0	17.4
Given less fluids	23.9	51.4
Given more food	12.7	5.0
Total number of children	91	191

Source: Primary analysis of the 1988/89 KDHS data.

Most of the health workers I interviewed in Western province, particularly in Busia district, said that most people, invariably mothers, sought medical treatment for their sick children when it was too late. They said that, because of high opportunity cost, lack of transport and sometimes ignorance, mothers sought medical attention only when they felt their children were very sick. The same was the case with sick adults. These views were confirmed during the focus group sessions at both Kotur and Kocholya villages. In contrast, the health workers interviewed in Nyeri district said late reporting of sickness among young children was generally rare. However, they said it was common among sick elderly people.

(e) Childhood nutrition

The nutritional standards of the children in Western province compare favourably with those of the children in Central province (Table 8.22). The nutritional status of the children in Western province also compare favourably with the average national nutritional status as well as the national nutritional standards. Only in 1982 were the nutritional levels among the children in Western province slightly lower than those of Central province and the national average. The district level nutritional indices for the districts in Western province also compare fairly well with those for the districts of the Central province (Table 8.23). However, the 1987 figures suggest that stunting was far less common among the children in Kakamega and Bungoma districts than among the children in most of the districts in Central province.

For the same period, the nutritional standards among the children in Busia district were higher than those among the children in Nyeri and Nyandarua districts but lower than those for the children in the rest of the districts in Central province. Table 8.22 indicates that between 1982 and 1987 there was a substantial improvement in the nutritional standards of the children in Western province as indicated by a decrease in the percentage of stunted children over the five year period.

Table 8.23 Nutritional status indicators in 1982 and 1987 in Western and Central provinces: Kenya

	Percentage stunted		Percentage wasted	
	1982	1987	1982	1987
Central Province	**24.0**	**12.8**	**2.8**	**1.5**
Nyeri	18.5	20.1	3.0	1.3
Muranga	24.8	12.0	4.2	4.2
Kiambu	17.5	5.7	1.2	1.7
Kirinyaga	24.5	2.5	1.9	1.9
Nyandarua	12.4	23.8	2.0	0.3
Western province	**25.7**	**10.4**	**2.0**	**2.1**
Kakamega	26.7	4.2	2.0	1.8
Bungoma	24.1	9.2	2.0	1.2
Busia	21.1	18.5	2.1	3.5
National	**24.0**	**19.6**	**3.0**	**2.5**

Source: Central Bureau of Statistics (1983: 32, 1991a: 44).

As pointed out in Chapter Two, some of the small-scale nutrition surveys carried out in Western province and almost all the informants and health workers I talked to in that province during my field work suggested to me that child malnutrition was a more serious problem than portrayed by the nutritional indices presented in Table 8.22. Whyte and Karuiki (1991: 172) indicate that 42 per cent of the children were malnourished in Busia District between 1988 and 1989.

In addition, the establishment in the early 1980s of a nutrition-intervention program in the Western province was an acknowledgment on the part of the government that malnutrition was a serious problem in the province and that the situation ought to be improved. To this end, in Busia district there are two Family Life Training Centres (FLTCs) at Butula and Nangina. Mothers and their malnourished children are admitted to these centres for a period of three weeks. The mothers are trained in principles of good nutrition and family health, and they are helped to feed their children intensively, using local foods. There are fourteen such centres in the country. The program is implemented by the Ministry of Culture and Social Services.

Masimba (1982: 11 cited in CBS and UNICEF, 1984: 76) indicated that among the 114,807 children that were seen in 1982 in clinics in Kakamega district, 1.3 per cent had kwashiorkor, 0.6 per cent had marasmus and 0.7 per cent had both kwashiorkor and marasmus. Most of the malnourished children came from Mumias and Kiamosi Divisions of the district. My discussions with several health workers in Bungoma and Kakamega districts revealed that malnutrition was quite wide-spread in these districts as well and that malnutrition was particularly serious in Mumias Division of Kakamega district, where sugar-cane growing was predominant.

My informants attributed childhood malnutrition in the province to the introduction of sugar cane growing in the area in the 1970s and the fact that most of the money from the sale of sugar-cane and other cash crops was not spent on meeting food requirements of the family. They also attributed it to population increase, absence of husbands in some households due to migration to urban areas, large families, a decrease in milk production, and changes in life styles[6] brought about by modernisation. Some of the informants were of the opinion that malnutrition in the province was also due to the fact that the majority of the mothers in the province were uneducated and thus lacked appropriate knowledge on proper feeding practices, particularly those relating to weaning.

In contrast, my discussions with some health workers in Central province also revealed that malnutrition was not a serious problem in that province. They, however, pointed out that there were isolated cases of malnourished children, particularly in the relatively poor parts of the province. For instance, in Nyeri district one health worker told me that she had seen a few malnourished children in the newly settled divisions of Kieni East and Kieni West. Some of the informants suggested that malnutrition was a common health problem among the children in some of the agriculturally poor parts of Muranga district.

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[6] For example preference for maize meal over the traditional sorghum and millet meal which is nutritionally richer than the maize meal. Another example is the preference for tea to porridge prepared from sorghum or millet.

8.5.4 Water and sanitation

My interviews and my own observations confirmed that most people in Western province lacked access to safe water. Most people depended on rivers and wells for water and most of the people did not boil water before drinking. In discussions in both Kotur and Kocholya villages, the women said that although they were aware that unboiled water from the river or the well was contaminated, they did not boil the water. They said that there was no time to do so and nobody did it in the village. In addition, they said they were not aware of anybody in their village who had died because of drinking unboiled water. In both Kocholya and Kotur villages some households had pit latrines and others did not have any toilet facility.

My observations and interviews also confirmed that in Central province access to safe water was fairly good. Sanitation was also good. For example, in Njoguini village, most households had access to a piped water supply and most households had a toilet facility. During the discussions, all the informants in Njoguini and Kanjora-B villages said that they had access to piped drinking water and that they had toilet facilities in their households.

8.6 Conclusion

The analysis in this chapter showed that the differences in infant and child mortality between the HMR and the LMR were largely due to difference in the structure of relations between the explanatory variables and mortality in the two regions. The lower average level of maternal education, the lower proportion of households of high economic status, the lower proportion of children belonging to households that had livestock, the lower level ever-use of modern contraception, and the lower proportion of children whose preceding sibling survived infancy contributed to the observed high infant mortality in the HMR relative to the LMR. The lower ever-use of modern contraception and the lower proportion of households with access to piped drinking water and a toilet facility, and the lower average level of maternal education contributed to the observed high child mortality in the HMR compared to the LMR.

Overall, the results showed that, other things being constant, infant and child mortality rates were more responsive to the changes in the average level of maternal education, household economic status, possession of livestock, ever-use of modern contraception and survival status of the preceding sibling at age one in the HMR than the LMR. Other things being constant, the infant mortality rate in the HMR was particularly responsive to an increase in the average level of maternal education and an increase in the proportion of infants with preceding siblings surviving to age one. Similarly, child mortality rate was more responsive to changes in the level of ever-use modern contraception, the proportion of children belonging to households with a toilet facility and the average level of education in the HMR than the LMR. Child mortality in the HMR was particularly responsive to an increase in access and use of health facilities and services as represented by ever-use of modern contraception. The results showed that changes in the values of the explanatory variables would bring about only minor changes in the levels of infant and child mortality in the low mortality region. This is so mainly because mortality is already low.

The results of analysis of the author's field work, the 1988/89 KDHS and secondary data suggest that the differences in the chances of child survival between Central and Western provinces, and by extension between the HMR and LMR, were due to the differences in the level of social and economic development, accessibility to medical care, utilisation of health facilities, and climatic and ecological conditions prevailing in the two provinces. The results show that Central province was characterised by higher levels of social and economic development. It has a stronger, robust and a more diversified economy than Western province which is essentially a peasant economy in which small-scale subsistence farming is the major economic activity. For example, Central province has a well-developed market-oriented agriculture, concentrating on tea and coffee production, and on animal husbandry industry. A higher percentage of households in Central than Western province had access to a piped water supply, a toilet facility, electricity, radio and television sets.

Women's status in relation to men in terms of education and the degree of bargaining power in the household was greater in Central than Western province. The majority of women in Central province were educated and most of them were involved in women's development groups. Because of higher educational attainment and involvement in women's development groups, a higher percentage of mothers in Central than Western province partake in the decision making processes in matters affecting their own and their own children 's welfare. This is indicated by a higher percentage of mothers who often discuss welfare issues, including family planning, with their husbands or partners.

Health facilities, including maternity clinics and nursing homes, were more available and accessible to the majority of the people in Central than Western province. Mothers in Central province, due to their higher level of education and ability to pay for the various services, coupled with wide-spread promotion of the use of health services, were highly motivated to partake in the health programs. This is reflected by the higher level of utilisation of health facilities. Contraceptive prevalence was higher in Central than Western province. The results showed that mothers in Central province than mothers in Western province were more likely receive ante-natal care from a doctor or trained nurse and that they were more likely to deliver their babies in health institutions under the supervision of a doctor or trained nurse. They were also more likely to take appropriate action when their children were sick (for example, to increase fluids in the diets of children suffering from diarrhoea to prevent dehydration) and to immunise their children. The situation in Western province was further complicated by high fertility and increasing poverty.

The higher utilisation of health facilities in Central province compared to Western province was further facilitated by the availability of better transport, better road infrastructure and networks. Most villages were connected to each other by good rural access roads. Most of the roads, including rural access roads, were served by reliable public transport. The good roads and reliable public transport enabled people to reach health facilities quickly, and they also facilitated the work of community health workers by allowing them to visit households in the villages easily. In contrast, in Western province, transport, road infrastructure and networks were poor and inadequate. Most rural access roads were not served by any public transport and most of them were impassable during the rain season.

Although the quantitative data presented in Table 8.20 show that children in Central and Western provinces had similar nutritional status, the results from small-scale studies and my discussions with a cross-section of people in Western and Central provinces seem to suggest that the nutritional levels were poorer in Western than Central provinces. Most of the informants suggested that the nutritional levels were deteriorating in Western province. They attributed this to factors such as increasing poverty, rapid population increase, high fertility, introduction of sugar-cane and tobacco growing in the province and the increasing prices of farm inputs.

Differences in climatic and ecological conditions that were discussed in Chapter Two are some of the other factors that could be associated with the differences in infant and child mortality between the two province. Malaria was more prevalent in Western than in Central province. The high altitude of Central province discourages malarial mosquitoes; hence malaria is less common there. Similarly, water-borne diseases, particularly diarrhoeal diseases, were more common in Western than Central province. This could be associated with flooding which is a common feature in some sections of Western province that are near the shores of Lake Victoria. The flooding could be due to the undulating terrain of Western province which gradually declines towards Lake Victoria.

CHAPTER NINE

CONCLUSION

This study had three main objectives. First, it aimed to establish the effects of selected socioeconomic factors and proximate variables on infant and child mortality in Kenya. The socioeconomic factors included maternal and paternal education, mother's work status, province of residence, place of residence, possession of livestock and household economic status. The proximate variables comprised maternal age at birth, birth order, preceding and succeeding birth intervals, survival status of the preceding child, ever-use of modern contraception, household's source of drinking water and whether the household had a toilet facility. Second, the study sought to establish the extent to which the socioeconomic factors influenced infant and child mortality through each other and through the proximate variables. Third, it aimed to establish the determinants of infant and child mortality in the low-and high-mortality provinces and to provide some insights into the differences in the levels of infant and child mortality between the two groups of provinces, and also between Western and Central provinces.

The data for this thesis were drawn from the 1988/89 Kenya Demographic and Health Survey (KDHS) and the information obtained from the author's field work in Western and Central provinces. Relevant supplementary information was obtained from various published and unpublished documents. All the analyses on infant and child mortality were based on the data drawn from the 1988/89 KDHS. The analysis on infant mortality was based on the single live births that occurred between 1970 and 1987. Analysis of child mortality was based on the single live births that occurred between 1970 and 1983 and who survived infancy. Due to the small numbers of exposed children in each of the provinces covered in the 1988/89 KDHS, multivariate analysis of the determinants of infant and child mortality was not carried out for each province. The provinces were grouped into two broad groups: the low-(LMR) and high-mortality (HMR) regions on the basis on their levels of infant and child mortality.

This was done in order to retain a sufficiently large number of observations in each mortality region. The analytical model developed by Mosley and Chen (1984) was adopted to guide the study. Logistic regression was used to analyse the effects of the explanatory variables on infant and child mortality.

The infant mortality rate for the children born between 1970 and 1987 was 57 per 1000 live births and the child mortality rate among the children born between 1970 and 1983 and who survived infancy was 37 per 1000. In 1989, a Kenyan woman, on average, had 6.7 children if she survived throughout her reproductive life. These results indicate that the Kenyan demographic scene is characterised by fairly high fertility and moderate mortality compared to other developing countries, particularly in Africa. The factors that significantly influenced infant mortality were the province of residence, the survival status of the preceding child at age one, the preceding birth interval, household economic status, birth order, paternal education and possession of livestock. With respect to child mortality, the factors that had most significant effects were the province of residence, the preceding birth interval, the succeeding birth interval, ever-use of modern contraception, household economic status and toilet facility. The effects of each of these factors on child mortality was net of the influence of the year of birth of the child.

Year of birth of the child was found to be a significant determinant of child mortality. Children who were born between 1980 and 1983 were significantly less likely to die than those children who were born in the 1970s. This means that there was a significant decline in child mortality over the period under review that was net of the effects of province of residence, both preceding and succeeding birth intervals, household economic status and ever-use of modern contraception. The decline in child mortality could be due to improvements in childhood nutritional status, and improving coverage and quality of public and private health services, including immunisation, malaria and diarrhoeal disease control programs. Over the same period, there were significant improvements in transport and communications networks in the country as a whole (MPND, 1989). These improvements could also have contributed to the decline in child mortality. Good roads and quick transport can save human life. People needing urgent medical attention can easily be taken to hospital or a clinic. As pointed out in Chapter Eight, expectant mothers and children sometimes die in Western province partly because of lack of urgent medical attention caused by lack of quick transport and poor roads. Good roads and transport networks facilitate the implementation of public health programs and other welfare programs, and the movement of people including health personnel, and the transportation of goods such as food and medical supplies from one part of the country to another where they may be needed urgently.

The results obtained from regional multivariate analyses showed some differences in the factors that had significant net effects on infant and child mortality in the LMR and the HMR. The determinants of infant mortality in the LMR were the survival status of the preceding sibling, the length of the preceding birth interval, birth order, household economic status and place of residence. On the other hand, the determinants of child mortality in the LMR descending in order of importance were length of the preceding birth interval, the succeeding birth interval, maternal age at birth, maternal education and place of residence.

The determinants of infant mortality in the HMR were the preceding birth interval, the survival status of the preceding sibling, possession of livestock, paternal education, maternal education, household economic status and maternal age at birth. With respect to child mortality, the determinants of child mortality were the preceding birth interval, ever-use of modern contraception, the succeeding birth interval and household economic status. The year of birth of the child was also found to be significantly related to child mortality in the HMR. The results also suggest that over the 1970-1983 period, significant improvement occurred in child mortality in the HMR that was net of the effects of birth intervals, household economic status, and access to and use of health services as represented by ever-use of modern contraception.

The study demonstrated that the province of residence was the most important factor determining infant and child mortality in Kenya. Residence in Nyanza, Western and Coast provinces had exceptionally high risks of infant and child mortality, while residence in Central, Rift Valley, Nairobi and Eastern provinces was associated with a lower risk of infant mortality. These results confirm the findings of previous studies (Anker and Knowles, 1980: 176-183; Mott, 1982: 20-23; Ewbank *et al.*, 1986: 42-47; Muganzi, 1984: 79). The effect of province of residence was stronger on child mortality than on infant mortality. The inter-provincial differentials in infant and child mortality were, by and large, independent of the explanatory variables included in this study. Hence, these results provide empirical evidence that inter-provincial differences in the characteristics of parents, as measured by the 1988/89 KDHS, are of little statistical significance in explaining the provincial differences in the levels of infant and child mortality.

Provincial differences in the level of social and economic development[1], accessibility to medical care and the level of utilisation of the health facilities, and disease environment appear to be important factors in the provincial differences in child survival prospects in Kenya. Malaria is endemic in Nyanza, Western and Coast provinces. The three provinces are also socially and economically less developed than Central, Nairobi, and some parts of the Rift Valley and Eastern provinces,

The study examined the extent to which infant and child deaths cluster in families by considering the effect of the survival status of the previous live birth on the mortality risk of the subsequent live birth. The survival status of the preceding child at age one was found to be one of the most important factors determining the level of infant mortality in the country. It had a significant net effect on infant mortality in each mortality region. Infants whose preceding sibling had died in infancy were at a significantly greater risk of dying than those whose immediately preceding sibling

[1] Such as differences in the educational attainment, participation in community development activities, transport and communication networks, existence of credit facilities, community welfare programs and support networks, and coverage of extension services of sectoral departments of Government.

survived infancy. In the analysis carried out in Chapter Four, it was found that the effect of the survival status of the preceding child persisted even when the controls for the length of the preceding birth interval, maternal age at birth and birth order were introduced. Hence, this study demonstrates a strong tendency for infant deaths to cluster in certain Kenyan families; a mother who had lost her previous child in infancy is more likely to lose her next child in its infancy. Similar results have been found in Nepal (Gubhaju, 1984: 134; Pant, 1995: 185-194), Indonesia (Hull and Gubhaju, 1986: 109-118), Bangladesh (Majumder, 1989: 132), India (Das Gupta, 1990: 441), Uganda (Ebong, 1993: 12) and Zimbabwe (Jhamba, 1995: 241-245).

The elevated risk of dying among infants whose preceding sibling died in infancy could be due to a combination of shared physiological problems affecting the mother and a shared social and physical environment. These could include factors such as poor nutritional reserves of mothers of such children, leading to premature birth and or low birth weight, poor parenting, social and economic deprivation and higher incidence of environmental contamination. Competition among siblings for household resources appear not to have been the major link in the association between the survival status of the preceding child and the mortality risk of the index child. If sibling competition for maternal attention and other household resources and disease transmission between siblings were the major link, then risk of dying should have been higher when the preceding child had survived infancy than when it had died in infancy. This is not the case here. The death of the preceding sibling removes or at least reduces the competition among siblings for maternal attention and other household resources. Similarly, the argument for the disease transmission mechanism is not plausible because the older child has died.

Surprisingly, the survival status of the preceding child at age one was not significantly related to child mortality among children who had both preceding and succeeding birth intervals. This was also the case in both the LMR and HMR. Although in the national level analysis the survival status of the preceding child was only weakly associated with the child mortality of the index child when all the children with at least a preceding birth interval were considered in the analysis, the statistical significance of its effect disappeared when the preceding birth interval was taken into account. This suggests that its effect was associated with the length of the preceding birth interval.

Birth intervals were found to be strongly and negatively associated with both infant and child mortality. The effect of the preceding birth interval was greater than that of the succeeding birth interval. A preceding birth interval of less than 24 months was associated with extremely poor child survival prospects of the index child, and the effect of the length of the preceding birth interval on infant and child mortality was largely independent of the survival status of the preceding child. Similarly, a succeeding birth interval of less than 24 months was equally devastating to the health of the older sibling between ages one and five years. The results showed that the effect of the succeeding birth interval on child mortality persisted even when the length of the preceding birth interval, survival status of the preceding child at exact age one, and ever-use of modern contraception were taken into account.

The preceding birth interval had significant net effects on both infant and child mortality in each mortality region. Similarly, the succeeding birth interval had a significant net effect on child mortality in each mortality region. These results confirm the findings of Muganzi (1984: 79) but contradict those of Boerma and van Vianen (1984: 479-483) and provide further empirical evidence that birth intervals are an important determinant of child survival in their own right. This conclusion is also supported by the evidence from Nepal (Gubhaju, 1984: 134; Pant, 1995: 102-109), Pakistan (Cleland and Sathar, 1984: 408-413), Latin America (Palloni and Millman, 1986: 46; Palloni, 1989: 164-166) and from a number of other developing countries (Boerma and Bicego, 1992: 235-243).

Household economic status was found to be closely associated with infant and child mortality. Children from poor households were at a significantly higher risk of infant and child mortality than children from relatively well-to-do households. To influence child survival, household economic status operated partly through a combination of access to safe drinking water, a toilet facility, and access to and use of health facilities. This relationship captured only part of the variation in infant and child mortality. The other part of the variation was due to some other factors not included in this study. Regional analysis showed that household economic status had significant net effects on both infant and child mortality in the LMR. However, in the HMR household economic status had a significant net effect only on infant mortality.

The study showed that the birth order of the child was significantly associated with infant mortality but not with child mortality. First-born children and children of sixth or higher birth order were at a significantly greater risk of infant mortality than children of the second and third or fourth and fifth birth orders. However, when maternal age at birth was taken into account, the odds of infant mortality of first births were not significantly different from those of the children of the second and third birth orders. The analysis in this study showed that 65 per cent of the first-born children occurred to young mothers under the age 20, and children of such mothers experienced higher mortality than children born to mothers in the prime reproductive ages, that is 20-29 years.

The higher infant mortality risk among first births was mainly because most of them occurred to younger mothers who are not physiologically and emotionally mature and lack child-care skills and experience (Pebley and Stupp, 1987: 43). The elevated risk of infant mortality among children of the sixth and higher birth orders may have been due to a combination of competition among siblings for maternal attention and household resources, and a decline in reproductive efficiency as a result of many pregnancies and child deliveries.

There were notable differences in the effect of birth order in the two mortality regions. Birth order had a significant net effect on infant mortality only in the LMR. In the HMR it had only a significant gross effect on infant mortality.

The results showed that paternal education was significantly related to infant and child mortality. However, in the final parsimonious model, paternal education was significantly related to only infant mortality. Children born to fathers who had no formal education were at a significantly greater risk of infant mortality than children born to fathers with at least secondary education. Paternal education appeared to have influenced infant mortality through a combination of mechanisms such as access to safe drinking water, a toilet facility, and increased access and use of modern health facilities. The analysis carried out in Chapter Five showed that part of the gross effect of paternal education on infant mortality was due to maternal education, as a result of educated men marrying educated women. Similar results showing a significant association between paternal education and infant mortality were found in Indonesia (Martin *et al.*, 1983: 422-425), Sri Lanka (Trussell and Hammerslough, 1983: 16) and Turkey (Gursoy, 1992: 4). When the year of birth of the child was included in the final model, paternal education had no significant net effect on child mortality. Therefore, it would appear that the apparent effect of paternal education on child mortality was associated with improving level of education of men over time.

The regional analysis revealed notable differences in the effects of paternal education on infant and child mortality in the two mortality regions. Paternal education had a significant net effect on infant mortality in the HMR but not in the LMR. It had no significant net effect on child mortality in either mortality region. These results imply paternal education may lose its role on infant mortality once mortality reaches moderate to low levels.

One of the key findings of this study was in relation to the effect of maternal education on infant and child mortality. In the gross effects model and in some of the multivariate models in which not all the explanatory variables were included, the effects of maternal education on infant and child mortality were statistically significant. However, when all the other explanatory variables were taken into account or when the parsimonious models were fitted, the effects of maternal education on both infant and child mortality were attenuated so much that they were no longer significant at the 5 per cent level. This suggests that the fitted models captured most of the mechanisms through which maternal education influenced child survival. Access to safe drinking water, a toilet facility, access to and use of health facilities were some of the underlying factors that took over some of the gross effects of maternal education. The results also indicated that educated women were likely to be in paid work, to belong to households of high economic status and to marry better-educated men. Maternal factors played a minor role in the association between maternal education and child survival. The results showed that birth order, maternal age at birth and birth intervals were not the link between maternal education and child mortality. The results suggest that a range of incremental advantages enjoyed by children of educated mothers ultimately results in substantial survival prospects and that the explanatory factors included in this study account for most of the difference in survival chances due to maternal education.

Regional-level analysis showed that maternal education had a significant net effect on infant mortality only in the HMR. It had a significant net effect on child mortality only in the LMR. In the bivariate analyses carried out, maternal education was shown to have greater effects on both infant and child mortality in the LMR and HMR. As in the case of paternal education, these results imply that maternal education may lose its effect on infant mortality once mortality reaches moderate to low levels.

Possession of livestock was found to be significantly related to infant mortality but not to child mortality. Children from households that did not keep livestock were more likely to die in infancy than children from households that kept livestock. Part of the effect of possession of livestock on infant mortality was due to some of the socioeconomic factors, particularly to some of the factors embedded in the province of residence variable. The effect of this variable was independent of the proximate variables considered in this study. However, its effect was considerably reduced in the parsimonious model.

Possession of livestock may have influenced infant survival through the nutritional status of children in the sense that children born in households with livestock, particularly cows, are more likely to have access to milk. This is particularly important in rural areas where the majority of women, with poor economic conditions coupled with frequent pregnancies and child deliveries, are likely to be undernourished and hence unable to produce adequate breast milk for their infants. In these circumstances cow's milk could be an important source of nutritious food for the infants. Also, cow's milk may be a substitute for breast milk during weaning. The role played by the cow's milk in the nutritional status of infants was apparent in the focus groups discussions and interviews held in Western and Central provinces. In Western province, for example, most of the informants and participants in the focus group discussions attributed the increase in childhood malnutrition in the province partly to the declining production of milk in the province. They argued that in the past when milk was abundant in the province, infants as well as other children had plenty of milk to drink, and most of the weaning diets had plenty of milk, and thus childhood malnutrition was less common.

Regional-level analysis showed that possession of livestock had a significant net effect on infant mortality only in the HMR, but no significant net effect on child mortality in either mortality region. These results appear to be consistent with views expressed by my informants in Western province.

The study showed that the ever-use of modern contraception was significantly related to child mortality but not to infant mortality. Children whose mothers had never used modern contraception were at a significantly greater risk of dying than the children whose mothers had ever used contraception. The effect of ever-use of modern contraception on child mortality was hardly reduced when birth intervals, birth order and maternal age at birth were taken into account. Ever-use of modern contraception was also significantly related to infant mortality even when controls for maternal age at birth, birth order and the length of the preceding birth interval were introduced. However, the statistical significance of its effect on infant mortality disappeared in the final model.

It would seem that the ever-use of modern contraception was positively linked to child survival through the use of other maternal and child health services being delivered in conjunction with family planning services. A mother who uses or has used a modern contraception is also likely to use other maternal and child health care services being offered in the same clinic where she goes for her family planning services. The fact that ever-use of contraception had a significant net effect on child mortality but not on infant mortality implies that the effects of access to and use of health services were more pronounced after infancy. The study of the nature of the association between use of contraception and child survival had been hitherto neglected in Kenya although family planning services have been officially promoted since 1967 not only with the aim of reducing fertility but also improving maternal and child health.

Regional differences in the effect of ever-use of modern contraception were striking; they had a significant net effect on child mortality only in the HMR. The fact that ever-use of modern contraception was significantly related to child mortality in the HMR where accessibility to medical and health care is poor relative to the LMR, suggests that health-seeking behaviour has a bigger effect when accessibility to health services is poor.

Household sanitary conditions, as measured by access to a toilet facility, had significant net effects on child mortality but not on infant mortality. The national-level analysis showed that children from households that did not have a toilet facility were at a significantly greater risk of child mortality than the children from households that had a toilet facility. The presence of a toilet facility was significantly related to infant mortality in a model which included the length of preceding birth interval, the survival status of the preceding child, birth order, ever-use of modern contraception, year of birth of the child and source of drinking water. However, it did not have a significant net effect on infant mortality in the final model of the determinants of infant mortality.

There were similarities as well as marked differences in the effect of the existence of a toilet facility in the two mortality regions. In both mortality regions, the existence of a toilet facility in the household had no significant net effect on infant mortality. However, the existence of a toilet facility had different effects on child mortality in the two region; it had a significant net effect on child mortality in the HMR but not in the LMR.

Maternal age at birth had a significant net effect on child mortality but not on infant mortality when proximate and other socioeconomic factors were included in the analysis. Children born to mothers below age 20 were at a significantly greater risk of dying between ages one and five years than children born to mothers in the prime reproductive ages 20-29 years. However, the risk of dying between ages one and five years among children born to mothers aged 30 or above was not significantly different from that of children born to mothers aged 20-29 years. However, the statistical significance of this effect disappeared when the year of birth of the child was included in the final parsimonious model. This seems to suggest that with its increase over the period 1970 to 1983 the apparent effect of maternal age at birth was lost.

The effect of maternal age at birth on infant and child mortality was different in the two mortality regions. Maternal age at birth had significant net effects on infant mortality in both mortality regions. However, it had a significant net effect on child mortality only in the LMR. In the HMR a significant effect on child mortality was recorded only when the year of birth of the child was not included in the model. This suggests that the effect on child mortality was due to increasing maternal age at birth during the period under review.

Birth order had a significant net effect on infant mortality but not on child mortality. Infants of sixth or higher birth order experienced a greater mortality risk than their counterparts of the second and third or fourth and fifth birth order. The results obtained in Chapter Four showed that first-born infants and infants of sixth or higher birth order experienced higher mortality risks than their counterparts of second and third birth order. The results also show that the higher mortality among first-born infants was due to the fact that the majority (65 per cent of first-born) occurred among mothers below 20 years whose children experienced higher mortality risk.

The effects of birth order was different in the two mortality regions. Birth order had a significant net effect on infant mortality in the LMR only. Children of sixth or higher birth order were at a significantly greater risk of infant mortality than the children of the second and third birth order. In contrast, birth order had no significant net effect on both infant and child mortality in the HMR.

Mother's current work status had significant gross effects on both infant and child mortality when all the children were considered in the analysis. The children of working mothers had lower infant and child mortality than the children of non-working mothers. Working mothers were more likely to be educated, to belong to households of high economic status, to have access to safe water and a toilet facility, and to have access to and use health facilities compared to non-working mothers. However, the effects of mother's current work status on both infant and child mortality were no longer significant once other socioeconomic factors were taken into account. In both mortality regions, mother's current work status had no significant net effects on both infant and child mortality.

National level analysis showed that place of residence had significant gross effect on infant mortality only when all children were considered in the analysis. Rural infants were at a significantly greater risk of infant mortality than urban children. However, the effects were no longer significant when maternal education or household economic status or household environmental conditions were taken into account. Regional analysis showed that place of residence had significant net effects on both infant and child mortality in the LMR. Surprisingly, rural children were significantly less likely to die in infancy and between ages one and five than urban children. In contrast, place of residence had no significant effects on both infant and child mortality in the HMR.

This study explored some of the mechanisms through which the socioeconomic factors included in this study influenced child survival. The results indicate that the socioeconomic factors influenced child survival through a complex web of pathways. Access to safe drinking water, a toilet facility, and access to and use of health facilities were some of the underlying factors for most of the socioeconomic factors. The results suggest that reproductive factors (birth order, maternal age at birth and birth intervals) were not the link between the socioeconomic factors and child mortality. They showed that the proximate variables included in this study did not mediate a statistically significant large proportion of the respective effects, as measured by odds ratios, of the socioeconomic factors on infant and child mortality.

The study also explored some of the factors associated with low child survival chances in the HMR relative to the LMR. The results in respect of infant mortality showed that the mean values of the explanatory variables, except for paternal education and the preceding birth interval, were significantly higher in the LMR than in the HMR. Similarly, for child mortality the mean values of the explanatory variables, except for the birth interval variables and percentage of births whose mothers resided in urban areas, were significantly higher in the LMR than in the HMR.

The results of the analysis using logistic regression decomposition technique demonstrated that most differences in the levels of infant and child mortality between the two mortality regions were due to the differences in the structure of relationship[2] between mortality and explanatory variables. The results indicated that infant and child mortality in the HMR would be lower by almost one-half if that region had the same structure of relationship as the LMR. In contrast, infant and child mortality rates

[2] The structure of relationship between an explanatory variable and mortality is indicated by the logit coefficient of the explanatory variable in question.

in the LMR would have been almost twice their current levels if the nature of relations were as those in the HMR.

The lower average level of maternal education, lower proportion of households of high economic status, lower proportion of children belonging to households that kept livestock, lower level of ever-use of modern contraception, and lower proportion of children whose preceding sibling survived infancy contributed to the observed high infant mortality in the HMR relative to the LMR. Lower access to and use of modern contraception and the lower proportion of children belonging to households with access to piped drinking water and toilet facilities, and the lower average level of maternal education contributed to the observed high child mortality rate in the HMR compared to the LMR.

Other things being constant, infant and child mortality rates were more responsive to the changes in the average level of maternal education, household economic status, possession of livestock, ever-use of modern contraception and in the proportion of the children with preceding sibling surviving to age one in the HMR than in the LMR. Infant mortality rate in the HMR was particularly responsive to an increase in the average maternal education and to an increase in the proportion of infants with preceding sibling surviving to age one. Similarly, the child mortality rate was more responsive to changes in the level of ever-use modern contraception, proportion of households with a toilet facility and the average level of maternal education in the HMR than in LMR. The child mortality rate in the HMR was particularly responsive to an increase in access to and use of health facilities and services as represented by ever-use of modern contraception.

The study also examined some of the factors that could be associated with the difference in the levels of infant and child mortality between Central and Western provinces. Through the analysis of field work data and the 1988/89 KDHS data, the results obtained suggest that the difference were due to the differences in the levels of social and economic development, accessibility and utilisation of health facilities, transport and communication networks, and ecological/climatic conditions in the two provinces. Central province is socially and economically more developed and has a more diversified and robust economy than Western province whose backbone is subsistence agriculture. Central province has a more educated population than Western province. People in Central province appear to be more aware of their needs and rights and were actively involved in seeking ways and means of improving their welfare in various ways including active participation in programs initiated by their organisations, such as women's development groups, village health committees and co-operative societies and unions.

Women's status in relation to men in terms of education and the degree of bargaining power in the household was higher in Central than in Western province. The majority of mothers in Central province were educated; this appeared to give a higher degree of bargaining power in the household than their counterparts in Western province. This is indicated by the fact that the majority of the mothers in Central province more often discussed welfare issues including reproduction and contraception with their husbands or partners. In contrast, in Western province most mothers did not discuss such matters with their partners. It also has been suggested that in Sub-Saharan Africa women who often discuss family planning with their partners are likely to be more independent and autonomous than others (Barbieri, 1991: 161). Studies in developing countries have shown a strong positive association between women's status, measured in terms of education, and child survival (Caldwell, 1979; Caldwell and Caldwell, 1993: 133-138; Ware, 1984).

Availability and accessibility of health facilities, including maternity clinics and nursing homes, was better in Central than Western province. Mothers in Central province, due to their high level of education and ability to pay for the various services, coupled with wide-spread and active health promotional activities by family health field educators and family planning workers, and encouragement from the village health committees and women development groups, were actively participating in health programs. Mothers in Central province were more likely to use modern contraception than their counterparts in Western province. Mothers in Central province were also more likely to receive ante-natal care from a doctor or trained nurse, deliver their babies in health institutions, and their delivery was more likely to be under the supervision of a doctor or a trained nurse. They were more likely to use home-made remedies or Oral Rehydration Sachets and increase fluids in the diets of children suffering from diarrhoea and to have their children immunised, suggesting that they were more efficient in producing and maintaining health at home than their counterparts in Western province.

The greater utilisation of health facilities in Central province compared to Western province was further facilitated by better road infrastructure, better public transport and communications networks. For example, most of the rural access roads were served by minibuses, *Matatus;* hence transport was not a big problem. Furthermore, there were many more alternative sources of medical help since there were many more non-government hospitals and clinics in Central than Western province. In contrast, in Western province, the majority of mothers did not have access to health care, had to travel a long distance to nearest health facility, had heavy domestic responsibilities and were poverty stricken. Public transport was inadequate or non-existent in most rural access roads. Most rural access roads were impassable during the rain season. Most villages did not have health committees and health or family planning workers to encourage the local people to partake in programs such as family planning or to seek medical assistance in case of need. Similarly, most villages did not have women's development groups which could provide fora to discuss and obtain encouragement to use family planning and other health services. The recurrent shortages of medical supplies in the rural health centres run by the government had discouraged some people from to seeking medical help there.

In addition, child nutritional levels seemed poorer in Western than Central province. A cross-section of the people interviewed in Western province suggested that childhood malnutrition in the province was more serious than portrayed by some of the national nutrition surveys . They said that child malnutrition was on the increase and attributed this to the decline in food production in the area due to the introduction of cash crops (sugar cane and tobacco) in the 1970s, the rapid decline in production of milk, population increase and changes in eating habits brought about by social change. This situation is further complicated by the low status of women, high fertility and increasing poverty, the effects of which had been accentuated by the stringent Structural Adjustment Programs being implemented in the country.

Climatic and ecological differences, signifying differences in disease environment, are other factors explaining the difference in the level of infant and child mortality between the two provinces. Malaria and diarrhoeal diseases were more prevalent in Western than in Central province. The highland (cold) climate of Central province is not conducive to mosquito infestation and hence malaria was less common there.

The results of this study have various implications both for improving the prospects of child survival and for future research. The deleterious effect of short birth intervals observed in the study implies that the prospects of child survival would be considerably enhanced if the intervals between births were at least 24 months. Therefore concerted efforts should be made to encourage Kenyan couples to allow for at least 24 months between their births. This could be achieved through strengthening existing breastfeeding programs towards longer breastfeeding. Breastfeeding not only lengthens the birth interval through delaying the return to ovulation, it also enhances child survival as it provides useful and appropriate nutritients and antibodies that protect the child against infections (Jelliffe and Jelliffe, 1978). Furthermore, couples should be encouraged to use appropriate and effective family planning methods to space their births.

This study has provided empirical evidence for Kenya that the use of modern contraception is significantly associated with lower risk of child mortality and that child mortality was lower in the LMR partly because of a higher proportion of children born to mothers who had used contraception. The effect of ever-use of modern contraception persisted even after birth intervals were taken into account. If the positive association between ever-use of modern contraception and child survival is due to utilisation of other maternal and child health care services delivered in conjunction with family planning services, there would be considerable gains in child survival chances if most women of reproductive ages were to use family planning services in conjunction with other health services. Provision of family planning services has been officially promoted in Kenya since 1967. The coverage and performance of the integrated family planning and maternal and child health (MCH/FP) program ought to be improved, particularly in the rural areas in the HMR, where the majority of the people lack access to such services.

Poverty, as represented by low household economic status in this study, was found to be associated with higher infant and child mortality. Concerted efforts aimed at alleviating poverty would considerably contribute to the reduction of infant and child deaths. Since most households, particularly in the high mortality provinces, depended on subsistence agriculture, improvement in the performance of this sector through provision of appropriate incentives, advice, credit facilities, and establishment of profitable pricing, and marketing policies and arrangements for the disposal of surplus produce would lead to an improvement in their economic conditions. This would not only improve the economic status of the households but also increase food security and might improve the nutritional status of children. In addition, rural households, particularly those in the HMR, should be encouraged to have at least one dairy cow from which to obtain milk as this study has clearly shown that possession of livestock (goats, sheep, and cows) was associated with lower infant mortality.

In this study children of mothers whose previous child died in infancy were found to be at a great risk of infant mortality. Therefore, medical and health care assistance needs to be focused on such mothers. This could entail encouraging such mothers to use modern ante-natal and post-natal health care. Such mothers could also be targeted for special education and information on family life, and other welfare assistance to improve their social and economic conditions. For example, they could be given education on the benefits of living in a healthy environment, having a balance diet, breast feeding their children and having appropriate weaning diets.

Furthermore, improvement in the status of women and the reduction of the load of multiple roles that women play in rural households would lead to an improvement in the women's and their children's welfare. This could be achieved through education and offering training and employment opportunities to girls and young women. In fact the results of this study imply that increases in the average levels of education of mothers would bring about a reduction in infant and child mortality particularly in the high mortality provinces. Programs need to be designed to encourage women to own property and to control the allocation of household resources, including the control and use of the proceeds of the sale of farm produce such as sugar cane and tobacco. At the moment, the majority of rural women work very hard on the farms but have no control over the use of the proceeds from the sale of farm produce. Some husbands are alleged to vanish from their homes when they receive the payments of the sale of sugar cane and tobacco and to return only when the money is finished. Information and education about the advantages of a small family and the disadvantages of a large family should be intensified, particularly in Western province where fertility is still very high and where some women continue to see a large family as a means of gaining recognition and status in the household and community.

This study showed that the prospects of child survival in the Coast, Nyanza and Western provinces were extremely poor relative to Central province, even after all the other explanatory variables were taken into account. Since malaria, diarrhoea and childhood malnutrition were more prevalent in the three high-mortality provinces, programs aimed at controlling malaria and diarrhoea and to improve the children's nutrition in these provinces should be strengthened. Similarly, improvements in the implementation of other child survival programs would contribute to reduction in both infant and child mortality in these provinces. In addition, improvements in transport and communication networks in the high mortality provinces would enhance the implementation of such programs and also would facilitate the use of health facilities.

The interviews conducted in Western province revealed that most mothers lacked access to basic health care, particularly maternal and child health care, and that many children died due to lack of urgent medical attention. In contrast, people in Central province had wide-spread accessibility of medical care and had high utilisation of such facilities. Therefore, efforts should be made to increase the availability and accessibility of health facilities in the high mortality provinces such as Western province. These could entail increasing the number of health facilities and improving the performance of some of the existing ones by ensuring they had regular supplies of drugs and other medical supplies, and the necessary qualified staff. The number of community based health and family planning workers, including traditional births attendants, should be increased. And all the traditional birth attendants should be trained on safe and hygienic child delivery procedures. Similarly, people should be encouraged to utilise health facilities through appropriate social marketing programs. For instance, the benefits of programs such as child immunisation and family planning could be demonstrated to the people using local examples, languages and venues appropriate to most rural people.

Since the results obtained in the study showed that, other things being constant, the infant and child mortality was generally more responsive to the values of explanatory variables in the HMR than in the LMR, there would be a substantial reduction in infant and child mortality if the HMR would be given more emphasis and priority in human capital investments, family planning programs and other intervention programs aimed at reducing infant and child mortality in the country.

As far as future research is concerned, a few issues may be pointed out. Since the province of residence has emerged in this study as the most important factor influencing child survival in Kenya, it is desirable to carry out investigations at the level of province or even district so as to enable the identification of province-specific factors determining infant and child mortality. Provincial- and district-level analyses are needed because of the differences in the level of social and economic development, provision of health services, and cultural and ecological configurations between the provinces. This is also in line with the Government's District Focus for Rural Development Strategy. This research cannot be meaningfully undertaken at the moment due to the small sample size of the demographic surveys such as the 1988/89 KDHS. There is therefore a need to increase the sample size of future demographic surveys so as to permit analyses of infant and child mortality of the more recently born children to be carried out at the level of province or district. This suggestion might make such surveys prohibitively expensive. However, the costs can be minimised by having a small but a carefully designed questionnaire on just a few of topics and having an execution strategy that is fairly cost-conscious.

In future demographic surveys, it is desirable to obtain a residential history including some basic characteristics such as access to safe water and a toilet facility for houses where the respondents have lived. The household characteristics of the mothers used in this study were those that prevailed at the time of the survey. Some of them may have been acquired only recently when some of the children had already died. Thus some have been relevant to all the children sampled for the study. For example, if a child in a particular household died ten years ago and a piped water supply was only recently connected to their household, higher mortality may be wrongly associated with piped water supply.

In addition, the data so collected would permit the inclusion of variables denoting household characteristics in micro-level analyses that seek to identify factors that account for the decline in infant and child mortality in Kenya. This suggestion is not unique. The Malaysian Family Life Survey (1976-1977) included a residential history which permitted the inclusion of variables denoting household's access to safe water and toilet facilities to be included in both cross-sectional and temporal analyses of infant and child mortality in that country (Da Vanzo, 1984, 307-309; Da Vanzo and Habicht, 1986: 143-146; Peterson *et al.*, 1986: 2-12).

This study used a number of proxy variables: ever use of modern contraception to represent access to and use of modern health facilities, an index of household economic status to denote household wealth or disposable income, and source of drinking water and toilet facility to represent exposure to disease. These proxy variables may not have appropriately represented the actual factors. Hence, it is desirable to use more direct measures of those factors in future research. It is also worthwhile to carry out further research to establish the factors underlying the negative association between possession of livestock and infant mortality, and between ever-use of modern contraception and child mortality. Furthermore, the study covered only a few of the many proximate determinants described in the Mosley and Chen (1984) analytical framework. Birth weight and nutrition, for example, were not included in this study because no data were available.

In the Mosley and Chen model adopted for this study, socioeconomic factors such as maternal education or province of residence operate through proximate variables to influence child survival. The results obtained in thesis showed that some of socioeconomic variables, such as province of residence, had large effects that were independent of the proximate variables. This was more true with respect to infant mortality than child mortality. These results suggest that some of the socioeconomic factors operate through proximate variables as well as have some direct effects on infant and child mortality. Future research adopting this model should be cognisant of the possibility that some socioeconomic factors may be having both indirect and directs effects on child health and thus mortality.

The study indicated that there was a significant decline in child mortality in Kenya, particularly in the high mortality provinces, between 1970 and 1983 that was net of the explanatory variables included in this study. It would be worthwhile to conduct research on variables which were not included in this study that were responsible for the decline in child mortality between 1970 and 1983.

In addition, this study could not focus on some of the mechanisms that have been suggested as linking maternal education and child survival. Specifically, this study did not examine household decision making processes, domestic child care, including food allocation, weaning practices and beliefs. These need to be included in future research on the pathways through which maternal education influences child survival. This means that there is still a wide scope for further research on the determinants of child survival in Kenya.

Finally, the prospects of significant gains in child survival in Kenya in the near future are not very bright. The adverse effects of the Structural Adjustment Program which is being implemented in the country, the HIV/AIDS pandemic and increasing poverty threaten to stabilise or even reverse the trend in infant and child mortality decline in the country.

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APPENDICES

Appendix 3.1 Themes used in the indepth interviews and focus group discussion

(1) An overview of the children's and women's situation in the district / community / village

(2) Availability and accessiblity of health facilities
- Types of health facilities available
- What was the situation in the past, say 5 years ago?
- Any problems with access to health services

(3) Use of local health facilities

(4) Availability of emergency services
- For example, ambulances

(5) Community or village level health activity
- Existence of village health committees
- Existence of field family health educators
- Existence of family planning workers

(6) Use of maternal and child health care services
- Use of modern ante-natal care services
- Use of modern post-natal care services
- Child immunisation

(7) Food availibility and childhood nutritional status
- Do most households have adequate food supply throughout the year?
- Are there any malnourished children in this community/village? If so, why are they malnourished?
- What can be done about the problem ?

(8) Family planning
- Acceptance and practice of family planning (traditional/modern)
- Availability of family planning services
- Obstacles to use of modern family planning methods

(9) Perceptions about the local health problems
- Do the local people usually know what is wrong with their sick children? For example, do they know common child diseases in the community and how to manage them?
- Do the households have toilets?
- Do the people always use the toilets?
- Do the people have access to clean drinking water?

Appendix 4.1 Odds ratios and likelihood chi-square values indicating the effect of sex of the child on infant and child mortality: Kenya, 1988/89 KDHS

	Gross effect	Adjusted for BO	Adjusted for MAGE	Adjusted for MAGE & BO
Infant mortality				
$LR\chi^2$	3.64	3.46	3.65	3.53
df	1	1	1	1
p	> 0.05	> 0.05	> 0.05	> 0.05
Sex of the child				
Female	1.00	1.00	1.00	1.00
Male	1.12	1.12	1.12	1.12
Child mortality				
$LR\chi^2$	2.37	2.48	2.56	2.56
df	1	1	1	1
p	> 0.05	> 0.05	> 0.05	> 0.05
Sex of the child				
Female	1.00	1.00	1.00	1.00
Male	1.16	1.16	1.16	1.16

Notes: Based on all live births. MAGE and BO stand for maternal age at birth and birth order, respectively.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 4.2 Mean length of the preceding birth interval by ever-use of modern contraception and maternal age at birth: Kenya,1988/89 KDHS

	Maternal age at birth			
	< 20	20-29	30+	All
Ever use of contraception				
Yes	24.4(467)	29.0(3476)	33.5(1473)	29.8(5416)
Never	26.0(1005)	30.2(6473)	34.7(3541)	31.4(11009)
All	**25.5(1472)**	**29.8(9948)**	**34.4(5005)**	**30.8(16425)**

Note: Based on births that occurred between 1970-87 that had a preceding birth interval. The figures in the parentheses are the number of births.

Source: Primary analysis of the 1988/89 KDHS.

Appendix 5.1 Percentage distribution of currently married women by education and husband's education: Kenya, 1988/89 KDHS

		Husband's education			
	All	None	Primary	Secondary+	
Level of education					Number of women
None	32.1	40.6	51.9	7.4	1680
Primary	51.3	12.5	57.1	30.4	2688
Secondary+	16.6	2.2	18.1	79.2	869

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 5.2 Percentage distribution of all women by household economic status and education: Kenya, 1988/89 KDHS

		Level of education			
	All	None	Primary	Secondary+	
Household economic status					Number of women
Low	32.5	40.7	23.6	7.4	2315
Medium	39.5	53.9	59.6	47.7	2817
High	28.0	5.4	16.7	42.8	1994

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 5.3 Percentage distribution of all women by education and current work status: Kenya, 1988/89 KDHS

Level of education	All	Current work status: Not working	Working	Number of women
None	25.0	95.5	4.5	2315
Primary	54.6	91.4	8.6	2817
Secondary	20.4	71.9	28.1	1994

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.1 Odds ratios and likelihood chi-square values indicating the effect of province of residence on infant mortality adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n = 18345)	
$LR\chi^2$ [a]	223.90	229.10	202.40
d.f.	6	6 6	
p	< 0.001	< 0.001	< 0.001
Province			
Central	1.00	1.00	1.00
Nairobi	1.01	1.25	1.01
Coast	2.80***	3.12***	2.46***
Eastern	1.25	1.21	1.18
Nyanza	2.54***	2.39***	2.38***
R.Valley	0.73*	0.69*	0.66**
Western	1.72***	1.65***	1.65***
Model $LR\chi^2$	223.90	241.20	239.50
Model d.f.	6	7 7	
Constant	-3.19(0.09)	-3.42(0.11)	-3.23(0.09)
		Second and higher order births (n = 14951)	
$LR\chi^2$ [a]	195.20	198.70	185.10
d.f.	6	6	6
p	< 0.001	< 0.001	< 0.001
Province			
Central	1.00	1.00	1.00
Nairobi	1.01	1.22	1.01
Coast	2.64***	2.90***	2.44***
Eastern	1.14	1.11	1.11
Nyanza	2.54***	2.40***	2.45***
R.Valley	0.62**	0.59**	0.59**
Western	1.71***	1.65***	1.67***
Model $LR\chi^2$	195.20	206.40	199.30
Model d.f.	6	7	7
Constant	-3.17(0.10)	-3.38(0.12)	-3.17(0.09)

Notes: [a] A $LR\chi^2$ value for province of residence only while Model $LR\chi^2$ value is due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Signifant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.2 Odds ratios and likelihood chi-square values indicating the effect of province of residence on child mortality adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n = 12595)	
$LR\chi^2$ [a]	129.10	131.30	120.50
d.f.	6	6	6
p	< 0.001	< 0.001	< 0.001
Province			
Central	1.00	1.00	1.00
Nairobi	2.22**	2.94***	2.20**
Coast	3.61***	4.14***	2.77***
Eastern	1.81**	1.75*	1.64*
Nyanza	3.87***	3.58***	3.42***
R.Valley	1.09	1.01	0.91
Western	4.02***	3.83***	3.75***
Model $LR\chi^2$	129.30	140.90	153.30
Model d.f.	6	7	7
Constant	-4.15(0.16)	-4.45(0.19)	-4.15(0.16)
		Second and higher order births (n = 9243)	
$LR\chi^2$ [a]	88.32	88.34	84.67
d.f.	6	6	6
p	< 0.001	< 0.001	< 0.001
Province			
Central	1.00	1.00	1.00
Nairobi	2.02*	2.95***	2.02**
Coast	2.84***	3.18***	2.20***
Eastern	1.47	1.43	1.34
Nyanza	3.48***	3.26***	3.10***
R.Valley	1.04	0.98	0.87
Western	3.49***	3.35***	3.27***
Model $LR\chi^2$	88.32	93.70	104.10
Model d.f.	6	7	7
Overal effect	-3.99(0.18)	-4.20(0.21)	-4.00(0.18)

Notes: [a] A $LR\chi^2$ value for province of residence only while Model $LR\chi^2$ value is due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.3 Odds ratios and likelihood chi-square values indicating the effect of maternal education on infant mortality adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n = 18345)	
$LR\chi^2$[a]	77.76	69.11	57.40
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Maternal education			
Secondary	1.00	1.00	1.00
Primary	1.59***	1.53***	1.56***
None	2.40***	2.25***	2.21***
Model $LR\chi^2$	77.76	81.20	94.50
Model df	2	3	3
Constant	-3.34(0.11)	-3.39(0.12)	-3 34(0.11)
		Second and higher order births (n = 14951)	
$LR\chi^2$[a]	59.43	53.85	49.41
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Maternal education			
Secondary	1.00	1.00	1.00
Primary	1.66***	1.60***	1.64***
None	2.47***	2.37***	2.36***
Model $LR\chi^2$	59.43	61.60	63.60
Model df	2	3	3
Constant	-3.41(0.14)	-3.49(0.14)	-3 41(0.14)

Notes: [a] A $LR\chi^2$ value formaternal education only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.4 Odds ratios and likelihood chi-square values indicating the effect of maternal education on child mortality adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n= 12595)	
$LR\chi^{2}$ [a]	37.55	31.31	24.42
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Maternal education			
Secondary	1.00	1.00	1.00
Primary	1.92**	1.80**	1.86**
None	2.86***	2.65***	2.50***
Model $LR\chi^2$	37.55	41.30	56.70
Model d.f.	2	3	3
Constant	-4.04(0.21)	-4.45(0.19)	-4.06(0.21)
		Second and higher order births (n =9243)	
$LR\chi^{2}$ [a]	21.02	18.42	13.19
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Maternal education			
Secondary	1.00	1.00	1.00
Primary	1.52	1.43	1.48
None	2.30**	2.14**	2.05**
Model $LR\chi^2$	21.02	23.80	32.50
Model d.f.	2	3	3
Constant	-3.82(0.25)	-3 91(0.26)	-3.84(0.25)

Notes: [a] A $LR\chi^2$ value for maternal education only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.5 Odds ratios and likelihood chi-square values indicating the effect of paternal education on infant mortality adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n= 18345)	
$LR\chi^{2a}$	55.03	49.23	38.26
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Paternal education			
Secondary	1.00	1.00	1.00
Primary	1.40***	1.35***	1.35***
None	1.95***	1.89***	1.78***
Model $LR\chi^2$	55.03	61.30	75.30
Model df	2	3	3
Constant	-3.09(0.07)	-3.18(0.08)	-3.11(0.07)
		Second and higher order births (n=14951)	
$LR\chi^{2a}$	45.14	41.24	36.52
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Paternal education			
Secondary	1.00	1.00	1.00
Primary	1.49***	1.45***	1.46***
None	2.01***	1.96***	1.91***
Model $LR\chi^2$	45.14	49.00	50.70
Model df	2	3	3
Constant	-3.16(0.08)	-3.24(0.09)	-3.17(0.09)

Notes: [a] A $LR\chi^2$ value for paternal education only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.6 Odds ratios and likelihood chi-square values indicating the effect of paternal education on child mortality, adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Exlanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n = 12595)	
$LR\chi^2$[a]	23.57	21.31	12.99
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Paternal education			
Secondary	1.00	1.00	1.00
Primary	1.19	1.13	1.13
None	1.84**	1.75***	1.58***
Model $LR\chi^2$	23.57	30.90	45.20
Model df	2	3	3
Constant	-3.52(0.11)	-3.67(0.12)	-3.55(0.11)
		Second and higher order births (n = 9243)	
$LR\chi^2$[a]	16.19	14.83	9.56
d.f.	2	2	2
p	< 0 001	< 0.001	< 0. 01
Paternal education			
Secondary	1.00	1.00	1.00
Primary	1.32	1.27	1.26
None	1.89***	1.83***	1.66**
Model $LR\chi^2$	16.19	20.20	28.90
Model df	2	3	3
Constant	-3.56(0.14)	-3.71(0.16)	-3.59(0.14)

Notes: [a] A $LR\chi^2$ value for paternal education only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.7 Odds ratios and likelihood chi-square values indicating the effect of place of residence on infant mortality adjusted for type of source of drinking water and availability of a toilet facility: Kenya , 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n = 18345)	
$LR\chi^2$ [a]	5.24	0.23	2.09
d.f.	1	1	1
p	< 0.02	> 0.50	> 0.10
Place of Residence			
Urban	1.00	1.00	1.00
Rural	1.21*	1.05	1.13
Model $LR\chi^2$	5.24	12.30	39.20
Model d.f.	1	2	2
Constant	-2.90(0.08)	-2.93(0.08)	-2.93(0.08)

Notes: [a] A $LR\chi^2$ value for place of residence only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source Primary analysis of the 1988/89 KDHS data.

Appendix 6.8 Odds ratios and likelihood chi-square values indicating the effect of household economic status on infant mortality, adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n = 18345)	
$LR\chi^2$ [a]	66.43	55.31	44.22
d.f.	2	2	1
p	< 0.001	< 0.001	< 0.001
Household economic status			
High	1.00	1.00	1.00
Medium	1.42***	1.38***	1.37***
Low	1.97***	1.91***	1.80***
Model $LR\chi^2$	66.43	76.40	81.30
Model d.f.	2	3	3
Constant	-3.15(0.07)	-3.18(0.08)	-3.16(0.08)
		Second and higher order births (n = 14951)	
$LR\chi^2$ [a]	59.13	51.85	47.66
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Household economic status			
High	1.00	1.00	1.00
Medium	1.49***	1.50***	1.50***
Low	2.09***	2.05***	2.00***
Model $LR\chi^2$	27	59.30	61.9
Model d.f.	2	3	2
Constant	-3.23(0.09)	-3.25(0.09)	-3.24(0.08)

Notes: [a] A $LR\chi^2$ value forhosehold economic status only while Model $LR\chi^2$ value is due to all the variables in the model. *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of 1988/89 KDHS data.

Appendix 6.9 Odds ratios and likelihood chi-square values indicating the effect of household economic status on child mortality, adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Exlanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n= 12595)	
$LR\chi^{2}$ [a]	35.67	28.05	20.07
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Household economic status			
High	1.00	1.00	1.00
Medium	1.46**	1.39**	1.39*
Low	2.12***	2.00***	1.84***
Model $LR\chi^2$	35.67	37.50	52.20
Model d.f.	1	3	3
Constant	-3.64(0.14)	-3.78(0.13)	-3.73(0.12)
		Second and higher order births (n= 9243)	
$LR\chi^{2}$ [a]	27.09	22.78	16.54
d.f.	2	2	2
p	< 0.001	< 0.01	< 0.01
Household economic status			
High	1.00	1.00	1.00
Medium	1.30*	1.25	1.25
Low	2.04***	1.94***	1.81***
Model $LR\chi^2$	27.09	28.20	36 30
Model d.f.	2	3	3
Constant	-3.64(0.14)	-3.70(0.15)	-3.65(0.14)

Notes: [a] A $LR\chi^2$ value for household economic status only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 data.

Appendix 6.10 Odds ratios and likelihood chi-square values indicating the effect of mother's work status on infant mortality, adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n= 18345)	
$LR\chi^2$[a]	26.18	20.09	19.50
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Mother's work status			
Working	1.00	1.00	1.00
No	1.80***	1.70***	1.67***
Model $LR\chi^2$	26.19	32.20	56.60
Model d.f.	1	2	2
Constant	-3.28(0.12)	-3.34(0.12)	-3.29(0.12)
		Second and higher order births (n= 14951)	
$LR\chi^2$[a]	17.07	13.16	13.83
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Mother's work status			
Working	1.00	1.00	1.00
No	1.69***	1.62***	1.62***
Model $LR\chi^2$	17.07	20.90	28.10
Model d.f.	1	2	2
Constant	-3.24(0.13)	-3.31(0.14)	-3.25(0.13)

Notes: [a] A $LR\chi^2$ value for mother's work status only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.11 Odds ratios and likelihood chi-square values indicating the effect of mother's work status on child mortality, adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect (Model I)	Adjusted for HWA (Model II)	Adjusted for HTF (Model III)
		All births (n= 12595)	
$LR\chi^2$ [a]	13.45	11.46	8.81
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.01
Mother's work status			
Working	1.00	1.00	1.00
No	1.89***	1.73**	1.69**
Model $LR\chi^2$	13.45	19.00	41.00
Model d.f.	1	2	2
Constant	-3.83(0.18)	-3.93(0.18)	-3.85(0.18)
		Second and higher births (n= 9243)	
$LR\chi^2$ [a]	4.76	3.00	2.79
d.f.	1 1	1	1
p	< 0.05	>0.05	> 0.05
Mother's work status			
Working	1.00	1.00	1.00
No	1.55*	1.43	1.41
Model $LR\chi^2$	4.76	8.40	22.10
Model d.f.	1	2	2
Constant	-3.63(0.21)	-3.73(0.21)	-3.65(0.21)

Notes: [a] A $LR\chi^2$ value for mother's work status only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHSdata.

Appendix 6.12 Odds ratios and likelihood chi-square values indicating the effect of possession of livestock on infant mortality, adjusted for type of source of drinking water and availability of a toilet facility: Kenya, 1988/89 KDHS

Explanatory variable	Gross effect	Adjusted for HWA	Adjusted for HTF
		All births (n=18345)	
$LR\chi^{2a}$	28.80	39.34	30.48
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Possession of livestock			
Yes	1.00	1.00	1.00
No	1.44***	1.55***	1.46***
Model $LR\chi^2$	28.80	51.40	67.60
Model d.f.	1	2	2
Constant	-2.84(0.04)	-3.09(0.07)	-2.93(0.04)
		Second and higher order births (n=14951)	
$LR\chi^{2a}$	25.68	33.34	26.35
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Possession of livestock			
Yes	1.00	1.00	1.00
No	1.47***	1.57***	1.48***
Model $LR\chi^2$	25.68	41.10	40.60
Model d.f.	1	2	2
Constant	-2.86(0.04)	-3.09(0.07)	-2.92(0.04)

Notes: [a] A $LR\chi^2$ value for possession of livestock only while Model $LR\chi^2$ value is due to all the variables in the model. * Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. HWA stands for source of drinking water, HTF stands for availability of a toilet facility. The numbers in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.13 Odds ratios and likelihood chi-square values indicating the effect of province of residence on infant mortality, adjusted for maternal variables: Kenya, 1988/89 KDHS

All births (n= 18345)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	223.90	220.90	220.80
d.f.	6	6	6
p	< 0.001	< 0.001	< 0.001
Province			
Central	1.00	1.00	1.00
Nairobi	1.01	1.04	1.00
Coast	2.80***	2.81***	2.78**
Eastern	1.25	1.24	1.24
Nyanza	2.54***	2.53***	2.50***
R.Valley	0.73*	0.73*	0.72*
Western	1.72***	1.70***	1.71***
Model $LR\chi^2$	223.90	250.50	240.80
Model d.f.	6	9	8
Constant	-3.19(0.09)	-3.31(0.10)	-3.30(0.09)

Second and higher order births (n= 14951)

	Gross effect (Model IV)	Adjusted for PBI (Model V)	Adjusted for SPB (Model VI)
$LR\chi^2$ [a]	195.20	196.10	151.10
d.f.	6	6	6
p	< 0.001	< 0 001	< 0 001
Province			
Central	1.00	1.00	1.00
Nairobi	1.01	1.02	1.02
Coast	2.64***	2.67***	2.31***
Eastern	1.14	1.18	1.10
Nyanza	2.54***	2.56***	2 30***
R Valley	0.62**	0.61**	0.63**
Western	1.71***	1.71***	1.61***
Model $LR\chi^2$	195.20	310.80	374.70
Model d.f	6	8	7
Constant	-3.17(0.10)	-3.69(0.10)	-3.28(0.10)

Notes: [a] A $LR\chi^2$ value for province of residence only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age (MAGE), preceding birth interval (PBI) and survival status of the preceding birth (SPB). *Significant at p < 0.05, **Significant at p < 0.01, ***Significant at p < 0.001.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.14 Odds ratios and likelihood chi-square values indicating the effect of province of residence on child mortality, adjusted for maternal factors: Kenya, 1988/89 KDHS

All births (n= 12595)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	129.10	130.10	126.50
d.f.	6	6	6
p	< 0.001	< 0.001	< 0.001
Province			
Central	1.00	1.00	1.00
Nairobi	2.22**	2.17**	2.11**
Coast	3.61***	3.60***	3.52***
Eastern	1.81**	1.81**	1.82**
Nyanza	3.87***	3.88***	3.76***
R. Valley	1.09	1.08	1.06
Western	4.02***	4.04***	3.97***
Model $LR\chi^2$	129.10	134.4	139.20
Model d.f.	6	9	8
Constant	-4.15(0.16)	-4.21(0.17)	-4.21(0.17)

Second and higher order births (n= 9243)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI & SBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	88.32	84.75	89.50	86.62
d.f.	6	6	6	6
p	< 0.001	< 0.001	< 0.001	< 0.001
Province				
Central	1.00	1.00	1.00	1.00
Nairobi	2.04*	1.99**	2.12**	2.05*
Coast	2.84***	2.75***	2.89***	2.81***
Eastern	1.47	1.47	1.53	1.46
Nyanza	3.48***	3.33***	3.51***	3.45***
R. Valley	1.04	1.00	1.02	1.04
Western	3.49***	3.43***	3.55***	3.48***
Model $LR\chi^2$	88.32	101.60	139.10	89.40
Model d.f.	6	10	8	7
Constant	-3.99(0.18)	-4.19(0.19)	-4.77(0.24)	-3.85(0.14)

Notes: [a] A $LR\chi^2$ value for province of residence only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age (MAGE), preceding and succeeding birth intervals (PBI & SBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.15 Odds ratios and likelihood chi-square values indicating the effect of place of residence on infant mortality, adjusted for maternal factors: Kenya, 1988/89 KDHS

	All births (n= 18345)		
Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$[a]	5.24	3.95	5.05
d.f.	1	1	1
p	< 0.02	> 0.05	< 0.02
Place of residence			
Urban	1.00	1.00	1.00
Rural	1.21*	1.18	1.21**
Model $LR\chi^2$	5.24	33.20	25.00
Model d.f.	1	4	3
Constant	-2.90(0.08)	-2.99(0.09)	-3.02(0.08)
	Second and higher order births (n= 14951)		
	Gross effect (Model IV)	Adjusted for PBI (Model V)	Adjusted for SPB (Model VI)
$LR\chi^2$[a]	1.71.	1.73	0.90
d.f.	1	1	1
p	> 0.10	> 0.10	> 0.30
Place of residence			
Urban	1.00	1.00	1.00
Rural	1.14	1.14	1.09
Model $LR\chi^2$	1.71	116.40	223.4
Model d.f.	1	3	2
Constant	-2.86(0.09)	-3.35(0.12)	-3.01(0.09)

Notes: [a] A $LR\chi^2$ value for place of residence only while Model $LR\chi^2$ value is due to all the variables in the model· Birth order (BO), maternal age(MAGE), preceding birth interval (PBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.16 Odds ratios and likelihood chi-square values indicating the effect of household economic status on infant mortality, adjusted for maternal variables: Kenya, 1988/89 KDHS

All births (n= 18345)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	66.43	64.86	64.15
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Household economic status			
High	1.00	1.00	1.00
Medium	1.42***	1.40***	1.41***
Low	1.97***	1.96***	1.95***
Model $LR\chi^2$	66.43	94.40	84.10
Model d.f.	2	5	4
Constant	-3.15(0.07)	-3.27(0.09)	-3.26(0.08)

Second and higher order births (n= 14951)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	59.13	54.07	63.76	44.44
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Household economic status				
High	1.00	1.00	1.00	1.00
Medium	1.49***	1.48***	1.56***	1.46***
Low	2.09***	2.02***	2.16***	1.92***
Model $LR\chi^2$	59.13	99.20	178.5	268.00
Model d.f.	2	7	4	3
Constant	-3.23(0.09)	-3.41(0.10)	-3.72(0.12)	-3.35(0.09)

Notes: [a] A $LR\chi^2$ value for household economic status only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age(MAGE), preceding birth interval (PBI) and survival status of the preceding birth (SPB). **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.17 Odds ratios and likelihood chi-square values indicating the effect of household economic status on child mortality, adjusted for maternal factors: Kenya, 1988/89 KDHS

All births (n= 12595)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^{2a}$	35.67	36.20	37.02
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Household economic status			
High	1.00	1.00	1.00
Medium	1.46**	1.47**	1.47**
Low	2.12***	2.14***	2.16***
Model $LR\chi^2$	35.67	40.40	49.60
Model d.f.	2	5	4
Constant	-3.72(0.12)	-3.75(0.14)	-3.73(0.12)

Second and higher order births (n= 9243)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI & SBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^{2a}$	27.09	26.74	29.75	26.09
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Household economic status				
High	1.00	1.00	1.00	1.00
Medium	1.30*	1.29	1.33	1.29
Low	2.04***	2.03***	2.13***	2.02***
Model $LR\chi^2$	27.09	43.60	73.20	28.80
d.f.	2	6	4	3
Constant	-3.64(0.14)	-3.81(0.16)	-4.85(0.25)	-3.65(0.14)

Notes: [a] A $LR\chi^2$ value for household economic status only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age(MAGE), preceding and succeeding birth interval (PBI & SBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.18 Odds ratios and likelihood chi-square values indicating the effect of maternal education on infant mortality, adjusted for maternal variables: Kenya, 1988/89 KDHS

All births (n= 18345)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	77.76	71.43	75.15
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Maternal education			
Secondary	1.00	1.00	1.00
Primary	1.59***	1.59***	1.56***
None	2.40***	2.38***	2.37***
Model $LR\chi^2$	77.76	81.00	120.10
Model d.f.	2	5	4
Constant	-3.33(0.11)	-3.42(0.12)	-3.42(0.11)

Second and higher order births (n= 14951)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	59.43	45.22	63.21	46.12
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Maternal education				
Secondary	1.00	1.00	1.00	1.00
Primary	1.66***	1.52**	1.71***	1.57**
None	2.47***	2.21***	2.56***	2.26***
Model $LR\chi^2$	59.43	90.30	177.90	269.60
Model d.f.	2	7	4	3
Constant	-3.41(0.14)	-3.47(0.14)	-3.68(0.12)	-3.51(0.14)

Notes: [a] A $LR\chi^2$ value for maternal education only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age(MAGE), preceding birth interval (PBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.19 Odds ratios and likelihood chi-square values indicating the effect of maternal education on child mortality, adjusted for maternal variables: Kenya, 1988/89 KDHS

All births (n= 12595)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^{2}$ [a]	37.55	42.80	45.26
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Maternal education			
Secondary	1.00	1.00	1.00
Primary	1.93**	2.06***	2.00**
None	2.86***	3.15***	3.14***
Model $LR\chi^2$	37.55	47.00	57.90
Model d.f.	1	5	4
Constant	-4.04(0.21)	-4.11(0.22)	-4.14(0.21)

Second and higher order births (n= 9243)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI & SBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^{2}$ [a]	21.02	21.04	22.49	20.10
d.f.	2	2	2	2
p	< 0.01	< 0.001	< 0.001	< 0.001
Maternal education				
Secondary	1.00	1.00	1.00	1.00
Primary	1.52	1.49	1.57*	1.51
None	2.30**	2.29**	2.40***	2.27**
Model $LR\chi^2$	21.02	37.90	71.90	23.00
d.f.	2	6	6	3
Constant	-3.82(0.25)	-3.93(0.26)	-4.77(0.24)	-3.83(0.25)

Notes: [a] A $LR\chi^2$ value for maternal education only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age(MAGE), preceding and succeeding birth interval (PBI & SBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data..

Appendix 6.20 Odds ratios and likelihood chi-square values indicating the effect of paternal education on infant mortality, adjusted for maternal variables: Kenya, 1988/89 KDHS

All births (n = 18345)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	55.03	49.39	53.99
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Paternal education			
Secondary	1.00	1.00	1.00
Primary	1.40***	1.38***	1.41***
None	1.95***	1.91***	1.96***
Model $LR\chi^2$	55.03	79.00	74.00
Model d.f.	2	5	4
Constant	-3.09(0.07)	-3.17(0.08)	-3.42(0.11)

Second and higher order births (n = 14951)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	45.14	35.78	49.73	33.94
d.f.	2	2	2	2
p	< 0.001	< 0.001	< 0.001	< 0.001
Paternal education				
Secondary	1.00	1.00	1.00	1.00
Primary	1.49***	1.40***	1.54***	1.42***
None	2.01***	1.87***	2.09***	1.85***
Model $LR\chi^2$	45.14	80.90	164.40	257.50
Model d.f.	2	7	4	3
Constant	-3.16(0.08)	-3.29(0.10)	-3.69(0.12)	-3.28(0.09)

Notes: [a] A $LR\chi^2$ value for paternal education only while Model $LR\chi^2$ value is due to all the variables in the model· Birth order (BO), maternal age (MAGE), preceding birth interval (PBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.21 Odds ratios and likelihood chi-square values indicating the effect of paternal education on child mortality, adjusted for maternal variables: Kenya, 1988/89 KDHS

All births (n = 12595)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	23.57	26.06	28.76
d.f.	2	2	2
p	< 0.001	< 0.001	< 0.001
Paternal education			
Secondary	1.00	1.00	1.00
Primary	1.20	1.24	1.26
None	1.85***	1.94***	2.01***
Model $LR\chi^2$	23.57	30.20	41.40
Model d.f.	1	5	4
Constant	-3.52(0.11)	-3 56(0.11)	-3.57(0.12)

Second and higher order births (n = 9243)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI & SBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	16.19	16.95	17.88	15.75
d.f.	2	2	2	2
p	< 0.01	< 0.001	< 0.001	< 0.001
Paternal education				
Secondary	1.00	1.00	1.00	1.00
Primary	1.32	1.34	1.38	1.31
None	1.89***	1.94***	1.97***	1.88***
Model $LR\chi^2$	16.19	33.80	54.30	18.50
d.f.	2	6	6	3
Constant	-3.56(0 14)	-3.72(0.16)	-4 38(0.26)	-3.57(0.14)

Notes: [a] A $LR\chi^2$ value for paternal education only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age (MAGE), preceding and succeeding birth interval (PBI & SBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.22 Odds ratios and likelihood chi-square values indicating the effect of mother's work on infant mortality, adjusted for maternal factors: Kenya, 1988/89 KDHS

All births
(n= 18345)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^{2}$[a]	26.18	23.59	24.11
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Mother's work status			
Working	1.00	1.00	1.00
No	1.80***	1.75***	1.76***
Model $LR\chi^2$	26.18	53.20	42.60
Model d.f.	2	4	4 6
Constant	-3.28(0.12)	-3.37(0.13)	-3.34(0.12)

Second and higher order births
(n= 14951)

	Gross effect (Model IV)	Adjusted for MAGE & BO (Model V)	Adjusted for PBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^{2}$[a]	17.07	12.85	16.99	13.20
d.f.	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001
Mother's work status				
Working	1.00	1.00	1.00	1.00
No	1.69***	1.60***	1.70***	1.58***
Model $LR\chi^2$	17.07	57.50	131.70	235.90
Model d.f.	2	7	3	3
Constant	-3.24(0.13)	-3.40(0.14)	-3.72(0.15)	-3.35(0.13)

Notes: [a] A $LR\chi^2$ value for mother's work status only while Model $LR\chi^2$ value is due to all the variables in the model· Birth order (BO), maternal age (MAGE), preceding and succeeding birth interval (PBI & SBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.23 Odds ratios and likelihood chi-square values indicating the effect of mother's work status on child mortality, adjusted for maternal factors: Kenya, 1988/89 KDHS

All births
(n= 12595)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	13.45	14.13	13.55
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Mother's work status			
Working	1.00	1.00	1.00
No	1.89***	1.92***	1.91***
Model $LR\chi^2$	13.45	18.30	26.20
d.f.	1	4	3
Constant	-3.84(0.18)	-3.87(0.19)	-3.84(0.17)

Second and higher order births
(n= 9243)

	Gross effect (Model IV)	Adjusted for BO & MAGE (Model V)	Adjusted for PBI & SBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	4.76	4.15	4.92	4.92
d.f.	1	1	1	1
p	< 0.05	< 0.05	< 0.05	< 0.05
Working	1.00	1.00	1.00	1.00
No	1.55*	1.51*	1.57*	1.53*
Model $LR\chi^2$	4.76	19.20	54.30	7.20
d.f.	1	6	6	2
Constant	-3.63(0.21)	-3.79(0.22)	-4 38(0.26)	-3.64(0.21)

Notes: [a] A $LR\chi^2$ value for mother's work status only while Model $LR\chi^2$ value is due to all the variables in the model. Birth order (BO), maternal age at birth (MAGE), preceding and succeeding birth intervals (PBI & SBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.24 Odds ratios and likelihood chi-square values indicating the effect of possession of livestock on infant mortality, adjusted for maternal factors: Kenya, 1988/89 KDHS

All births
(n=18345)

Explanatory variable	Gross effect (Model I)	Adjusted for BO (Model II)	Adjusted for MAGE (Model III)
$LR\chi^2$ [a]	28.80	31.46	28.71
d.f.	1	1	1
p	< 0.001	< 0.001	< 0.001
Possession of livestock			
Yes	1.00	1.00	1.00
No	1.44***	1.47***	1.44***
Model $LR\chi^2$	28.80	61.00	47.00
Model d.f.	1	4	3
Constant	-2.84(0.04)	-2.98(0.06)	-2.93(0.04)

Second and higher order births
(n=12951)

	Gross effect (Model IV)	Adjusted for MAGE & BO (Model V)	Adjusted for PBI (Model VI)	Adjusted for SPB (Model VII)
$LR\chi^2$ [a]	25.68	28.41	25.30	18.75
d.f.	1	1	1	1
p	< 0.001	< 0.001	< 0.001	< 0.001
Possession of livestock				
Yes	1.00	1.00	1.00	1.00
No	1.47***	1.51***	1.47***	1.40***
1.43***				
Model $LR\chi^2$	25.68	73.50	140 00	242.30
Model d.f.	1	6	3	2
Constant	-2.86(0.04)	-3.11(0.07)	-3.35(0.09)	-3.02(0.04)

Notes: [a] A $LR\chi^2$ value for possession of livestock only while Model $LR\chi^2$ value is due to all the variables in the model· Birth order (BO), maternal age (MAGE), preceding birth interval (PBI) and survival status of the preceding birth (SPB). *Significant at $p < 0.05$, **Significant at $p < 0.01$, ***Significant at $p < 0.001$. The figures in the parentheses are the standard errors.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.25 Percentage distribution of the infants born between 1970 and 1987 according to maternal age at birth and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS

	Maternal age at birth			
	< 20 years	20-29 years	30+ years	Number of births
Province	**(χ^2 = 168.2, df =12, p < 0.001; V = 0.06)**			
Central	17.1	57.6	25.3	2957
Nairobi	25.9	59.4	14.7	983
Coast	19.7	59.5	20.8	1382
Eastern	15.6	55.9	28.5	3590
Nyanza	22.6	53.1	24.3	3719
R. Valley	20.8	54.0	25.2	4651
Western	18.4	55.7	25.9	2941
Place of residence	**(χ^2 = 162.7, df = 2, p < 0.001, V = 0.09)**			
Rural	18.7	55.0	26.2	17961
Urban	25.4	60.0	14.6	2261
Maternal education	**(χ^2 = 836.0, df =4, p < 0.001; V = 0.14)**			
None	14.4	51.0	34.6	7679
Primary	22.9	56.0	21.1	10172
Secondary	21.2	69.0	9.8	2348
Paternal education	**(χ^2 = 576.8, df =4, p < 0.001; V = 0.12)**			
None	13.8	50.4	35.0	4382
Primary	18.3	55.0	26.7	10397
Secondary	23.6	62.6	13.8	4572
Mother's work status	**(χ^2 = 45.3, df =2, p < 0.001; V = 0.04)**			
Works	19.8	54.8	25.4	17925
No	16.7	62.5	20.8	2094
Household economic status	**(χ^2 = 52.9, df =4, p < 0.001; V = 0.04)**			
Low	18.5	54.2	27.3	7629
Medium	20.8	55.3	23.9	8129
High	18.6	58.7	22.8	4435
Possession of livestock	**(χ^2 = 30.7 df = 2, p < 0.001; V = 0.04)**			
Yes	18.8	55.4	25.7	15415
No	21.5	56.1	22.3	4786
Total	**19.5**	**55.6**	**24.9**	**20222**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the total (20222) because of missing cases.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.26 Percentage distribution of the infants born between 1970 and 1987 according to birth order and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS

	Birth order of the child				
	1	2-3	4-5	6+	Number of births
Province	(χ^2 = 244.9, df =18 , p < 0.001; V = 0.06)				
Central	19.2	32.1	24.9	23.8	2957
Nairobi	30.6	40.1	19.2	10.1	983
Coast	19.2	32.7	23.0	25.1	1382
Eastern	18.3	31.3	24.1	26.3	3590
Nyanza	17.5	30.3	24.0	28.3	3719
R Valley	18.3	33.0	23.7	25.0	4651
Western	17.3	29.6	24.0	29.1	2941
Place of residence	(χ^2 = 413.8, df =3, p < 0.001; V = 0.14)				
Rural	17.4	31.0	24.4	27.2	17961
Urban	29.9	39.0	19.0	12.1	2261
Maternal education	(χ^2 = 13642.2, df = 6, p < 0.001; V = 0.18)				
None	11.9	27.1	26.2	34.7	7679
Primary	20.2	33.1	23.5	23.2	10172
Secondary	34.8	42.4	16.9	5.9	2348
Paternal education	(χ^2 = 878.4, df =6, p < 0.001; V = 0.15)				
None	12.5	27.8	25.7	34.1	4382
Primary	15.6	30.4	25.0	28.9	10397
Secondary	26.9	39.0	21.2	12.9	4572
Mother's work status	(χ^2 =106.4, df =2, p < 0.001, V = 0.07)				
No	23.0	36.7	23.3	17.0	17925
Works	18.3	31.3	23.8	26.6	2094
Household economic status	(χ^2 = 117.6, df = 6, p < 0.001; V = 0.05)				
High	22.7	33.6	21.9	21.8	7629
Medium	19.0	31.6	23.6	25.8	8129
Low	16.2	31.1	25.1	27.5	4435
Possession of livestock	(χ^2 = 56.2, df = 3, p < 0.001; V = 0.05)				
Yes	18.3	31.2	23.8	26.8	15415
No	20.2	34.3	23.9	21.6	4786
Total	**18.8**	**31.9**	**23.8**	**25.5**	**20222**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the total (20222) because of missing cases.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.27 Percentage distribution of the infants born between 1970 and 1987 according to the preceding birth interval and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS

	Preceding birth interval (in months)			
	< 24	24-35	36+	Number of births
Province	**(χ^2 = 45.2, df =12, p < 0.001; V = 0.04)**			
Central	35.2	39.5	25.4	2389
Nairobi	35.4	33.5	31.1	683
Coast	34.4	38.4	27.2	1117
Eastern	31.4	40.9	27.7	2934
Nyanza	37.4	36.1	26.5	3069
R.Valley	35.9	38.4	25.7	3800
Western	36.6	39.1	24.3	2434
Place of residence	**(χ^2 = 13.6, df =2, p < 0.001; V = 0.03)**			
Rural	35.1	38.9	26.0	14841
Urban	36.4	34.4	29.1	1584
Maternal education	**(χ^2 = 46.5, df =4, p < 0.001; V = 0.04)**			
None	34.5	37.4	28.1	6763
Primary	34.8	40.3	24.9	8114
Secondary	40.5	33.9	25.6	1531
Paternal education	**(χ^2 = 59.6, df =4, p < 0.001; V = 0.04)**			
None	34.5	36.4	29.1	3836
Primary	34.5	40.8	24.7	8773
Secondary	39.3	35.7	25.1	3343
Mother's work status	**(χ^2 = 19.1, df =2, p < 0.001; V = 0.03)**			
No	35.1	39.0	25.9	14645
Works	36.7	33.7	29.6	1612
Household economic status	**(χ^2 = 32.6, df =4, p < 0.001; V = 0.03)**			
High	38.6	35.3	26.1	3429
Medium	34.4	40.2	25.4	6581
Low	34.3	38.4	27.3	6393
Possession of livestock	**(LRχ^2 = 10.4, df = 2, p < 0.001; V = 0.02)**			
Yes	34.8	39.1	26.0	12593
No	36.6	36.2	27.1	3819
Total	**35.2**	**38.5**	**26.3**	**16425**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the total (20222) because of missing cases. Based on the births that occurred between 1970-87 that had a preceding birth interval irrespective of whether or not they had a succeeding birth interval.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.28 Percentage distribution of the infants born between 1970 and 1987 according to the succeeding birth interval and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS

	Succeeding birth interval (in months)			
	< 24	24-35	36+	Number of births
Province	(χ^2 = 39.2, df =12 , p < 0.001; V = 0.04)			
Central	35.1	39.7	25.2	2384
Nairobi	34.6	34.4	31.1	724
Coast	34.7	38.4	26.8	1106
Eastern	31.9	41.2	27.0	2928
Nyanza	37.3	37.6	25.2	3091
R. Valley	35.4	39.2	25.4	3868
Western	36.1	40.2	23.7	2482
Place of residence	(χ^2 = 13.3,. df =2, p < 0.001; V = 0.03)			
Rural	35.0	39.6	25.3	14909
Urban	35.9	35.5	28.7	1674
Maternal education	(χ^2 = 34.9, df =4, p < 0.001; V = 0.04)			
None	34.7	38.4	26.9	6505
Primary	34.5	40.9	24.6	8332
Secondary	39.3	34.5	26.2	1728
Paternal education	(χ^2 = 50.7 df =4, p < 0.001; V = 0.04)			
None	34.7	37.2	28.1	3691
Primary	34.5	41.5	24.0	8772
Secondary	38.3	36.5	25.2	3623
Mother's work status	(χ^2 = 32.4, df =2, p < 0.001; V = 0.03)			
No	35.0	39.8	25.2	14837
Works	36.5	33.2	30.3	1594
Household economic status	(χ^2 = 33.9, df = 4, p < 0.001; V = 0.03)			
High	38.6	36.2	25.2	3449
Medium	34.4	40.8	24.8	6694
Low	33.9	39.2	26.9	6418
Possession of livestock	(χ^2 = 10.0, df = 2, p < 0.001; V = 0.02)			
Yes	34.7	39.8	25.4	12677
No	36.5	37.0	26.5	3890
Total	**35.1**	**39.2**	**25.7**	**16562**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the total (16562) because of missing cases. Based on the births that occurred between 1970-87 that had a succeeding birth interval irrespective of whether or not they had a preceding birth interval.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.29 Percentage distribution of the infants born between 1970 and 1987 according to the survival status of the preceding child and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS

	Survival status of the preceding child at age one		
	Alive	Dead	Total births
Province	(χ^2 = 162.8, df =6 , p < 0.001; V = 0.10)		
Central	95.8	4.2	2389
Nairobi	96.1	3.9	683
Coast	88.8	11.2	1117
Eastern	94.3	5.7	2934
Nyanza	90.9	9.1	3069
R. Valley	96.3	3.7	3800
Western	92.9	7.1	2941
Place of residence	(χ^2 =2.5, df = 1, p > 0.10; V = 0.0)		
Rural	93 8	6 2	14841
Urban	94.7	5.3	1584
Maternal education	(χ^2 = 24.7, df = 2, p < 0.001; V = 0.04)		
None	92.7	7.3	6763
Primary	94.6	5.4	8114
Secondary	94.9	5.1	1531
Paternal education	(χ^2 = 17.6, df = 2, p < 0.001; V = 0.03)		
None	92.4	7.6	3836
Primary	94.0	6.0	8773
Secondary	94.7	5.3	3343
Mother's work status	(χ^2 = 6.7, df = 1, p < 0.01; V = 0.02)		
No	93.7	6.3	14645
Works	95.4	4.6	1612
Household economic status	(χ^2 = 52.2, df = 2, p < 0.001; V = 0.06)		
High	96.0	4.0	3429
Medium	94.1	5.9	6581
Low	92.4	7.6	6393
Possession of livestock	(χ^2 =29.1, df = 1, p < 0.001; V = 0.04)		
Yes	94.4	5.6	12593
No	92.0	8.0	3819
Total	**93.7**	**6.1**	**16562**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the total (16562) because of missing cases. Based on the births that occurred between 1970-87 that had a preceding birth interval irrespective of whether or not they had a succeeding birth interval.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.30 Percentage distribution of the infants born between 1970 and 1987 according to the source of drinking water, availability of a toilet facility and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS

	Source of drinking water		Availability of toilet	
	Piped water	Other source	Toilet present	No toilet
Province	(χ^2 = 4235, df = 12, p < 0.001; V = 0.5)		(χ^2 = 162.9, df = 6, p < 0.001; V = 0.3)	
Central	36.5	63.5	99.6	0.4
Nairobi	96.1	3.9	98.0	2.0
Coast	48.9	51.1	55.2	44.7
Eastern	22.5	77.5	83.2	16.8
Nyanza	11.2	88.8	81.9	18.1
R.Valley	11.9	88.1	77.3	22.7
Western	17.1	82.9	88.3	11.7
Place of residence	(χ^2 = 5608.0, df = 1, p < 0.001; V = 0.5)		(χ^2 = 352.0, df = 1, p < 0.001; V = 0.1)	
Rural	16.6	83.4	95.6	4.4
Urban	88.6	11.4	82.0	18.0
Maternal education	(χ^2 = 1250.0, df = 2, p < 0.001; V = 0.3)		(χ^2 = 1205.3, df = 2, p < 0.001; V = 0.2)	
None	17.0	83.0	72.3	27.7
Primary	24.0	76.0	89.2	10.8
Secondary	52.9	47.1	95.9	4.1
Paternal education	(χ^2 = 508.1, df = 2, p < 0.001; V = 0.2)		(χ^2 = 1358.2, df = 2, p < 0.001; V = 0.3)	
None	18.2	81.8	65.9	34.1
Primary	21.3	78.7	86.5	13.5
Secondary	36.5	63.5	93.1	6.9
Mother's work status	(χ^2 = 1415.6, df = 1, p < 0.001; V = 0.3)		(χ^2 = 332.7, df = 1, p < 0.001; V = 0.1)	
No	20.7	79.3	81.9	18.1
Works	58.3	41.7	97.6	2.4
Household economic status	(χ^2 = 1937.4, df = 4, p < 0.001; V = 0.3)		(χ^2 = 1948.5, df = 2, p < 0.001; V = 0.3)	
High	49.2	50.8	97.3	2.7
Medium	21.0	79.0	89.0	11.0
Low	14.3	85.7	69.9	30.1
Possession of livestock	(χ^2 = 688.0, df = 1, p < 0.001; V = 0.2)		(χ^2 = 0.7, df = 1, p > 0.40; V = 0.0)	
Yes	20.2	79.2	83.4	16.6
No	38.9	61.1	83.9	16.1
Total	**24.6**	**75.4**	**83.5**	**16.5**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the total (20222) because of missing cases. Based on the births that occurred between 1970-87.

Source: Primary analysis of the 1988/89 KDHS data.

Table 6.31 **Percentage distribution of the infants born between 1970 and 1987 according to whether the mother ever-used modern contraception and selected socioeconomic characteristics of the parents: Kenya, 1988/89 KDHS**

	Ever-use of modern contraception		
	Ever used	Never used	Total births
Province ($\chi^2 = 978.9$, df =6, $p < 0.001$; V = 0.2)			
Central	50.5	49.50	2957
Nairobi	59.1	40.9	893
Coast	31.0	69.0	1382
Eastern	32.2	67.8	3590
Nyanza	24.2	75.8	3719
R. Valley	27.6	72.4	4651
Western	25.9	74.1	2941
Place of residence ($\chi^2 = 522.1$, df = 1, $p < 0.001$; V = 0.2)			
Rural	30.0	70.0	17961
Urban	53.9	46.1	2261
Maternal education ($\chi^2 = 1413.5$, df = 2, $p < 0.001$; V = 0.3)			
None	19.1	80.9	7679
Primary	37.0	63.0	10172
Secondary	58.0	42.0	2348
Paternal education ($\chi^2 = 1016.8$, df = 2, $p < 0.001$; V = 0.2)			
None	17.0	83.0	4382
Primary	32.1	67.9	10397
Secondary	48.5	51.5	4572
Mother's work status ($\chi^2 = 587.4$, df = 1, $p < 0.001$; V= 0.2)			
No	29.9	70.1	17925
Works	56.2	43.8	2094
Household economic status ($\chi^2 = 1474.5$, df = 2, $p < 0.001$; V = 0.3)			
High	54.1	45.9	4435
Medium	32.5	67.5	8129
Low	20.2	79.8	7629
Possession of livestock ($\chi^2 = 120.2$, df = 1, $p < 0.001$; V = 0.1)			
Yes	30.6	69.4	15415
No	39.2	60.8	4786
Total	**32.7**	**67.3**	**20222**

Notes: V stands for Cramer's V statistic. Some of the categories do not add up to the t (20222) because of missing cases.

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 6.32 Percentage distribution of the 7150 women covered by KDHS 1988/89 according to the source of drinking water, availability of a toilet facility and ever-use of modern contraception: Kenya, 1988/89 KDHS

	Had access to piped water		Had a toilet facility		Ever-used contraception	
	Yes	No	Yes	No	Yes	No
Province						
Central	38.0	62.0	99.6	0.4	34.9	65.1
R.Valley	14.9	85.1	75.5	24.5	20.1	79.9
Nairobi	95.8	4.2	97.7	2.3	39.0	61.0
Eastern	24.4	75.6	84.8	15.2	23.9	76.1
Western	22.5	77.5	89.9	10.1	18.4	81.6
Nyanza	16.8	83.2	82.9	17.1	17.3	82.7
Coast	57.2	42.8	63.6	36.4	23.6	76.4
Place of residence						
Urban	90.9	9.1	96.8	3.2	36.6	63.6
Rural	18.2	81.8	82.6	17.4	21.5	78.5
Level of education						
None	19.9	80.1	69.1	30.9	15.7	84.3
Primary	28.0	72.8	88.3	11.7	23.8	76.2
Secondary	51.5	48.5	95.9	4.1	35.4	64.6
Husband's education						
None	21.2	78.8	64.3	35.7	14.1	85.9
Primary	24.3	75.7	85.5	14.5	28.1	71.9
Secondary	42.7	57.3	92.0	8.0	40.2	59.8
Household economic status						
High	56.5	43.5	98.0	1.1	37.4	62.6
Medium	24.4	75.6	87.9	12.1	22.2	77.8
Low	16.5	83.5	70.4	29.6	14.9	85.1
Work status						
No	26.8	73.2	83.4	16.6	21.3	78.7
Working	61.5	38.5	97.3	2.7	45.6	54.4
Household possessed livestock						
Yes	24.9	75.1	84.6	15.4	22.2	77.8
No	49.2	50.8	86.5	13.5	30.1	69.9
All	30.8	69.2	85.0	15.0	24.1	75.9

Source: Primary analysis of the 1988/89 KDHS data

Appedix 6.33 Distribution of births and children of the second and higher birth order used in the analysis of infant and child mortality: Kenya, 1988/89 KDHS

Explanatory variable	Births used in analysis of infant mortality	Children used in analysis of child mortality
Province of residence		
Central	2743	1773
Nairobi	989	552
Coast	1542	925
Eastern	1976	1255
Nyanza	2897	1730
Rift Valley	2346	1499
Western	2458	1509
Household economic status		
High	3380	2034
Medium	5855	3636
Low	5716	3573
Paternal education		
None	3410	2281
Primary	8067	5123
Secondary^{+}	3474	1839
Maternal education		
None	6147	4091
Primary	7215	4404
Secondary^{+}	1589	748
Mother's current work status		
Working	1544	926
Not working	13407	8317
Place of residence		
Urban	2300	1248
Rural	12651	7995
Possession of livestock		
Yes	11672	7114
No	3602	2129
Year of birth of the child		
1970-74	2669	2404
1975-79	4038	3535
1980-83	4074	3304
1984-87	4170	------
Survival status of preceding child		
Alive	13988	8707
Dead	983	536
Preceding birth interval		
< 24	5406	3513
24-35	5720	3594
36+	3125	2136

Continued

Appedix 6.33 Distribution of births and children of the second and higher birth order used in the analysis of infant and child mortality: Kenya, 1988/89 KDHS

Explanatory variable	Births used in analysis of infant mortality	Children used in analysis of child mortality
Birth order		
2-3	5946	4037
4-5	4384	2823
6+	4621	2383
Maternal age at birth		
< 20	1296	978
20-29	9116	5987
30+	4539	2278
Source of drinking water		
Piped	4613	2719
Other	10338	6524
Availability of a toilet facility		
Yes	12672	7855
No	2279	1388
Succeeding birth interval		
< 24	------	3123
24-35	------	3557
36+	------	2563

Source: Primary analysis of the 1988/89 KDHS data.

Appendix 8.1 Percentage of currently married women aged 15-49 years who approved of family planning and who said their husbands/partners approved of family planning and who discussed family planning more often with husband/partner : Kenya, 1988/89 KDHS

Approved/discussed family planning	Central province	Western province
Woman approved	92.1	87.7
Husband approved	69.9	53.7
Discussed family planning with husband more often	57.3	20.2
Total number of women	787	745

Source: Primary analysis of the 1988/89 KDHS data.