TITLE

"EFFECT OF INFANT AND CHILD MORTALITY ON FERTILITY IN KENYA"

By

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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ABSTRACT

The specific objective of this study was to assess whether behavioural effects on fertility of replacement and insurance following an infant or child death exist in Kenya independent of biological effects. A further general objective was to find out whether the measured values of such effects depended on the methods utilized for analysis. To achieve the above objectives, several hypotheses to determine the magnitudes of these effects were tested by applying the Ordinary Least Square (OLS) and the Hazards models to data drawn from the Kenya Demographic and Health Survey (KDHS) which was conducted in 1989.

The above hypotheses were tested within a conceptual framework developed from the Bongaart and Mosley and Chen frameworks for the analysis of fertility and infant and child mortality respectively. To operationalize this conceptual framework the birth interval was taken as the dependent variable and also a measure of fertility while seven variables were defined for the assessment of the effects. Several socio-economic, cultural and demographic variables were included in this framework as control variables.

Results of the analysis are presented and discussed in Chapters 6 (bivariate) and 7 (multivariate) of the Thesis. The results in chapter 6 showed that infant and child deaths were associated with shorter birth intervals in case of the

analysis based on the OLS and higher risks of birth interval termination in the case of the hazards models. For example, birth intervals were shorter on the average by about 4 months for deaths of female births taking place in those intervals where the birth opening the interval was alive at the time of the survey. In terms of the risk, it was 1.5 higher in case of such deaths compared to when there were no such deaths.

The assessment of the replacement and insurance effects undertaken in Chapter 7 showed that the shorter birth intervals associated with infant and child deaths were in part explained by differences in coital frequency, contraceptive use and breastfeeding among the two groups of mothers. These results suggest the existence of replacement and insurance effects. Coital frequency and contraceptive use were found to explain about 10 per cent of the differences while breastfeeding explained about 34 per cent. The results obtained from the two method were also found to be consistent.

The main conclusion which is drawn is that the findings of the study are consistent with the existence of replacement and insurance effects. Further research is, however needed before firm conclusions can be drawn. The main policy implications of the findings of the study is that infant and child survival programmes should be integrated as part of the overall strategy for the increased acceptance and use of family planning in areas where infant and child mortality is high in Kenya. Emphasis of the role of breastfeeding may be an additional strategy for increasing infant and child survival and lowering fertility.

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CHAPTER 1

INTRODUCTION AND STATEMENT OF THE PROBLEM

1.1. Introduction

The relationship between fertility and mortality is considered one of the key areas of demographic research. This study focuses on one specific aspect of this relationship: the effect of infant and child mortality on fertility. Besides its contribution in the understanding the nature and form of the more general relationship referred to above, studying how fertility would respond to changes in infant and child mortality is considered important for a number of other reasons. From a theoretical perspective, studying this relationship would increase our understanding of the role of infant and child mortality as a determinant of variations in fertility. On the other hand programmes for reducing infant and child mortality with the reduction of fertility as one of the ultimate outcomes would be based on a better understanding of this relationship.

The effect of infant and child mortality on fertility is usually conceptualized within two broad categories: biological and behavioural. The latter is assumed to take place as a result of mothers attempting to replace infants or children who have died or having more children than desired number surviving in anticipation that some of them will die. The direct response to experienced deaths is referred to as replacement effect while the effect due to anticipated deaths is referred to as insurance or hoarding.

Biological effects of infant or child deaths occur primarily as a result of the curtailment of breastfeeding when an infant or a child who is breastfeeding dies. This curtailment in turn hastens the return of ovulation and thus exposes the mother to the risk of pregnancy sooner than if the infant or the child had not died.

One of the main areas of focus in the studies assessing these effects has been to establish the existence of the behavioural effects independent of the biological effects. Establishing the existence this effect has been considered crucial since if child survival is not strongly related to the motivation to have fewer births, this may lead to a rise in the rate of population growth (Mensch, 1985) which as pointed out by Preston (1978) has in turn an enormous array of implications for social welfare.

1.2. Statement of the Problem

The assessment of behavioural effects independent of the biological effects is considered to be a difficult task (Suchindran and Adlakha, 1984). As pointed above, the death of an infant or a child who is breastfeeding exposes the mother to the risk of pregnancy sooner than if the infant survived. This is expected to result in a shorter subsequent interval on average. However, if the replacement desires exists, it would be anticipated that a behavioural response would occur following such a death making the birth intervals even shorter. Thus, a child death may give rise to a biological effect which may be followed by behavioural responses and which are difficult to distinguish.

Olsen (1980) and Lehrer (1984) have further observed that distinguishing these effects may be even more difficult if the mothers are aware of the contraceptive effect of breastfeeding. As the researchers have pointed out such knowledge may tend to bias downwards the behavioural effects.

The application of different methods in the assessment of the behavioural effects in different and at times in the same settings have yielded inconsistent results. The Chowdhury et al.(1975) and Suchindran and Adlakha (1981) studies for instance show no evidence of the behavioural effects of replacement in Bangladesh, Pakistan and Sri Lanka. The Lehrer (1984) and Olsen (1988) studies on the other hand suggest that such effects exist in Malaysia.

Although recent studies (Taylor et al.,1976; Suchindran and Adlakha,1984;

Ritcher and Adlakha,1989) seem to suggest that such different results may in part be explained by the socio-economic cultural and demographic differences, the possibility that such differences may also be due to the methods employed in the analysis and use of different measurements of these effects has not been investigated. Can the same general conclusions be reached regarding these effects by the application of different methods on the same data?

1.3. Objectives of the Study

As a consequence of the discussion above, one of the general objectives of this study is to examine whether the same conclusions on the behavioural effects can be reached by applying two different methods of analysis on the same data. The other more specific objective of the study is to assess whether the behavioural effects of replacement and insurance exist independent of the biological effects in Kenya.

In order to achieve these objectives, a conceptual framework incorporating these three effects was developed and then operationalized by defining measurements for each of these three effects. Finally the data from the Kenya Demographic and Health Survey (KDHS) were utilized in this assessment.

1.4. Study Justification

In several ways, this research extends on previous studies which have examined the effect of infant and child mortality on fertility in Kenya. First, the analysis in this study is undertaken within a more general conceptual framework of analysis and utilizing methods of analysis in which confounding variables are incorporated in the analysis. Brass and Barrett (1978) and Suchindran and Adlakha (1981,1984) among others have pointed out the need of including such variables in the analysis.

Second, an attempt has been made to refine further the separation of the biological and behavioural effects. These effects are analyzed within a shorter reproductive span-the birth interval. Chowdhury et al. (1975) and Santow and Bracher (1984) have pointed out the advantages of examining these effects within the birth interval. Stantow and Bracher, for instance, note that with a greater knowledge of events occurring between one birth and the next, it becomes possible to identify with some precision the causal chain linking child mortality with fertility.

Finally, the application of two methods of analysis to the same data set enables us to examine the more general methodological issue of the role of applying different approaches in assessing the effects.

Establishing the existence of the behavioural effects of infant and child mortality on fertility has an important implication to the theory of demographic transition. The demographic transition theory was formulated to explain why fertility and mortality declined in Europe and with the latter lagging behind fertility. One of the explanations offered by this theory is that lower infant and child mortality assures that fewer births are needed to attain a given family size.

At the practical level, findings of the study can be useful in developing strategies for integrating infant and child mortality programmes to programmes aimed at fertility reduction.

1.5. Scope and Limitation of the Study

The study focuses on the roles of the behavioural effects (replacement and insurance) of infant and child mortality on fertility and specifically with respect to their relative importance in Kenya. Thus the study does not examine the influence of demographic, socio-economic and other factors which may have an influence on these effects. In addition, the effects are examined at one point in time, so our analysis cannot give an indication of the possible changes with time. Biological effects are influenced by the duration of breastfeeding and are therefore high in societies where duration of breastfeeding is long and infant and child mortality high, the typical case of a developing country such as Kenya. It would thus be anticipated that the magnitudes of these effects should change with time. Replacement effects depend on the extent of conscious family limitation, and so may be expected to increase as fertility declines.

A number of restrictions are imposed on the data utilized in the analysis due to a number of methodological considerations. Thus for instance our analysis is limited to births occurring within 60 months from the time of the survey. Reasons for such restrictions are fully discussed in the relevant sections of the study.

1.6. Summary

This study focuses on assessing the existence of behavioural effects of replacement and insurance on fertility as a result of infant and child deaths. Since as noted studying these effects independent of the biological effects is a difficult task, we anticipate that the strategy adopted in this study may have some methodological implications in the future studies focusing on such assessments.

The establishment of whether or not the behavioural effects exist is of both theoretical and practical value. From a theoretical perspective we expect our findings to lead to a better understanding of the behavioural mechanisms through which infant and child deaths affect fertility. The findings of the study are expected to have direct implications on the role of infant and child mortality to the demographic transition theory in general and in particular as it applies to Kenya. From the policy point of view, we expect the findings to be relevant in the development of policies relating to child survival and family planning programmes in Kenya. Finally the application of two methods in the analysis will increase our understanding on the possible sources of differences in the results obtained with respect to the existence of behavioural effects.

1.7. Organization of the Thesis

The thesis is organized in eight chapters, in addition to this chapter, as follows. The literature on the relationship between infant and child mortality and hypotheses of the study are examined in chapter 2. Chapter 3 presents the theoretical framework within which the study was conceptualized and subsequent testing of hypothesis undertaken. The data utilized in the testing of the study hypothesis are provided in Chapter 4. In Chapter 5 the conceptual framework discussed in chapter 3 is operationalized by providing definition of variables utilized in the analysis. Methods which were used in testing the hypotheses are also provided in this chapter. The bivariate results of the study are discussed in Chapter 6 while Chapter 7 presents the main results which were based on the multivariate analysis. Chapter 8 provides the summary, conclusions and recommendations of the study.

CHAPTER 2

LITERATURE REVIEW

In this chapter, we review the literature on the effect of infant and child mortality on fertility. This review is undertaken to achieve two broad objectives. First, we draw evidence from existing studies to determine what is known with respect to these effects. This is discussed in the first part of the review. In the second part of this review we focus on the main issues arising from the studies examined in part one with respect to the assessment of the effects.

2.1. Effect of Infant/Child Mortality on Fertility

Although various measures of fertility and mortality have generally been observed to be positively correlated, little evidence has been available until recently to indicate the nature of these relationships. As discussed earlier this relationship can be as a result of the biological and/or behavioural mechanisms. Since the late 60's, however, evidence has accumulated through the implementation of several studies in both developing and developed countries utilizing different approaches. These studies are reviewed below to determine the nature and magnitudes of these effects.

Evidence obtained from both historical data and recent surveys particularly World Fertility Survey (WFS) shows that birth intervals are shorter when an infant dies than when it survives. In a cross-sectional study involving 22 countries with comparable data from the WFS, neonatal deaths were found to shorten the first birth intervals by an average of 4.7 months in all the 22 countries and post-neonatal deaths by 2.4 months (Cochrane and Zachariah,1983). Similar shortening were also obtained for the third and fifth intervals from the same study. It was further found that this shortening also depended on the date of death of the child, being shorter if the infant died earlier. The authors observed that the majority of this shortening could probably be due to the biological effects.

Knodel (1968) in an earlier study undertaken using historical data from parishes in three Bavarian villages in Germany also concluded that the shortening of the birth intervals observed in the data following an infant death was mainly due to the biological effect. The researcher observed that although the analysis was inconclusive with respect to the magnitudes of the behavioural effects, even if such effects existed it would be minimal compared to the biological.

Further evidence supporting the minimal role of behavioural effects is contained in two other studies based on historical data from Europe (Knodel, 1978;1981).

In the first of these studies evidence from data covering the period prior to the demographic transition in Europe from European villages in France, Germany,Denmark and Switzerland was reviewed. It was noted that an infant death typically resulted in shortening the time taken to the next birth by an average of 2 to 13 months, most of which can be accounted for by the interruption of lactation. Evidence to support the operation of child replacement effect in pre-industrial Europe prior to the onset of at least moderately widespread voluntary family limitation obtained from the data was however much less consistent and hence it was not possible to conclude whether deliberate efforts to replace dying children existed or not.

In the other study which was based on data from 14 Germany village genealogies relating to couples married during eighteenth and early nineteenth centuries, little evidence of replacement effects was found among couples indicated as having natural fertility (i.e. with little practice of family planning). Replacement effects were however more pronounced among couples characterized as practicing family planning. In some villages where there was no evidence of family planning practice however, replacement behaviour was also exhibited.

Some studies using recent data have also not yielded consistent evidence with respect to the existence of replacement effects. Using data from Bangladesh and Pakistan Chowdhury et al.(1975) found no evidence of the existence of replacement effects. In this study which included 2,910 currently married women aged between 35 and 55 years in a survey conducted in 1968-69 in Pakistan and 5,236 women in Bangladesh, it was found that the shorter birth intervals following an infant death was mainly due to the biological effects. The basis for this conclusion was that no significant differences were found between median birth intervals between the *i*th and *i+1*th births for women who had experienced previous infant death and those who had not among women whose ith birth was still alive. The exclusion of the intervals in which the *i*th birth had died ensured that biological effects due to the death of these births were eliminated.

Similar findings have been obtained for Bangladesh using WFS data (Sofian and Johnston,1989). In this study median birth intervals between successive birth orders *i* and *i+1* were found not to be shorter when some siblings of order *i* to *i-1* had died than when all such siblings survived. Although the interval lengths were generally shorter if the mother had an urban than a rural residence at the survey date, this difference was attributed only to shorter durations of breastfeeding and not strong desire to replace dead offspring.

The findings for Pakistan are not consistent. While Rao and Beaujot (1986) study using the 1975 WFS data from Pakistan found no evidence of replacement effects and hence is in agreement with Chowdhury et al.'s study, two other studies Rukanuddin (1982) and Richter and Adlakha (1989) found evidence of replacement effects. In Rukanuddin's study, which was based on the data from Pakistan National Impact Survey (1968-69), it was found that the experience of an infant and child mortality had shorter birth intervals than those who had not experienced such deaths and this shortening was found to be even shorter if the infant death was a male. The researcher therefore concluded that these differences may largely be attributed to behavioural responses of couples who experienced male infant deaths compensating for the earlier deaths.

In Ritcher and Adlakha's study, evidence to replace a child who had died was also found. It was further found that women in rural areas have a higher probability of replacement than urban women.

Three studies based on the WFS data from Sri Lanka (Suchindran and Adlakha,1981; Rao and Beaujot,1986; and Ritcher and Adlakha,1989) provide conflicting evidence of replacement effects. In Suchindran and Adlakha's study in which the analysis was undertaken using the multivariate life table (Cox, 1972), it was found that although the death of an infant opening the interval increased the chances of having an additional birth, the number of prior infant deaths had no statistical significant effect. In fact women with prior infant deaths were found to be less likely to have an additional birth. These findings were interpreted to imply that the analysis did not support behavioural replacement effects. Thus the differences in the birth intervals appeared to be primarily as a result of lactation effects.

Rao and Beaujot's study suggested that child replacement in Sri Lanka was low. Examining deaths at specific parities and controlling for age,time since last birth and a series of socio-economic factors, it was found that there was no difference in the attained family sizes among those who had experienced child loss and those without.

The recent study of Ritcher and Adlakha, however, seems to indicate the existence of replacement effects among educated women and those living in estates. In this study undertaken using Cox proportional hazards model women with highest level of education were found to be twice as likely to continue child bearing if her child died than if the child survived. Similarly women living in estates experiencing an infant death were found to be nearly 3 times as likely to have an additional birth if they experienced an infant death.

Studies undertaken in Korea are consistent in suggesting the existence of replacement effects. The analysis of data from 6,285 women collected in a National Fertility Abortion Survey of Korean Institute for Family Planning (KIFP) undertaken by Park et al. (1979) concluded that the increased risk of child bearing experienced due to an infant death may in the early days have been largely, if not solely, to physiological effect. In this study an adjustment was made for factors such as residence, education, occupation and age which could confound the relationship between birth intervals and infant mortality. Since 1965 when vigorous contraceptive programmes were offered to the public, the researchers observed that the replacement effects had began to emerge.

Further evidence of replacement effects in Korea is provided by the study of Mensch (1985) in which the Korean data from WFS were analyzed together with those from Columbia and Costa Rica. In this study replacement effects were found to exist for all parities as reflected by the use of contraception or the desire to do so. For instance the risk of having a fourth birth for contraceptors who had lost a child was 2.5 times as large as that for women whose children had survived. The probability that a woman whose children had survived would use contraception was 1.5 times that of a woman whose children have died for the fourth interval among Korean women.

Two studies using Malaysian data are also consistent in their findings on the existence of replacement effects.The study undertaken by Lehrer (1984) using data from Malaysian Family Life Survey and the Cox proportional hazards model found that the death of the fourth birth increased the probability that another child will be born within two years by approximately 35 per cent most of this was found to be due to the behavioural effects since holding the duration of breastfeeding constant only reduced this per cent to 29. Mortality effects operating through the behavioural channels were found to be weaker for the fifth and sixth births and also there was no evidence to support the hypothesis that the sex of deceased child had an impact on parents' desires for quick replacement.

Olsen (1988) using the same data set and a waiting time regression model for analysis found that the effect of an infant death on the probability of conception was 35 per cent and each of the three channels; couples seeking to directly replace children who had died; couples having more children in anticipation of future deaths and the shortening of the period of post-partum amenorrhea due to child death; and each accounted for about one-third of the above effect. Thus the total estimated behavioural effects in this case is slightly lower, about 25 per cent compared to the 29 per cent in the other study discussed above.

Evidence of behavioural effects in some Latin American countries has also been found. Ritcher and Adlakha (1989) using the WFS data from Columbia concluded that there was some evidence of replacement effects and that this effect was similar across all the groups (i.e. did not vary by type of residence and levels of education). Using the same data set Mensch (1985) found the existence of replacement effects but only after the fifth birth interval. In this study previous child loss was found to affect the woman's decision to use birth control during the fifth and sixth birth intervals where the probabilities were 1.2 and 1.4 times greater among women whose children died compared to those whose children had survived. However, Rutstein and Medica's study using Multiple Classification Analysis (MCA) and controlling for a number of socio-economic, demographic and other variables found that the experience with child mortality was associated with only a slight reduction (only 4 per cent) in the proportion who had ever used contraception.

In Costa Rica, evidence indicates the existence of replacement effects for some births. For instance Mensch (1985) found that in the third interval the probability that a woman whose first child survived will use contraception was 1.8 times that of a woman whose child had died. The decision to use contraception is however not linked with previous mortality experience for higher birth intervals. Similarly among women contracepting in the third interval, the probability of having a birth was found to be greater when the child died than when it survived. Rutstein and Medica (1978) on the other hand concluded that the increase in actual fertility as response to direct experience of child mortality was small, much less than necessary for the replacement of lost children.

Several studies undertaken in African countries have also revealed the existence of replacement behaviour. In Egypt this evidence is contained in two studies undertaken using the WFS data from this country. In one of these studies Hamed(1980), women who had lost two or more children were found to desire 1.3 more children on the average compared to those without a child loss experience. Similarly, women who had never experienced child loss were found to have higher rates of ever having used contraception or current use. In this study it was therefore concluded that the observed larger desired family size and less intention to use contraception in future among women who had experienced death of their children seemed to suggest the existence of insurance effects whereas the additional children wanted and current use rates of contraception indicated the intention of couples to replace dead children.

Marcotte and Casterline (1990) using the same data found that the hazard for the next pregnancy after a child loss net of weaning and other control variables was 3.22 times the hazard without a child death. This estimated effect suggested deliberate efforts to replace dead children.

Analysis undertaken using the WFS data for Sudan (Saleh,1980) found that biological and behavioural effects were evident. In this study, the survival status of the penultimate child had a significant effect on the waiting time to conception.

In Kenya there is evidence suggesting that a child who had died is replaced. Ritcher and Adlakha (1989) found that women at parity 4 and above who had experienced an infant death were nearly twice as likely to have an additional birth compared to those who did not. Deaths occurring outside marriage were less likely to be replaced.

Evidence from several other studies undertaken in six geo-cultural regions has also been reviewed by Taylor et al. (1976). According to this review, replacement effects exist in Turkey, the Philippines and Taiwan. In addition an insurance effect has been found in Sierra Leone in West Africa in communities where the child mortality rates were high.

2.2. Issues Related to the Assessment of Biological and Behavioural Effects

Several methodological issues related to the assessment of the biological and behavioural effects have been discussed in the studies reviewed above. In this sub-section these issues are reviewed.

As discussed earlier, one of the main difficulties encountered in the assessment of the biological and behavioural effects is the separation of the latter effects from the former. Several approaches have been adopted in attempt to overcome this difficulty. Two of the earliest of these approaches were applied by Knodel (1968) and Chowdhury et al.(1975).

In Knodel's study, the two effects were separated by considering the effect of the fate of the first born on the interval between second and third children by holding constant the survival status of the second child. The difference in lengths of the interval between the second and third births for the cases when the two births survives and when the first one dies gives an indication of the replacement effects. The difference being referred to here is the difference in birth intervals between the sequences died-survived and survived-survived for the first and second births respectively. Since the second child survives, the biological effect of the birth which opens this interval (second birth) does not exist and thus facilitating analyzing its motivation effect in this interval. Similarly the sequences where the first child dies and the second one survives(died-survives) and where the first one survives and the second one dies(survives-died) gives a measure of lactation effect since in both cases there is equal motivation to have another child.

In order to avoid the truncation bias arising from considering only closed intervals as pointed out by Suchindran and Adlakha (1981), this procedure has been extended so that birth intervals are constructed through the life table technique in which both open and closed intervals are considered. Since as further pointed out Suchindran and Adlakha (1984), the duration of a typical birth interval can be divided into three components: post-partum amenorrhea following a live birth; waiting time to conception; and non-susceptible periods following fetal losses, the differences in the lengths may be due to differences in one or the other of these components. Suchindran and Adlakha (1981;1984) have in addition therefore examined whether the group of women experiencing infant death is a selected one with higher fertility.

Although the life table analysis is useful for detecting the influences of infant death on the ensuing birth intervals, the interpretation of the results is limited due to lack of adequate controls of the other confounding variables. Brass and Barrett (1978) have noted that if both fertility and mortality are affected in the same direction by the same variable e.g education, then there will be an association between the two characteristics which does not come from the effect of one on the other and hence the relationship would be spurious. It is thus necessary that the effects of such variables be controlled.

In Chowdhury et al.'s approach, the biological effects were separated from the behavioural effects by constructing median birth intervals between parities i and $i+1$ for only those women who had not experienced the death of ith birth. Thus the median birth intervals are constructed for those who have experienced infant or child death among births 1 up to $i-1$ and those who had not experienced any child loss. This approach however suffers from the same limitations pointed out since the effects of the other variables which may affect birth intervals were not controlled for. In fact, Chowdhury et al. have recognized this and noted that dissecting the birth intervals into the above mentioned components would permit a more precise quantification of mortality effects on fertility.

Additional limitations with respect to this approach have been raised by Lehrer (1984) and Sufian and Johnston (1989). Lehrer observes that by excluding cases with a death at parities *i* in the analysis of spacing between parities *i* and *i+1*, the place where most of the effect is expected is removed from the analysis and hence the fact that the death of a child before parity *i* has no effect on the spacing between births of parity *i* and *i+1* is not conclusive evidence that there is no behavioural effects. Emphasizing the same point, Sufian and Johnston observe that couples probably have the greatest motivation to replace a dead child immediately after the death and hence the proper birth interval for analysis is not the one between two consecutive live births but the one between a child's death date and the next birth date after the death. In their study therefore, median birth intervals were examined on the basis of whether children of parities below *i* had died in the interval (*i,i+1*). In Lehrer's study on the other hand, intervals in which the birth initiating the interval and previous deaths in the interval occurring prior to the end of the interval in question were considered.

The separation of the biological and behavioural effects in Lehrer's study was achieved by controlling for the duration of breastfeeding by introducing this variable in the regression model. In Sufian and Johnston's study, the separation of these effects was undertaken through the approach of Chowdhury et al. discussed above.

An additional observation with respect to the approach of separating the effects adopted in Lehrer's study is that if the mothers are aware of the contraceptive effects of breastfeeding then this variable may include some of the bevarioural effects and mothers who have not experienced child deaths may breastfeed the child for a longer period in order to delay the next birth. Adopting a similar argument Olsen (1988) observe that if parents conceive a child directly to replace one who is anticipated to die, then this will tend to produce an upward bias in the estimated importance of breastfeeding in preventing pregnancy and a downward bias in the estimated importance of replacement and hence the overall behavioural effect.

Another issue which has been raised relates to the timing of the deaths of children and their effects on fertility. As Olsen (1980) has pointed out, it is important to state which deaths of children elicit replacement response since all children must eventually die. More specifically however, Marcotte and Casterline (1990) have noted that for one state A to have an effect on another state B then the former must occur first, though as Olsen notes, anticipating A could affect B. Thus deaths occurring after the pregnancy leading to the next live birth would therefore not be expected to have an effect on the timing of that birth. Due however to the already known effect where short birth intervals may lead to higher mortality of the births opening the interval, this may introduce an upward bias in the estimated behavioural effects of replacement.

The choice of an appropriate fertility measure is another issue which has been raised by several researchers. Chowdhury et al. (1975) observes that the choice of the dependent variable and how the fertility is to be measured is a crucial decision in any future research. The authors further observed that the birth interval is a useful measure for avoiding many of the pitfalls in the assessment of the effects. Santow and Bracher (1984) also note that aggregate measures have generally not resulted in a conclusion regarding even the existence of a strict relationship between fertility and mortality. Williams (1977) has also questioned whether regressing children ever born against a function of experienced mortality is the best way of postulating a response of fertility on mortality. In addition, Williams has pointed out the statistical problems of regressing children ever born on a measure of mortality which may lead to an upward bias in the estimated replacement effects although Olsen (1980) has addressed this issue.

Another issue relates to the use of contraception to quantify the replacement effects. As has been pointed out in several studies (Friedlander (1980) ;Knodel,1968 and 1981; Knodel and Van de Walle,1968; Rutstein and Medica, 1978; and Mensch,1985) the replacement effect assumes that some form of family limitation is practiced by couples. In some studies (e.g Rutstein and Medica (1978) and Mensch (1985)) the practice of family limitation is measured through the use of contraception. As Knodel (1968) has noted, couples may rely on some other forms of family limitation such as abstinence to attempt to space births without the intention of limiting the ultimate number. Thus, if a newborn infant survives, the parents would control their fertility in order to delay the next conception. Marcotte and Casterline(1990) have also noted that conscious desire to replace a deceased child may result in behavioural responses such as changes in coital frequency in addition to contraceptive use. Thus, it seems that relying on the use of contraception as a measure of replacement effects may introduce a downward bias in the estimated effects.

2.3. Hypotheses of the Study

In Kenya birth intervals are shorter when an infant dies than when it survives. The conclusions from Ritcher and Adlakha's study reviewed above further gives an indication that some of the shortening may be due to replacement effects in addition to the biological effects. Although the literature reviewed earlier suggests that most of this effect would be biological, the magnitude of each is not known. In this study we therefore test several hypotheses to determine the magnitudes of these effects. In addition we distinguish the replacement and insurance effects. We hypothesize that in addition to the biological effect, behavioral effect of replacement and insurance have significant effects on birth intervals in Kenya. We further investigate the hypothesis that the use of different analytical approaches in assessing these effects may be responsible for the inconsistent conclusions noted in some of the studies reviewed above. In the next chapter a conceptual framework which addresses the various issues raised in the literature reviewed is developed. These hypotheses will be tested in this framework.

CHAPTER 3

CONCEPTUAL FRAMEWORK FOR THE STUDY

This chapter conceptualizes the theoretical framework for the study. Since as pointed out in the previous chapter, the focus of the study is on the effect of infant/child mortality on fertility, the framework which is developed for the study attempts to conceptualize the relationship between these two concepts. Fertility will thus be treated as the primary dependent variable with infant and child mortality as one of the independent variables. Because the study involves both fertility and infant and child mortality, the development of the framework is based on two frameworks: the Bongaarts (1978) framework for the analysis of fertility and the Mosley and Chen (1984) framework for the analysis of infant and child mortality. In each of these two frameworks, the proximate determinants factors through which socio-economic, cultural, environmental and demographic factors operate to influence fertility (in the case of Bongaarts framework) and infant and child mortality (for Mosley and Chen) have been specified.

The chapter is organized in two broad sections as follows. In section 3.1 below the basic components of the framework are presented. The empirical evidence supporting the relationships between the various concepts is presented in section 3.2.

3.1. The Study Framework

Studies of the effect of infant and child mortality on fertility have been conceptualized and undertaken at various levels of analysis utilizing a variety of infant/child mortality and fertility measures. Brass and Barrett (1978) categorized these studies into: aggregate and family studies. In aggregate studies, the analysis is undertaken for groups or families using a variety of fertility measures such as crude birth rates, child-woman ratios, age specific fertility rates, age standardized marital fertility rates and adjusted mean number of children. These measures are then examined along with mortality measures such as crude death rates and infant mortality rates for these subgroups.

Other measures which have been utilized in aggregate studies are the median birth intervals and parity progression ratios (PPR) obtained from the life tables constructed by birth orders (Chowdhury et al., 1975; Rutstein and Medica, 1978; Park et al., 1979; Suchidran and Adlakha, 1981 and 1984). The median intervals measures spacing while PPRs measures voluntary or involuntary termination of childbearing. In these studies life tables are constructed by the survival status of the birth opening the interval.

In family studies the relationship between deaths of children and infants on one hand and total number of births on the other are examined. One of the approaches adopted in such studies (Knodel, 1982) is to compare subsequent fertility behaviour of couples who have reached similar stages in childbearing process according to their previous experience in child loss while controlling for several factors which could bias or confound the results. Other fertility measures used in such studies include additional number of children born after a woman has reached a certain parity and probabilities of stopping child bearing (Knodel,1978). Olsen (1980) has also demonstrated how the number of births can be regressed against the number of deaths while taking into account the bias noted by Williams as discussed earlier. Another measure of fertility in family studies is the additional number of children desired (Adlakha and Richter,1989).

As noted earlier, several conceptual and statistical problems relating to aggregate and family studies have been pointed out. Santow and Bracher (1984) observe that studies based on aggregate measures have generally not resulted in a conclusion regarding even a strict relationship between fertility and mortality. A similar observation is made by Friedlander who notes that studies which do not control for other confounding variables have not contributed much to the understanding of this complex relationship. Williams (1977), in addition to the statistical and conceptual problems mentioned earlier, notes that researchers are increasingly starting to view the fertility decision making process by couples as being sequential based on the couple's mortality and fertility experiences at each time. Thus, a couple's decision to have or not to have an additional birth is based on their past fertility and mortality experiences.

One of the approaches adopted to deal with some of the problems discussed above is to use the birth interval as a unit of measurement of fertility. As Brass and Barrett (1978) have noted, detailed maternity histories in which births and child deaths can be arranged as a dated series of events either in whole or part provides a further option to eliminate the first order correlation between child mortality and fertility, though such studies are often hampered by the inability to adequately control for the timing of events. One of the approaches adopted to resolve this problem is to use the birth interval as the measure of fertility. Santow and Bracher (1984) observe that with a greater knowledge of events occurring between one birth and the next, it becomes possible to identify with some precision the causal chain linking child mortality with fertility. In view of the above and arguments presented earlier, birth interval will be used as unit of fertility measure in this study. The effect of infant and child mortality was therefore analyzed as it relates to the fertility dimension of length of time between births and hence the effects occurring due to the other dimension of the length of exposure were not considered. As noted above, we are likely to learn more about the link between fertility and child mortality by focusing on the former dimension. In the sub-section below, the birth interval and infant and child mortality are conceptualized within a broader framework.

3.1.1. Basic Components of the Framework and Its Organization

The length of the interval between any two live births is determined by the lengths of its four components: post-partum amenorrhea, waiting time to conception, periods of pregnancy and post-partum amenorrhea associated with abortions and still births, and the gestation period associated with the live birth.

The component of post-partum amenorrhea is the period following a birth when the woman cannot ovulate. This component is primarily a function of breastfeeding behaviour (Bongaarts and Potter,1983). During breastfeeding, the receptors in the breast nipple are stimulated and this initiates a neutral signal to the hypothalamus, a nerve center in the brain which in turn signals the pituitary gland to increase the hormone proclactin which inhibits ovulation by reducing the release of gonadotrophic hormones needed for ovulation.

The waiting time to conception, also called the fecundable or ovulatory interval (Bongaarts and Potter,1983) is largely determined by the frequency of intercourse and use of contraception. It may also be influenced by the underlying fecundity of the woman, the monthly probability of conception, which although primarily determined by coital frequency and contraception may depend on the woman's characteristics. Thus when coital frequency is high and contraception is not being practiced, this component of the interval is expected to be short. The waiting time to conception is expected to lengthen with reduced coital frequency and particularly use of contraception. The component due to fetal loss (induced or spontaneous) depends on the number of such losses, the gestation lengths associated with them and the periods of amenorrhea associated with their termination. The duration of pregnancy associated with a live birth is the least variable component of the live birth (about 9 months) although the exact timing of delivery cannot be predicted with certainty.

The above factors which determine the lengths of the various components of the birth intervals viz:- breastfeeding duration, contraception, coital frequency, fecundity and fetal losses are referred to as the proximate determinant factors of fertility. As pointed out by Bongaarts (1983), all other factors must operate through these in order to affect fertility.

The death of an infant or a child may result in the shortening of the birth interval. Such shortening can be due to either voluntary or involuntary mechanisms or a combination of both but can only be realized indirectly through the proximate determinant factors. The involuntary mechanism is usually referred to as the biological or physiological effect of an infant/child death on fertility and occurs primarily as a result of cessation of breastfeeding following a child death. It has been pointed out (Chowdhury et al.,1975; Suchindran and Adlakha,1981 and 1984; Knodel,1982) that the death of an infant or a child by interrupting breastfeeding shortens the period of post-partum amenorrhea consequently increasing the probability of conceiving and thus leading to the shortening of the birth interval. Thus, the physiological effects of an infant or child death on fertility would mainly be reflected in the post-partum amenorrhea component of the birth interval.

The voluntary mechanism otherwise referred to as the behavioural effect occurs as a result of couples modifying their behaviour in response of actual infant/child death or anticipated deaths. In such cases, these behavioural changes would be manifested in the proximate determinant factors such as coital frequency, acceptance and continued use of contraception. In fact this reasoning has been applied in some studies (Ruststein and Medica,1978 and Mensch, 1985) to study the effect of infant and child mortality on fertility by testing whether the woman's use of contraception or her decision to use is partly determined by her child mortality experience.

Another behavioural change that would be consistent with replacement of dead infants or children is the resumption of sexual relations following an infant or child death. However, as noted by Santow and Bracher (1984), the interpretation of such behaviour is complicated by the fact that it is not possible to say whether this early resumption of sexual activity is because it is no longer necessary to abstain or because of a conscious effort to attempt to replace the child who has died.

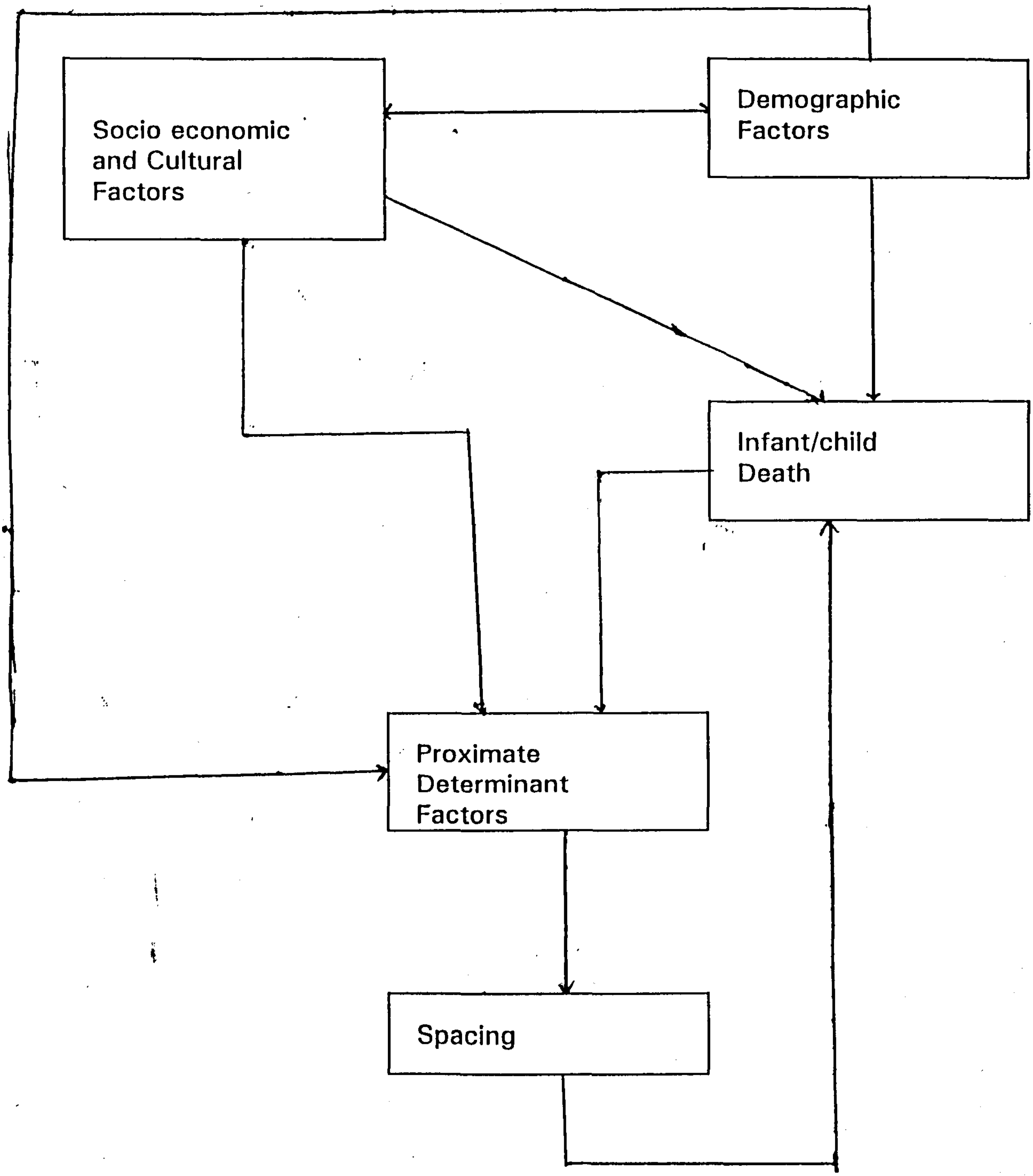
The insurance effect is assumed to occur as a result of mothers living in communities where mortality is high having more births as an insurance against possible future deaths. In such communities mothers would be expected to exhibit behaviour consistent with such desire if this effect exists (i.e higher coital frequency and low levels of contraceptive use).

Fertility and infant and child mortality are both influenced by socio-economic, cultural, demographic and environmental factors. In the frameworks of analyzing fertility as presented by Bongaarts (1978) and Bulatao and Lee (1983) these factors are conceptualized to influence fertility indirectly through the proximate determinant factors. In the framework for studying infant and child mortality (Mosley and Chen,1984) the same factors influence infant and child mortality through a different set of proximate determinant factors. In the framework developed for this study, the latter proximate determinants are omitted since the focus of the study is not to explain the infant/child mortality phenomenon. As was pointed out earlier (Brass and Barrett,1978) adequate control of these factors, which simultaneously affect infant/child mortality and fertility is needed for an accurate assessment of the former on the latter.

Another aspect of the relationship between infant and child mortality and fertility which requires consideration while developing a conceptual framework for studying the effect of infant and child mortality on fertility is the reverse effect of fertility on infant or child mortality. As Brass and Barrett (1978) have pointed out, this reverse effect is well established and hence researchers focusing on the assessment of the effect of infant and child mortality on fertility requires to identify and control it. This has been emphasized further by Chowdhury et al. (1975) who observe that it is necessary to recognize this mutual interaction between infant/child mortality and fertility and exclude it from the analysis.

Figure 1 summarizes the basic components of the framework as discussed in the preceding paragraphs. The main point conveyed in this framework is that infant and child mortality only effect fertility through the proximate determinants of the latter. Fertility and mortality are also seen to be affected by the same socio-economic, cultural, demographic and environmental factors as discussed earlier. Finally, the framework shows that spacing may be affected by infant/child mortality as discussed above.

Figure 1. Conceptual Framework for Assessing the Effect of Infant and Child Mortality on Fertility



3.2. Empirical Evidence for the Proposed Framework

Several studies which have been undertaken on the determinants of birth intervals provide general evidence indicating that the effect of socio-economic and the other factors discussed in the preceding section affect fertility through the proximate determinants. The extent to which this has been reflected by the data however, seem to depend on the proximate factors considered, the accuracy for the measurements of such factors and the methods of analysis applied.

Trussell et al. (1985) applying a hazards model on data from Indonesia, Malaysia and Philippines found that the effect of socio-economic factors on the risk of pregnancy was reduced when the proximate determinant factors were included in the model. The researchers therefore concluded that the effect of such factors was through the latter. The researchers attributed the continued significance of some socio-economic factors such as ethnicity in Malaysia, male occupation in Philippines, urban residence, male occupation and education in Malaysia even after the introduction of the proximate factors in the model partly to the measurements errors of some of the proximate determinants. It was noted that these socio-economic variables found to be significant could be indicating differences that could not be measured such as fecundity, coital frequency, effectiveness and length of use of contraception or incidences of abortion.

The continued significance of socio-economic factors even after the introduction of proximate determinant factors in the model has been found in other studies e.g. Bumpass et al. (1982). In this study education was found to be an important factor in explaining the differences in the probability of closing the birth intervals in Korea and the Philippines even when the effect of proximate determinant factors of contraceptive use, stillbirths or spontaneous abortions and infant mortality were taken into account. The researchers suggested that the significance of education could have been due to the omission of some of the proximate determinant factors.

In another study Bumpass et al. (1986), in which the Korean data was analyzed by applying a different method of analysis (Logistic regression) and different set of proximate determinant factors (contraception, abortion, breastfeeding, infant and child mortality, marital separation and age at the beginning of the interval), it was found that a number of socio-economic variables remained significant even when the above proximate determinant factors were included in the model.

Jain and Bongaarts (1981) analyzed data from 8 countries (Bangladesh, Indonesia, Sri Lanka, Jordan, Peru, Guyana, Columbia and Panama) using multiple linear regression technique and found that socio-economic factors had little and insignificant explanatory power on the variations in the lengths of the last closed birth intervals once breastfeeding duration and use of contraception were included in the model. These two latter variables were found to explain most of the variations in these lengths. In the sections below empirical evidence relating to specific relations in the framework are examined.

(a) Proximate Determinants, Socio-Economic and Demographic Factors

The approach adopted in this section is to examine the relationship of each of the proximate determinants with socio-economic and demographic variables in turn starting with breastfeeding.

Available evidence drawn from several studies seem to suggest that the role of breastfeeding as a determinant of birth interval length diminishes as the level of socio-economic development and modernization increases. Data from developing countries of Asia and Africa show that the duration of breastfeeding decreases with the level of education. Quoting results obtained from Jain and Bongaarts' study based on WFS data in 8 developing countries referred to above, Nag (1983) noted that in these countries, mothers with no education were found to have longer mean durations of breastfeeding than the grand mean whereas those with secondary and above level of education had shorter durations than the grand mean. Reviewing further evidence from other developing countries, Nag concluded that in these countries, educated women in general breastfed for shorter periods than those who are uneducated.

Additional evidence of the role of education on duration of breastfeeding is obtained from the WFS data. Analysing this data from 28 contries, Ferry and Smith (1983) found that for each country investigated, the length of breastfeeding decreased monotonically with increases in education in those countries with the exception of Fiji. The duration of breastfeeding for women with 1-3 years of education was found to be shorter by 1-2 months compared to those with no education, while among women with 7 years or more of education the duration was marked with greater decrease.

Similar findings have been obtained with regard to place of residence where an inverse relationship between urbanization and the duration of breastfeeding has been observed (Nag,1983). It has also been suggested that cultural beliefs and norms may influence the duration of breastfeeding where a traditional cultural environment may be more favourable to breastfeeding than in more modernized ones.

Studies on the relationship between breastfeeding and the demographic factors is less consistent than the relationship with socio-economic and cultural factors reviewed above. Whereas WFS (1984) and Smith and Ferry (1984) analyses tend to suggest that the duration of breastfeeding increases with age and parity, the Jain and Bongaarts (1981) study did not find a consistent pattern either in direction or magnitude in the relationship between these two variables and breastfeeding.

A number of hypotheses have been advanced to suggest why contraceptive use should increase with socio-economic development. Kasarda et al. (1986) for instance observes that education provides the environment and the resources to learn about contraception and the incentive to use it by promoting a better understanding of the benefits to be gained by limiting family sizes and by correcting false myths regarding contraceptive practice.

Several analyses undertaken using the WFS data give evidence in support of these hypotheses. At the national levels, data from 41 counties covered in the WFS indicated that contraceptive use is higher in developed countries compared to the developing countries (WFS, 1984). Similar results have been obtained at the individual level (Sathar and Chidambaram, 1984). In this latter analysis contraceptive use was found to increase with the woman's years of schooling and also women in urban areas are more likely to use contraception compared to those in rural areas. Work status does not reveal a consistent pattern in its relationship with breastfeeding (Sathar and Chidambaram, 1984).

Analysis of contraceptive use with age in many countries indicate that contraceptive use is lowest in the early years of reproductive life, increases in the middle ages and then falls towards the end of the reproductive life (Bongaarts and Potter,1983; WFS,1984; and Sathar and Chidambaram,1984). In African and Asian countries, the pattern of contraceptive use peaks at around four children whereas this peak is reached earlier at parity two in the Latin American countries (Sathar and Chidambaram, 1984).

In the absence of contraceptive use, it has been pointed out that variations in the frequency of intercourse can be expected to have a corresponding effect on the probability of conception. In fact as pointed out Bongaarts and Potter (1983), fecundability (the monthly probability of conception for fecund women) is directly influenced by coital frequency.

Nag (1983) observes that it is difficult to make any generalizations about the relationship between coital frequency and socio-economic status due to the contradicting evidence. Although in the USA coital frequency has been found to be higher among women with more education in some cases, other evidence suggests that poor people have higher average coital frequency than the rich (Nag,1983). Different cultural norms may also lead to different levels of coital frequency. Coital frequency is also likely to be lower among women in polygamous unions than for those who are monogamously married.

Fetal losses increase substantially with age. Such losses are lowest in the early 20's, rise slowly up to the mid-thirties and then increase sharply thereafter (Bongaarts,1983). As noted by Bongaarts and Potter (1983), the majority of fetal deaths are caused by genetic defects which would be assumed to operate independently of socio-economic and health factors. This view has been supported further by evidence from both developing and developed countries which suggest that the differences in fetal losses between these countries may be quite small (Bongaarts,1983).

Besides coital frequency, demographic and socio-economic factors may be expected to influence fecundability. As pointed out by Bongaarts and Potter (1983), one of the requirements for a conception to take place is for a cycle to be ovulatory. Since the incidences of anovulatory cycles increases with age (Bongaarts and Potter,1983) and malnutrition (Gray,1982) and the latter is related to socio-economic status, one would expect that these characteristics may influence fecundability indirectly through this mechanism.

(b) Infant/Child Mortality, Socio-economic and Demographic Factors

The proposed framework for the study shows that infant/child mortality is influenced by socio-economic and demographic factors. In this subsection we examine the empirical evidence on these relationships.

Education as a determinant of infant and child mortality has received increased attention because of the strong inverse relationship between the two. As Chen (1983) notes, the negative relationship between maternal education and infant and child mortality has been consistent and persists even after controlling for income and other several key variables. Analyzing WFS data from 28 countries in Asia, Africa and Latin American Hobcraft et al. (1984) concluded that mothers education has an important association with infant and child mortality, especially the latter.

The type of place of residence (i.e. rural/urban, or other regional breakdowns), which is likely to be a proxy for inequality of provision of services Hobcraft et al. (1984), is another socio-economic variable which has been associated with infant and child mortality. In most countries surveyed in the WFS, infant and child mortality was found to be lowest in metropolitan areas, higher in other urban areas and still higher in rural areas (WFS,1984).

Several reasons have been advanced to explain why infant/child mortality would be expected to be associated with birth order. On the one hand first borns are expected to be born to mothers who are biologically and economically unprepared to bear and bring up a child (WFS,1984). On the other hand, children of higher birth orders are more likely to be born to older mothers who are physically worn out, are expected to face competition from the other older children for the food and other resources, and may be cared for by someone else other than the mother (WFS,1984). Thus, one would expect higher mortality for first borns and higher order births.

Results from the World Fertility Survey in general suggest that first borns are only slightly more likely to die during infancy than second or third births while those after the sixth are more likely (39 per cent) to die at infancy than the second or third births (WFS,1984). Mortality between ages one to four increases sharply with birth order in nearly all the countries covered in the World Fertility Survey.

Using data from 29 countries covered in the WFS, Rutstein (1983) found that the expected U-shaped relationship between infant and child mortality on one hand and mother's age at the child's birth on the other was evident from the data, particularly with infant mortality. Hobcraft et al.(1985) however, found that in general there was nothing to suggest increased risks for children born to older mothers when birth order, sex of the child, duration of preceding and following births and mother's education were controlled for. Risks of child deaths were found to be still higher among children of teenage mothers.

(c) Infant Mortality and Proximate Determinants

The proposed framework of the study indicates that infant and child mortality only affect birth spacing through the proximate determinant factors. In this sub-section, these relationships are examined.

One of the mechanisms through which infant and child death affects birth intervals is its curtailment of breastfeeding which in turn shortens the duration of post-partum amenorrhea and hence hastens the return of ovulation. Thus it would be expected that death of an infant or a child would be associated with shorter durations of breastfeeding. Analyses of both historical and recent data support this expectation. Using the late 19th and early 20th century data from three German States Knodel and Van de Walle (1968) found a negative correlation between infant death and duration of breastfeeding even after controlling for marital fertility.

Similar findings have been obtained (Jain and Bongaarts,1981) using data from

8 countries collected in the World Fertility Survey. In this analysis, the average duration of breastfeeding for those who had died at infancy was found to be much shorter than for those who had died at a later age. This shortening was also found to decrease with the date of death. In Indonesia for instance, for those infants who had died under one year, the average duration of breastfeeding was 4.1 months compared to 19.2 months for those who had survived beyond the first year of life. Similar results were obtained for the other 7 countries in the study.

In some studies examining the effect of infant and child mortality on fertility, a contraceptive variable has been used as the dependent variable. Overall, these studies suggest that use of contraception is lower where infant and child mortality is higher. In one such study by Ruststein and Medica (1978) in which data from three Latin American countries were analyzed, the proportion of women using contraception at the time of the survey was found to be reduced by the increase in child mortality. Continued use of contraception was however found to be in general higher where the mortality experience was higher.

Wamucii (1991) using the Kenya Fertility Survey (KFS) and the KDHS data from Kenya found that experience of child death was an important predictor of contraceptive use rates in Kenya during 1977-78 period. Mothers who had experienced at least one child death had contraceptive use rates of less than half those of mothers who had not had such a loss. These differentials were however found to have narrowed considerably by 1989.

Evidence on the relationship between infant and child mortality and the other three proximate determinants: fecundity, fetal loss and coital frequency appears to be limited. As has been noted by Chowdhury et al. (1975) quoting Yureshalmy et al. (1956), fetal wastage is poorly associated with child mortality although it is associated with previous fetal wastage and hence the downward bias introduced in the behavioural effects by excluding this variable from analysis is probably not large. Similar results have been obtained by Casterline (1989) using WFS data from 8 countries (Ivory Coast, Tunisia, Syria ,Korea, Philippines, Costa Rica, Mexico and Guyana).

Regarding the relationship between coital frequency and infant/child mortality, Knodel and Van de Walle (1968) have hypothesized both conscious and unconscious behaviour which would suggest that an infant/child death would be associated with increased coital frequency. At the conscious level, the researchers observed that couples may rely on contraception or abstinence for spacing purposes although without the intent of reducing the family size. In such a case the death of an infant or a child may lead to the resumption of sexual relations. Sub-consciously, the presence of an infant may reduce the frequency of intercourse in several ways such as separate sleeping arrangements between the husband and the wife where the former sleeps away from the wife who sleeps with the baby. The presence of an infant may also overburden the mother reducing her sexual desire.

For the relationship between the woman's underlying fecundity and infant and child mortality, it can be argued that as long as the two are influenced by socio-economic factors a spurious association between the two would be hypothesized.

(d) Birth Intervals and Infant/Child Mortality

The death of an infant/child may be the consequence of short spacing and not vice versa. Recent studies focusing on this relationship have been reviewed by Winikoff (1983) while Knodel (1968) has discussed earlier studies. According to these reviews, a consistent evidence of a negative relationship between birth intervals and infant and child mortality has been found to exist. Several recent studies (Palloni,1984; Palloni and Millman,1984 and 1986; Palloni and Tienda,1986; and Rutherford et al.,1989) have also investigated the mechanisms through which such relationships occur.

In general the hypothesized mechanisms are of biological and behavioural nature and can affect both the birth opening the interval (Index Child) or the one closing the interval. The biological mechanism may operate directly through its effect on the health of the infant before it is born or indirectly by affecting the mother physically making her less capable of giving adequate care to the infant (Knodel,1968). Alternatively, the health of the infant opening the interval may be affected through the cessation of breastfeeding.

The behavioural effect may operate through affecting the resources for raising the infant both in terms of time for the mother and materials for the infant (Knodel,1968; Winikoff,1983; and Palloni and Tienda,1986). The significance of the length of the previous birth interval as a determinant of the death of the birth closing the interval has been demonstrated in several studies (Cleland and Sathar,1984; Gubhaju,1986; Palloni and Tienda,1986; Hobcraft et al.,1985; and Rutherford et al.,1989).

However, a study undertaken in Northern region of Machakos district of Kenya by Boerma and Vianen (1984) did not demonstrate adverse effects of short birth intervals on survival status of young children. The authors concluded that this could be suggesting the importance of the socio-economic setting.

3.3. Summary

The conceptual framework which was utilized for the assessment of the effects of infant and child mortality on fertility in this study was developed and discussed in this chapter. In the development of this framework, several issues raised in the literature reviewed earlier, were taken into account. For instance, the framework included socio-economic and demographic variables which can produce spurious association between the relation of interest (i.e. infant/child mortality and fertility).

The other important point portrayed in the framework is that infant and child deaths can only affect fertility through the proximate determinant factors. Another issue which was addressed in this framework relates to the unit of fertility measurement used in the analysis. In this framework, the birth interval was utilized as the measure of fertility. As already noted several reasons why birth interval is considered appropriate for the studies as this one have been given.

Finally, the possible reverse effect of fertility on mortality was incorporated in the formulation of this framework. The strategies adopted to operationalize this framework are examined in the next two chapters starting with the presentation of the data used in chapter 4.

CHAPTER 4

SOURCES AND QUALITY OF DATA

This chapter presents a description of the data employed for analysis in this study. Section 4.1 describes the design of the survey, the nature of the data that was collected and selection of the subset of the cases employed in the analysis. The quality of this data is examined in section 4.2.

4.1. Sources of Data

The data employed for analysis in this study is drawn from the Kenya Demographic and Health Survey (KDHS). This was a national survey which was carried out between December, 1988 and May, 1989 by the National Council for Population and Development (NCPD) in collaboration with the Central Bureau of Statistics (CBS) and the Institute for Resource Development, USA as part of the world wide Demographic and Health Survey Programme.

In this survey, a total of 7,150 women aged 15-49 years were sampled and interviewed. The sampling procedure was based on a National Sample (referred to as a master sample) which CBS has maintained since 1975 and which is discussed in details by Aliaga (1988).

Briefly, the master sample on which KDHS is based is known as NASSEP-II and was updated on the basis of the 1979 census. NASSEP-II consists of 768 rural clusters in 32 rural districts and 150 clusters in 7 urban strata in 7 out of the 8 administrative provinces of Kenya (Excluded are the North Eastern province and 4 districts in Eastern and Rift Valley provinces) and is designed to be representative of 95 per cent of the total population.

From the above master sample, a total of 351 rural clusters in addition to the 150 urban clusters and a total of 9,836 households in these clusters were selected for inclusion in the KDHS. However, in order to meet the specific objectives of the survey, the selection was undertaken so that there was over-sampling in 13 out of the 32 rural districts so as to obtain reliable estimates of key parameters for these districts. This over-sampling did not however affect the national representativeness of the survey.

According to the KDHS report published by the NCPD in 1989 (NCPD,1989), the implementation of the survey was successfully undertaken. The response rate was high about 96 per cent of the 7,424 eligible women who were sampled and slightly over 95 per cent of the 7,500 expected interviews.

A complete birth history covering all live births for each of the women interviewed was obtained. For each of such births, the survival status at the time of the survey was ascertained and also the age at death for those infants or children who had died. Thus it is possible to determine the spacing between any two live births and also intervals in which the infant or child deaths occurred.

Other information which is relevant to this study and which was also collected is that relating to breastfeeding. The duration of breastfeeding was obtained for a maximum of up to 6 children born in the 5 years from the time of the survey. For the most recent birth, information was also gathered as to whether the child was still breastfeeding at the time of the survey.

Finally, for each respondent, her background and demographic characteristics were obtained. Also information on sexual behaviour and family planning practice (expected to have a direct effect on the woman's reproductive performance) was collected. One aspect of the latter information which imposes a limitation on the analysis is that, unlike the breastfeeding information which was obtained for each interval, the sexual and contraceptive behavioural information does not relate directly to any specific birth interval.

4.1.1. Selection of the Birth Intervals and Sub-sample For Analysis

Two problems are encountered in an analysis involving birth intervals. The first, which is referred to as the selectivity problem, involves determining the most appropriate subset of intervals for analysis. The second problem, referred to as the censoring, is methodological in nature and will be discussed in the methodology section. In this subsection we focus on the first problem.

As pointed out by Bumpass et al. (1982), the need to select a subset of intervals for analysis arises from the fact that analyzing all the intervals can bias the results. This occurs because of over-representation among maternity histories for women aged 15-49 of intervals begun at young ages. Consider, for example, women in the KDHS whose second birth interval began when they were aged 15 years. Such intervals include those intervals began in 1989 for women aged 15 years in 1989 and those began in 1955 for women aged 49 years at the time of the survey. In other words, all intervals begun between 1955 and 1989 are eligible for inclusion in the analysis, whereas intervals starting at age 40 have to be initiated between 1980 and 1989. As pointed out by Bumpass et al. (1982), such over-representation can bias the results because of the relationship between the age and the length of the birth interval and also if there is a trend in any of the independent variables. In addition, intervals began many years before the survey raise two other problems: the quality of the data for such intervals and the fact that a considerable number of intervals are missed for those women who had died.

One of the approaches adopted to minimize the above problem is to restrict the analysis to intervals that were initiated in the recent past, say 5 or 10 years before the survey, and at the same time ensure that a sufficiently large sample is maintained to obtain stable estimates. In order to ensure this, the analysis in this study was restricted to intervals begun in the 5 years before the survey, since this is also the time up to which breastfeeding information is available. Thus the longest possible intervals considered will be of sixty months. As Marcotte and Casterline (1990) have noted, breastfeeding and child deaths should have little influence on pregnancy after 60 months.

The other approach which is adopted to minimize this bias is to exclude from analysis birth intervals of higher birth orders. As pointed out by Bumpass et al. (1982), the restriction of the sample to only women who are aged less than 50 years at the time of the survey excludes from analysis intervals which were begun during the period in question, in this case the 5 years before the survey, but cannot be included since the women were aged 50 years and over at the time of the survey. Thus in this case intervals begun between 1985 and 1989 by women aged between 45 and 49 are omitted because some of these women were aged over 49 years at the time of the survey. Bias due to such omission is minimized by restricting the analysis to intervals of lower birth orders. As in previous studies (Rodriquez et al.,1984; Trussell et al.,1985) the intervals that were considered in the analysis are those started by births of orders 8 or less. Also, since the previous birth interval is one of the independent variables in the analysis, only women who had at least two closed intervals (excluding the interval from marriage to first birth) are included in the analysis. Trussell et al.(1985) point out that the interval from marriage to first birth is often poorly defined. Finally only women who were continuously married, i.e. those who were indicated to be married and in first union, were included in the analysis.

Of the 7150 women interviewed in the KDHS, 4221 (or 59 per cent) were still in their first marriage at the time of the survey and hence continuously married. 3542 of these had at least one closed interval. However, only 1846 among them had such intervals initiated in the last five years preceding the survey and hence contained the breastfeeding information. In addition, in 316 of the cases had only one closed interval and hence did not have a previous birth interval thus leaving 1530 women with such intervals. A further 210 of the above remaining cases were closed by births of order 9 and above. In addition another 125 cases had some missing information for at least one of the variables utilized for analysis eventually leaving 1195 cases for analysis. These cases had a total of 1525 closed interval in the five years preceding the survey and 1068 open interval which would have been closed by births of order 8 or less.

A comparison of the distributions of some of the socio-economic, demographic and proximate variables for this sub-sample and the entire KDHS sample, the sub-sample for the continuously married women and for the women with at least one closed interval are presented in Table 4.1. The distributions for the entire sample which are presented in column 1 of this table indicate that the sample sizes in each of the 7 provinces correspond to the population distributions in the provinces. Thus Rift Valley Province which has the highest proportion of the population in the country had the highest proportion in the sample while Coast Province with the smallest proportion had the least. The sample also reveal a good representation of the major ethnic groups in Kenya: Kikuyu (34.3 per cent), Luhya (17.4 per cent), Luo (16.1 per cent), Kamba (9.6 per cent), Kalenjin (8.6 per cent) and Kisii (6.3 per cent).

Table 4.1:- Comparison of the Sub-sample Selected for Analysis with Currently Married and in First Union, Married and with at Least One Closed Interval and the Main KDHS Sample

Variable	KDHS N=7150	Currently Married N=4221	With Closed Interval N=3542	Sub-Sample for Analysis N=1195
Province				
Nairobi	12.0	11.6	9.9	7.9
Central	17.9	17.4	18.5	16.1
Coast	10.1	10.2	9.7	8.5
Eastern	12.6	12.1	12.9	13.0
R-Valley	17.7	17.9	17.9	18.2
Nyanza	15.4	15.9	16.1	16.7
Western	14.4	15.0	15.0	19.7
Age				
15-19	20.7	6.4	5.5	0.8
20-24	19.6	18.9	14.5	17.6
25-29	19.0	24.1	25.8	41.2
30-34	14.1	17.4	19.8	24.9
35-39	11.6	15.0	17.4	12.7
40-44	9.0	11.0	12.6	2.3
45-49	6.0	7.2	8.4	0.6
Residence				
Urban	26.8	24.6	20.8	19.0
Rural	73.2	75.4	79.2	81.0
Education				
None	23.8	28.6	31.8	25.9
Primary	53.5	51.1	50.1	54.1
Secondary	22.2	19.9	18.0	20.0
Higher	0.3	0.4		
Ethinicity				
Kalenjin	8.6	9.4	10.0	11.2
Kamba	9.6	9.1	8.9	9.5
Kikuyu	24.3	22.2	23.3	18.7
Kisii	6.3	6.2	6.7	6.7
Luhya	17.4	17.7	16.9	21.4
Luo	16.1	17.5	16.3	17.2
Meru-Embu	5.3	5.0	5.7	4.9
Mijikenda	6.6	6.8	6.7	5.6
Somalia	0.2	0.2	0.2	0.3
Other	5.7	5.9	5.5	4.4
Ever Used				
None	61.4	54.8	51.9	56.5
Traditional	12.5	13.1	12.9	15.1
Modern	26.1	32.1	35.2	28.4
Current Use				
None	77.8	73.3	70.8	76.2
Traditional	6.8	7.2	7.3	7.9
Modern	15.4	19.6	21.8	16.0
	100.0	100.0	100.0	100.0

Comparing the proportions with those of the other sub-samples presented in the other columns of the table indicate no major significant differences except for age. As is evident from the table, the proportion aged 15-19 years is much lower in the three sub-samples in comparison with the entire sample. This is due to the fact that few women were married at this age. The proportion is observed to be even lower for women with at least 3 children confirming further the fact that few women had attained parity three at this age as would be expected. It is also observed that the sub-sample utilized for analysis had a very low proportion for the age groups 40 years and above. This again may be as a result of the restriction imposed on this sample in which women with births of orders 8 and above, most of whom are expected to be in these age groups, are excluded from the analysis

Finally, the table reveals that the proportion for Nairobi in the sub-sample for analysis was lower by about 4 per cent whereas that for Western province is higher by about the same proportion. This is also reflected in the distributions among the various ethnic groups in which the proportion for the Luhya (the dominant ethnic group in western Kenya) in the sub-sample is noted to be higher. Differences within the other regions and ethnic groups are slight. The proportions of those in the rural areas is also higher in the sub-sample. There are only slight variations in the four samples with respect to the level of education.

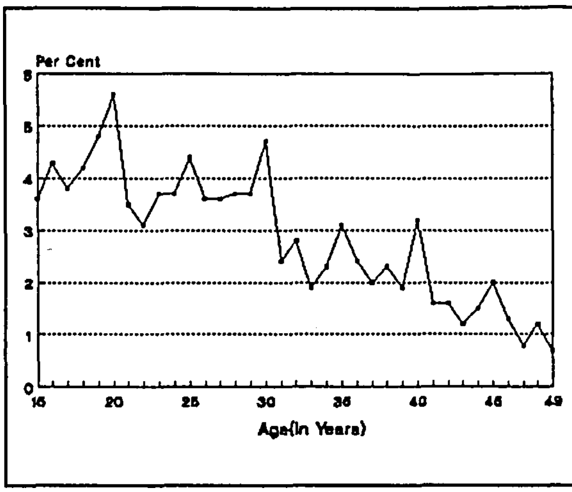
4.2. Assessment of the Quality of Data

As Bumpass et al. (1982) has pointed, analysis of birth intervals on child spacing demands high quality data. Thus the data utilized for analysis in this study were examined in detail through several approaches to determine their quality. The analysis of this assessment was undertaken at various levels. At the first level, the overall quality in terms of reporting was examined. The second level of this assessment focused on the quality of reporting for the births and deaths. This gives an indication of the quality of the data for the dependent variable and the main independent variables. The assessment of the quality of the data for the independent variables of duration of marriage and breastfeeding which are more likely to be affected by the quality of reporting were next examined. The final level of the assessment focused on the quality of the data on the birth intervals, the dependent variable for the study.

4.2.1. Age Distribution of Women

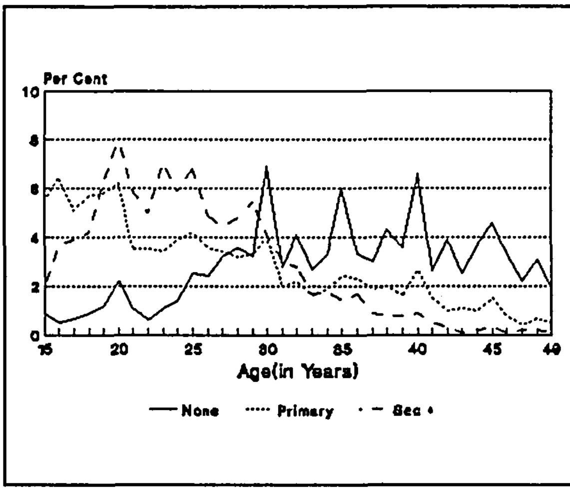
In order to first obtain a general picture of the nature in the reporting of events we begin this analysis by examining the quality in the reporting of the respondent's ages. This is provided in Figures 4.1(a) and 4.1(b) below. In Figure 4.1(a), the per cent of women (Appendix I) is plotted against the reported ages in single years. This plot is expected to decline smoothly with age. Thus peaks suggest preferences against the corresponding digits.

Figure 4.1(a): Per cent Distribution of Women in Single Years



The distributions in this figure show that reported ages are falsely concentrated at points indicating preference at digits 0, 5 and to a lesser extent 2. In particular preference for 0 seem to be remarkable. When these plots are presented by levels of education (Figure 4.1(b)), the extent of misreporting is noted to decrease with level of education. These plots show that the extent of heaping is very limited among women with secondary and above level of education aged 30 years and over.

Figure 4.1(b): Per cent Distribution of Women in Single Years by Level of Education



In order to quantify the extent of digit preference for "0" and "5" noted above, the Whipples Index was calculated. This index is given by :-

$$WI=\frac{\sum P_a}{\frac{1}{5}\sum_{15}^{49} P_i}x100 \qquad a=15,20,25,30,35,40,45$$

The index varies between 100, representing no preference for 0 or 5 and 500 indicating that only 0 and 5 were reported. For the entire KDHS sample (7150), this index was 133 indicating that the extent of the preference for the two digits in the reporting of age was not very serious. However, when calculated for each of the three educational categories, it confirms that preference for the two digits was less for the more educated women. For women with secondary and above level of education, this index was 118 compared to 149 for those with no education.

4.2.2. Assessment of Omission and Misplacement in the Reporting of Births and Deaths

The birth history data can be affected by the omission of births or their misplacement over time. The omission in reporting of live births was determined through the approach adopted by Miguel (1980). In this approach sex ratios at birth for various periods before the survey and also by socio-economic characteristics of rural/urban and educational levels were calculated. The criteria used to determine the omission was examining the extent to which the calculated sex ratios differed from the expected ratio of 1.05. A sex ratio smaller than the above was interpreted to mean that the male births were omitted while a larger one implied the omission of female births.

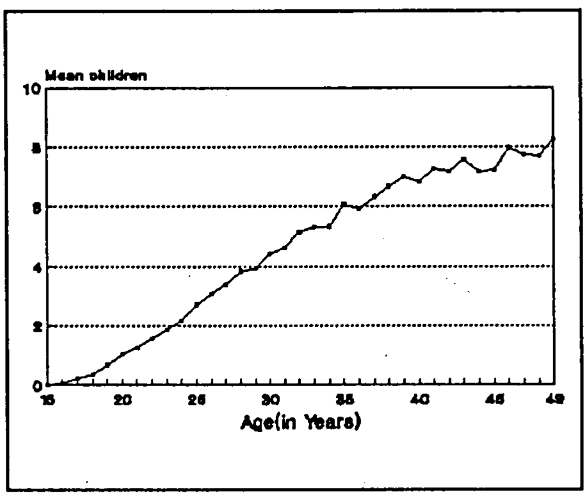
The results of the above analyses are reported in Tables 4.2(a)-4.2(c). Table 4.2(a) reports the sex ratios which are also provided by years before the survey,age, level of education, and residence. The calculation of the ratios was based on all the reported live births (Appendix II). The sex ratio of 102 obtained for the entire sample as reported in this table is lower than the expected ratio of 105. This suggests the possibility of the omission of male births. Such omissions if they exist would be expected to be more pronounced for rural women and those with low levels of education. However examining these ratios, which are reported in the same table, suggest, that births are omitted more among women in urban areas and those with secondary and above level of education. Sex ratios are observed to be low among these groups and also among women aged between 20 and 29 years. While reasons for these unexpected results may be unclear, they may suggest the unwillingness on the part of these enlightened mothers to report births of their children who had died, in particular the males.

Table 4.2(a):-Sex Ratio of Births by Period and Some Socio-Economic and Demographic Characteristics of the Mother

Characteristic	Sex Ratio
All	1.02
Period(Years before the Survey)	
0- <5	0.996
5- <10	1.016
10- <15	0.969
=>15	1.090
Age(Yrs)	
15-19	1.096
20-24	0.988
25-29	0.961
30-34	1.050
35-39	1.020
40-44	1.060
45-49	1.010
Residence	
Urban	1.037
Rural	0.946
Education	
None	1.004
Primary	1.041
Secondary	0.984

A further assessment of the possible omission of reporting births is provided in Figures 4.2(a), 4.2(b) and Table 4.2(b). In Figure 4.2(a), the mean number of births for each single year is plotted against age in single years. These means were obtained by dividing the total number of births to women in a given age by their corresponding number of women (Appendix III). The figure shows that the mean number of children increases with age as expected. After age 40 however, the figure shows some irregularities. These irregularities appear to be more due to the misreporting of the ages of the respondents than due to the omission or misplacement of births.

Figure 4.2(a): Mean Number of Children Ever Born



Data presented in Table 4.2(b) further suggest no major errors in the misplacement or omission in the reporting of births. The mean number of children presented in this table show that these increase as expected except for the age group 45-49 among those with secondary and above level of education. This may however be due to the small numbers used for this calculation and hence subject to large sampling errors or to real cohort effects.

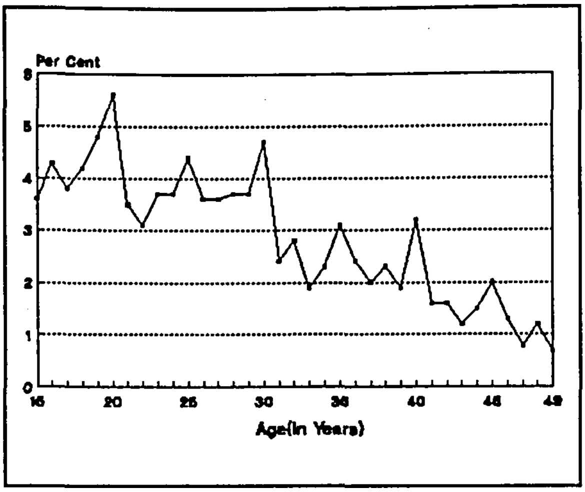
Table 4.2(b):- Mean Number of Children Ever Born by Educational Level of the Mother and Residence

Current Age Group	Total	Residence		Education		
		Rural	Urban	None	Primary	Sec+
15-19	0.288	0.283	0.299	0.634	0.310	0.136
20-24	1.531	1.647	1.325	2.183	1.742	1.065
25-29	3.355	3.722	2.479	4.008	3.582	2.569
30-34	4.866	5.238	3.818	5.341	5.060	3.654
35-39	6.358	6.627	5.283	6.799	6.382	4.537
40-44	7.119	7.523	4.813	7.237	7.338	(4.000)
45-49	7.663	7.997	5.491	7.558	8.305	(3.313)

Note: Figures in brackets are based on less than 100 cases

The misstatement in the reporting of the dates of births are examined further in Figure 4.2(b) in which the per cent births is plotted against years since birth (Appendix V). The plot reveals the existence of preference for years ending in 0 and 2. Since as noted above the omission of births is limited, this suggests the possibility of misstatement in the reporting of dates of births. As revealed by this plot however, this is not very pronounced.

Figure 4.2(b): Per Cent Births by Age at Birth



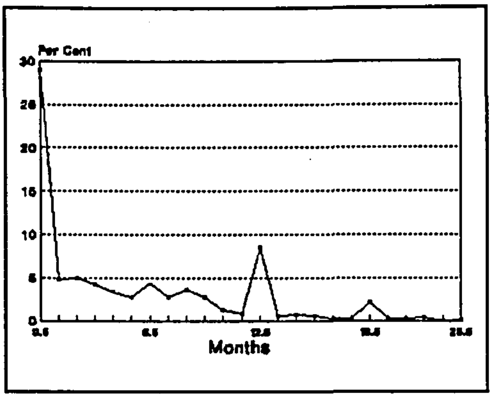
A test to determine whether the births which may be omitted are those which had died is provided in Table 4.2(c). In this table, the proportions of dead children by sex are presented. The figures are based on dead children among all births in each of the corresponding group. The figures reported in this table show that the proportions for the male children who had died does not increase with age as expected. This may suggest that the omitted male births are most likely those who had died.

Table 4.2(c):- Proportions of Children Dead by Age of the Mother

Current Age Group	Proportion Dead Male	Female	All
15-19	0.117	0.138	0.127
20-24	0.108	0.074	0.091
25-29	0.089	0.081	0.085
30-34	0.112	0.084	0.098
35-39	0.108	0.110	0.109
40-44	0.134	0.120	0.127
45-49	0.137	0.148	0.142
Total	0.114	0.104	0.109

Accurate reporting in the ages at deaths of infants and children is desirable for this study so as to determine the intervals in which such deaths took place. An indication of the accuracy in this reporting is provided in Figure 4.3 in which the per cent distribution of deaths of infants and children is provided by the month of death (Appendix VI). Because of the manner in which the coding of age at death in KDHS was done, this figure was drawn up to 23 months. Deaths occurring after 2 years and above since birth were coded to the nearest years. Thus for instance the deaths indicated at 24 as occurring at 24 months includes those which had occurred between 24 and 30 months. The figure reveal a strong tendency for reporting infant and child deaths with whole numbers and half years. The figure shows a high degree of heaping at month 12 and to a lesser extent at months 6 and 18. Limited extent of heaping is also noted at months ending with even numbers.

Figure 4.3: Per Cent Distribution of Deaths of Infants and Children in Last Two Years in Months



4.2.3. Assessment of the Nuptiality Data

Two approaches were utilized to detect whether there was misreporting in the dates of marriage. The first was to examine the extent of heaping by plotting the per cent married versus age in single years (Appendix VII). The proportions ever-married for each current age were also examined for the expected trend of increase in this proportion with age (Appendix VIII).

The above analysis is shown in Figures 4.4(a) and 4.4(b). In Figure 4.4(a), the per cent married is plotted against the duration since first married in single years. Heaping is noted at durations 9, 15, 18 and 25. It is further noted that the extent of heaping is more pronounced at the time nearer the survey.

Figure 4.4(a): Years Since First Marriage

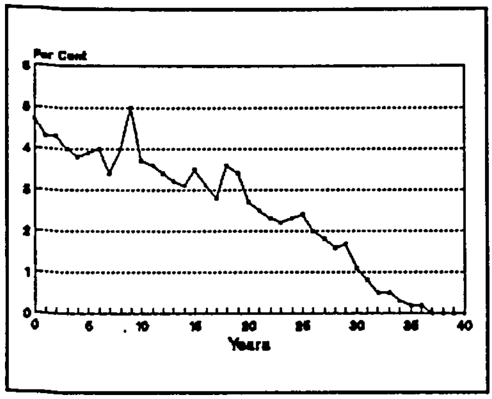


Figure 4.4(b): Cumulative Proportions Married at Each Age

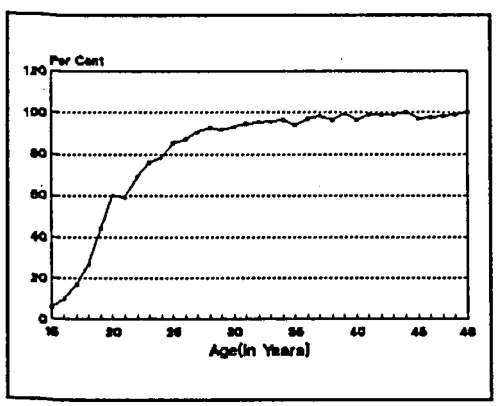


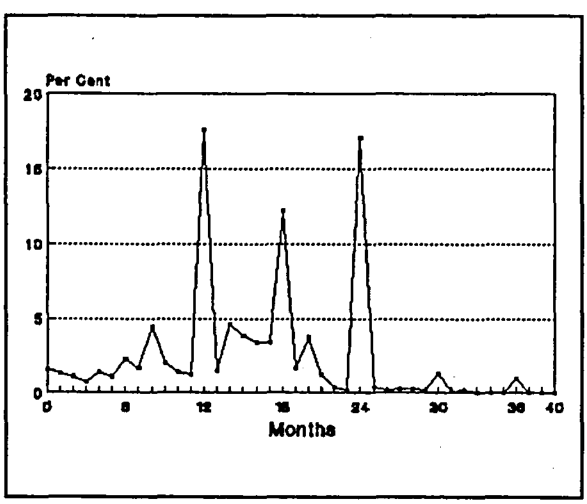
Figure 4.4(b) above shows a plot of the cumulative proportion married at each age versus current age in single years. These proportions are expected to increase with age. This figure reveals this to be generally the case although some irregularities are observed particularly at ages above 35. This figure

therefore confirms that the extent of heaping is minor.

4.2.4. Assessment of the Quality of Breastfeeding Data

Several checks to determine the quality of the breastfeeding data were undertaken. First the extent of heaping was determined by examining the plot of per cent of women versus duration of breastfeeding in the last closed interval (Appendix IX). This plot which is shown in Figure 4.5(a) reveals extensive heaping on half and whole numbers of years. Heaping is particularly extensive for months 12 and 24.

Figure 4.5(a): Per Cent Breastfeeding in Months



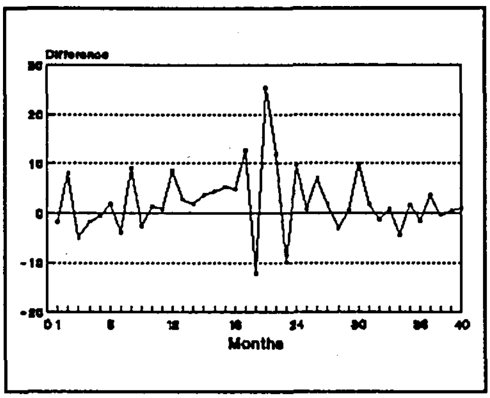
In order to check whether the heaping noted above reflect actual breastfeeding practice, first differences in the proportions of women were constructed for births occurring 60 months prior to the survey. If P_x is the proportion still breastfeeding x months prior to the survey, then,

$$D_x = P_x - P_{x+1} \quad x = 1,2..........60$$

True peak in the z month above would be reflected in the first difference peak either month z-1 or z. Presence of peaks in the difference apart from those expected would suggest that much of the peaking is due to misreporting (Goldman et al.,1979).

The plot of the above differences are shown in Figure 4.5(b). These differences were obtained using the total number of births in the five years preceding the survey summarized in Appendix X. At each age (in months) the number still being breastfed was obtained and hence used to calculate the proportions still being breastfed shown in column 3 of this appendix. To obtain the first difference say at age x months, the proportions breastfed at month x+1 was subtracted from that at age x. Actual peaks in the duration of breastfeeding at month x is supposed to be reflected by a peak at either durations x or x-1 in the difference table. As shown in this figure, the peaks in these differences are at durations 19, 21, 24 and 30. The fact that these are not highest at the durations where the heaping is highest suggests that much of the heaping is due to misreporting in the durations.

Figure 4.5(b): First Difference in the Proportions Still Breastfeeding



Finally, in order to find out whether breastfeeding introduces a bias in the length of breastfeeding, the cumulative proportions breastfeeding in the last closed intervals are compared with the distributions of proportions still breastfeeding in the open interval. The former being always lower suggests that the reported breastfeeding in the last closed interval has introduced a downward bias (Goldman et al.,1979).

Comparison of the above proportions are reported in Table 4.3 above. The proportions for the closed intervals were obtained from the 1784 intervals in which the breastfeeding information was consistent. The proportions for duration zero also includes those indicating no breastfeeding. Proportions still breastfeeding for duration zero were obtained by subtracting 100 from the proportion breastfed for zero months. The other proportions were obtained by subtracting cumulative proportions still breastfeeding from those up to the next duration. These proportions show that they are much lower in the closed interval at each duration compared to the corresponding proportion in the open interval. This implies that heaping has introduced a downward bias in the reported duration of brestfeeding in the closed interval.

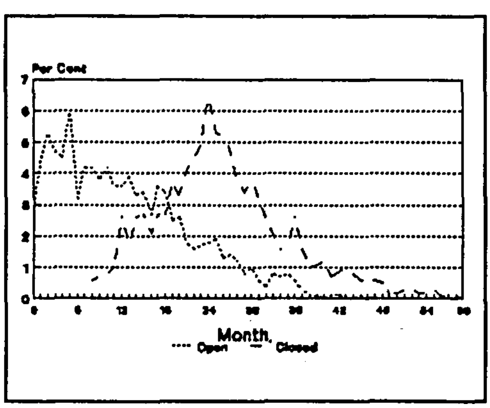
Table 4.3: Proportions Still Breastfeeding in the Open and Closed Intervals

Month	Proportion(%) Closed Interval	Proportion(%) Open Interval	Month	Proportion(%) Closed Interval	Proportion(%) Open Interval
0	96.1	97.7	16	47.6	75.9
1	94.9	97.1	17	44.1	72.2
2	93.7	98.8	18	31.8	66.7
3	92.9	90.4	19	30.1	66.0
4	91.8	92.9	20	25.9	41.8
5	90.6	95.0	21	24.6	47.5
6	88.5	94.7	22	24.3	38.9
7	86.8	94.6	23	24.1	25.0
8	82.6	97.2	24	4.7	38.5
9	80.5	86.4	25	4.3	30.0
10	79.3	92.0	26	4.1	32.1
11	78.1	92.3	27	3.7	22.2
12	61.2	88.2	28	3.3	17.9
13	59.7	77.5	29	3.2	35.3
14	55.3	82.4	30	1.6	17.4
15	51.2	76.6	31	1.5	21.4
			32	1.3	10.0
			33	1.4	11.1

4.2.5. Checking the Quality of the Data on Closed and Open Intervals

Data on birth intervals were analyzed to determine whether there were serious preference for certain digits. This analysis is shown in Figure 4.6 in which the per cent distributions for the open and closed intervals are shown (Appendix XI). These figure was based on the data on closed and open intervals in the five years preceding the Survey. The figure for the closed intervals show preference in intervals of half and one year durations particularly at 30 months. Heaping for open intervals is less consistent although there seems to be a tendency for preference of durations ending in zero.

Figure 4.6: Per Cent Distributions of Open and Closed Intervals



In order to quantify the extent of preference at half and one year durations, the approach of Srinivasan (1980) was used. This approach is based on the fact that in fairly large samples, the distributions of the frequencies for the residuals should be uniform. Thus each of the residual cells would have 1/6 of these frequencies. Adopting Srinivasan's notation, if the total frequencies in the sample is denoted by f and frequencies with the residuals 1,2,3,4,5 and 6 by f_1,f_2,f_3,f_4,f_5 and f_6, then under the null hypothesis that there are no digit preferences, the quotient

$$q_1=\sum_{1}^{6}\frac{|6f_i-f|}{f}$$

should be approximately zero. On the other hand if all the residuals are concentrated at one digit, the value of the quotient is 10. Thus, $Q_1=q_1/10$, takes values between 0 and 1 and the calculated values give the extent of heaping. For the closed intervals this value was 0.20 while that for the open intervals it was 0.26. These small values suggest that the extent of digit preference is low. The higher value for the open interval further suggests that reporting was slightly better for the closed intervals.

4.3. Summary

The assessment of the quality of data undertaken in this sub-section in general shows no major errors in the data. The misreporting in the dates of marriage detected in the data is not unusual and is not expected to affect the analysis undertaken much. The misstatement of the dates of deaths of infants and children as revealed by heaping, the possible omission of male children who may have died and misstatement in durations of breastfeeding needs to be borne in mind in subsequent analyses.

Another point that needs to be noted relates to the manner in which the age at the death was coded in KDHS. As noted earlier, deaths occurring after 2 years since birth were coded to the nearest year. This implies that for such deaths accurate identification of the intervals in which the deaths occurred was not possible. Since however, deaths of most births (about 79%) in this sample took place before attaining the age of 2 years, the bias arising from this is not expected to be large.

Data on contraceptive use and coital frequency as already noted was not available for each of the birth intervals included in the analysis. The limitations in the assessment of the effects of infant and child deaths on fertility arising from this and strategies adopted to resolve it will be addressed to in the next chapter. Finally, the quality of the data for the open and closed intervals as reflected by the extent of digit preferences was found to be good.

CHAPTER 5

ANALYTICAL MODEL AND METHODS

In this chapter the conceptual framework presented in chapter 3 is operationalized by specifying the variables which were included in the analysis and the methods utilized for this analysis. The specification of the variables is discussed in section 5.1 under the broad topic of the analytical model. The data presented in chapter 4 is utilized in this specification. Methods that were utilized in fitting the models are presented and discussed in section 5.2. Section 5.3 presents the procedures of how the variables specified above and the methods presented in section 5.2 were utilized to develop models for the assessment of the behavioural effects of infant and child mortality on fertility. The final section of the chapter, section 5.4, discusses the procedures utilized to undertake the assessment of the above effects.

5.1. Analytical Model

In the conceptual model presented in chapter 3, it was noted that infant and child mortality affects birth intervals only through proximate determinant factors. As further noted, this relationship can be confounded by socio-economic, cultural and demographic variables and hence these variables were included in the analytical model for the assessment of the effects. In this subsection, these and the other variables which were included in the analytical model are presented.

5.1.1. Socio-economic, Cultural and Demographic Variables

The empirical evidence on the conceptual framework presented in chapter 3 revealed that several socio-economic and demographic variables are both related to the infant and child mortality on one hand and birth intervals on the other. These variables are presented in this subsection.

(a) Socio-economic and Cultural variables

Mother's education and urban residence have been found to have a negative association with infant and child mortality. On the other hand, these variables would be expected to affect birth intervals through their influence on the proximate determinants.

In those societies where the increase in the use of contraception with rising education levels of the mother has been insufficient to counteract the shorter durations of post-partum amenorrhea and abstinence, the pace of child bearing has been found to be faster (Rodriquez et al.,1984). In a cross-sectional analysis of World Fertility Survey data from 9 countries, it was found that in

Kenya for instance, the shorter duration of breastfeeding with increasing levels of education had not been fully offset by the corresponding increasing use of contraception and consequently more educated women were found to have a faster pace of child bearing in the initial stages.

In urban areas of Kenya however, the duration of breastfeeding and consequently the duration of post-partum amenorrhea appear to have been compensated for by the higher use of contraceptive use such that the birth intervals for the rural women were the same (30 months) as for the urban women (Mosley et al.,1982). Infant and child mortality in rural areas of Kenya has been found to be higher than in the urban areas and also decreases with increasing levels of education according to the findings of Ruststein et al. (1983) in a cross-sectional analysis of WFS data. Thus both mother's education and residence would be expected to confound the relationship between infant/child mortality and birth intervals. These two variables were therefore included in the analytical model. Education (EDUC) was specified as a set of two dummy variables to capture the effect of the primary and secondary and above levels of education while residence was categorized to distinguish those respondents who were staying in the urban areas at the time of the survey from those staying in the rural areas (Table 4.1)

Different ethnic groups in Kenya have different social characteristics and also different patterns of breastfeeding and cohabitation. This may in turn influence the length of birth intervals. Analysis undertaken using the KFS data (Mosley et al. 1982) indicate this to be the case. In this analysis, members of the Mijikenda tribe in the Coast region were found to have the longest birth intervals whereas the Karenjin, Luhya and the Kisii had the shortest. In order to capture the effect of this variable and at the same time to ensure that the number of categories was not large, this variable was categorized into the following four categories:- Mijikenda, Luhya, Kikuyu-Embu-Meru, and the other ethnic groups together.

One of the mechanisms through which infant and child deaths can affect birth intervals is by changing sexual behaviour. Since coital frequency is related to the type of marital union (Mosley et al.,1982) a variable to indicate the type of union (UTYPE) was therefore specified so as to control for the above effect. This variable was categorized into monogamous and polygamous unions. Coital frequency is also expected to be lower for respondents who do not stay with their husbands. In order to control for the differences in coital frequency arising from this, a dummy variable indicating whether the husband was staying with the respondent (LIV2) was specified.

(b) Demographic Variables

According to the evidence presented in chapter 3, age at the start of the interval (which is used to index fecundity) is expected to confound the relationship between infant/child mortality and birth interval. Age at start of the interval has been found to be an important determinant of birth intervals in Kenya (Rodriquez et al.,1984). Infant/child mortality in Kenya also shows the expected U-shaped relationship with age (Ruststein,1984). As also noted in the presentation of the conceptual framework, previous birth interval would be expected to be related to both Infant and child mortality on one hand and birth intervals on the other and hence confound the relationship. Hence the variable (PLCBIG), a set of two dummy variables indicating the length of the previous birth interval was specified. Another variable which was specified to index fecundity in this study is the average birth interval(PBIAG) (Knodel,1982).

The other demographic variable which is likely to confound the relationship between infant and child mortality with birth intervals in Kenya is the birth order. This variable was specified as a set of two dummy variables (BOGR). Another reason for including this variable is that replacement effects in Kenya have been found to vary with parity Ritcher and Adlakha (1989).

The final demographic variable included in the analytical model is duration of marriage (DMARLCY). Coital frequency tends to decline with the duration of marriage (Bongaarts and Potter,1983) and hence the inclusion of this variable controlled for the variations in coital frequency arising from this variable.

5.1.2. Variables for the Assessment of the Effects of Infant and Child mortality on Fertility

In this subsection the variables for the assessment of the effects of infant/child mortality on fertility are specified. In this specification, we aim at attaining the primary objective of this study of separating the behavioural and the biological effects of infant/child mortality on birth intervals. Further with respect to the behavioural effect, we would also like to distinguish the insurance and the replacement effects. Also, as has been noted in the literature review section, one sex may have higher replacement effects than the other. This aspect was therefore taken into account in the specification of the variables. Finally, these specifications ensured that the possible reverse effect of birth interval on infant and child mortality was taken into account.

(a) Variables for the Assessment of the Insurance Effects

Insurance effect is a behavioural response to anticipated deaths of infant and children where mothers in areas of high mortality would give birth to a large number of children as an insurance against those who are expected to die. If such effects exists, we would expect it to be reflected across all the birth intervals. Thus we should expect women in areas of high mortality on the average to have shorter birth intervals compared to areas of low mortality. Another additional effect which is independent of the above effect would be anticipated based on the individuals past mortality experience. Thus for mothers who have experienced higher infant and child deaths in the past, even in areas of high mortality, would be expected to have even shorter birth intervals on the average due to this effect which can be interpreted as the insurance based on individual mortality experience.

In order to distinguish these effects referred to above, two variables were specified, one to measure mortality at the community level to capture the community insurance effects, the other to capture the response at the individual level. The variable utilized to measure the insurance effects at the community level is the proportion of children who had died in each of the clusters (PDEAD) among all children born 5 years before the survey. This variable was specified to distinguish intervals in which infant and child mortality was low from those in which it was high.

The variable for the assessment of the insurance effects (INSEF) at the individual level was based on all previous death experienced by each of the respondents. This variable was defined as a dummy variable indicating intervals which were preceded by at least one previous death and in which the birth opening the interval survived beyond the conception leading to the birth closing the interval.

(b) Variables for Assessing the Replacement Effects

Replacement effect is the behavioural response on fertility as a result of an infant or a child death. This effect is distinguished from the other two effects discussed in (a) above. For a mother whose infant or a child has died in the interval, if she is not pregnant, then she would be expected to have the next birth sooner if there is an immediate and direct response aimed at replacing this infant or child. Thus, whereas the effects we discussed earlier may be considered indirect in the sense that they are not aimed at any specific birth, the effect referred to above can be considered to be direct since it is a response to a death of a specific child. The other two effects discussed above can therefore be viewed as responses to the community and individual infant and child mortality environments which may be reflected in the pace of child bearing either consciously or sub-consciously. Replacement effect on the other hand can be viewed as a behavioural changes arising from an infant or child death aimed at ensuring that the next conception and hence the next birth is realized sooner than would otherwise have been the case. It can therefore be expected that if such a behaviour exists then the birth interval in which a death of an infant or child has taken place should be shorter compared to intervals without such deaths.

Timing of the death within the birth interval is important. Infant or child deaths occurring after the conception leading to the next live birth would not have an effect in that birth interval but in the next interval. This follows from the reasoning of Marcotte and Casterline (1990) that an event occurring after another cannot influence it. Thus, only deaths occurring within the live birth's conception intervals (interval between conceptions leading to live births) would have a replacement effect in the corresponding birth interval. In Figures 5(a) and 5(b), the deaths that would be expected to have this effect and those that would not are illustrated for a general interval between births *i* and *i+1*, the (*i,i+1*)th interval.

As shown in figure 5(a), deaths of any previous birth (*1* to *i-1*) have a replacement effect in the interval (*i,i+1*) if such deaths occurred after the conception interval leading to the ith birth, P_i and before the conception leading to the *i+1*th birth (i.e. within the *i*th conception interval (P_i,P_{i+1})). Thus in order to measure this effect a dummy variable (REPEF) which indicates the interval in which an earlier death had occurred while the birth opening the interval survived beyond conception P_i was specified (Table 5.1).

Since according to evidence presented earlier, some studies have shown that replacement may depend on the sex of the infant or child who had died, a dummy variable to capture these differences (FREPEF) was specified. This variable indicates the female deaths and hence specifies intervals in which female deaths had occurred.

Figure 5(a). Deaths of Infants/Children having Behavioural Replacement Effect in Interval (*i,i*+ *1*)

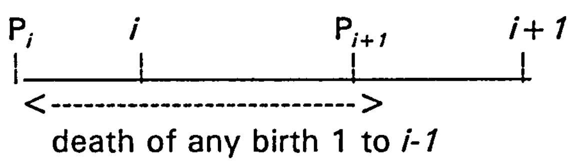
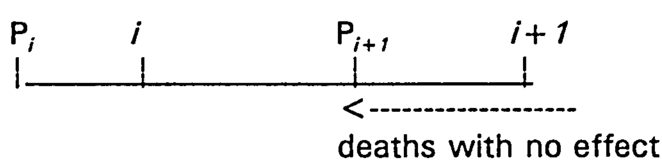


Figure 5(b). Deaths of Infants/Children without Behavioural Effect in Interval (*i,i*+ *1*)



(c) Variables for Assessment of the Combined Effects

Biological and Behavioural effects may occur when the birth opening the interval dies. Biological effect would occur if the infant or the child who dies was breastfeeding at the time of death whereas behavioural effects occur due to the motivation to replace the dead infant or child. In addition if such deaths were preceded by an earlier death, an additional effect due to these previous death(s) may be present. Thus the shortening in the intervals which may be observed in such cases may include these three effects which are difficult to distinguish. If the three effects exist, then such intervals would be expected to be shortest. In order to capture these three effects combined, a dummy variable, BIREINF, was defined. This variable specifies the intervals in which the birth opening the interval had died and which in addition were preceded by an earlier death. If however, the death opening the interval was not preceded by an earlier death, the insurance effects arising from the individual's past mortality experience would not be expected to exist and hence only the biological and replacement effects would be expected in this case.

In order to capture the above two effects combined (biological and replacement), a dummy variable (BIREPEF) was specified. This dummy variable thus specifies the intervals in which the birth opening the interval had died and in which in addition there were no previous death(s). A dummy variable (FBIREEF) derived from (BIREPEF) which indicates deaths of only female births was also specified to capture the effect of sex on the effects.

Finally, in order to control for the possible reverse effects of birth intervals on infant and child deaths, intervals in which the death of birth opening the interval occurred after the conception leading to the next live birth were excluded from the analysis.

5.1.3. Proximate Determinant Factors

Since infant and child mortality can only affect birth intervals through the proximate determinant factors, several variables were specified in the analytical model to measure these variables.

Three variables were specified to capture the effects of contraceptive use on birth intervals viz :-ever used (V302), current use (V313) and use in the interval (CONTINT). Use in the interval as explained in the chapter on data was not available in each of the interval in the KDHS and hence this variable was obtained indirectly using the number of living children at first use. Each of the above three contraceptive variables was specified as a set of two dummy variables to distinguish non users and users of traditional and modern methods as shown in table 5.1.

Coital frequency like contraceptive use variables could not be related to specific intervals. The variable employed in this study to measure the effect of this variable is the reported coital frequency within the last month (COFREGR). This variable was specified as a set of two dummy variables (Table 5.1).

The final proximate determinant variable included in the analytical model is the duration of breastfeeding in the interval (BRFEED). This variable was specified as a set of two dummy variables (Table 5.1).

Table 5.1 below presents the variables discussed above. Column 3 presents the initial operational definitions of the variables as utilized in the analyses while column 4 indicates the role of the variables in the study. The codes for each of the variable as used in the analysis are provided in column 2 of the table

Table 5.1: Specification of the Variables

Variable	Variable Code	Operational Definition	Role of the Variable
Dependent (LCBI)		Length of Birth Interval	Dependent
Variables for Assessing Effects of Infant/Child Deaths			
Biological, Replacement and Insurance effects	(BIREINF)	1 = Death 0 = No Death	Assess Effects
Biological and Replacement Effects	(BIREPEF)	1 = Death 0 = No Death	
Replacement Effects	(REPEF)	1 = Death 0 = No Death	Assess Effects
Insurance Effects	(INSEF)	1 = Death 0 = No Death	Assess Effects
Female Births Biological and Replacement Effects	(FBIREPEF)	1 = Female Death 0 = No death/male Death	Assess Effects
Female Births Replacement Effects	(FREPEF)	1 = Female Death 0 = Alive/male Death	Assess Effects
Proportion Dead in the Community	(PDEADGR)	0 = 0- < 20% 1 = = > 20%	Assess Effects
Socio-Economic and Cultural			
Education of Woman	(EDUC)	A set of three dummy variables . None [Ref. Category] . 1-4 Years . 5-8 Years . 8+ Years	Control
Residence	(URBAN)	1 = Urban 0 = Rural	Control
Ethnicity	(ETHN)	A set of three dummy Variables . Mijikenda [Ref. Category] . Kikuyu/Embu/Meru . Luhya . Others	Control
Type of Union	(UTYPE)	1 = Monogamous 0 = Polygamous	Control
Living with Husband	(LIV2)	1 = living with 0 = living away	Control
Demographic			
Age at start of interval	(AGEBLY)	A set of two dummy variables . 15-24 Years [Ref.Category] . 25-34 Years . >35 Years	Control

table 5.1-continued

Variable	Variable Code	Operational Definition	Role of the Variable
Previous Birth Interval	(PLCBIG)	A set of two dummy variables . < 2 Years [Ref. Category] . 2-3 Years . > 3 Years	Control
Previous Birth Interval Mean	(PBIAG)	A set of two dummy variables . < 2 Years [Ref. Category] . 2-3 Years . > 3 Years	Control
Birth Order	(BOGR)	A set of two dummy variables . 3 [Ref. Category] . 4-5 . 6-8	Control
Duration of Marriage	(DMARLCY)	A set of two dummy variables . 0-5 Years [Ref. Category] . 5-9 Years . >=10 Years	Control
Proximate Determinants			
Coital Frequency	(COFREGR)	A set of two dummy variables . None [Ref. Category] . 1-3 times . > 3 times	Explanatory
Contraceptive Use			
Ever Use	(V302)	A set of two dummy variables . Never used [Ref. Category] . Used Traditional . Used Modern	Explanatory
Current Use	(V313)	A set of two dummy variables . Not Using [Ref. Category] . Traditional . Modern	Explanatory
Use in Interval	(CONTINT)	A set of two dummy variables . None [Ref. Category] . Traditional . Modern	Explanatory
Breastfeeding	(BRFEED)	A set of two dummy variables . < 10 Months [Ref. Category] .10-<19 Months .= >20 Months	Explanatory

5.2. Methods of Analysis

For reasons discussed earlier, the measure of fertility utilized in this study is the birth interval. Studies undertaken recently to assess the effect of infant and child mortality on fertility using this measure have attempted to resolve two main problems identified in earlier researches: the bias due to the use of only closed intervals in the analysis, and incorporating the confounding variables in the analysis.

The first problem arises since in cross-sectional data, such as those used in this study, some of the intervals are not closed at the time of the survey. This is the problem referred to in the previous chapter as censoring. Rodriquez and Hobcraft (1980) have illustrated this problem using the Colombian data collected in the World Fertility Survey. The problem of censoring is resolved by using life table procedures which combine information from both the closed and open intervals.

Confounding variables are incorporated in the analysis through regression models. In the assessment of the effect of infant and child mortality on fertility regression analysis involving only closed intervals has been undertaken using Multiple Classification Analysis (MCA) (Park et al.,1979). This is a type of dummy variable regression analysis which is based on an additive model.

Regression analysis for life tables are based on the hazards model proposed by Cox (1972). Several researchers (Suchindran and Adlakha,1981 and 1984; Santow and Bracher,1984; Mensch,1985; Lehrer,1984;and Marcottee and Casterline,1990) have adopted various approaches to operationalize this model in the assessment of the effect of infant and child mortality on fertility.

In this study two regression models, one for closed intervals and the other for both open and closed intervals will be utilized. This will facilitate the assessment of whether the conclusions reached are sensitive to the type of analysis used. In the section below, each of the techniques is discussed beginning with a presentation of the underlying assumptions for each of the models. The operationalisation of the models focusing on their application in the study will then be provided.

5.2.1. Simple and Multiple Linear Regression Models

A multiple linear regression model defines a linear relationship between one variable (referred to as the dependent variable or the regressand) and a set of variable(s) referred to as independent variable(s) or the regressors. The special case when the dependent variable is related to only one of independent variable is referred to as simple linear regression. In the discussion below we focus on the multiple regression model although the arguments presented hold equally well for this special case.

In a multiple regression model, the expected value of the dependent variable, Y_i, is assumed to bear a systematic linear relationship with the independent variables. Thus, if Y_i is assumed to be related to P independent variables, then this relationship for the Y_ith observation is expressed as:

$$E(Y_i) = \beta_0+\beta_1 X_{1i}+\ldots\ldots.+\beta_p X_{pi}$$

The difference between the random variable Y_i and its expected value, $E(Y_i)$, is the departure of the Y_i from the population regression line relating Y and the X_j's. This difference is referred to as the error or the disturbance. Thus the multiple regression model can be re-written as:

$$Y_i = \beta_0+\beta_1 X_{1i}+\ldots\ldots\ldots\ldots+\beta_p X_{pi}+\epsilon_i$$

To specify the model completely, the errors are assumed to be normally and independently distributed with zero mean and common variance i.e.

$$E(\epsilon_i^2) = N(0,\sigma^2) \quad and \quad \epsilon_i, \epsilon_j$$

In this study, the lengths of the closed birth intervals for women in the population are expressed as a linear function of socio-economic, demographic, infant/child death and proximate variables as specified in the analytical model.

The β_i's are referred to as the partial regression coefficients or the slopes. Each of the β_i's gives the expected change in each of the Y_i for a unit change in the corresponding X_i while the other independent variables, X_j's, remain unchanged. Thus B_1 gives the expected change in Y for a unit change in the variable X_1 when all the other independent variables X_i's remain unchanged.

The X_j's can also represent categorical variables. Such variables are referred to as dummy variables and identify the various categories of a given variable. In specifying dummy variables, one of the categories is taken as the reference category while the dummy variables are utilized to index the other categories. Thus a categorical variable having k categories is represented by k-1 dummy variables provided that the model contains a constant term.

The partial regression coefficients for dummy variables represent the difference in the predicted means between the categories. Thus, for instance, if education were represented as a set of three categories (X_0=None, X_1=primary and X_2=secondary and above), then this relationship would be expressed with education as a set of two dummy variables as:

$$E(Y) = \beta_0+\beta_1X_1+\beta_2X_2$$

where the β_1 expresses the difference between the expected value of Y for those with no education and those with primary education. Similarly, β_2 can be interpreted as expressing the difference in the dependent variable between those with secondary and above level of education and those with none while β_0 represents the mean for those with no education.

Multiple regression analysis involves using the available data on the dependent variable and the independent variables obtained from a sample of the population and a variety of statistical techniques to obtain the most appropriate model describing the relationship between these variables and examine its appropriateness. This is achieved by obtaining the estimates of the unknown parameters β_i's and ϵ_i's denoted by β_i's and ϵ_i's and testing for their statistical significance to determine the important variables describing the relationship.

The estimation of these parameters for this study was undertaken using the ordinary least squares (OLS) technique using the SPSS package. In this approach, the estimates of the parameters are chosen such that the residual (i.e. the estimate for the error) is minimized i.e.

$$E(e_i^2) = \sum (Y_i - \hat{Y}_i)^2$$

is minimized.

The β_i's obtained are said to be unbiased and hence have the smallest mean-square error provided that the assumptions of the errors hold.

Tests of statistical significance for the variables were undertaken using the t-test which is given by:

$$t = \frac{\beta_i}{s.e.(\beta_i)} \sim t_{n-p-1}$$

The above statistic has a t-distribution with *n-p-1* degrees of freedom where *n* is the sample size and *p* is the number of independent variables.

The standard error of β_j, s.e.(β_j), is given by:

$$s.e. = \frac{RSS(X^TX)^{-1}}{n-p-1}$$

In each case, the estimate of β_j was taken to be significant if the t value exceed the 5% level.

The test of significance of the overall model was undertaken using the F-test. This statistic is defined as:

$$F = \frac{(SSY-SSE)/p}{SSE/n-p-1} \sim F_{p,n-p}$$ for a model with p independent variables

i.e. the statistic above has an F-distribution with *p* numerator degrees of freedom and *n-p-1* denominator degrees of freedom for a model containing p independent variables. The model was accepted as significant if the calculated F exceeded the 95% level.

$$SSY = \sum (Y_i - \bar{Y})^2$$

is the total sums of squares

and,

$$SSE = \sum (Y_i - \hat{Y})^2$$

is the regression sums of squares

The importance of the model in explaining variations in the dependent variable was determined by the multiple correlation coefficient R^2 which gives the proportion of the variation in the dependent variable which is explained by the X_i's in the regression model. R^2 is given by:

$$R^2 = \frac{SSY-SSE}{SSY}$$

5.2.2. Hazards Model

Regression analysis for the open and closed intervals in this study was undertaken using the regression model for the life table which was proposed by Cox in 1972. In this model, the dependent variable is taken as the probability of instantaneous occurrence of a given event at a given time *t*. This instantaneous rate which is referred to as the instantaneous failure rate or the force of mortality gives the risk of the occurrence of an event at time *t* given that the event has not occurred earlier. In this study, this rate refers to the risk or the hazard of having a live birth *t* months since the last birth. If this risk is denoted by λ(t) then,

$$\lambda(t) = \frac{f(t)}{S(t)}$$

where f(t) is failures at *t*, and S(t) is the survival function (in this study is the number of women who gave birth *t* months earlier who have not had another birth). *S(t)* is related to the cumulative density function of failures as follows:

$S(t) = 1 - F(t)$

where, *F(t)* is the cumulative density function of failures, and

f(t) is the associated density function.

Since,

$$f(t) = \frac{d}{dt}(F(t)) = -\frac{d}{dt}(S(t))$$

, then S(t) and λ(t) are related as follows,

$$S(t) = e^{-\int_0^t \lambda(u)\,du}$$

The model which was proposed by Cox assumes that the risk can be related to the independent variables in a log-linear manner i.e.

$$\lambda(t,X) = \lambda_0(t)\, e^{X^T\beta}$$

where, λ(t) is referred to as the baseline hazard

X is a set of variables which the risk is assumed to depend on.

B is a vector of coefficients

Thus,

$$\ln\lambda(t,X) = \ln\lambda_0(t) + X^T B$$

Several approaches have been adopted to operationalise this model for the study of fertility and child mortality linkages, and hence obtain the estimates of the parameters. Suchindran and Adlakha (1981, 1984); Santow and Bracher (1984); Lehrer (1984); and Richter and Adlakha (1989) assumed (t) to be an unspecified and arbitrary baseline hazard and then used the maximum likelihood to obtain the estimates of the parameters. In this approach, the estimates obtained are such that the likelihood function(to be defined below) is maximized and therefore the estimates are those which maximizes the probability of observing the outcome which was observed to occur.

Marcotte and Casterline (1990) utilized the log-logistic and Weilbull distributions as a specification of the baseline hazard. The estimates were obtained through the method of maximum likelihood.

Another approach, and the one we adopt for this study, is to divide the time interval into duration categories and to assume that the baseline hazard is constant in each of such durations (Holford,1976 and 1980). This implies that in each of such durations the survival function is exponential. This approach has been applied by Mensch (1985) to assess the effect of infant and child mortality on fertility.

(a) Estimation and Interpretation of the Parameters

The parameters for the hazards model in this study were estimated through the method of the maximum likelihood for a multi-dimensional contingency table using the GLIM package. Thus all the variables utilized in this analysis were categorical. In this approach as shown by Trussell and Hammerslough (1983), these maximum likelihood estimates are such that the expected number of failures (which in this study is the number of births), is equal to the observed number. As further shown by Liard and Oliver (1981) and pointed out by Selmer (1990), the likelihood function is proportional to that of the Poisson distribution which implies that one can use these likelihood functions interchangeably for deriving maximum likelihood estimates.

In general, the maximum likelihood estimate of the risk is given by *f/T* where f is the number of failures and *T* is the total exposure. Thus in our case, months of exposure in the *i*th duration, this risk is given by B_i/T_i where B_i are the births given in this duration and T_i is the total exposure in this duration.

Using the SPSS package and the same variables as defined in the case of the multiple linear regression, the number of births and total exposure in each of the intervals and categories were obtained. These values were then used in GLIM.

Finally, in order to obtain unique estimates for the parameters some restriction had to be imposed on some of the parameters as pointed out by Little (1978). Why this restriction is necessary is illustrated below using the log-linear model presented earlier. Suppose we assume that in this earlier model the risk of childbearing is influenced by the level of education which is categorized into three categories and we also assume that this varies in each of the five durations. Then, this model can be presented as:

$$\ln\lambda_{de} = \lambda + \lambda_{1d} + \lambda_{2e} + \lambda_{12de}$$

$d=1,\ldots\ldots,5$, and

$e=1,2,3$

where,

λ is referred to as the constant

λ_{1d} refers to the effect of each of the 5 durations

λ_{2e} refers to each of the three education categories

λ_{12de} represents the effects for the 3*5 = 15 interaction terms

Thus, in the above model we have 24 parameters to be estimated. Since, the estimation is undertaken by the matching of the margins (Trussell and Hammerslough, 1983), we have only 3*5 = 15 equations from which the estimation can be undertaken. This implies that a restriction on at least 9 parameters has to be imposed. The GLIM package utilized in this analysis imposes the restrictions on those categories having the smallest values and the estimates of the other categories are interpreted in reference to this category. In this case the restrictions were imposed as follows:

$$\lambda_{11}=\lambda_{21}=\lambda_{12d1}=\lambda_{121e}=1$$

for all d and e

This implies that,

$$\ln\lambda_{11}=\ln\lambda_{21}=\ln\lambda_{12d1}=\ln\lambda_{121e}=0$$

for all d and e

The model obtained under the above restriction is referred to as the saturated model and will be discussed further in the next section.

(b) Fitting and Testing for the Models

The first step of the analysis was to determine the effects of each of the variables on the dependent variable. This was undertaken using the general procedure in GLIM which is briefly described below.

The fit of a model in GLIM is assessed through the deviance which measures the deviations of the estimated risks from those which are observed. Since the addition of a variable is expected to improve the fit, the deviance is expected to be reduced each time an additional variable is added to the model. In fact, the saturated model reproduces the observed risks and hence has a deviance of zero. The model containing no parameters has the largest deviance and is referred to as the null model. The general procedure of assessing the effects of the variables is therefore to determine the changes in deviance that result from adding these variables in the model.

In this study the strategy adopted for assessing the effect of each of the variables was to compare the deviances for the null model and the model containing each of the variables in turn. As explained above the addition of these variables is expected to reduce the deviance and the larger this reduction is the greater the effect of the variable.

The test of significance for the variables were undertaken using the χ^2 test where the statistics for this test is given by:

$$de_{\phi}-de_{v} \quad \sim \quad \chi^2_{df_{\phi}-df_{v}}$$

i.e. the difference between the deviance for the null model de_{ϕ} and the model containing the variable de_{v} is distributed as χ^2 with degrees of freedom being the difference in degrees of freedom between the two models. Larger values of χ^2 indicate that the variable had a significant effect. The statistical significant of the overall model was determined by extending the above argument to models with more than one variable. Thus the deviance for the model containing a given set of variables was compared with that for the null model and the χ^2 test described above was undertaken.

The tests of significant for specific categories of variables were undertaken using the t-statistics which is given by:-

$$t = \frac{s.e.(\lambda)}{\lambda}$$

The t-statistics above was calculated from the estimates and standard errors which is given as part of the GLIM output. The estimate was taken to be significant if the calculated t value exceeded the 5% level.

5.3. Procedures for Fitting the Models for the Assessment of the Behavioural Effects of Infant and Child Mortality on Fertility.

In this subsection we describe how the variables specified in section 5.1 and the methods discussed above were utilized to obtain the most appropriate model for testing the hypotheses of the study.

5.3.1. Definition of Variables

The first step in fitting the models, was to obtain the most appropriate categorizations of the continuous variables. The criteria used to obtain this categorization was the strength of the relationship between each of the independent variables and the dependent variable as reflected by the value of R^2 and the significant levels for each of the categories of the variable. This was undertaken using OLS as described below.

To determine the appropriate categories of the variables, several regressions models were undertaken with each of the variables starting with the categories presented in table 5.1. Tests of significance for each of the regression were then undertaken and the one with the largest R^2 and in which the categories of the variable reflected overall the highest *t*-values was taken as the most appropriate form.

5.3.2. Fitting of the Models

Since the aim of this study is to develop models for describing the relationship between the infant/child mortality variables and the birth interval, the first step was to determine the variables among those which were presented in table 5.1 which should be retained in the model describing the relationship between infant and child mortality on one hand and birth intervals on the other. Several approaches as discussed below were followed in order to achieve this.

The first criteria utilized to determine those variables which were to be retained in the final models was based on the theoretical importance of the variables to the study. Under this criteria, all the 7 variables defined for the assessment of the effects of infant and child mortality and the proximate determinant factors were considered of theoretical importance to the study. Two other variables each among the socio-economic and demographic groups viz:-education and birth order respectively were also considered to fall under this category. As pointed out earlier several studies have shown that the effect infant and child mortality on birth intervals may vary with these variables. Thus the models developed for the assessment of the effects included the above variables.

The next step was to determine which of the remaining socio- economic and demographic variables we had to retain as control variables in the model. In order to do this, the first step was to run a regression model for each of methods (OLS and Hazard) which included all the variables specified in table 5.1. The dependent variable for the OLS was the length of the closed intervals (LCBI) while the log of the risk ($Ln(\lambda)$) was taken as the dependent variable in case of the hazards model.

For each of the above models, the socio-economic and demographic variables which were not significant was determined using the t-test presented earlier. A variable was only considered not significant if none of its categories was significant. Starting with the socio-economic variables, the variable with the lowest level of significant was determined and the above models were re-fitted by excluding this variable. The changes in the coefficients of the variables for the assessment of the effects and the proximate determinant factors were determined. Changes in R^2 in case of the OLS model and deviance in case of the Hazards models were also determined. If the changes above were not substantial, this implied that the variable which was removed from the model did not confound the relationship. The above procedure was repeated for all the other insignificant variables among the socio-economic variables starting with the variable having the next lowest t-value. The above procedure was repeated to determine the demographic variables to be included in the final model.

Finally, in order to determine the effect of removing the variables which according to the above criteria were not confounding the relationship, these variables were removed from the model as a group and the changes in the coefficients of the variables for assessing the effects were determined by comparing the model containing all the variables with the above model.

5.3.3. Assessing the Appropriateness of the Models

Before utilizing the OLS models obtained above, the appropriateness of these models in terms of the extent to which the assumptions were violated was assessed.

The error term of the OLS regression model is based on several assumptions. The examination of whether these assumptions were violated was undertaken through examining the residuals which are the estimates of the errors. Approaches to undertake the examination of the violation of these assumptions are contained in several standard texts (Draper and Smith,1966; Chalterjee and Price,1977; and Kleinbaum et al.,1988).

One of the assumptions of the regression model is that the errors are normally distributed. If the assumption is correct, then the observed residuals should also be expected to be normally distributed. Two approaches were adopted to determine whether there were any serious violation of this assumption for the models fitted in this study. As Kleinbaum et al. (1988) have pointed out small departures from normality do not create serious problems.

The first of the approaches adopted to examine the assumption of normality was to plot the frequencies of the standardized residuals. The standardized residual is given by:

$$z_i = \frac{\epsilon_i}{s} \sim N(0,1)$$

where s^2 is given by,

$$s^2 = \frac{\sum \epsilon_i^2}{n-k-1} = \frac{SSE}{n-k-1}$$

s^2 is unbiased estimate of the variance, if the model involving k parameters is correct

The above plot is expected to be approximately that of the standard normal if the assumption of normality is not violated.

The other plot which was examined is the normal probability plot. In this plot, the standardized residuals are ordered from the smallest to the largest and the cumulative frequency distribution obtained. The latter distribution is supposed to be represented by a straight line and deviations from it indicate the extent to which there is a deviation from the normality assumption.

The other assumption of the errors is that of the equality of the variances. When this assumption is violated, the estimates of the parameters obtained are no longer the best in precision of the variance. Heteroscedasticity, as this unequalness of variance is referred to, was examined through the plot of the standardized residual against the estimated value of *Y*. This plot is supposed to be distributed randomly about zero if this assumption is not violated. This also indicates that the model is not inadequate.

Another problem which arises from the data even when the model is properly specified is that which is referred to as multicollinearity. Multicollinearity arises if the independent variables are strongly interrelated. When this is the case, the interpretation of the parameter estimates is ambiguous as it is not possible to estimate the unique effects of the individual variables in the regression.

An initial assessment as to whether multicollinearity may cause trouble was undertaken by examining the simple linear correlation coefficients between the independent variables. Very high correlations of 0.9 or greater would suggest that multicollinearity may be present in the data.

The other approach applied to quantify collinearity in this study was to use the variance inflation factor(VIF) which is defined for each of the independent variable regressed against the other independent variables.

For the *j*th independent variable, VIF is defined as:

$$VIF_j = \frac{1}{1-R_j}$$

Where, *R* is the multiple regression coefficient between the *j*th independent variable taken as the dependent variable against the other independent variables.

VIF values larger than 10 are considered troublesome and corresponds to $R > 0.9$

In this study multicollinearity was examined using 1/VIF which is referred to as the tolerance as it is directly obtained from the SPSS output.

Thus 1/VIF < 0.1 was considered troublesome.

5.4. Procedures for the Assessment of the Effects of Infant and Child mortality on Fertility

In this subsection we describe how the models described above were utilized to assess the behavioural effects of infant and child mortality on fertility independent of the biological effects.

In order to assess the behavioural effects of the death of an infant or a child on birth intervals, the approach of Cleland et al.(1979) was utilized. In this approach the regression models are developed in steps starting with the basic models which includes the variables of interest. Thus in this study the basic model included the variables for the assessment of the effects. Three such models were developed in for this study. Model I which included only four variables Viz:- BIREINF, for the assessment of the three effects combined; BIREPEF, for the assessment of biological and replacement effects; REPEF, for the assessment of replacement effects; and INSEF, for the assessment of the insurance effects due to infant and child mortality experiences at the personal level. Model II included two additional variables (FBIREPEF) and (FEREP) to capture the additional effects due to sex differences of the behavioural effects. Model III included in addition (PDEADGR), the variable for the assessment of the insurance due to mortality level at the community. The dependent variable for the OLS was the length of the closed interval (LCBI) while the log of the risk was the dependent variable for the hazards model. These three models are shown below for each of the methods. The codes presented in table 5.1 are utilized to present these models. The OLS models are given by:

Model I

$$LCBI = \beta_0^1+\beta_1^1 BIREINF+\beta_2^1 BIREPEF+\beta_3^1 REPEF+\beta_4^1 INSEF$$

Model II

$$LCBI = \beta_0^2+\beta_1^2 BIREINF+\beta_2^2 BIREPEF+\beta_3^2 REPEF+\beta_4^2 INSEF+\beta_5^2 FBIREPE.$$

Model III

$$LCBI = \beta_0^3+\beta_1^3 BIREINF+\beta_2^3 BIREPEF+\beta_3^3 REPEF+\beta_4^3 INSEF+\beta_5^3 FBIREPE.$$

The corresponding basic hazards models are given by:-

Model I:

$$Ln(\lambda(t)) = \lambda_0^1+\lambda_1^1 BIREINF+\lambda_2^1 BIREPEF+\lambda_3^1 REPEF+\lambda_4^1 INSEF$$

Model II:

$$Ln(\lambda(t)) = \lambda_0^2+\lambda_1^2 BIREINF+\lambda_2^2 BIREPEF+\lambda_3^2 REPEF+\lambda_4^2 INSEF+\lambda_5^2 FBIF$$

Model III:

$$Ln(\lambda(t)) = \lambda_0^3+\lambda_1^3 BIREINF+\lambda_2^3 BIREPEF+\lambda_3^3 REPEF+\lambda_4^3 INSEF+\lambda_5^3 FBIF$$

Note that different notations have been used in specifying the coefficients between each set of the three models because we expect them to be different.

In order to assess the effects of infant and child mortality on fertility, the proximate determinant variables specified in table 5.1 were utilized. These variables were included in the Models IV and V. Model IV included the coital frequency variable (COFREGR) while in Model V, the three contraceptive variables viz:- ever used a method (V302); current use of a method (V313) and use in the interval (CONTINT) were added. As noted in the conceptual formulation, these variables are expected to explain the differences in birth intervals and are referred to as the posterior variables (Little,1980).

To determine the role of Socio-economic and demographic variables on the birth intervals in general and their effects on the variables for assessing the effects in particular, three other models were utilized. Model VI in which only socio-economic and demographic variables were included; model VII in which the proximate factors were added and model VIII which included all the variables. As indicated in the conceptual framework, these variables are expected to influence infant and child mortality variables and not vice versa and are therefore referred to as prior variables (Little, 1980). Changes in the coefficients of these variables between models VI and VII show the extent to which the proximate factors capture the effects of socio-economic variables.

The differences in the coefficients for the assessment of effect of infant and child mortality on birth intervals between models VII and VIII indicate the differences arising due to differences in socio-economic characteristics.

Because of the possible reverse effect of breastffeding on infant and child mortality as demonstrated in several studies and which would have made the interpretation of the effects of this variable difficult, two sets of models were developed. The first of this are the models presented above. These models were based on the 1478 birth intervals which included the deaths of births opening the intervals and in which the breastfeeding variables were excluded. The second set of models were restricted to only the intervals in which the births opening the interval were still alive at the time of the survey. As result of the above restriction, the variables whose definitions were based on the survival status of the birth opening the interval were not possible. The basic models for this latter set are provided below. The three basic models for OLS were defined as:-

Model I:

$$LCBI = \beta_0^1+\beta_1^1 REPEF+\beta_2^1 INSEF$$

Model II:

$$LCBI = \beta_0^2+\beta_1^2 REPEF+\beta_2^2 INSEF+\beta_3^2+\beta_4^2 FREPEF$$

Model III:

$$LCBI = \beta_0^3+\beta_1^3 REPEF+\beta_2^3 INSEF+\beta_3^3 FREPEF+\beta_4^3 PDEADGR$$

The corresponding basic hazards models are given by:-

Model I:

$$Ln(\lambda(t)) = \lambda_0^1+\lambda_1^1 REPEF+\lambda_2^1 INSEF$$

Model II:

$$Ln(\lambda(t)) = \lambda_0^2+\lambda_1^2 REPEF+\lambda_2^2 INSEF+\lambda_3^2 FREPEF$$

Model III:

$$Ln(\lambda(t)) = \lambda_0^3+\lambda_1^3 REPEF+\lambda_2^3 INSEF+\lambda_3^3 FREPEF+\lambda_4^3 PDEADGR$$

As in the first set of models, coital frequency and contraceptive variables were included in models IV and V respectively while the breastfeeding variables were included in Model VI. Models VII, VIII and IX are similar to the last three models in the first set except for the additional variable of breastfeeding.

Behavioural effects of infant and child mortality on fertility were determined by utilizing models IV and V for the first set of models and models IV-VI for the second set by examining the changes in the coefficients of the variables for the assessment of the effects. For instance the changes in these coefficients between models III and IV gives the effect on the birth intervals due to an infant or child death which are explained by differences in the coital frequency between the cases when an infant or child had died and when they had survived. The effects accounted for is referred to as the indirect effect while that which is not account for by these variables is referred to as the direct effect.

5.4.2. Procedures for the Assessment of the Magnitude of Effects

The changes in the coefficients discussed above were quantified through the partial *R* which was proposed by Cleland et al. (1979). Partial *R* was obtained from the partial R^2 obtained from the analysis of variance and it indicates the squared difference in the birth interval length when an infant/child dies and when it survives. Partial *R* which is defined below, on the other hand, summarizes the absolute value of these differences.

To calculate partial *R*, two regression models were fitted one in which the variable whose effect we wish to quantify was included as the only variable in step 1 and the other in which it was excluded. The models were then developed by including the other variables for the assessment of the effects in the second step and socio-economic and demographic variables in the third.

The proximate determinants were included in the last two and three steps for the first and second sets of models respectively. From these two models the partial *R* defined as:

$$\partial\ R = \sqrt{\frac{SS_{idv+ov}-SS_{ov}}{SST}}$$

was obtained.

SS_{idv+ov} is the sum of squares in the regression model containing all the other variables (ov) and the Infant/Child death variable (idv).

SS_{ov} is the sum of squares of the regression model containing the other variables but excluding the infant death variable.

SST is the total sum of squares.

Partial *R* is equivalent to the Beta measure of Multiple Classification Analysis (MCA) and at each step gives an indication of the differences in the dependent variable due to the infant/child mortality variable which can be accounted for by the variable entered in the regression model at that step. Thus by examining the differences in Partial *R* in the steps in which the proximate variables were included for models including and excluding the variable whose quantification of the effect is sought, the role of these factors in accounting for the changes in this variable was assessed. The partial *R* was simply obtained as the difference in the *R* between the two regression models at each step using the

SPSS output for the two regression models.

5.5. Summary

This chapter focused on outlining the procedures which were utilized to operationalize the study. This process involved two main steps. First we demonstrated how the data which was presented in chapter 4 was utilized to obtain the operational definitions of the variables which were used in the analysis. In the second step we illustrated how these variables were utilized in the analysis by presenting the analytical techniques and the procedures which were applied. The results obtained by the application of these procedures are presented in the next two chapters.

CHAPTER 6

DEFINITION OF VARIABLES AND NATURE OF THEIR RELATIONSHIP WITH BIRTH INTERVALS

This chapter focuses on examining the nature of the relationships between the variables for the assessment of the effect of infant and child mortality on fertility and the other variables specified in Chapter 5 on one hand, and birth intervals on the other.

The definitions of the variables utilized for analysis are discussed in Section 6.1. The approach described in Section 5.3.1 is utilized in obtaining these definitions. The nature of the relationship between the dependent variable and each of the independent variables are examined in Section 6.2. These relationships are presented for both the ordinary least square(OLS) and the hazards models. Finally, the relationships between the independent variables are examined in Section 6.3. The theoretical framework presented in Chapter 3 is utilized as a basis for discussing these relationships.

6.1. Categorization and Definition of the Variables

This Section presents the definition of the variables as utilized in fitting the models. Most of these variables as presented in Table 5.1 of Chapter 5 are categorical in nature. Continuous variables on the other hand were categorized using the approach discussed in Section 5.3.1. The categorization of these variables is discussed first before presenting the definitions.

6.1.1. Categorization of the Variables

The education variable as shown in Table 5.1 was initially defined in four categories viz:-none, lower primary (1-4 Years), upper primary (5-8 Years) and secondary and above (9+ Years). The bivariate analysis undertaken for this variable indicated that lower primary category is not significantly related with the dependent variable. Thus two additional re-analyses were undertaken with this category combined with each of the adjacent categories so as to give three categories of this variable. Although in both of these new categorizations all the three categories were significant, the relationship where the none category was combined with that for lower primary had a higher level of significance for all the categories and a higher R^2 (Appendix XII) value and hence was chosen as the most appropriate categorization for this variable.

The categorization of the ethnicity variable was based on earlier studies (e.g. Mosley et.al,1982). According to these studies, the Mijikenda ethnic group in the coast region of Kenya should be expected to have the longest birth intervals while Luhya in western part of the country should be expected to have the shortest birth intervals. The other ethnic groups should lie in between. In order to capture the confounding effect of this variable and at the same time to ensure that the number of categories was not large, this variable was categorized into the following four categories:- Mijikenda, Luhya, Kikuyu-Embu-Meru, and the other ethnic groups together.

Most of the demographic variables utilized in this study are continuous in nature but the procedure applied above was utilized to obtain the most appropriate groupings for these variables as discussed below. The bivariate analysis for the age variable using the definition viz:-15-19 Years, 20-34 Years and 35+ Years revealed that the category 20-35 Years was not significant. Subsequent analyses undertaken using different definitions of this variable indicated that this variable is most appropriately defined in two categories viz:- $<$ 25 Years and $\geq$ 25 Years. Similar analyses undertaken for the previous birth intervals (PLCBIG) and means of previous intervals (PBIAG) variables indicated that the initial categorizations for these variables as provided in Table 5.1 viz:- $<$ 2 Years, 2-$<$ 3 Years and $\geq$ 3 Years are the most appropriate. The analysis for the duration of marriage (DMARLCY) variable indicated that this variable is most strongly related to the dependent variable when categorized as: $<$ 10 Years and $\geq$ 10 Years.

Among the main independent variables only proportion dead in the community

(PDEADGR) is continuous. The bivariate analysis for this variable showed that the categories < 20 per cent and ≥ 20 per cent were most appropriate. The definitions of the other variables as provided earlier were found to be appropriate.

6.1.2. Definition of the Variables

The definitions of the variables are presented in Table 6.1. Column 1 of this table shows the means for each of the variables expressed in percentage for the 1525 closed intervals used for the OLS regression. Column 3 gives the means for both closed and open intervals also in percentages. As indicated earlier these were utilized for fitting the hazards models.

The definitions of these variables are presented in four broad groups based on the theoretical framework. The first group gives the definitions of the variables utilized for testing the main hypotheses of the study. This group includes 7 variables which constitute the main independent variables. Also included in this group are three variables indicating the deaths of the births opening the interval (BRT2SU), those dying prior to the conception of the birth closing the interval (CE) and those dying after the conception of the birth closing the interval (FE).

The control variables are presented in two groups: socio-economic and cultural as one group and demographic as the other. The proximate determinant variables through which the variables in the other three groups affect fertility are presented as the final and fourth group.

(a) Dependent Variable

The mean of the closed interval as presented in the table is slightly over 26 months. This is lower than the mean of 30 months obtained from the KFS. This could be due to several reasons. First, our selection procedure in which only intervals both started and completed in the last five years preceding the survey were included removes longer intervals. Secondly, as will be seen later the proportions with higher levels of education which is negatively associated with birth intervals increased over the same period.

(b) Variables for the Assessment of the Effect of Infant/Child Mortality on Fertility

The definitions of the seven main independent variables related to infant and child mortality provide the basis for the assessment of the three effects of infant and child mortality on fertility independent of each other as well as for the testing of sex differences in the replacement effects. The variable for the assessment of replacement effects (REPEF), was defined as a dummy variable indicating the intervals in which at least one previous birth to the one opening the interval had died. Such deaths had taken place in about 2.7 per cent of the intervals included in this analysis.

Table 6.1:- Definition of Variables for the Regression and Hazards Models

Variable	Closed Intervals N=1527	Open Intervals N=1078	Open and Closed N=2603
Dependent			
Length of Birth Interval(LCBI)	26.2		
Main Independent			
Death of Birth opening the Interval(BRT2SU)			
Dead	10.4	3.9	7.7
Alive	89.6	96.1	92.3
Death of Birth opening the Interval prior to conception of next live birth(CE)			
Dead	7.2	3.9	5.8
Alive	92.8	96.1	94.2
Biological,Replacement and Insurance Effects(BIREINF)			
Death	3.3	1.7	2.6
No death	91.7	98.3	97.4
Biological and Replacement Effects(BIREPEF)			
Death	3.9	2.2	3.2
No death	96.1	97.8	96.8
Female Births Biological and Replacement Effects(FBIREPEF)			
Death	2.1	1.1	1.7
No death	97.9	98.9	98.3
Replacement Effects(REPEF)			
Death	2.7	3.2	2.9
No death	97.3	96.8	97.1
Female Births Replacement Effects(FREPEF)			
Death	1.4	1.8	1.6
No death	98.6	98.2	98.4
Insurance Effects(INSEF)			
Death	20.6	25.2	22.5
No death	79.4	78.8	77.5
Proportion Dead in the Community (PDEADGR)			
0-< 20 per cent	87.7	87.1	87.3
> = 20 per cent	12.3	12.9	12.7
Death of Birth opening the Interval after conception of next live birth(FE)			
Dead	3.2	0.0	1.9
Alive	96.8	100.0	98.1
Socio-Economic and Cultural			
Education of Woman(EDUC)			
None and Lower Primary	39.2	37.8	38.6
Upper Primary	41.7	42.2	41.8
Secondary and Above	19.2	19.9	19.5

table 6.1-continued

Variable	Closed Intervals N=1527	Open Intervals N=1078	Open and closed N=2603
Residence**(V102)**			
Urban	18.7	20.1	19.2
Rural	81.3	79.9	80.8
Ethnicity**(ETHN)**			
Mijikenda	5.3	5.7	5.5
Kikuyu-Embu-Meru	22.9	23.8	22.1
Luhya	22.5	21.5	23.3
Others	49.4	49.0	49.2
Type of Union**(UTYPE1)**			
Monogamous	81.4	82.0	81.7
Polygamous	18.6	18.0	18.3
Husband Lives in the House**(V504)**			
Stays with her	80.2	80.1	80.2
Stays away	19.8	19.9	19.8
Demographic			
Birth Order**(BOGR)**			
Birth order 3	23.6	0.0	13.8
Birth order 4-5	39.1	51.1	44.1
Birth order 6-8	37.3	48.9	42.1
Age at start of interval **(AGEBLY)**			
< 25 Years	47.9	31.5	41.9
>= 25 Years	52.1	68.5	58.9
Previous Birth Interval**(PLCBIG)**			
< 2 Years	38.6	34.1	36.8
2-< 3 Years	40.0	47.4	50.7
>= 3 Years	21.3	18.5	12.4
Previous Birth Interval Mean **(PBIAGL)**			
< 2 Years	31.4	23.1	28.0
2-< 3 Years	50.9	59.7	54.6
>= 3 Years	17.7	17.2	17.4
Duration of Marriage**(DMARLCY)**			
< 10 Years	70.9	61.7	67.0
>= 10 Years	29.1	38.3	33.0
Proximate Determinants			
Breast feeding Duration **(BRFEED)**			
< 10 Months	16.8	41.8	27.2
10- < 19 Months	54.1	42.2	49.1
>= 20 Months	29.1	16.0	23.7
Contraceptive Use			
Ever Use**(V302)**			
Never Used	57.0	55.9	56.6
Used Traditional	15.1	15.5	15.3
Used Mordern	27.9	28.6	28.2
Current Use**(V313)**			
Not Using	76.8	76.1	76.5
Using Traditional	7.5	8.0	7.7
Using Modern	15.7	16.0	15.8
Use in Interval**(CONTINT)**			
Never Used	93.9	76.1	86.5
Used Traditional	1.7	8.0	4.3
Used Mordern	4.4	16.0	
Coital Frequency**(COFREGR)**			
None	32.9	33.0	32.9
1-3 times	35.0	33.9	34.8
>= 3 times	32.1	33.1	32.5
	100.0	100.0	100.0

The assessment of the sex differences in the replacement effects was facilitated through the dummy variable (FREPEF) derived from REPEF above and which specifies the proportion of intervals in which a female birth to the one opening the interval had died. This variable indicates that such deaths had occurred in only 1.4 per cent of all the intervals included in the analysis. This variable suggests that the female deaths were higher than those for the males. This may be a further indication of the omission of male births which had died in comparison with those for the females.

Insurance effects due to the mortality experiences at the individual level was assessed through (INSEF) a dummy variable which indicates intervals in which the birth opening the interval were preceded by at least one previous death and in which the birth opening the interval had survived beyond the conception leading to the birth closing the interval. About 21 per cent of the intervals were preceded by such deaths.

Insurance effects at the community level were assessed through (PDEADGR) a dummy variable which distinguishes intervals in communities with high infant and child mortality from those in which it was low. About 12 per cent of the intervals were in the former communities as shown in the table.

The two other dummy variables in this group were defined to give an indication of the combined effects of biological and replacement (BIREPEF) effects for both sexes and (FBIREPEF) for the female deaths only. As shown in the table, 3.7 per cent of all the interval consisted of those in which the deaths of births opening the interval were not preceded by an earlier death. Such intervals were fewer for the open intervals (3.2%) and consequently for the open and closed intervals combined (2.9%).

FBIREPEF as noted above indicates intervals among those discussed above in which the deaths opening the interval were of female births. This variable shows that 2.1 per cent of all the intervals in which the female births opening the interval had died were preceded by an earlier death.

The final variable among the variables for the assessment of the effects which was defined is BIREINF. This dummy variable was defined to facilitate the assessment of the three effects combined. BIREINF indicates those intervals in which the birth opening had died before the conception leading to birth closing the interval and which in addition were preceded by an earlier death. This variable as presented in the table, shows that such intervals were about 3.3 per cent of the all intervals included in the analysis.

The definitions for the other three variables defined with the main independent variables provided in the table indicate that 10.4 per cent of all the births opening the interval had died at the time of the survey (BRT2SU). This is consistent with the 10.9 per cent of infants and children who had died among all the 25,173 reported live births in the survey. This indicates that the mortality in the sub-sample is not different compared to that of the entire sample. In the open and closed intervals, this proportion is lower (7.7 per cent) because of the lower proportions in the open intervals. About 7.2 per cent of the above deaths occurred before the conception of the birth closing the interval (CE) while 3.2 per cent occurred after the conception (FE).

(c) Socio-economic, Cultural and Demographic

Nearly half of all the intervals in the sub-sample are contributed by the women of the other tribes while the Mijikenda contribute only about 5 per cent. The remaining intervals are shared equally between the two other ethnic categories.

About 42 per cent of the intervals are contributed by women with upper primary level of education while those due to women with lower primary and no education is 40 per cent. The proportion due to women with secondary and above is about 19 per cent. About 19 per cent of the intervals are due to women reported to be living in urban areas at the time of the survey while the rest are due to women reported to be in rural areas. The table further shows that most of the intervals (81 per cent and 80 per cent respectively) are due to women in monogamous unions and those staying with their husbands.

Slightly over 51 per cent of the closed intervals were initiated by women aged 25 years and over while the rest were initiated while the women were aged less than 25 years. The open intervals were initiated at an older age such that 69 per cent of the open intervals were initiated at age 25 and over. Most of the intervals (79 per cent) were preceded by intervals of less than three years. Nearly 30 per cent of the intervals were initiated by women who had been married for more than 10 years. As expected, the proportion of open intervals initiated by women who were married for more than 10 years is higher(38 per cent).

Birth order was defined as the order which closed or would close the interval in case of the open intervals. As shown in the table there are no open intervals which would have been closed by births of order 3 since the intervals selected for analysis were of orders 3 to 8. This is reflected in the proportions of birth of order 3 for the closed and open intervals.

(d) Proximate Determinants

The current and ever use of contraceptives is not substantially different in the sub-sample with that of the entire KDHS sample. The table shows that the proportion who had never used any contraceptive method is lower than those who are currently using. The use of modern methods in both cases is higher than the use of traditional methods.

The data on contraception were not gathered in a manner that can be directly related to specific intervals. Thus the contraceptive use in the intervals (CONTINT) was obtained indirectly using the number of living children at first use. Using this approach however, only contraceptive use for women with no children who had died could be identified. Thus this approach is expected to underestimate use in the intervals. This is reflected in the figures for the closed intervals presented in the table. Contraceptive use was only identified in 6 per cent of the closed intervals. Use in the open intervals was taken to be the same as current use (V313).

Coital frequency like contraceptive use could not be related to specific birth intervals. The variable employed in this study to measure the effect of this variable is the reported coital frequency within the last one month (COFREGR). As shown in the table in about one-third of the intervals, no coitus was reported within the last one month.

In about 54 per cent of the intervals the duration of breastfeeding was between 10 and 19 months. Overall, the mean duration for the intervals used for this analysis is about 16 months. This is lower by about 3 months than the mean of 19.4 months reported by the KDHS. An estimate of the length for all the closed intervals in the last five years of 19.6 months obtained for these intervals is however consistent with that reported in the KDHS report.

For the hazards analysis the duration of breastfeeding was defined as set of 3 dummy variables for each of the duration segments. Forty per cent of the births opening the interval were breastfed for at least 17 months, 18 per cent for over 23 months, 4 per cent over 29 months and only 1 per cent for over 41 months.

6.2. The Relationship Between the Dependent and Independent Variables

The relationships between the dependent variable and each of the independent variables are reported in Table 6.2. Column 1 of this table gives the relationships for the closed intervals which was based on the OLS regression. Column 2 gives these relationships for the analysis based on the 2604 closed and open intervals. The latter intervals were used to create an aggregate file consisting of all the variables presented in Table 6.2 and on which the above analysis was based.

Table 6.2:- Relationship Between the Length of Interval and the Variables

Variable	Coefficient OLS	Coefficient Hazard
Main Independent		
Death of Birth opening the Interval(BRT2SU)		
Dead	-4.32***	0.381***
Alive [Ref. Category]	26.61	-4.474
Death of birth opening the Interval prior to the next live birth conception(CE)		
Dead	-2.11**	0.166*
Alive	26.31	-4.448
Biological Insurance and Replacement Effects(BIREINF)		
Death	-1.32	0.063
No death [Ref. Category]	26.20	-4.439
Biological and Replacement Effects(BIREPEF)		
Death	-2.63**	0.249*
No death [Ref. Category]	26.26	-4.446
Female Births Biological and Replacement Effects(FBIREPEF)		
Death	-2.71*	0.314*
No death [Ref. Category]	26.21	-4.443
Replacement Effects(REPEF)		
Death	-1.49	-0.071
No death [Ref. Category]	26.20	-4.435
Female Births Replacement Effects(FREPEF)		
Death	-3.80**	0.427**
No death [Ref. Category]	26.21	-4.445
Insurance Effects(INSEF)		
Death	-0.40	-0.096
No death [Ref. Category]	26.07	-4.417
Proportion Dead in the Community (PDEADGR)		
= > 20 per cent	0.86	-0.020
0-< 20 per cent [Ref. Category]	26.05	-4.434
Death of birth opening the Interval after the next live birth conception(FE)		
Dead	-8.43***	1.057***
Alive [Ref. Category]	26.43	-4.471
Socio-Economic and Cultural		
Education of Woman(EDUC)		
None & Lower Pry [Ref. Category]	27.26	-4.568
Upper Primary	-1.56***	0.197***
Secondary and Above	-2.38***	0.227***
Residence(V102)		
Urban	0.19	-0.102
Rural [Ref. Category]	26.12	-4.418

table 6.2-continued

Variable	Coefficient OLS	Coefficient Hazard
Ethnicity(ETHN)		
Mijikenda [Ref. Category]	27.40	-4.544
Kikuyu-Embu-Meru	-0.85	0.072
Luhya	-1.86*	0.151
Others	-1.27	-0.057
Type of Union(UTYPE1)		
Monogamous	-1.04*	0.158*
Polygamous [Ref. Category]	27.01	-4.568
Living with Husband(V504)		
Living away [Ref. Category]	26.79	-4.501
Staying with her	-0.79	0.080
Demographic		
Birth Order(BOGR)		
Birth order 3 [Ref. Category]	25.89	-4.316
Birth order 4-5	-0.31	-0.061
Birth order 6-8	1.03*	-0.251***
Age at start of interval (AGEBLY)		
< 25 Years [Ref. Category]	25.23	-4.308
> = 25 Years	1.78***	-0.246***
Previous Birth Interval(PLCBIG)		
< 2 Years [Ref. Category]	25.08	-4.381
2-< 3 Years	1.69***	-0.097*
> =3 Years	1.89***	0.087
Previous Birth Interval Mean (PBIAGL)		
< 2 Years [Ref. Category]	24.76	-4.287
2-< 3 Years	1.81***	-0.204***
> = 3 Years	2.71***	-0.291***
Duration of Marriage(DMARLCY)		
< 10 Years [Ref. Category]	25.26	-4.617
> =10 Years	1.42***	0.256***
Proximate Determinants		
Breast feeding Duration (BRFEED)		
< 10 Months [Ref. Category]	22.09	
10- < 19 Months	3.21***	
> =20 Months	7.98***	
Contraceptive Use		
Ever Use(V302)		
Never Used [Ref. Category]	26.38	-4.440
Used Traditional	-0.78	0.069
Used Modern	-0.03	-0.027
Current Use(V313)		
Not Using [Ref. Category]	26.57	-4.470
Using Traditional	0.72	-0.010
Using Modern	-2.97***	0.174**
Use in Interval(CONTINT)		
Never Used [Ref. Category]	26.11	-4.394
Used Traditional	-1.80	-0.001
Used Modern	1.80*	-0.660***
Coital Frequency(COFREGR)		
None [Ref. Category]	27.94	-4.623
1-3 times	-2.35***	0.275***
> =3 times	-2.76***	0.247***

Note: * Significant at 10%
** Significant at 5%
*** Significant at 1%

In each of the cases the nature of the relationship and the levels of statistical significance are specified. For the regression analysis, the coefficients indicate the differences in the estimated lengths of intervals in months between the reference category and the other category(ies). Thus the coefficient -4.32 for the variable (BRT2SU) is interpreted to mean that the birth intervals were on the average shorter by 4.32 months if the birth opening the interval had died in comparison to the intervals in which such births were alive. This relationship is also noted to be highly significant

The coefficients for the hazards analysis are interpreted in terms of the risk of giving a birth in a given segment. The coefficient -4.47 for the variable BRT2SU, gives the log risk of giving a birth for the reference category viz:-in segment 8-17 months and where the birth opening the interval had survived. Thus the absolute risk for this category is obtained by exponentiating this coefficient. It implies that in this case the risk of giving birth for this category is 0.011.

The coefficient 0.381 for the other category of this variable gives the log risk relative to the reference category. A positive coefficient implies that the risk for that category is higher compared with that of the reference category while a negative one implies that it is lower. In order to obtain the relative risk this coefficient is exponentiated. In the case of (BRT2SU), the risk of child bearing is therefore about 1.46 times when the birth opening the interval had died compared to when it had survived. This result is consistent with the results based on the closed interval discussed above. The table further reveals that the level of significance are also the same in both cases. The relationships for the other variables are examined below.

Focusing on the relationships for the main independent variables, based on the closed intervals as presented in column 1, it is noted that the coefficients of these variables indicate that all are in the expected directions except for indicator of community level child mortality (PDEADGR). It is further observed that several of these relationships are also significant. Thus for these variables intervals in which a death of an infant or a child had occurred are shorter than if the child had survived. Examining the magnitudes of these relationships, however, indicates that they do not completely conform to expectations. Although the birth interval should be expected to be shortest for the variable measuring the three effects combined (BIREINF), this is not the case. In fact the shortest birth intervals are for the variable measuring the replacement effects of the deaths of female infants and children (FREPEF).

The relationships for these variables based on the hazards model are in general consistent with those based on the OLS analysis discussed above. Thus in this case the results as presented in column 2 of the table show that deaths of infants and children are in general related to higher risks of child bearing. Exceptions to consistency are the variables (REPEF) for the measurement of replacement effects and (INSEF) for the measurement of the insurance effects. As the results in the table show, the risks of child bearing in the case of these two variables are indicated by the hazard analysis to be lower in the case of infant or child deaths compared to when they survived. It may be noted in both cases the negative effects on the birth intervals estimated by the OLS were quite small.

The lengths of the birth intervals on the average shortens with the increasing levels of education. Results summarized in the table are consistent with respect to this relationship for the two models. Birth intervals are also slightly shorter in the rural areas compared with urban areas. Similarly, women in monogamous unions as expected have shorter intervals. Analyses based on the two models indicate that the Luhyas have the shortest birth intervals while the Mijikendas have the longest. This is consistent with earlier studies. Similarly, the results for the variable indicating whether the respondent's husband lives with her is consistent with prior expectations. The coefficients for this variable shown in the table indicate that women staying with their husbands are at higher risks of giving birth to a live birth, though the results are not significant.

The demographic variables are all significantly related with the dependent variable in the expected direction for the analysis based on the closed intervals with the exception of birth order. Birth intervals initiated when the women were aged over 25 years are on the average longer by 1.8 months compared to those initiated when the women were aged less than 25 years. The previous birth intervals and the means of previous intervals are similarly related. As reported in the table, the relationship between each of these variables and the dependent variable is positive and highly significant. Women who had a previous birth interval of between 2 and 3 years had intervals which were longer by about 1.7 months. Birth intervals preceded by intervals longer than 3 years were longer by over 2 months. A similar relationship is noted with the means of the previous intervals. Finally, intervals initiated by women who had over 10 years since their first marriage are as expected longer by about 1.4 months compared to those initiated by women with less than 10 years since their first marriage. The results discussed above are consistent with those based on the hazards models as reflected in the table.

The relationship between the birth order and the birth interval as noted above is not significant. Also length of the interval does not increase with birth order as expected. Although intervals closed by birth orders 6-8 are longer by nearly one month as expected and this relationship is significant, intervals closed by birth orders of 4 and 5 are shorter compared to those closed by births of order 3 contrary to what would be expected.

The proximate determinant variables of breastfeeding and coital frequency are related to the dependent variables as expected. Lengths of birth intervals increase with duration of breastfeeding. Intervals in which infants and children were breastfed for more than 20 months are shown to be longer by 8 months compared to those in which this duration was less than 10 months.

The length of the birth interval is expected to be inversely related with coital frequency. This is reflected in the results reported in the table. Women who reported coital frequency of more than three times in the month preceding the survey had intervals which were shorter by about 3 months compared to those who reported no coital activity. The hazards models give similar results. Women reporting coital frequency of more than 3 times had slightly higher risks of childbearing compared to those who indicated none. Note, however, that coital frequency refers to the month before the survey, rather than in the interval.

The three contraceptive variables defined to capture the effect of contraceptive use on birth intervals are not consistently related with these intervals except for the variable (CONTINT), which indicates the use in the interval. As shown in the table, intervals in which use of modern contraceptives is indicated were longer by about 1.8 months while those in which use of traditional methods was indicated are shorter by the same magnitude. This latter relationship is, however, not significant.

Neither ever use of contraceptives nor current use shows the expected relation to birth interval. In the case of current use, intervals for women who indicated to be currently using a modern method are unexpectedly shorter by nearly 3 months while for intervals in which traditional methods were indicated are longer. Ever use of either modern or traditional methods is associated with shorter intervals. The shorter birth intervals associated with use of modern method could however make sense where short preceding intervals motivate the women to accept contraception.

6.3. Relationship Between the Independent Variables

The theoretical framework presented in Chapter 3 indicated the nature of the relationships that would be expected among the independent variables. In this section we examine the extent to which the data reflect these conceptualized relationships. This analysis was undertaken using the cross-tabulations. The format of presenting the empirical evidence of the theoretical framework of Chapter 3, in which the related groups of variables were examined together, is also adopted in this section.

(a) Relationship Between Proximate Determinant Factors, Socio-economic and Demographic Factors

The evidence presented earlier in Chapter 3 indicated that the duration of breastfeeding shortens as the levels of education increases. Women in urban areas have also been found to have shorter durations of breastfeeding compared to those in rural areas. Some studies have also shown that breastfeeding duration increases with demographic factors of age and birth order. In addition it has been suggested that some traditional cultures may be more supportive of longer duration of breastfeeding.

The relationships between breastfeeding and these variables reported in Tables 6.3a(i) and 6.3a(ii) show similar relationships. As shown in Table 6.3a(i), the duration of breastfeeding decreases with increasing levels of education. The proportion of births opening the interval who were breastfed for more than 20 months is 22 per cent for those with secondary and above level of education compared with 34 per cent for those with none and lower primary. This proportion is also observed to be lower in rural areas (27 per cent) compared to 30 per cent in the urban. Duration of breastfeeding is also seen to be longest among the Mijikenda tribe and shortest among the Luhya.

Relationship between the duration of breastfeeding and the other socio-economic variables are also displayed in Table 6.3a(i). Duration of breastfeeding appears to be longer among women who reported living with their husbands. The proportion breastfeeding for more than 20 months is higher among these women as shown in the table. The results in Table 6.3a(i) show no substantial differences between duration of breastfeeding and type of union.

Table 6.3a(i): Relationship Between Proximate Determinants and Socio-economic Variables

Variable	Ethnicity				Educational Level			Residence		Union Type		Husband	
	Ki-eb-ru	Lu-h-ya	M/ke-nda	Ot-her	Non/lo-pry	upper pry	Se+	Ru-ral	Ur-ban	Mono-gamous	Poly-gamous	with	away
Breast-feeding (Months)													
0-9	12	19	17	18	16	13	27	24	15	17	15	18	12
10-19	57	56	46	53	50	59	52	49	55	54	56	52	61
20+	30	26	37	29	34	29	22	27	30	29	29	30	28
Contraceptive Use													
Ever													
None	40	66	85	58	70	56	32	45	60	55	68	57	59
T/nal	18	8	4	18	12	16	20	2	13	17	9	15	18
Modern	42	27	11	24	18	28	48	9	19	29	23	30	24
Current													
None	63	87	91	78	84	78	60	68	79	75	86	76	82
T/nal	9	2	1	10	6	8	11	7	8	8	5	8	6
Modern	29	11	7	13	10	14	30	14	25	17	10	17	12
Interval													
None	91	95	96	95	97	92	92	93	94	94	95	94	92
T/nal	2	1	1	2	1	2	3	0	2	2	2	2	2
Modern	7	4	3	4	2	6	6	6	3	5	4	4	5
Coital Frequency (Times)													
None	34	35	17	33	39	29	29	34	33	32	37	27	56
1-3	29	34	35	38	34	37	35	31	36	35	38	35	34
3+	37	31	48	29	27	35	36	35	31	34	26	38	10

Note: Figures in the table are in percentages

Age at the start of the interval and duration of breastfeeding are positively associated as reflected in Table 6.3a(ii). Similarly births of higher orders appear to be breastfed for longer durations. Women who were married for more than 10 years breastfed their children for longer durations. As shown in the table, the proportion breastfeeding for more than 20 months is 40 per cent among women married more than 10 years compared to 25 per cent for those married for less than 10 years. Longer previous birth intervals and means of such intervals are also associated with longer durations of breasfeeding.

The relationship between each of the three measures of contraceptive use and the socio-economic and demographic variables is also reported in Tables 6.3a(i) and 6.3a(ii). The results presented in Table 6.3a(i) show that contraceptive use is highest among the Kikuyu-Embu-Meru tribes and lowest among the Mijikenda.

Use of contraceptives is expected to increase with levels of education. The relationships between each of the three contraceptive measures and the level of education confirm this to be the case. As shown in table 6.3a(i), the proportions using modern methods and those who have ever used them are much higher among those with secondary and above level of education. The results in the table also show that contraceptive use is higher in urban areas compared to the rural. Women reported to be living with their husbands and those in monogamous unions also use contraception more.

Contraceptive use is expected to be highest in the middle years of reproductive life. The data show that women are slightly more likely to be using contraceptives or to have ever used them for intervals initiated when the women were aged over 25 years. On the other hand, use in the interval is higher for intervals initiated before the woman attains age 25. Contraceptive use is also seen to be highest for intervals closed by births of orders 5 and below as would be expected. Contraceptive use is higher for intervals initiated 10 years since first marriage. Finally, the results in table reveal that use of modern methods is higher if the preceding interval was short.

Coital frequency is associated with cultural and woman status variables. As reported in table 6.3a(i), coital frequency is highest among the Mijikenda followed by the Kikuyu-Embu-Meru tribes. While the former may be attributed to the cultural environment, the latter may be attributed to higher socio-economic development. As the table further reveals, coital frequency increases with level of education and is higher in rural areas. Women in monogamous unions and those who reported to be living with their husbands as expected have higher levels of coital frequency.

Table 6.3a(ii): Relationship Between Proximate Determinants and Demographic Varirables

	Age(Yrs)		Previous Birth Interval (Yrs)			Mean Previous Interval Yrs			Birth Order			Duration of Marriage(Yrs)	
	<25	>25	<2	2-3	>3	<2	2-3	>3	3	4-5	6-8	<10	>10
Breast-feeding (Months)													
0-9	20	14	21	13	17	19	15	19	18	19	14	19	11
10-19	55	53	58	57	44	63	51	47	54	55	52	56	49
20+	25	33	22	31	39	18	34	34	27	26	34	25	40
Contraceptive Use													
Ever													
None	58	57	56	57	60	52	58	65	57	54	61	54	64
T/nal	16	15	13	17	15	15	16	14	15	16	15	15	15
Modern	27	29	31	27	25	33	27	21	29	31	24	30	22
Current													
None	79	75	76	78	77	75	77	81	74	77	78	76	79
T/nal	7	8	6	8	9	6	8	9	8	6	9	7	9
Modern	14	17	18	15	14	20	15	10	19	16	13	17	13
Interval													
None	92	96	94	93	96	93	94	94	92	93	96	93	97
T/nal	2	1	1	2	2	2	1	2	2	2	1	2	2
Modern	6	3	5	5	2	5	4	3	6	5	3	6	2
Coital Frequency (Times)													
None	33	33	30	32	39	30	33	40	33	31	35	31	37
1-3	35	35	36	37	32	36	36	30	31	39	39	35	36
3+	32	32	35	31	30	34	32	30	36	31	31	34	28

Note: Figures in the table are in percentage

The data shows no association between the age at the start of the interval and coital frequency. Women who reported to be 10 years and over since their first marriage are shown to have higher coital frequency. Shorter previous intervals and births of low orders are associated with higher coital frequency.

(b) Relationship Between Infant/Child Death and Socio-economic, Cultural and Demographic Variables

In this sub-section, we examine the relationship between the infant/child death variables on one hand and socio-economic and demographic on the other. This examination is based on Tables 6.3b(i) and 6.3b(ii) in which these relationships are reported.

A negative relationship between woman's level of education and the infant/child death variables is expected. The associations reported in this table show this to be the case. The relationship between each of the variables and education is negative. For instance, the proportion of births opening the interval reported to have died among women with secondary and above level of education was 7 per cent compared with about 12 per cent for women with none or lower primary level of education.

In general similar negative associations between each of the above variables and residence is noted in the proportions reported in the same table although a number of unexpected relationships are also noted where these proportions are higher in the urban areas. Infant and child deaths are also more among women in polygamous unions. The relationship between infant and child mortality and whether the husband was staying with the respondent is not consistent.

Table 6.3b(i): Relationship Between Main Independent Variables and Socio-economic Variables

Variable	Ethnicity				Educational Level			Residence		Union Type		Husband	
	Kiebru	Luhya	M/kenda	Other	None-lopry	Upper Pry	Se+	Rural	Urban	Monogamous	Polygamous	Away	With
Birth opening Interval (BRT2SU)													
Dead	4	15	15	11	12	11	7	12	10	9	16	11	8
Alive	96	85	85	89	88	89	93	88	90	91	85	89	92
Births Prior to Conception next birth (CE)													
Dead	3	12	11	7	8	7	5	9	7	7	10	8	3
Alive	97	88	89	93	92	93	95	91	96	93	90	92	97
Biological Replacement & Ins. Effects (BIREPINF)													
Death	1	4	7	4	2	3	2	3	3	3	6	4	1
No death	99	96	93	96	95	97	98	97	97	97	94	96	99
Biological & Rep. Effects (BIREPEF)													
Death	2	7	4	3	4	5	3	6	4	4	4	4	2
No death	98	93	96	97	96	95	97	94	96	96	96	96	98
Female Bio. & Rep. Effects (FBIREPEF)													
Death	1	4	0	2	2	3	1	3	2	2	2	2	2
No death	99	96	100	98	98	97	99	97	98	98	98	98	98
Replacement Effects (REPEF)													
Death	1	6	4	2	2	4	1	3	3	2	5	3	3
No death	99	94	96	98	98	96	99	97	97	98	95	97	97
Female Rep. Effects (FREPEF)													
Death	0	3	0	2	1	2	1	1	2	1	4	1	2
No death	100	97	100	98	99	98	99	99	98	99	96	99	98
Insurance Effects (INSEF)													
Death	16	27	32	19	24	22	11	16	22	20	24	20	24
No death	84	73	68	81	76	78	89	85	78	80	76	80	76
Proportion Dead (PDEADGR)													
<20%	2	19	30	13	15	12	9	10	13	10	24	12	14
>20%	98	81	70	87	85	88	91	90	87	90	76	88	86

Note: Figures in the table are in percentages

The death of an infant/child is higher if the interval was initiated when the woman is aged less than 25 years. The relationship between infant/child death and birth order does not conform to the hypothesized U-shaped relationship. As shown in Table 6.3b(ii), deaths are highest among intervals closed by births of orders 4 and 5.

Births preceded by short birth intervals are expected to be at higher risks of dying. The results reported in Table 6.3b(ii) in general indicate this to be the case. As shown in this table, the proportions of deaths of births opening the interval is 14 per cent if the preceding interval was less than 2 years compared with about 7 per cent and 10 per cent if such intervals were between 2 and 3 years and more than 3 years respectively.

Finally, the relationship between each of the infant/child death variables and ethnicity reported in Table 6.3b(i) show that infant and child mortality is lowest among the Kikuyu-Embu-Meru in central region of Kenya and highest in the western region among the Luhya and Mijikenda in the coast region.

Table 6.3b(ii): Relationship Between Main Independent Variables and Demographic Variables

Variable	Age (Yrs)		Previous Birth Interval (Yrs)			Mean Previous Interval (Yrs)			Birth Order			Marriage Duration (YRS)	
	<25	>25	<2	2-3	>3	<2	2-3	>3	3	4-5	6-8	<10	>10
Birth opening Interval **(BRT2SU)**													
Dead	12	9	14	7	10	10	11	10	9	12	10	11	10
Alive	88	91	86	93	91	90	89	90	91	88	90	89	90
Births Prior to Conception next birth **(CE)**													
Dead	10	5	10	4	7	8	7	7	7	8	6	8	6
Alive	90	95	90	96	93	92	93	93	93	92	94	92	94
Biological Replacement & Ins. Effects **(BIREPINF)**													
Death	4	3	6	1	2	4	3	3	2	3	5	3	5
No death	96	97	94	99	98	96	97	97	98	97	95	97	95
Biological & Rep. Effects **(BIREPEF)**													
Death	6	2	4	3	5	4	4	4	5	6	1	5	1
No death	94	98	96	97	95	96	96	96	95	94	99	95	99
Female Bio. & Rep. Effects **(FBIREPEF)**													
Death	3	1	3	2	1	2	2	2	3	3	1	3	1
No death	97	99	97	98	99	98	98	98	97	97	99	97	99
Replacement Effects **(REPEF)**													
Death	4	2	5	2	1	4	2	1	2	3	2	3	2
No death	96	98	95	98	99	96	98	99	98	97	98	97	98
Female Rep. Effects **(FREPEF)**													
Death	3	1	3	1	0	3	1	0	1	2	1	2	1
No death	97	99	97	99	100	97	99	100	99	98	99	98	99
Insurance Effects **(INSEF)**													
Death	17	24	22	19	21	22	22	16	9	18	31	17	29
No death	83	76	78	81	79	78	79	84	41	82	70	83	71
Proportion Dead **(PDEADGR)**													
<20%	13	12	11	11	17	12	12	16	13	12	13	12	13
>20%	87	88	89	89	83	88	88	84	87	88	87	88	87

(c) Relationship Between Infant/Child Mortality Variables and the Proximate Determinants

Death of an infant or a child as noted earlier can only affect the birth intervals through the proximate determinant factors. Thus a negative association between each of the proximate determinants and infant/child mortality variables would be expected. In this section these relationships which are reported in Table 6.3(c) are discussed.

Relationship between duration of breastfeeding and the variables for the biological effects are in the expected direction. As reported in the table, the proportions of infants and children breastfed for more than 20 months is nearly 4 times if the infant was still alive compared to the proportion for those who had died. As further noted from this table, the relationship between breastfeeding duration and the variables for the assessment of the replacement and insurance effects are not as strong. In fact the table shows that the proportion breastfeeding for more than 20 months are higher for the variables (INSEF) and (PDEADGR) for the assessment of insurance effects at individual and community levels respectively.

The relationship between each of the three contraceptive variables and each of the infant/child death variables is also reported in the table. As these proportions reveal, more infant and child deaths are associated with lower use of contraception. For instance the ever use of modern methods is 28 per cent compared with about 21 per cent for intervals in which the birth opening the interval had died. Similar results are obtained with the other contraceptive variables and each of the other infant/child death variables as shown in the table.

Table 6.3(c): Relationship Between Proximate Determinants and Main Independent Variables

Variable	BRT2SU		CE		BIREINF		BIREPEF		FBIR-EPEF		REPEF		FREPEF		INSEF		PDEA-DGR	
	De- ad	Al- ive	De- ad	Al- ive	De- ath	No de- ath	De- ath	No De- ath	De at h	No De at h	De- ath	No de at h	De- ath	No de at h	De a th	No de a th	< 20	> 20%
Breast-feeding (Months)																		
0-9	64	11	79	12	86	14	73	15	75	16	20	17	27	17	10	19	17	17
10-19	26	57	17	51	10	56	23	55	22	55	54	54	59	54	53	54	51	55
20+	9	32	4	31	4	30	3	30	3	30	27	29	14	29	37	27	32	29
Contraceptive Use																		
Ever																		
None	69	56	71	56	70	57	72	57	63	57	78	57	64	57	62	56	73	55
T/nal	9	16	8	16	16	15	2	16	0	15	5	15	5	15	17	15	10	16
Modern	21	29	21	28	14	28	27	28	38	28	17	28	32	28	21	30	17	30
Current																		
None	84	76	86	76	88	77	85	77	81	77	88	77	77	77	83	75	91	75
T/nal	2	8	2	8	4	8	0	8	0	8	5	8	9	8	8	7	4	8
Modern	15	16	12	16	8	16	15	16	19	16	7	16	14	16	9	17	5	17
Interval																		
None	96	94	96	94	100	94	92	94	88	94	100	94	100	94	96	94	96	94
T/nal	0	2	0	2	0	2	0	2	0	2	0	2	0	2	2	2	2	2
Modern	4	4	5	4	0	5	8	4	13	4	0	5	0	5	2	5	2	5
Coital Frequency (Times)																		
None	35	34	25	33	26	33	27	33	31	33	46	33	36	33	38	32	33	33
1-3	37	35	31	35	30	35	32	35	16	35	24	35	23	35	37	35	37	35
3+	38	31	43	31	44	32	42	32	53	32	29	32	41	32	25	34	31	32

Deaths of infants or children opening the intervals is associated with higher levels of coital frequency as reported in the table. The other variables for the assessment of the combined effects reveal a similar relationship. The variables for the assessment of the replacement effects however show no significant differences in the coital frequency though the variable for the assessment of female replacement effects show that coital frequency is higher if the infant or child had died.

6.4. Summary

Several conclusions can be drawn from the analyses undertaken in this chapter. The definition of variables as discussed in Section 6.1 revealed that the variables for the assessment of the effects of infant/child deaths on fertility are highly skewed towards live births. These variables are therefore not expected to explain much of the variations in the birth intervals in the sample even if the effects of these variables on birth intervals were substantial.

The deaths of infants/children has a substantial and significant effects on the birth intervals and hence is worth exploring. The analysis as presented in Section 6.2 revealed that these results were more less the same for the two (OLS and hazard) models. Thus similar conclusions on these effects would therefore be expected from the application of the two models. The analysis in that section also revealed that several socio-economic and demographic factors are significantly related to birth intervals and would therefore be expected to confound the assessment of the effects. In order to accurately assess the effects, these variables are controlled for in the analysis undertaken in Chapter 7.

Finally, the appropriateness of the conceptual framework for examining and explaining the effects was confirmed in the analysis presented in Section 6.3. This analysis in particular revealed that the variables for the assessment of the effects of infant/child mortality on fertility are related to the proximate determinant factors in the expected directions. These variables are therefore expected to be useful in revealing the mechanisms through which infant/child mortality affects birth intervals and hence the assessment of the effects of infant and child mortality on birth intervals. This analysis is undertaken in chapter 7.

CHAPTER 7

ASSESSMENT OF THE BEHAVIOURAL EFFECTS OF INFANT AND CHILD MORTALITY ON BIRTH INTERVALS

The objective of this chapter is to describe the analysis and present the results for testing the main hypotheses of the study as stated in chapter 2. This testing involved two main steps. In the first of these, appropriate models describing the relationship between the variables for the assessment of the effects of infant and child mortality and birth intervals were developed. The development of these models is described in section 7.1. The procedures presented in Chapter 5 were utilized to develop these models. In the second step, these models were utilized to undertake the statistical tests for the assessment of the effects utilizing the statistical approaches presented in Chapter 5. These results are presented and discussed in section 7.2. Other related findings arising from the analyses undertaken are presented in section 7.3.

7.1. Development of the Models for the Assessment of the Effects of Infant and Child Mortality on Birth Intervals

As indicated in the previous chapter, the first step in the assessment of the effects of infant and child mortality on fertility was to obtain the most appropriate models for describing the relationship between the variables for the assessment of these effects and birth intervals. The development of these models is described in this subsection.

7.1.1. OLS Models

According to the criteria specified in chapter 5, the 7 variables defined for the assessment of the effect of infant/child mortality on birth intervals, education and birth order were considered to be of theoretical importance to this study and hence were considered as basic variables for the models developed for the assessment of the effects. The other variables which were selected for inclusion in these models are those which were found to significantly related to birth intervals and those which had substantial effects on the coefficients of the variables for the assessment of the effects. The development of these models is discussed below.

(a) Selection of the Model

The selection of the appropriate OLS model was based on the models presented in Table 7.1. These models are based on the 1478 closed interval in which no death had occurred after the conception leading to the birth closing the interval. The exclusion of the latter intervals was undertaken so as to remove the possible reverse effect of the short birth intervals on infant and child mortality. As noted earlier the existence of such effects is well established.

Model I in table 7.1 is the basic model for determining the variables which should eventually be retained in the final model. This model includes all the variables as defined in the previous chapter. The other models presented in the table are derived from this model by excluding the insignificant variables using the criteria specified in section 5.3.2. Model II for instance was obtained from Model I by excluding the variable (LIV2) which indicates whether the respondent was staying with her husband. Thus this variable had the lowest level of significance among the socio-economic and cultural variables. The other models were similarly obtained. The presentation of the models also indicates the significance of the individual categories of each of the variables, that of the overall model and R^2.

The exclusion of the variable indicating whether the husband was staying with the respondent, LIV2, had little effect on the model as shown by the comparison of Models I and II. In particular, R^2 remain unchanged. The coefficients of the main independent variables and proximate determinants change very little. This suggests that the removal of this variable would not affect the interpretation of our results.

The effect of removing ethnicity in model III is assessed by examining the changes in the coefficients between model II and model III. Examining these coefficients shows that they change when this variable is removed. For instance, the coefficients of the main independent variables change by over 0.1 month. This implies that this variable should be retained in the final model. The removal of the type of union variable in model IV considerably affect the coefficient for the assessment of the replacement effects for the female births as observed by comparing the coefficients for this variable between models II and IV. As noted from these two models, the removal of this variable reduces the effect of this variable. On the other hand the removal of the variables for the place of residence and duration of marriage in models V and VI respectively have little effect on the coefficients and hence these variables were removed from the model.

Models VII and VIII assess the effects of removing the variables of previous birth interval (PLCIB) and the means of previous intervals(PBIAG) respectively. Comparing the coefficients of these variables with those of Model IV shows that the removal of these variables have considerable effects on the coefficients for the assessment of the effects infant and child mortality on birth intervals and hence it was decided that these variables should be retained in the final model. Similarly the removal of ever use of contraception in Model IX reduces the effects of the variables for the assessment of biological, insurance and replacement effects (BIREINF) and for the replacement effects of female births(FREPEF).

Table 7.1:- Models for Selecting Variables to be Retained in the Final OLS Regression Model

Variable	Coefficients Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX	Model X
Main Independent										
Biological Behav & Insurance (BIREPINF)	1.95	1.93	1.85	2.03	1.97	1.96	1.80	1.99	1.83	1.99
Biological & Behavioural (BIREPEF)	0.72	0.70	0.59	0.73	0.74	0.74	0.65	0.74	0.61	0.74
Replacement(REPEF)	0.06	0.03	-0.16	0.07	0.10	0.10	0.12	0.16	0.00	0.16
Insurance(INSEF)	0.01	0.02	-0.03	0.00	0.02	0.02	-0.02	0.01	-0.03	-0.01
Female Biological & Behavioural (FBIREPEF)	-0.68	-0.65	-0.76	-0.67	-0.64	-0.59	-0.59	-0.62	-0.48	-0.62
Female Replacement (FREPEF)	-2.50	-2.45	-2.34	-2.11	-2.53	-2.54	-2.48	-2.65	-2.42	-2.65
Proportion dead (PDEADGR)	1.00	1.00	0.91	1.08	0.97	0.97	0.97	0.96	0.97	0.96
Socio-Economic and Cultural										
Education of woman(EDUCL)										
Upper Pry	-0.93*	-0.92*	-0.99*	-0.95*	-0.88*	-0.86*	-0.85*	-0.87*	-0.83*	-0.87*
Sec+	-1.08	-1.07	-1.15*	-1.15*	-0.92	-0.90	-0.90	-0.90	-0.78	-0.90
Ethnicity(ETHN)										
Kimereb	0.00	-0.01	-	-0.15	-0.13	-0.13	-0.07	-0.10	-0.04	-0.10
Luhya	-1.03	-1.07	-	-1.11	-1.08	-1.09	-1.05	-1.10	-1.01	-1.10
Other	-0.27	-0.28	-	-0.36	-0.29	-0.29	-0.26	-0.27	-0.24	-0.27
Residence (V102)										
Urban	0.89	0.87	0.82	0.86	-	-	-	-	-	-
Type of Union (UTYPE)	-0.70	-0.70	-0.64	-	-0.70	-0.69	-0.63	-0.76	-0.81	-0.76
Living with Husband (LIV2)	-0.18	-	-	-	-	-	-	-	-	-
Demographic										
Birth Order (BOGR)										
4-5	-0.78	-0.79	-0.82	-0.80	-0.88	-0.88	-0.87	-0.94	-0.91	-0.95
6-8	-0.82	-0.82	-0.82	-0.82	-0.96	-1.03	-1.04	-1.19	-1.14	-1.19
Age at start of Interval (AGELBIY)										
>25 Yrs	1.55***	1.56***	1.57***	1.58***	1.60***	1.57***	1.52***	1.74***	1.17***	1.74***

table 7.1-continued

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX	Model X
	Coefficients									
Previous birth Interval (PLCBIG)										
2-3 Yrs	0.62	0.62	0.62	0.56	0.64	0.65	-	0.85*	0.83*	0.85*
> 3 Yrs	-0.39	-0.39	-0.39	-0.42	-0.88	-0.38	-	0.20	0.21	0.20
Previous birth Interval mean(PBIAGL)										
2-3 Yrs	0.42	0.42	0.45	0.47	0.38	0.36	0.59	-	-0.91	-0.95
> 3 Yrs	1.17	1.16	1.25	1.25	1.16	1.14	0.91	-	-0.91	-0.95
Duration of Marriage (DMARCY)										
> 10 Years	-0.12	-0.13	-0.17	-0.11	-0.15	-	-	-	-	-
Coital Frequency (COFREGR)										
1-3 times	-1.73***	-1.75***	-1.75***	-1.75***	-1.79***	-1.79***	- 1.79***	-1.83***	-1.83***	-1.83***
>3 times	-2.02***	-2.07***	-2.05***	-2.10***	-2.10***	-2.10***	-2.08***	-2.10***	-2.08***	-2.10***
Contraceptive Ever Use (V302)										
Traditional	-0.44	-0.43	-0.36	-0.47	-0.50	-0.50	-0.50	-0.56	-	-0.56
Modern	1.06	1.06	1.05	1.08	1.20	1.21	1.18	1.15	-	1.15
Current Use (V313)										
Traditional	1.14	1.13	1.20	1.11	1.18	1.18	1.15	1.25	0.83	1.24
Modern	-2.90***	-2.90***	-2.76***	-2.93***	-2.94***	-2.95***	-3.00***	-3.02***	-2.07***	-3.02***
Use in Interval (CONTINT)										
Traditional	-1.77	-1.77	-1.75	-1.70	-1.86	-1.88	-1.85	-1.87	-2.36	-1.87
Modern	3.01***	3.02***	3.05***	3.02***	3.00***	2.98***	3.03***	3.04***	3.72***	3.04***
Breastfeeding (BRFEED)										
10-<20 Months	2.83***	2.83***	2.83***	2.87***	2.81***	2.80***	2.80***	2.76***	2.65***	2.76***
= >20 Months	7.18***	7.18***	7.21***	7.20***	7.18***	7.16***	7.11***	7.14***	7.09***	7.14***
Constant	24.67	24.54	24.15	24.04	24.79	24.79	24.87	25.10	25.19	25.10
R	0.143	0.143	0.142	0.142	0.142	0.142	0.140	0.141	0.139	0.141
Adj R	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.123	0.124
Sig. F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: * Significant at 10% level or above
** Significant at 5% level or above
*** Significant at 1% level or above

Finally, the assessment of whether the removal of the three variables above viz:- LIV2, indicating whether husband was staying with the respondent; type of residence (V102) and duration of marriage (DMARLCY) as a group introduces considerable changes in the coefficients is assessed using Model X. This assessment was undertaken by comparing the coefficients for model X with those for model I. Comparison of these coefficients shows little differences in these coefficients for the two models. The removal of these variables in addition do not reduce R^2. This implies that the model excluding these variables is as appropriate as the one including them and hence Model X is the most parsimonious model for describing the relationships between the variables for the assessment of the effects of infant and child mortality and birth intervals.

(b) Appropriateness of the OLS Model Selected for Assessing the Effect of Infant and Child Mortality on Fertility

Before utilizing the above model in the assessment of the effects, its appropriateness was examined first. This examination, which focused on examining the extent to which the assumptions of the OLS models as presented in chapter 3 are satisfied, is discussed below.

The adequacy of the model was assessed using the plot of the standardized residuals against the estimated values of the dependent variable. This plot showed no trend about zero indicating that the model is adequate.

To determine the extent to which the normal assumptions about the errors are satisfied, the plots of the standardized residuals and those of the cumulative standardized residuals are examined. As indicated earlier, when this assumption is not violated, the plot of the standardized residuals is expected to be normally distributed while that of the cumulative residual should be a straight line. When the departures from the normal distribution are small, then this does not create serious problems. Examining these plots showed this to be the case indicating that there is no serious violation of this assumption.

The other problem which arises from data is that of multicolinearity which as pointed out earlier may lead to imprecise estimation of the parameters. The extent of multicolinerality in this study was assessed from the correlation matrix and the tolerance. Examining the correlation matrix suggested that no serious collinearity exists, most of the correlation coefficients in this matrix are not high with only a few exceeding 0.5 and none exceeds 0.8. The tolerance values for each of the variables confirmed this to be the case. None of the tolerance values was less than 0.1 confirming that multicolinearity among the variables included in the model for this study is not serious.

The model which was presented assumes that there is no interaction between the variables of interest and the other variables. As noted earlier, when interaction exists then it is inappropriate to undertake the adjustment as has been done in this case. As however pointed out further by Cleland et al. (1979), the estimates obtained in this case weights the effects across the levels of the other regressors. The strategy adopted in this study is use the simpler model developed above to interpret the effects.

Finally, the selected model explains about 14 per cent of the variations in birth intervals. This is consistent with the results of Jain and Bongaarts (1981) where the amount of variation explained was found to vary between 5 per cent and 15 per cent for the 8 countries studied. As noted by the authors, it is very difficult to explain much of the variations in birth intervals at the individual level due to the stochastic nature of the reproductive process.

7.1.2. Selection of the Hazards Models

Obtaining the most appropriate hazards model describing the relationship between infant and child mortality and birth intervals was undertaken in a similar manner to that for the OLS discussed above. The preliminary models used to identify the final model are presented in Table 7.2. The fitting of these models was undertaken using the same birth intervals utilized to fit the OLS models discussed above.

Table 7.2:- Models for Selecting Appropriate Hazards Models for Assessing the Effect of Infant and Child Mortality on Birth Intervals

Variable	Coefficients Model I	Model II	Model III	Model IV	Model V	Model VI
Main Independent						
Biological Behav & Insurance (BIREPINF)	-0.15	-0.143	-0.10	-0.16	-0.14	-0.14
Biological & Behavioural (BIREPEF)	-0.10	-0.09	-0.08	-0.12	-0.12	-0.10
Replacement(REPEF)	-0.16	-0.16	-0.14	-0.15	-0.16	-0.15
Insurance(INSEF)	-0.05	-0.05	-0.03	-0.05	-0.05	-0.05
Female Biological & Behavioural (FBIREPEF)	0.26	0.24	0.24	0.25	0.24	0.24
Female Replacement (FREPEF)	0.47	0.46	0.44	0.41	0.46	0.44
Proportion dead (PDEADGR)	-0.02	-0.02	-0.01	-0.04	-0.03	-0.03
Socio-Economic and Cultural						
Education of woman(EDUCL)						
Upper Pry	0.16***	0.16***	0.17***	0.17***	0.16**	0.16**
Sec+	0.19***	0.18***	0.19***	0.20***	0.18*	0.18*
Ethnicity(ETHN)						
Kimereb	-0.06	0.06	-	0.03	-0.06	0.07
Luhya	0.12	0.12	-	0.14	-0.12	0.16
Other	-0.09	-0.09	-	-0.07	-0.09	-0.09
Residence (V102)						
Urban	-0.20***	-0.19***	-0.19***	-0.19***	-0.19***	-0.21***
Type of Union (UTYPE)	0.13*	0.13*	-0.11	-	0.13	0.13
Living with Husband (LIV2)	0.06	-	-	-	-	-
Demographic						
Birth Order (BOGR)						
4-5	0.03	0.03	0.03	-0.03	0.03	0.03
6-8	-0.01	-0.01	0.01	-0.01	0.00	0.00
Age at start of Interval (AGELBIY)						
>25 Yrs	-0.19***	-0.20***	-0.19***	-0.20***	-0.19	-0.19

table 7.2-continued

Variable	Coefficients					
	Model I	Model II	Model III	Model IV	Model V	Model VI
Previous birth Interval (PLCBIG)						
2-3 Yrs	0.00	-0.01	0.00	0.01	0.01	0.01
> 3 Yrs	0.18*	-0.18*	-0.19*	-0.18*	-0.18*	-0.18*
Previous birth Interval mean(PBIAGL)						
2-3 Yrs	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13
> 3 Yrs	0.33***	-0.33***	-0.33***	-0.34***	-0.33***	-0.33***
Duration of Marriage (DMARCY)						
> 10 Years	-0.02	-0.03	-0.02	-0.02	-	-
Coital Frequency (COFREGR)						
1-3 times	0.21***	0.22***	0.22***	0.22***	0.22***	0.22***
>3 times	0.22***	0.23***	0.24***	0.24***	0.23***	0.23***
Contraceptive Ever Use (V302)						
Traditional	0.07	0.07	0.05	0.07	0.07	-
Modern	-0.06	-0.06	-0.06	-0.05	0.06	-
Current Use (V313)						
Traditional	-0.05	-0.05	-0.08	-0.04	-0.05	-0.01
Modern	0.24**	0.25**	0.24**	0.24**	0.25**	0.20**
Use in Interval (CONTINT)						
Traditional	-0.03	-0.03	-0.03	-0.04	-0.03	-0.01
Modern	-0.81***	-0.81***	-0.80***	-0.81***	-0.81***	-0.84***
Breastfeeding (BRFEED)						
< 17	0.30***	0.30***	0.30***	0.30***	0.30***	0.30***
< 23	0.38***	0.37***	0.37***	0.37***	0.37***	0.37***
< 29	0.40**	0.40**	0.40**	0.40**	0.40**	0.40**
< 41	1.14	1.14	1.09	1.14	1.14	1.16
Constant	-6.665	-6.623	-6.596	-6.545	-6.647	-4.737
Deviance	4546	4547	4556	4550	4547	4420
D.F.	4159	4160	4163	4161	4161	3802

Note: * Significant at 10% level or above
** Significant at 5% level or above
*** Significant at 1% level or above

As in the case of OLS, Model I is the basic model from which all the other models were derived using the procedures described above. The variables indicating whether the respondent was staying with the husband (LIV2) and the duration of marriage (DMARLCY) are not significant. The removal of LIV2 (model II) does not affect the coefficients of model I while removal of ethnicity (ETHN) from model III appears to have a considerable effect on those of model II. The removal of duration of marriage (model IV) and ever use of contraceptives (V302) in model V are observed to have little influence on the coefficients of Model II. Model V in which LIV2, DMARCY and V302 have been removed was therefore taken as the most appropriate hazards models for describing the relationship between infant/child deaths and birth intervals.

7.1.3. Selection of the Variables for Final OLS and Hazards Models

The analyses undertaken in subsections 7.1.1 and 7.1.2 for the OLS and hazards models respectively suggest that the duration of marriage and living with the husband are not significantly related to the birth intervals once the effects of the other variables are taken into account. Further these variables do not confound the relationship between infant/child death and birth intervals. In the case of the OLS models based on the closed intervals, residence was also not found to be significantly related to the birth intervals though for the hazards models it was found to be highly significant. Ever use of contraception appears to be an important variable explaining the effects of infant/child mortality on birth intervals in the case of closed intervals.

In order to ensure consistency in the two models utilized for the assessment of the effects, the residence variable was included in the final OLS model and ever use in the hazards model. Since neither of these two variables is significant in the models in which we include them, we do not expect them to affect the results much.

Finally since current use of contraceptives is associated with short birth intervals and also occurs after the closure of the birth intervals (in the case of closed intervals), this variable is not expected to explain the behavioural changes arising from an infant or child death in the preceding interval. Since however, this variable is highly significant, it was retained in the final model among the socio-economic and demographic variables.

7.2. The Effect of Infant/Child Death on Birth Intervals

In this section we utilize the models developed in the previous section to examine the main hypotheses of the study, namely the magnitudes of the effects of infant/child mortality on fertility. In order to undertake these assessments, the approach specified in section 5.4 was utilized. This was achieved by entering the proximate determinant factors in the model after the variables for the assessment of the effects were entered. The variables utilized for the assessment of the behavioural effects were the coital frequency and the contraceptive variables while the biological effects are expected to be reflected through the breastfeeding variable, though this variable may in addition have some behavioural effects. Due to the possible reverse effect of the breastfeeding variable on infant/child mortality, an effect which makes the interpretation of the effect of the variable difficult, two sets of models were utilized in each of the cases. Breastfeeding variables are only included in the second set of models which were restricted to those intervals in which the birth opening the interval had survived. The first set of these models for the OLS and the hazards model are presented in Tables 7.3a(i) and 7.3b(i). The second set of the models are presented in Tables 7.3a(ii) and 7.3b(ii) for the OLS and the hazard respectively. We focus first on the OLS results which are presented in Tables 7.3a(i) and 7.3a(ii).

7.2.1. Assessment of the Effects of Infant and Child Mortality on Birth Intervals Using the OLS Models

The first set of the OLS models for the assessment of the effects are summarized in Table 7.3a(i). Models I-III in this table are the basic models for the assessment of the effects as presented in section 5.4. Thus model I contains the variables for the assessment of the three effects while Model II includes the additional variables for the assessment of the sex differences in the effects. Model III includes the additional variable for the assessment of the insurance effects at the community level.

The assessment of the effects was facilitated through models IV and V in which the coital frequency and contraceptive variables are included respectively. Changes in the coefficients of the variables for the assessment of the effects when these variables were included in the models indicates the differences in birth intervals which can be accounted for by these variables and hence provides a basis for the assessment of the behavioural effects. We therefore anticipate that if these effects exist, these variables would be expected to account for some of the differences in the birth intervals for the variables for the assessment of the effects.

The posterior variables of socio-economic, cultural and demographic factors are included in Model VIII. As noted earlier, these variables are not expected to be affected by the infant/child death and hence cannot explain this phenomenon. The coefficients for the infant/child death variables in this model indicates the differences in the birth intervals due to each of the variables for measuring these effects after controlling for the differences in the posterior variables. As also pointed out, these coefficients gives the total effects of these variables on the birth intervals. Changes in the coefficients of the variables for the assessment of the effects indicate that some of the differences in birth intervals are accounted for by differences in socio-economic, cultural and demographic factors. This model therefore shows the extent to which these variables confound the relationship between infant/child mortality and birth intervals. Models VI and VII have been included to show the extent to which the proximate determinant capture the effects of socio-economic and hence facilitate the assessment of the effects.

Examining the coefficients of the main independent variables in Model III, it is noted that these coefficients are large and most of them are in the expected direction, except for the variables for the assessment of insurance effects at the community (PDEADGR) and (INSEF), at the individual level. The coefficient for the variable for the assessment of the insurance effects at the individual levels shows little differences in the lengths of the birth intervals and is also not in the expected direction. Similarly the coefficient of the variable for the assessment of the insurance effects at the community level show that women who are in communities with higher infant/child mortality have longer birth intervals. Assuming that infant/child mortality is a reasonable indicator of the health of the general population including that of the mothers, it can be argued that the longer birth intervals may be as a result of the effect on fertility of the poor health of mothers due to lower fecundity and higher fetal wastages which have a direct effect on the lengths of birth intervals.

Table 7.3a(i):- Regression Models for Assessing the Effect of Infant and Child Mortality on Birth Intervals

Variable	Coefficients Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
Main Independent								
Biological, Behavioural & Insurance (BIREPINF)	-1.63	1.63	-1.84	-1.65	-1.72	-	-	-1.42
Biological & Behavioural (BIREPEF)	-2.88**	-2.73	-2.92*	-2.69	-2.86*	-	-	-2.21
Replacement(REPEF)	-2.58*	0.09	-0.05	-0.55	-0.77			0.11
Insurance(INSEF)	0.77	0.77	0.63	0.52	0.54			0.31
Female Biological & Behavioural (FBIREPEF)		-0.29	-0.29	-0.43	-0.48	-	-	-0.70
Female Replacement (FREPEF)	-	4.96*	-5.26*	-4.79*	-4.39			-3.86
Proportion dead (PDEADGR)			1.59**	1.60**	1.54*	-	-	1.27*
Proximate Factors								
Coital Frequency (COFREGR)			-	-				
1-3 times				-2.20***	-2.19***	-	-1.83***	-1.87***
>3 times				-2.55***	-2.46***		-2.16***	-2.05***
Contraceptive Ever Use (V302)	-	-	-					
Traditional					-0.07	-	-0.08	0.17
Modern					-1.07		1.34*	1.30*
Use in Interval (CONTINT)	-	-	-	-				
Traditional					-2.84		-2.33	-2.47
Modern					3.04***	-	2.54**	2.57**
Current Use (V313)								
Traditional							0.80	0.87
Modern							-3.71***	-3.61***
Socio-Economic and Cultural	-	-	-					
Education of Woman(EDUCL)								
Upper Pry						-1.07*	-1.91*	-0.89
Sec+				-	-	-2.13***	-1.70**	-1.69**

table 7.3a(i)-continued

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
			Coefficients					
Ethnicity(ETHN)								
Kimereb						-0.06	-0.40	-0.11
Luhya						-0.98	-1.65	-1.34
Other						-0.21	-0.76	0.50
Residence (V102)								
Urban						0.95	0.80	0.88
Type of Union (UTYPE)						-0.80	-0.64	-0.71
Demographic	-	-	-	-	-			
Age at start of Interval (AGELBIY)						1.46**	1.83***	1.62***
>25 Yrs								
Previous birth Interval (PLCBIG)	-	-	-	-	-			
2-3 Yrs						0.81	0.79	0.60
> 3 Yrs						0.10	0.23	0.00
Previous birth Interval mean(PBIAGL)	-	-	-	-	-			
2-3 Yrs						1.14*	0.95	1.05*
> 3 Yrs						1.89**	1.31	1.40
Birth Order (BOGR)	-	-	-	-	-			
4-5						-0.87	-1.07*	-0.96
6-8						0.62	-1.04	-0.97
Constant	26.51	26.51	26.37	27.97	28.16	28.49	28.53	28.37
R	0.008	0.01	0.0137	0.030	0.037	0.050	0.069	0.076
Adj R	0.005	0.006	0.0089	0.024	0.028	0.040	0.055	0.058
Sig F	0.0187	0.0194	0.0051	0.000	0.000	0.000	0.000	0.000

Note: * Significant at 10% level or above
** Significant at 5% level or above
*** Significant at 1% level or above

The coefficients for the five other variables for the assessment of the effects are in the expected directions. Birth intervals are shorter by over one and half months for the variable (BIREINF) for the assessment of the three effects combined and by about 3 months for the variable (BIREEF) which measures the replacement and biological effects. The above results do not therefore completely conform to what we would have expected since birth intervals should have been expected to be shortest for the variable assessing the three effects combined. This results are however consistent with the earlier results presented in chapter 5.

The coefficient for the variable for the assessment of the replacement effects (REPEF) becomes small and unstable when the variable for the assessment of the replacement effects due to the death of female births (FREPEF) is introduced. This seems to suggest that most of the replacement effects are due to the female births. Since there is no evidence suggesting why the female births may be replaced more than the male births, this may be due to the poor reporting for the male births as discussed earlier.

Coefficients for the variables for the assessment of the effects of infant/child death on fertility are observed to change when the coital frequency and contraceptive variables are introduced in Models IV and V respectively. As shown in the table, these changes are in the expected directions. For instance, the coefficient for the variable for the assessment of the three effects combined (BIREINF) is reduced in magnitude from -1.84 to -1.65 when the coital frequency variable is introduced. This implies that birth intervals would have been slightly longer if the level of coital frequency was the same as for the entire sample. This in turn suggests that coital frequency was higher in case of an infant/child death. However coefficient for this variable increases to -1.72 when the contraceptive variables are introduced. Similar changes are observed for the variable (BIREPEF) for the assessment of the biological and behavioural effects. The coefficient for the variable (FREPEF) for the assessment of the female replacement effects is reduced further when the contraceptive variables are introduced. This indicates that some of the effects of infant/child death due to this variable are realized through contraceptive use.

The above results show that some of the differences in the birth intervals following an infant/child death can be explained by the variables employed in this study to measure coital frequency and contraceptive use. This seems to indicate behavioural response associated with infant/child death. Thus coital frequency appears to be higher when an infant or a child dies and this in turn leads to shorter intervals. Contraceptive use on the other hand appears to be reduced only in case of an earlier female death.

Further changes in the coefficients of the variables for the assessment of the effects are observed when the socio-economic and demographic factors are introduced in model VIII. The coefficients of all the variables are considerably reduced. These changes implies that some of the differences in birth intervals are due to the differences in socio-economic and demographic characteristics. This in turn indicates that these variables should be included as control variables in the assessment of the effects.

7.2.2. Assessment of the Behavioural Effects of Breastfeeding

A further assessment of the behavioural effects to determine whether breastfeeding has any behavioural effects is undertaken using the intervals in which the birth opening the interval were still alive at the time of the survey. The restriction of the analysis to these intervals facilitates the assessment of the behavioural effects of breastfeeding independent of the biological effects. In this analysis, however, only 4 of the 7 variables for the assessment of these effects viz:-REPEF, for the assessment of the replacement effects (INSEF) for the assessment of the insurance effects at the individual level (FREPEF) for the assessment of the female replacement effects and (PDEADGR) for the assessment of the insurance effects at the community level could be included. The other three variables for the assessment of these effects could not be included as their definitions were based on the deaths of the births opening the interval.

Table 7.3a(ii):- Regression Models for Assessing the Effect of Infant and Child Mortality on Birth Intervals

Variable	Coefficients								
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Main Independent									
Replacement(REPEF)	-2.58*	0.09	-0.05	-0.48	0.64	-0.61	-	-	0.09
Insurance(INSEF)	0.77	0.77	0.64	0.55	0.58	0.41			-0.09
Female Replacement (FREPEF)		-4.96*	-5.25*	-4.78	-4.49*	-2.87	-	-	-2.38
Proportion dead (PDEADGR)			1.51**	1.53**	1.48*	1.21	-	-	1.05
Coital Proximate Factors									
Frequency (COFREGR)									
1-3 times				-1.94***	-1.80***	-1.96***	-	-1.47***	-1.51***
>3 times				-2.07***	-2.01***	-2.14***		-1.66***	-1.66***
Contraceptive Ever Use (V302)									
Traditional					0.20	-0.17	-	-0.13	-0.14
Modern					-0.95*	-0.64		1.18	1.20
Use in Interval (CONTINT)									
Traditional					-3.01*	-2.23*	-	-1.86	-1.93
Modern					3.53***	3.77***		3.32**	3.27***
Breastfeeding (BRFEED)									
10-<20 Months						3.77***	-	2.13***	2.05***
>20 Months						6.74***		6.37***	6.26***
Current Use (V313)									
Traditional							-	1.07	1.14
Modern								-3.14***	-3.08***
Socio-Economic and Cultural									
Education of woman(EDUCL)									
Upper Pry							-1.15**	-0.98**	-0.93*
Sec+							-2.55***	-1.53**	-2.10***
Ethnicity(ETHN)									
Kimereb							-0.62	-0.49	-0.21
Luhya							-1.46	-1.57	-1.40
Other							-0.94	-0.98	-0.77
Residence (V102)									
Urban							1.36**	1.16**	1.19*
Type of Union (UTYPE)							-0.35	-0.38	-0.39

Table 7.3a(ii):- Regression Models for Assessing the Effect of Infant and Child Mortality on Birth Intervals

Variable	Coefficients								
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Main Independent									
Replacement(REPEF)	-2.58*	0.09	-0.05	-0.48	0.64	-0.61	-	-	0.09
Insurance(INSEF)	0.77	0.77	0.64	0.55	0.58	0.41			-0.09
Female Replacement (FREPEF)		-4.96*	-5.25*	-4.78	-4.49*	-2.87	-	-	-2.38
Proportion dead (PDEADGR)			1.51**	1.53**	1.48*	1.21	-	-	1.05
Coital Proximate Factors									
Frequency (COFREGR)									
1-3 times				-1.94***	-1.80***	-1.96***	-	-1.47***	-1.51***
>3 times				-2.07***	-2.01***	-2.14***		-1.66***	-1.66***
Contraceptive Ever Use (V302)									
Traditional					0.20	-0.17	-	-0.13	-0.14
Modern					-0.95*	-0.64		1.18	1.20
Use in Interval (CONTINT)									
Traditional					-3.01*	-2.23*	-	-1.86	-1.93
Modern					3.53***	3.77***		3.32**	3.27***
Breastfeeding (BRFEED)						3.77***	-	2.13***	2.05***
10-<20 Months						6.74***		6.37***	6.26***
>20 Months									
Current Use (V313)							-	1.07	1.14
Traditional								-3.14***	-3.08***
Modern									
Socio-Economic and Cultural									
Education of woman(EDUCL)									
Upper Pry							-1.15**	-0.98**	-0.93*
Sec+							-2.55***	-1.53**	-2.10***
Ethnicity(ETHN)									
Kimereb							-0.62	-0.49	-0.21
Luhya							-1.46	-1.57	-1.40
Other							-0.94	-0.98	-0.77
Residence (V102)							1.36**	1.16**	1.19*
Urban									
Type of Union (UTYPE)							-0.35	-0.38	-0.39

table 7.3a(ii)-continued

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Demographic									
Age at start of Interval (AGELBIY)									
>25							0.94	1.34**	1.26**
Previous birth Interval (PLCBIG)									
2-3 Yrs							0.49	0.52	0.46
> 3 Yrs							-0.20	-0.43	-0.54
Previous birth Interval mean(PBIAGL)									
2-3 Yrs							1.62**	0.74	0.75
> 3 Yrs							2.69***	1.71*	1.72*
Birth Order (BOGR)									
4-5							-0.59	-0.68	-0.64
6-8							-0.54	-0.98	-0.91
Constant	26.51	26.15	26.38	26.54	27.86	27.76	24.46	25.26	25.05
R^2	0.003	0.005	0.008	0.043	0.029	0.021	0.104	0.132	0.134
Adj R^2	0.001	0.003	0.005	0.030	0.022	0.016	0.096	0.116	0.116
Sif F	0.1587	0.0712	0.0254	0.000	0.000	0.001	0.000	0.000	0.000

Note : * Significant at 10% level or above
** Significant at 5% level or above
*** Significant at 1% level or above

The models for the assessment of the above effects are provided in Table 7.3a(ii). The first five models in this table are similar to those in table 7.3a(i). Models IV and V are for the assessment of the behavioural effects due to coital frequency and contraceptive use respectively. The assessment of behavioural changes in breastfeeding arising from the death of an infant or a child are examined in model VI. Models VII, VIII and IX are similar to the last three models in table 7.3a(i) except for the inclusion of the breastfeeding variable.

The results presented in this table are in general consistent with those presented in table 7.3a(i) with only a few exceptions. The proximate determinant factors affect the birth intervals as expected and are highly significant. The additional breastfeeding variable is in particular highly significant and in the expected direction confirming the importance of breastfeeding as a determinant of birth intervals. Age appears to be less important in these models than in the previous models while the mean of previous intervals and residence are more important. These two latter variables are noted to be highly significant in the final model presented in this table.

The assessment of the effects of infant and child mortality on birth intervals is undertaken in a similar manner as in the previous case by examining the changes in the coefficients of the four variables for the assessment of the effects included in the models. A comparison of the results presented in this table with those in the previous table shows that they are highly consistent. The variable for assessment of the replacement effects, REPEF as in the previous case is small and unstable when the coefficient for the female replacement effects (FREPEF) is introduced. This suggests that the replacement effects are mainly due to the female deaths. The effects of the other two variables (INSEF) and (PDEADGR) are observed to be similar in magnitude and direction to those in the models presented in table 7.3a(i).

Inclusion of the breastfeeding variable in Model VII shows substantial further reduction in the coefficients for all the four variables. This implies that when a death preceding the one opening the interval dies in that interval, the breastfeeding duration for the birth which had opened the interval is shorter. This further implies that the effect of breastfeeding following an infant or child death may be due to both biological and behavioural reasons. Although it cannot be said with certainty whether the observed effects for the variable FREPEF are a conscious attempt to replace an infant or a child who had died or is due to other behavioural changes associated with a child death, the fact that a similar shortening is observed for the variable, (PDEADGR) may suggest that the shortening is most likely a conscious effort to ensure that the next pregnancy is realized as soon as possible. The fact that the effect of breastfeeding is higher in those intervals in which the death has taken place is an indication that the replacement effects are higher in the interval where the death has taken place as suggested by some researchers. The effects obtained for the variable (PDEADGR) is a further indication of the existence of insurance strategies in addition to the replacement effects. Finally, the behavioural effects due to contraception and coital frequency obtained from the models in the above table are comparable to those obtained in the earlier models.

7.2.3. Comparison of the OLS Results with those of the Hazards Models

Comparison of the results discussed above with those obtained through the hazards models is facilitated through the models summarized in Tables 7.3b(i) and 7.3b(ii). The models in table 7.3b(i) are comparable to those in table 7.3a(i) while those in table 7.3b(ii) are comparable to those in table 7.3a(ii). Thus corresponding models in each of the two sets of tables contain the same variables. The effects of infant/child mortality in the models in table 7.3b(i) can therefore be assessed using models IV and V while those in table 7.3b(ii) can be assessed using models IV-VI.

Table 7.3b(i):- Hazards Models for Assessing the Effect of Infant and Child Mortality on Birth Intervals

Variable	Coefficients							
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
Main Independent								
Biological Behav & Insurance (BIREPINF)	0.079*	0.078	0.089	0.102	0.073	-	-	0.073
Biological & Behavioural (BIREPEF)	0.261	0.188	0.197*	0.184	0.166	-	-	0.135
Replacement(REPEF)	-0.352*	-0.325	-0.314	-0.302	-0.193	-	-	-0.259
Insurance(INSEF)	-0.099	-0.100	-0.096	-0.090	-0.108	-	-	-0.069
Female Biological & Behavioural (FBIREPEF)		-0.142	0.139	0.203	0.281	-	-	0.231
Female Replacement (FREPEF)		0.880**	0.878***		0.854***	0.759**	-	-0.703
Proportion dead (PDEADGR)			0.049	-0.041	-0.047	-	-	0.028
Proximate Factors								
Coital Frequency (COFREGR)								
1-3 times				0.271***	0.279***		0.241***	0.251***
>3 times				0.237***	0.258***		-0.209***	0.198***
Contraceptive Ever Use (V302)								
Traditional					0.156		0.054	0.069
Modern					0.133*	-	-0.053*	0.055*
Use in Interval (CONTINT)								
Traditional					-0.027		0.016	0.023
Modern					-0.789**	-	0.847***	0.840***
Current Use (V313)								
Traditional							0.013	0.019
Modern						-	0.345***	0.344***
Socio-Economic and Cultural								
Education of woman(EDUCL)								
Upper Pry						0.133*	0.130*	0.126**
Sec+						0.203**	0.193*	0.178**
Ethnicity(ETHN)								
Kimereb						-0.016	-0.038	0.003
Luhya						-0.142	0.231	0.198
Other						0.004	0.052	0.015

table 7.3b(i)-continued

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
	Coefficients							
Residence (V102)								
Urban						-0.228***	-0.186***	-0.184***
Type of Union (UTYPE)						0.120	0.120	0.139
<u>Demographic</u>								
Age at start of Interval (AGELBIY)						0.148*	0.169*	0.150***
>25 Yrs								
Previous birth Interval (PLCBIG)								
2-3 Yrs						0.011	0.010	0.013
> 3 Yrs						0.198*	0.121	0.121
Previous birth Interval mean(PBIAGL)								
2-3 Yrs						-0.211***	-0.187**	-0.191**
> 3 Yrs						-0.383***	-0.312**	-0.315***
Birth Order (BOGR)								
4-5						-0.020	0.00	-0.012
6-8						-0.097	-0.087	-0.067
Constant	-4.556	-4.562	-4.558	-4.742	-4.753	-4.508	-4.743	-4.737
Deviance	4568	4560	4560	4538	4494	4508	4431	4420
D.F.	3827	3825	3824	3822	3818	3817	3809	3803

Note: * Significant at 10% level or above
** Significant at 5% level or above
*** Significant at 1% level or above

Focusing on the models in table 7.3b(i) we note that the results in these models are very similar to those of corresponding models in table 7.3a(i). The coefficients for the variables for the assessment of the effects changes as expected when the variables for coital frequency and contraception are introduced in Models IV and V. For example the risk of childbearing which is about 22 per cent higher when an infant or a child dies for the variable BIREINF in model III is 20 per cent higher in Model V which includes coital frequency and contraception variables. This suggests that some of the effect of this variable when an infant or a child dies can be accounted for by the differences in the coital frequency and contraceptive variables.

Table 7.3b(ii):- Hazards Models for Assessing the Effect of Infant and Child Mortality on Birth Intervals

Variable	Coefficients								
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Main Independent									
Replacement(REPEF)	0.05	-0.33	-0.33	-0.32	-0.21	-0.14	-	-	0.15
Insurance(INSEF)	-0.10	-0.10	-0.10	-0.09	-0.11	-0.07			-0.06
Female Replacement									
(FREPEF)		0.90***	0.89***	0.88***	0.78***	0.55			0.48
Proportion dead									
(PDEADGR)			-0.01	-0.02	-0.02	-0.04	-	-	-0.02
Proximate Factors									
Coital									
Frequency									
(COFREGR)									
1-3 times				0.24***	0.25***	0.24***		0.20***	-0.20***
>3 times				0.19***	0.21***	0.26***	-	0.20***	-0.18***
Contraceptive									
Ever Use									
(V302)									
Traditional					0.09	0.07		0.04	0.04
Modern					0.13*	0.08	-	-0.07	-0.07
Use in Interval									
(CONTINT)									
Traditional					0.00	-0.03*		0.03	-0.03
Modern					-0.82***	-0.81***	-	-0.85**	-0.85***
Current Use									
(V313)							-	-0.04	-0.05
Traditional								0.26**	0.37**
Modern									
Breastfeeding									
(BRFEED)									
>17 Months						0.26***	-	0.28***	0.26***
>23 Months						0.38***		0.38***	0.37***
>29 Months						0.43***		0.41***	0.41***
>41 Months						0.89	-	0.89***	0.89***

table 7.2b(ii)-continued

Variable	Coefficients Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Socio-Economic and Cultural									
Education of woman(EDUCL)									
Upper Pry							0.17**	0.18***	0.18***
Sec+							0.28***	0.27***	0.26***
Ethnicity(ETHN)									
Kimereb							0.05	0.01	-0.02
Luhya							0.21	0.21	0.19
Other							0.08	0.00	0.02
Residence (V102)							-0.28***	-0.25***	-0.25***
Urban									
Type of Union (UTYPE)							0.05	0.06	0.07
Demographic									
Age at start of Interval (AGELBIY)							-0.11	-0.18***	-0.18**
>25 Yrs									
Previous birth Interval (PLCBIG)									
2-3 Yrs							0.05	0.52	0.05
> 3 Yrs							-0.21	0.21	0.21*
Previous birth Interval mean(PBIAGL)									
2-3 Yrs							-0.27***	-0.17*	-0.17*
> 3 Yrs							-0.44***	-0.38***	-0.39***
Birth Order (BOGR)									
4-5							-0.05	0.00	0.01
6-8							-0.08	0.01	0.02
Constant	-4.609	-4.616	-4.615	-4.766	-6.508		-4.604	-6.483	-6.456
Deviance	4379	4371	4371	4318	4315		5695	4122	4119
D.F.	3855	3854	3853	3861	3847		3843	3821	3827

Note : * Significant at 10% level or above
** Significant at 5% level or above
*** Significant at 1% level or above

The hazards models results presented in table 7.3b(ii) above are consistent with the results presented above and also with those presented in table 7.3a(ii). Thus the coefficients for the assessment of the effects are smaller in models IV and V which includes coital frequency and contraceptive variables. As pointed above this implies that some of the differences in the risks are explained by these variables and this suggests the existence of the replacement effects. A substantial reduction in the coefficient for the variable assessing the replacement effects due to female births are observed in Model VI which includes the breastfeeding variable. This result, which is consistent with that obtained from OLS model, implies that mothers who experience deaths of infant or children in an interval may be shortening their duration of breastfeeding in an attempt to replace the infant or children who have died.

7.2.4. Magnitudes of the Effects of Infant and Child Mortality on Birth intervals

The analyses undertaken in subsections 7.2.2 and 7.2.3 above showed that the differences in birth interval lengths following an infant or child death can be accounted for by the proximate determinant variables used for analysis in this study. In this subsection the magnitude of these effects are quantified. This quantification which is summarized in tables 7.4a and 7.4b was undertaken using the approach specified in section 5.4.2. As indicated in that section the first row of the results presented in these tables gives the partial *R* due to each of the variable entered in the regression model in the first step. Each of these variables entered in this first step is indicated in the corresponding columns at the top of each of the tables. Thus for instance .033 in table 7.4a in the first column indicates the partial *R* for the variable (BIREINF) for assessing the three effects combined.

economic and cultural variables as should be the case. This as noted in other earlier studies confirms the inability of the data used to measure the proximate determinants accurately.

Because it was not possible to obtain accurate measurements of the coital frequency and contraceptive variables in the intervals from the data utilized, we expect that the magnitudes of the estimated effects to provide a lower bound for these effects. Nonetheless these magnitudes provide a general picture of the relative magnitudes of the three effects.

Table 7.4b: Assessment of the Magnitudes of the Behavioural Effects of Breastfeeding

Step No.	Variable(s) Added	Added R FREPEF	PDEADGR
1.	Variable in Correp. Col.	0.062	0.050
2.	Other Vars. to Assess Effe.	0.052	0.055
3.	Socio-econ &Demog.	0.035	0.041
4.	Coital Frequency	0.033	0.042
5.	Contraception	0.035	0.043
6.	Breastfeeding	0.023	0.037
Contraception and Coital Frequency(%)		5.7	0.0
Breastfeeding		34.3	14.0
Total		40.0	14.0

7.3. Other Findings

Although the focus of this study was to assess the behavioural effects of infant and child mortality on fertility, the results presented in the previous subsections contained interesting findings relating to the determinants of birth intervals. In this subsection these results which are contained in the last three models of tables 7.3a(i), 7.3a(ii), 7.3b(i) and 7.3b(ii) are examined.

The last models in each of the tables referred to above included all the variables utilized for analysis in this study. The models in the second last column included the socio-economic, demographic and proximate determinant factors while those in the preceding column included only socio-economic and demographic variables. Comparison for the coefficients between the latter two models allows the assessment of whether socio-economic factors affects birth intervals through the proximate determinant factors while the last models allowed the further assessment whether there are additional effects through infant/child mortality. Since as noted above, the OLS and hazards results were similar, we focus on the OLS results which were presented in tables 7.3a(i) and 7.3a(ii).

In general the results presented in these tables show that socio-economic and cultural variables affect birth intervals through the proximate determinant factors. The final model in each of above two tables show that except for the education category of secondary and above, most of the variables which are signigficant variables are the proximate determinant factors as would be expected. The assessment of whether socio-economic variables affects birth intervals through the proximate determinants is examined by comparing the changes in the coefficients of the socio-economic variables in the models excluding (models VI table 7.3a(i) & VII tables 7.3b(i)) and including (models VII table 7.3a(ii) & VIII table 7.3b(ii)) the proximate factors.

Examination of the changes in these coefficients show that they change as expected for most variables. For instance, the coefficient for educational category of secondary and above is reduced in magnitude from -2.13 to -1.70 which implies that some of the effect of this variables on birth intervals is captured by the proximate determinants utilized in this study. Similar reductions in coefficients for the variables indicating type of residence (V102), type of union (UTYPE) and for the means of previous birth intervals (PBIAG) are also noted.

The role of infant and child mortality as a factor through which socio-economic variables affect birth intervals is assessed by examining the changes in the coefficients of the socio-economic and demographic variables in the last two models. Examining these changes, it is noted that the coefficients for education, ethnicity and previous birth intervals are reduced which implies that some of the effects of these variables on birth intervals is through infant and child mortality. On the other hand, the coefficients for the type of residence (V102), type of union (UTYPE) and previous birth intervals (PLCBIG) increases. This suggests that differences in birth intervals due to these variables are not explained by differences in infant and child mortality.

The effects of most of the variables included in the analysis are in the expected directions. The lengths of birth intervals increases with the duration of breasfeeding, as would be expected, whereas the reverse is noted to be the case for coital frequency. The effects of use of a modern contraceptive method in the interval and age are also in the expected directions. Birth intervals are on the average longer by about 3 months among women using modern contraceptives in the interval while those initiated when the women were aged over 25 years are longer by about 1.6 months. Reported use of traditional methods is associated with shorter birth intervals, however. Birth intervals are also longer if the previous intervals were long.

Current use of modern methods is associated with shorter birth interval. For instance birth intervals are shorter by over three and half months for women who were currently using a modern contraceptive method. This may perhaps imply that one of reasons motivating women to adopt contraception is the realization that the preceding birth interval was too short.

Increases in levels of education in Kenya are associated with shorter birth intervals. For instance, birth intervals are shorter by about one and half months for women with secondary and above level of education compared to those with none/lower primary while birth intervals are shorter by about 1 month for those with upper primary level. This would suggest that birth intervals would be expected to shorten with modernization in Kenya.

Cultural variables seem not to play a significant role in determining the lengths of birth intervals in Kenya although the results in the tables show that birth intervals are shortest among Luhya women in Western Kenya and longest among the Mijikenda ethnic groups in the Coast region. Women in monogamous unions as expected have shorter birth intervals compared to those in polygamous unions.

The findings in this study are generally consistent with those of other studies on the determinants of birth intervals. Thus the results show that birth order is not an important determinant of birth intervals, which is consistent with the findings of Rodriquez et al. (1984) and Trussell et al. (1985).

7.4. Summary

On the basis of the results presented in this chapter, several conclusions with respect to the main objectives of the study and the testing of hypothesis can be drawn. One of the first major observations is that the use of different techniques in the assessment of the effects of infant and child mortality on fertility does not lead to different conclusions on these effects. As demonstrated by the analysis undertaken in this chapter, similar results from which similar conclusions were drawn were obtained through the two techniques utilized for the assessment of these effects. This further implied that the use of only closed intervals in the analysis would not be expected to lead to different conclusions on the effects.

Arising from the above observation is the question of what could explain the different conclusions reached in the studies reviewed earlier. Part of this it seems can be explained by differences in the conceptualization, measurements and interpretation of the results. For instance in some studies, the variable indicating the death of a previous birth which in this study is (INSEF), defined for the assessment of insurance effects at the individual level, has been used for the assessment of replacement effects. As noted in this study, and which is consistent with these other studies, this variable is not related with birth intervals in the expected direction and hence this has led the researchers to conclude that the replacement effect does not exist. As noted further by some researchers however, biological and behavioural effects should be expected to be highest in the intervals in which the death has taken place. Thus these effects for deaths which had taken place earlier are expected in those intervals where they occurred and hence only insurance effects, if any, can be expected to be observed in subsequent intervals. Because, as further noted, birth intervals are likely to be longer in areas of high infant and child mortality , the replacement effect is unlikely to be discerned if we focus on the differences in lengths of birth intervals.

The observation made above therefore underscores the usefulness of the approach adopted in this study in the assessment of the effects. In the analysis undertaken in this study it was possible to assess these effects even in cases where birth intervals were longer when an infant has died by examining changes in the differences in the birth intervals following an infant death that could be explained by the proximate variables.

On the main hypothesis of the study, the analysis undertaken demonstrated the existence of behavioural effects of replacement and insurance. The analysis further revealed that breastfeeding may in addition to its biological effects have some behavioural effects. This implies that studies which have attributed all the effects of breastfeeding to biological mechanisms may have overestimated this effect and consequently underestimated the behavioural effects.

The analysis undertaken in this study has further shown the need to control for factors which may confound the relationship between infant and child mortality as has been recommended in some studies. The analysis showed that some of the differences in lengths of birth intervals when the child dies and when it survives are due to the differences in socio-economic cultural and demographic characteristics.

Finally, the model developed for testing the study hypotheses confirmed further that the proximate determinant factors utilized could not capture all the effects of socio-economic and cultural variables as should be the case. This as noted in other earlier studies confirms the inability of the data used to measure the proximate determinants accurately.

CHAPTER 8

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In this chapter we utilize the findings of the study to make conclusions and recommendations. The chapter is organized in three sections. A summary of the strategies adopted in the design and implementation of the study are reviewed in Section 8.1. In section 8.2 the conclusions drawn from the findings of the study as presented in chapter 7 and the strategies reviewed above are provided. In section 8.3 the above conclusions are utilized to recommend strategies for further research. The policy implications arising from the findings of the study above are also discussed in this section.

8.1. Summary

In this study we designed and implemented an investigation to test a number of hypotheses to assess the existence and magnitudes of behavioural effects of replacement and insurance of infant and child mortality on fertility. We also investigated whether these effects were influenced by the choice of the methods selected for analysis. The data utilized for this analysis was drawn from the KDHS which was undertaken as part of the DHS programme in 1989. An extensive check of the quality of this data, which was undertaken as part of this study, revealed that it was in general appropriate for testing the above hypotheses.

The conceptual model developed and utilized for the analysis was based on Bongaarts' framework of fertility and Mosley and Chen's framework of infant and child mortality. Thus, the variables for the assessment of the effects were conceptualized within this broad framework where socio-economic and other variables affect birth intervals through a fixed set of proximate determinant factors. The socio-economic and demographic variables were included in this framework as control variables to ensure accurate assessment of the effects as noted earlier. The proximate determinant factors on the other hand facilitated the assessment of the magnitudes of the effects and possible mechanism through which these effects take place.

In operationalising the above framework, several of the issues raised in earlier research were taken into account. For instance, in the definitions of the variables for the assessment of the effects, we recognized that deaths of infants or children occurring after the conception leading to the next live birth could not have an effect on the preceding interval. As has also been pointed by some authors, an infant or a child death was assumed to have the greatest effect in the interval in which the death takes place. An additional point which was considered in these definitions is that the effects of previous deaths in subsequent intervals was mainly insurance. The replacement effects were assessed by identifying those intervals in which an earlier death had taken place while the ones opening the interval had survived. This approach which incorporated both the Chowdhury et al. (1975) and Lehrer (1985) approaches enabled us to assess the behavioural effects independent of the biological effect.

The OLS and hazards techniques utilized for analysis facilitated the control of the effects of the socio-economic and demographic factors referred to above and hence ensured the accurate assessment of these effects. In addition, the hazards models included both the open and closed intervals as has been recommended and implemented in some studies. The use of the two methods in addition facilitated the assessment of whether different results on the behavioural effects noted earlier, could be due to the different methods used.

8.2. Conclusion

The results of the bivariate analysis as presented in Chapter 6 were consistent with results of earlier studies. These results showed that the death of an infant or a child is associated with shorter birth intervals. For each of the seven variables defined for the assessment of the effects, with the exception of the variable for the assessment of the insurance effects at the community, birth intervals were shorter in case of child deaths compared to when there were no such deaths.

Several socio-economic and demographic variable were also found to be significantly related to the birth intervals. Increases in the levels of education was found to be associated with shorter birth intervals while women staying in urban areas had longer birth intervals compared to those in the rural areas. Demographic factors of age at the start of the interval, previous birth interval, means of previous intervals and duration of marriage were also related to birth intervals in the expected manner. This implied that it was necessary to include such variables in the multivariate analysis.

The assessment of the magnitudes of the various effects of infant and child mortality on fertility was undertaken in chapter 7. The results presented in that chapter indicated the possible existence of behavioural effects of replacement and insurance. According to that analysis, the shorter birth intervals associated with the infant/child deaths as discussed above was partly due to the increased coital frequency, lower contraceptive use and even shortening of the duration of breastfeeding. These results indicate the existence of behavioural effects. The behavioural effects of insurance arising from the mortality experiences at personal level was found to be higher than that due to mortality at the community. The conclusion which can be drawn from this finding is that the personal experience of an infant or a child death has a slightly stronger motivation for insurance than the slightly more removed perceptions of the community level conditions.

Another important conclusion relates to the existence of the behavioural effects of breastfeeding in addition to its biological effects. The analysis showed that breastfeeding explained a larger proportion of the variations in the birth intervals than coital frequency and contraceptive use put together. This suggests that in Kenya, the replacement of infants/children who had died is partly realized through the curtailment of breastfeeding of later-born children.

Caution needs to be exercised in interpreting the above results as confirming the existence of behavioural effects of replacement and insurance. Although the results discussed above are consistent with the existence of these effects, it is still not possible with the data utilized to conclude that these effects exist. Such a conclusion can only be reached after it is established that the behavioural changes noted above are as a result of conscious effort of replacing or insuring against deaths of infants or children.

The other conclusion relates to the implications of the approach adopted in this study to strategies for future researches. The conceptualization and implementation of this study incorporated several recommendations encountered in the literature reviewed as part of the study. Thus, the methods selected for analysis and the conceptual model facilitated the incorporation of the variables which may confound the relationship. In the definition of the variables for the assessment of the effects it was also recognized that behavioural effects of infant or child mortality on fertility can also be realized through behavioural changes of breastfeeding and coital frequency in addition to contraceptive use. In these definitions further note was taken of the fact that infant/child deaths is most likely to have the greatest behavioural effects in the intervals in which they occur and that deaths occurring after the interval cannot have any effect in the preceding interval. Note was also taken of the fact that earlier deaths would mainly have insurance effects in the subsequent intervals since the replacement effects would have been reflected in the intervals in which the death took place. In addition a distinction was made in the insurance effects due to mortality experience at the personal level and that due to the mortality at the community.

To a large extent the above considerations are supported by the findings of this study. As discussed earlier, the differences in birth intervals following infant/child death are partly due to the differences in socio-economic and demographic characteristics of the mothers. The coefficients for these former variables were found to change substantially when socio-economic and demographic variables were included in the model. For example, the coefficient for the assessment of the three effects (biological, replacement and insurance) combined (BIREINF), was reduced in magnitude to -1.72 from -1.42 when socio-economic and demographic variables were introduced. This therefore underscores the importance of including these variables in the analysis.

The roles of breastfeeding and coital frequency as additional factors through which the behavioural effects of infant or child death occur have already been referred to above. In fact these variables were found to be the two most important factors through which infant and child mortality affect mortality in Kenya.

Variables defined for the assessment of the effects in the interval were found to have larger effects in the interval than variables for the assessment of the insurance effects. This seems to suggest that the assumption that effects are highest in the intervals in which the deaths occur is correct.

The approach undertaken in this study in the separation of the biological effects from the behavioural effects has an additional methodological implication. As noted earlier separating these two effects is a difficult task, as is recognized in the studies which have been reviewed earlier. In the approaches adopted in those studies, the authors noted that the behavioural effects may have been underestimated. The approach adopted in this study made it possible to separate these effects and also to examine the assessment of the behavioural effect of breastfeeding.

Finally, the analysis in this study revealed the need for accurate data on the proximate determinants in the assessment of the effects. As already pointed out, the data on contraceptive use and coital frequency were not available for each and every one of the intervals included in the analysis, while the durations of breastfeeding were not accurately reported. As a consequence of this, these variables accounted for less than half of the differences in birth intervals when the infant/child had died and when it they survived.

Male deaths also seemed to have been omitted to a greater extent than female deaths. One of the implications of this was that the effects of child deaths on birth intervals could not be accurately assessed. However, the results seem to suggest that the replacement of the female deaths was higher than that for males.

8.3. Recommendations and Policy Implications

Further research is needed not only to determine the relative magnitudes of the effects of infant/child mortality on fertility in other settings but in addition to increase our understanding of the mechanisms through which such effects occur in these settings. It seems from the findings of this study that in countries of fairly low contraceptive use such as Kenya, the main mechanism is through the curtailment of breastfeeding and increased coital frequency, whereas in countries where contraceptive use is high these changes would be reflected in changes in contraceptive use and coital frequency. Such additional studies may also lead to further understanding of why different results relating to the behavioural effects have been obtained.

Other related researches which would complement the above researches are those which would focus on the motivation for the observed changes in breastfeeding behaviour, coital frequency and contraceptive use following an infant or child death. As noted above, the findings of this study were inconclusive as we did not have evidence on the motivation for the changes. Such changes can occur due to other reasons unrelated to the conscious efforts to have the next pregnancy soon.

One of the difficulties encountered in this study was lack of accurate data on the proximate determinant factors in the intervals. The availability of such information would undoubtedly contribute greatly to the implementation of the studies proposed above.

The findings of this study has two main policy implications for Kenya. The first relates to the implementation of the family planning programmes in regions where infant and child mortality is still high in Kenya. Because of the findings of this study which revealed the possible replacement and potential insurance behaviour against possible deaths, it implies that acceptability and practice of family planning is unlikely to increase in such areas. Thus integrating infant and child survival programmes as part of the overall strategy for increasing the acceptability and practice of family planning may be the most appropriate approach for the future development of family planning programmes.

The second policy implication relates to the role of breastfeeding as factor in the survival of infants and children and its effect on fertility. The findings of this study seem to suggest that the death of an earlier infant or a child may influence that of subsequent infants and children indirectly through the curtailment of breastfeeding. This vicious circle of infant and child mortality may lead to higher fertility. Thus emphasis on the role of breastfeeding in survival of infants and children may be necessary not only as a tool for increasing their chances of survival but also as a strategy for fertility reduction.

REFERENCES

Aliaga, A. 1988. Alternative Sample Design for the Kenya Demographic and Health Survey. National Council for Population and Development and The Institute for Resource Development (NCPD and IRD).

Beaver, S.E. 1975. Demographic Transition Theory Reinterpreted.D.C. Health and Company.

Boerma, J. J. and H. A. W. van Vianen. 1984. Birth Interval, Mortality and Growth of Children in a Rural Area in Kenya. *Journal of Biosocial Science 16*: 475-486.

Bongaarts, J. 1978. A Framework for Analyzing the Proximate Determinants of Fertility. *Population and Development Review 4(March)* :105-132.

Bongaarts, J. 1983. The proximate Determinants of Natural Fertility. Pp 103-138 in *Determinants of Fertility in Developing Countries Vol 1* edited by R. A. Bulatao and R.D. Lee. New York: Academic Press.

Bongaarts, J and R. G. Potter. 1983. Fertility,Biology,and Behaviour:An Analysis of the Proximate Determinants. New York: Academic Press Inc.

Brass, W. and J. C. Barrett. 1978. Measurement Problems in the Analysis of Linkages between Fertility and Child Mortality Pp. 209-233 in *The Effects of Infant and Child Mortality on Fertility* edited by Samuel H.Preston. New York: Academic Press.

Bulatao, R. A. and R. D. Lee. 1983. A framework for the Study of Fertility Determinants Pp 1- in *Determinants of Fertility in Developing Countries Vol. 1*, edited by R.A. Bulatao and R.D.Lee. New York: Academic Press

Bumpass, L. L., R. R. Rindifuss, J. A. Palmore, Mercedes Con'ception and B. M. Choi. 1982. Intermediate Variables and Educational

Differentials in Fertility in Korea and the Philippines. *Demography 19(2)*: 241-260

Bumpass, L. L., R. R. Rindifuss and J. A. Palmore. 1986. Determinants of Korean Birth Intervals: The Confrontation of Theory and Data. *Population Studies 40*: 403-423

Bumpass, L. L., R. Rindfuss, J. A. Palmore. 1986. Determinants of Korean Birth Intervals:The Confrontation of Theory and Data. *Population Studies 40(November)*: 403-423

Bumpass, L., R. R. Rindfuss, J. A. Palmore, M. Conce'ption and B. M. Choi. (1982). Intermediate Variables and Educational Differentials in Fertility in Korea and the Phillipines. *Demography 19(March)*: 241-260.

Casterline, J. B. 1989. Maternal Age, Gravidity and Pregnancy Spacing Effects on Spontaneous Fetal Mortality. *Social Biology 36(3-4)*:186-212.

Chatterjee, S and B. Price. 1977. Regression Analysis by Example. New York: Wiley.

Chen, L. C. 1983. Child Survival: Levels, Trends, and Determinants.Pp 163-198 in *Determinants of Fertility in Developing Countries Vol. 1*, edited by R.A. Bulatao and R.D. Lee. New York: Academic Press.

Chowdhury, A. K. M., A. R. Khan and L. C. Chen. 1975. The Effect of Child Mortality Experience on Subsequent Fertility:An Empirical Analysis of Pakistan and Bangladesh Data. The Ford Foundation, Dacca(March)

Cleland, J. G. and Z. A. Sathar. 1984. The Effect of Birth Spacing and Childhood Mortality in Pakistan. *Population Studies 38*: 401-418.

Cleland, J. G., R. J. A. Little and P. Pitaktepsombati. 1979. Illustrative Analysis: Socio-Economic Determinants of Contraceptive Use in Thailand. *WFS Scientific Report 5*. Voorburg, The Netherlands: International Statistical Institute.

Cochrane, S. H. and K. C. Zachariah. 1983. Infant and Child Mortality as a Determinant of Fertility: The Policy Implications. World Bank

WPS 556.

Cox, D. R. 1972. Regression Models and Life Tables. *Journal of Royal Statistical Society Series B 34*: 187-202.

Draper, N. R. and H. Smith. 1966. Applied Regression Analysis. New York: John Wiley and Sons Inc.

Ferry, B. and D. P. Smith. 1983. Breastfeeding Differentials. *WFS Comparative Studies 23*. Voorburg, The Netherlands:International Statistical Institute.

Goldman, N., A. J. Coale and M. Weinstein. 1979. The Quality of Data in the Nepal Fertility Survey. *WFS, Scientific Reports 6*. Voorburg, The Netherlands: International Statistical Institute.

Gray, R. 1983. The Impact of Health and Nutrition on Natural Fertility. Pp 163-198 in *Determinants of Fertility in Developing Countries Vol 1* edited by R. A. Bulatao and R.D. Lee. New York: Academic Press.

Gubhaju, B. B. 1986. Effect of Birth Spacing on Infant and Child Mortality in Rural Nepal. *Journal of Biosocial Science 184*: 435-447.

Hobcraft, J. N., J. W. MacDonald and S. O. Rutstein. 1984. Socio-Economic Factors in Infant and Child Mortality: A cross-national Comparison. *Population Studies 38*: 193-223.

________________. 1985. Demographic Determinants of Infant and Early Childhood Mortality: A Comparative Analysis. *Population Studies 39*: 363-385.

Holford, J.R. 1980. The Analysis of Rate and Survivorship Using Log-Linear Models. *Biometrics 36*: 299-305.

Holford, J. R. 1976. Life Table with Concomitant Information.*Biometrics 32*: 587-597

Jain, A. K. and J. Bongaarts. 1981. Breastfeeding: Patterns,Correlates, and Fertility Effect. *Studies in Family Planning 12(3)*: 79-99

Kasarda, J. D.,J. D. G. Billy and K. West. 1986. Status Enhancement and Fertility, Academic Press Inc.

Kleinbaum, D. G., L. L. Kupper and K. E. Muller. 1988. Applied Regression Analysis and Other Multivariable Methods, PWS-KENT Publishing Company.

Knodel, J. and E. Van de Walle. 1968. Breastfeeding, Fertility and Infant Mortality: An Analysis of Some Early German Data. *Population Studies* 109-131.

Knodel, J. 1968. Infant Mortality and Fertility in Three Bavarian Villages: A n :analysis of Family Histories From the 19th Century. *Population Studies 22(November)*:

Laurentin, A. R. and D. Benoit. 1976. Infant Mortality and Birth Intervals. *Population Studies,30 (July)*: 279-293.

____________ .1986. The Effects of Breastfeeding and Pace of Childbearing at Early Ages. *Demography 23(February)*: 31-51.

Lehrer, E. 1984. The Impact of Child Mortality on Spacing and Parity: A Cox Regression Analysis. *Demography 21(3)*: 323-337

Liard, N. and D. Oliver. 1981. Covariance Analysis of Censored Survival Data Using Log-Linear Analysis Techniques. *Journal of the American Statistical Association 76(374)*: 231-240.

Little, R. J. A. 1980. Linear Models for WFS Data. *WFS, Technical Bulletins No. 9/Tech*. 1282p. Voorburg,The Netherlands: International Statistical Institute.

Little, R. J. A. 1978. Generalized Linear Models for Cross-Classified Data from WFS. *WFS, Technical Bulletins No. 5/Tech. 834*. Voorburg, The Netherlands: International Statistical Institute.

Marcottee, J. and J. B. Casterline. 1990. Interrelations Among Child Mortality, Breastfeeding and Fertility in Egypt, 1975-80. Population and Human Resources Department, The World Bank, WPS 487.

Mensch, B. S. 1985. The Effect of Child Mortality on Contraceptive Use and Fertility in Colombia, Costa Rica and Korea.*Population Studies 39*: 309-327.

Mosley, W. H. and L. C. Chen. 1984. An Analytical Framework for the Study of Child Survival in Developing Countries. *Population and Development Review Supplement 10.*

Miguel, G. J. 1980. Evaluation of the Dominican Republic National Fertility Survey, 1975. *WFS, Scientific Reports 14.* Voorburg, The Netherlands: International Statistical Institute.

Mosley, W. H., L. A. Werner and S. Becker. 1982. The Dynamics of Birth Spacing and Marital Fertility in Kenya. *World Fertility Survey Scientific Reports 30.* Voorburg, The Netherlands: International Statistical Institute.

Olsen, R.J. 1980. Estimating the Effect of Infant and Child Mortality on the Number of Births. *Demography 17(November)*: 429-443.

Olsen, R.J. 1988. Cross-Sectional Methods for Estimating the Replacement of Infants Pp 111-936 in *Research in Population Economics* edited by T. Paul Schultz Vol 6.

Palloni, A. and M. Tienda. 1983. The Effect of The Pace of Childbearing and Breastfeeding on Mortality at Early Ages: The Case of Peru. Center for Demography and Ecology. *Working Paper 83-43.*

Park, C. B., S. H. Han and M. K. Choe. 1979. The Effect of Infant and Child Death on Subsequent Fertility and the Role of Family Planning. *American Journal of Public Health 69(6)*: 557-565.

Preston, S. H. 1978. Introduction. Pp 1-17 in *The Effect of Infant and Child Mortality on Fertility*, edited by Samuel H.Preston. New York Academic Press.

Rao, K. V. and R. Beaujot. 1986. Effect of Infant and Child Mortality on Subsequent Fertility in Pakistan and Sri Lanka. *Journal of Biosocial Science 18:* 297-303

Richter, K. and A. Adlakha. 1989. The effect of Infant and Child Mortality on Subsequent Fertility. *Journal of Population and Social Studies 2(1)*: 43-62.

Rodriquez, G and J. N. Hobcraft. 1980. Illustrative Analysis: Life Table Analysis of Birth Interval. *WFS Scientific Report 16.* Voorburg, The Netherlands: International Statistical Institute.

Rodriquez, G. J. Hobcraft, J. McDonald, J. Menken and J. Trussell. 1984. A Comparative Analysis of the Determinants of the B i r t h Intervals. *Comparative Studies 30 London*: World Fertility

Survey.

Rukanuddin, A.R. 1982. Infant-Child Mortality and Son Preference as Factors Influencing Fertility in Pakistan. *Pakistan Development Review 21(4)*: 297-328.

Rutherford, R. D., M. K. Choe, S. Thapa, and B. B. Gubhaju. 1989. To What Extent Does Breastfeeding Explain Birth-Interval Effects on Early Childhood Mortality. *Demography 26(3)* :439-450.

Rutstein, S. O. 1983. Infant and Child Mortality: Levels, Trends and Differentials. *WFS; Scientific Reports 24,* Voorburg, The Netherlands: International Statistical Institute.

Rutstein, S.O. and V. Medica. 1978. The Latin America Experience Pp. 93-112 in *The Effects of Infant and Child Mortality on Fertility* edited by Samuel H. Preston. New York: Academic Press.

Santow, G. and M. D. Bracher. 1986. Child Death and Time to the Next Birth in Central Java. *Population Studies 38(July)*: 241-253

Selmer, R. 1990. A Comparison of Poisson Regression Models Fitted to Multiway Summary Tables and Cox's Survival Model Using Data from Blood Pressure Screening in the City of Bergen, Norway. *Statistics in Medicine 9*: 1157-1165

Smith, D. P. and B. Ferry. 1984. Correlates of Breastfeeding. *WFS Comparative Studies 41.* Voorburg, The Netherlands:International Statistical Institute.

Srinivasan, K. 1980. Birth Interval Analysis in Fertility Studies. *Scientific Reports* No 7: WFS

Suchindran, C. M. and A. L. Adlakha. 1981. Infant Mortality and its Effects on Fertility:The Experience of Sri Lanka,A Paper Presented at the 50th Annual Meeting of the Population Association of America. Washington D.C.,March

__________ . 1984. Effects of Infant Mortality on Subsequent Fertility of Women in Jordan: A life Table Analysis. *Journal of Biosocial Science 16(April)*: 219-229

Sufian, A. J. M. and N. E. Johnston. 1989. Son Preference and Child

Replacement in Bangladesh: A New Look at the Child Survival Hypothesis. *Journal of Biosocial Science 21*:207-216.

Taylor, C. E., J. S. Newman and N.U. Kelly. 1976. The child Survival Hypothesis. *Population Studies 30(2)*:263-278.

Trussell, J., L. G. Martin, R. Feldman, J. A. Palmore, M. Con'ception, and B. M. A. Barkar. 1985. Determinants of Birth Interval Lengths in the Philippines, Malaysia and Indonesia: A Hazard Model Analysis. *Demography 22(May)*: 145-168.

Trussell, J and C. Hammerslough. 1983. A Hazards-Model Analysis of the Covariates of Infant and Child Mortality in Sri Lanka. *Demography 20(1)*: 1-26.

Wamucii, N. 1991. Trends and Determinants of Contraceptive Use in Kenya. *Demography 28(1)*: 83-99.

WFS. 1984. WFS Major Findings and Implications. Voorburg, The Netherlands: International Statistical Institute.

Winikoff, B. 1983. The Effects of Birth Spacing on Child and Maternal Health. *Studies in Family Planning 14(10)*:231-245.

Appendix I: Age Distribution and by Levels of Education

Age	Total	Level of Education		
		None	Pry	Sec+
15	3.6	0.9	5.5	2.0
16	4.3	0.5	6.4	3.7
17	3.8	0.7	5.1	3.9
18	4.2	0.9	5.7	4.2
19	4.8	1.2	5.8	6.2
20	5.6	2.2	6.2	8.0
21	3.5	1.1	3.5	5.9
22	3.2	0.6	3.5	5.0
23	3.7	1.1	3.4	7.0
24	3.7	1.4	3.9	5.9
25	4.4	2.5	4.2	6.8
26	3.6	2.4	3.6	4.9
27	3.6	3.2	3.4	4.0
28	3.7	3.6	3.2	4.8
29	3.7	3.2	3.3	5.4
30	4.7	6.9	4.0	4.1
31	2.4	2.8	2.0	3.0
32	2.8	4.1	2.2	2.8
33	1.9	2.7	1.6	1.7
34	2.3	3.3	1.9	1.8
35	3.1	6.0	2.4	1.4
36	2.4	3.3	2.3	1.7
37	2.0	3.0	1.9	0.9
38	2.3	4.3	2.0	0.8
39	1.9	3.6	1.6	0.8
40	3.2	6.6	2.7	0.9
41	1.5	2.6	1.5	0.5
42	1.6	3.9	1.0	0.3
43	1.2	2.5	1.1	0.1
44	1.5	3.7	1.0	0.2
45	2.0	4.6	1.5	0.3
46	1.3	3.3	0.8	0.1
47	0.8	2.2	0.4	0.2
48	1.2	3.1	0.7	0.2
49	0.7	1.9	0.5	0.1
Total	100.0	100.0	100.0	100.0

Appendix II: Data on Births by Sex Used for Calculating Sex Ratios in Table 4.2(a)

Period(Years before the Survey)	Male	Female	All
0- <5	3,553	3,563	7,116
5- <10	3,256	3,207	6,463
10- <15	2,550	2,629	5,179
=>15	3,344	3,071	6,415
Age			
15-19	223	203	426
20-24	1,067	1,079	2,146
25-29	2,231	2,322	4,553
30-34	2,507	2,393	4,900
35-39	2,666	2,611	5,277
40-44	2,363	2,236	4,599
45-49	1,646	1,626	3,272
Residence			
Urban	2,165	2,286	4,451
Rural	10,538	10,184	20,722
Education			
None	4,894	4,877	9,771
Primary	6,232	5,984	12,216
Secondary	1,555	1,590	3,145
All	12,703	12,470	25,173

Appendix III: Data for Calculating Mean Number of Children Ever Born in Single Years

Age	Births	Women	Mean births	Age	Births	Wonen	Mean births
15	6	257	0.023				
16	22	310	0.071	33	728	137	5.314
17	58	272	0.213	34	871	163	5.344
18	109	300	0.363	35	1,330	219	6.073
19	231	342	0.675	36	1,022	172	5.941
20	423	401	1.054	37	892	141	6.326
21	310	249	1.245	38	1,088	163	6.675
22	348	225	1.547	39	945	135	7.000
23	485	261	1.858	40	1,569	230	6.822
24	580	266	2.180	41	805	111	7.252
25	848	313	2.709	42	805	112	7.188
26	783	255	3.071	43	651	86	7.570
27	857	254	3.374	44	769	107	7.187
28	1,014	265	3.826	45	1,031	143	7.210
29	1,051	267	3.936	46	725	91	7.967
30	1,477	335	4.409	47	434	56	7.750
31	794	172	4.616	48	645	84	7.679
32	1,030	200	5.150	49	437	53	8.245

Appendix IV: Births and Women for Calculating Mean Number of Children Ever Born in Table 4.2(b)

Current Age Group	All		Residence			
			Rural		Urban	
	Births	Women	Births	Women	Births	Women
15-19	426	1,481	298	1,053	128	428
20-24	2,146	1,402	1,477	897	669	505
25-29	4,553	1,357	3,559	956	994	401
30-34	4,900	1,007	3,892	743	1,008	264
35-39	5,277	830	4,400	664	877	166
40-44	4,599	646	4,137	550	462	96
45-49	3,272	427	2,959	370	313	57
Total	25,173	7,150	20,722	5,233	4,451	1,917
Current Age Group	**Level of Education**					
	None		Primary		Sec+	
	Births	Women	Births	Women	Births	Women
15-19	45	71	338	1,091	43	317
20-24	238	109	1,366	784	540	507
25-29	1,018	254	2,425	677	1,092	425
30-34	1,800	337	2,282	451	793	217
35-39	2,339	344	2,489	390	431	95
40-44	2,381	329	2,062	281	140	35
45-49	1,950	258	1,254	152	53	16

Appendix V: Data for Calculating Distribution of Births by Year Before the Survey

Age (Years)	Percent	Age (Years)	Percent	Age (Years)	Percent
0	5.4	14	3.4	28	0.5
1	5.2	15	2.7	29	0.3
2	5.3	16	2.6	30	0.2
3	4.8	17	2.5	31	0.1
4	4.9	18	2.2	32	0.1
5	4.7	19	2.2	33	0.1
6	5.3	20	2.2	34	0.0
7	4.3	21	1.6	35	0.0
8	4.9	22	1.5	36	0.0
9	4.2	23	1.2	37	0.0
10	4.4	24	1.1		
11	3.4	25	1.0		
12	3.6	26	0.9		
13	3.5	27	0.5	All	100.0

Appendix VI: Distribution of Deaths by Months

Month	Percent	Month	Percent	Month	Percent
0	29.0	13	3.5	26	0.9
1	4.8	14	3.4	27	0.5
2	4.9	15	2.7	28	0.5
3	4.2	16	2.6	29	0.3
4	3.4	17	2.5	30	0.2
5	2.8	18	2.2	31	0.1
6	4.3	19	2.2	32	0.1
7	2.7	20	2.2	33	0.1
8	3.6	21	1.6	34	0.0
9	2.8	22	1.5	35	0.0
10	1.2	23	1.2	36	0.0
11	0.8	24	1.1	37	0.0
12	8.5	25	1.0		
				All	100.0

Appendix VII: Data on Years Since First Marriage

Years	Percent	Years	Percent	Years	Percent
0	4.7	14	0.7	28	1.6
1	4.3	15	0.5	29	1.7
2	4.3	16	0.3	30	1.1
3	4.0	17	0.2	31	0.8
4	3.8	18	2.2	32	0.5
5	3.9	19	0.3	33	0.5
6	4.0	20	0.2	34	0.3
7	3.4	21	0.4	35	0.2
8	4.0	22	0.0	36	0.2
9	5.0	23	0.1	37	0.0
10	3.7	24	9.7	38	0.0
11	3.6	25	1.0	39	0.0
12	3.4	26	0.0	40	0.0
13	3.2	27	1.8		
				All	100.0

Appendix VIII: Cumulative Proportion Married

Age (Years)	Married Women	All Women	Percent	Age (Years)	Married Women	All Women	Percent
15	15	257	5.8	34	157	163	96.3
16	32	310	10.3	35	206	219	94.1
17	46	272	16.9	36	167	172	97.1
18	81	300	27.0	37	139	141	98.6
19	151	342	44.2	38	157	163	96.3
20	241	401	60.1	39	134	135	96.3
21	147	249	59.0	40	222	230	96.5
22	156	225	69.3	41	110	111	99.1
23	199	261	76.2	42	111	112	99.1
24	208	266	78.2	43	85	86	98.8
25	270	313	85.4	44	107	107	100.0
26	222	255	87.1	45	139	143	97.2
27	230	254	90.6	46	89	91	97.8
28	246	265	92.8	47	55	56	98.2
29	245	267	91.8	48	83	84	98.8
30	312	335	93.1	49	53	53	100.0
31	163	172	94.8				
32	187	200	93.5	Total	5298	7150	
33	131	137	95.6				

Appendix IX: Proportions Breastfeeding

Month	Percent	Month	Percent	Month	Percent	Month	Percent
0	3.9	12	16.9	24	19.4	36	1.1
1	1.2	13	1.5	25	0.4	37	0.0
2	1.2	14	4.4	26	0.2	38	0.0
3	0.8	15	4.1	27	0.4	39	0.0
4	1.1	16	3.6	28	0.4	40	0.0
5	1.2	17	3.5	29	0.2	41	0.0
6	2.1	18	12.3	30	1.6	42	0.0
7	1.7	19	1.7	31	0.1	43	0.0
8	4.2	20	4.2	32	0.2	44	0.1
9	2.1	21	1.3	33	0.0		
10	1.2	22	0.3	34	0.1		100.0
11	1.2	23	0.2	35	0.0		

Appendix X: Data Used to Calculate the First Difference Figures Plotted in Figure 4.5(b)

Month	No. of Births	No. of Births Breast-feeding	Percent Breast-feeding	First Diffe-rence
0	44	43	97.7	-
1	69	66	95.7	2.0
2	83	81	97.6	-1.9
3	76	68	89.5	8.1
4	75	71	94.4	-4.9
5	102	98	96.1	-1.7
6	58	56	96.6	-0.5
7	75	71	94.7	1.9
8	73	72	98.6	-3.9
9	67	60	89.6	9.0
10	77	71	92.2	-2.6
11	67	61	91.0	1.2
12	72	65	90.3	0.7
13	77	63	81.8	8.5
14	74	59	79.7	2.1
15	72	56	77.8	1.9
16	62	46	74.2	3.6
17	86	60	69.8	4.4
18	76	49	64.5	5.3
19	62	37	59.7	4.8
20	68	32	47.1	12.6

Month	No. of Births	No. of Births Breast-feeding	Percent Breast-feeding	First Diffe-rence
21	54	32	59.3	-12.2
22	50	17	34.0	25.3
23	59	13	22.0	12.0
24	59	19	32.2	-10.2
25	71	16	22.5	9.7
26	58	13	22.4	0.1
27	65	10	15.4	7.0
28	69	9	13.6	1.8
29	54	9	16.7	-3.1
30	74	12	16.2	0.5
31	65	4	6.2	10.0
32	67	3	4.5	1.9
33	69	4	5.8	-1.3
34	78	4	5.1	0.7
35	84	8	9.5	-4.4
36	77	6	7.8	1.7
37	75	7	9.3	-1.5
38	59	3	5.1	4.2
39	73	4	5.5	-0.4
40	61	3	4.9	0.6
41	65	2	3.1	1.8

Appendix XI: Distributions of Open and Closed Intervals

Months	Open	Closed	Months	Open	Closed
0	2.9	0.0	31	0.6	3.2
1	4.3	0.0	32	0.4	2.5
2	5.3	0.0	33	0.8	2.1
3	4.7	0.0	34	0.7	1.6
4	4.5	0.0	35	0.8	1.7
5	6.0	0.0	36	0.6	2.6
6	3.2	0.0	37	0.3	1.6
7	4.2	0.3	38	0.1	1.0
8	4.2	0.6	39	0.0	1.1
9	3.8	0.9	40	0.1	1.2
10	4.2	0.8	41	0.2	0.7
11	3.6	1.0	42	0.0	0.9
12	3.6	2.6	43	0.0	1.0
13	3.9	1.7	44	0.0	0.8
14	3.3	2.6	45	0.1	0.6
15	3.4	2.7	46	0.0	0.6
16	2.7	2.1	47	0.0	0.6
17	3.6	2.7	48	0.0	0.5
18	3.4	2.7	49	0.0	0.2
19	2.5	3.7	50	0.0	0.2
20	2.6	3.3	51	0.0	0.3
21	1.8	4.1	52	0.0	0.3
22	1.6	4.5	53	0.0	0.2
23	1.7	4.9	54	0.0	0.2
24	1.8	6.5	55	0.0	0.3
25	1.9	5.3	56	0.0	0.1
26	1.3	5.2	57	0.0	0.0
27	1.4	4.8	58	0.0	0.1
28	1.2	3.8	59	0.0	0.0
29	0.8	3.4	60		0.0
30	1.0	3.9			

Appendix XII: Categorization of the Variables

Variable	Categories	Sif. T	R^2	F
Age at Start of Interval (AGELBY)	15-19 [Ref. Category]	0.0332		
	20-34	0.0332	0.004	3.009
	>= 35	0.8907		
	< 35 [Ref. Category]			
	>= 35	0.0144	0.004	6.006
	< 25 [Ref. Category]			
	>= 25	0.0001	0.010	14.982
Previous Birth Interval Mean(PBIAG)	< 2 [Ref. Category]			
	2-3	0.0000		
	>= 3	0.0050	0.014	10.926
	< 2 [Ref. Category]			
	>= 2	0.0000	0.012	18.390
	< 3 [Ref. Category]			
	>= 3	0.0448	0.003	4.0340
Previous Birth Interval (PBIAG)	< 2 [Ref. Category]			
	2-3	0.0010		
	>= 3	0.0006	0.0103	7.909
	< 2 [Ref. Category]			
	>= 2	0.0010	0.0100	15.350
	< 3 [Ref. Category]			
	>= 3	0.0448	0.003	4.0340
Duration of Marriage(DMARLCY)	< 15 [Ref. Category]			
	>= 15	0.0037	0.006	8.472
	< 10 [Ref. Category]			
	10-20	0.1007	0.009	6.816
	>= 20	0.0007		
	< 10 [Ref. Category]			
	>= 10	0.0027	0.006	9.017

Appendix XII-continued

Variable	Categories	Sif. T	R^2	F
Education of Mother (EDUC)	None [Ref. Category]			
	Lower Pry	0.4172		
	Upper Pry	0.0040	0.011	5.539
	Sec+	0.0020		
	None/ Low Pry [Ref. Category]			
	Upper Pry	0.0002	0.010	7.980
	Sec+	0.0048		
	None [Ref. Category]			
	Low Pry	0.0030		
	Upper Pry/Sec +	0.4174	0.009	7.187
	Sec+	0.0048		
Proportion Dead (PDEADGR)				
	< 10 [Ref. Category]			
	10-20	0.1826	0.002	
	>= 20	0.7568		
	< 20 [Ref. Category]			
	>= 20	0.2105	0.001	0.2105