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**Abstract**

This paper goes beyond the physiological impact of infant deaths on fertility by examining whether such deaths elicit an explicit, conscious and intentional fertility response in sub-Saharan Africa. The major research questions are: what are the long term implications of childhood mortality on reproductive behavior? Does the death of the first child, for instance, affect the risk of a higher order birth? These questions are examined using DHS data from Ghana and Kenya. At each parity, women with childhood mortality experience were found to have a higher number of subsequent than those without. Additionally, multivariate results suggest that infant deaths tend to have a long term impact on reproductive behaviour. The death of the first child in particular was found to associate with the risk of a higher order birth. This is probably because first births in most African cultures are deemed special and as such their death as infants has a long term effect on a woman's reproductive behaviour. From a policy perspective, these finding suggest that improvement in child survival programs could significantly improve fertility through both the biological and behavioural effects

## Introduction

Notwithstanding the extensive social scientific research, there are still unanswered questions regarding the persistence of high fertility in sub-Saharan Africa. According to the theory of demographic transition, declining childhood mortality is a significant impetus for fertility decline. With the rapid decline of child mortality in much of sub-Saharan Africa, there is thus considerable interest in understanding its effect on fertility. As Lloyd and Ivanov (1988) argue, improvement in child survival creates an environment within which the relationship between the number of children ever-born and those surviving becomes predictable enough for couples to set family size goals. Invariably, couples are more likely to regulate reproductive behavior if they are confident that the few children they have will survive into adulthood. This is particularly relevant in the context of sub-Saharan Africa where the *inter-generational flow of wealth* goes from children to parents as John Caldwell has emphasized.

Thus, understanding the childhood mortality-fertility relationship is of practical policy relevance and goes to the heart of public intervention programs. As Wolpin (1998:74) argues, "the fertility and mortality processes are the driving forces governing population changes, so an understanding of the way they are linked is crucial for the design of policies that attempt to influence the course of population change." While considerable research efforts have been given to understanding the physiological effects of infant deaths on subsequent fertility, the other pathways have been less studied. According to Montgomery (1998), for example, no theory has been formulated to explain the lag in fertility response.

This paper contributes to this effort by examining the long term impact of infant mortality and whether such deaths elicit an explicit, conscious and intentional fertility response. The major research questions may be stated as follows: what are the long term implications of childhood mortality on reproductive behavior in sub-Saharan Africa? Does the death of the first child, for instance, affect the risk of a higher order birth? These questions will be examined using Demographic and Health Survey data from Ghana and Kenya, two countries at different stages of fertility transition in sub-Saharan Africa. The next section examines the theoretical framework for the study while section 3 deals with the data and methods of analysis. The results and conclusions are presented in sections 4 and 5 respectively.

## 2.0 Theoretical framework

The theoretical pathways through which childhood mortality affects fertility have been identified as physiological, behavioral replacement, and insurance effects (e.g., Preston, 1978; Cohen and Montgomery, 1998). Recently, LeGrand and colleagues (2001) have suggested the possibility of other pathways on the basis of qualitative research in Senegal and Zimbabwe. The physiological effect mainly operates through premature weaning and truncation of the inter-birth interval following an infant death. Previous studies in diverse regions have found the risk of a subsequent birth to be higher among women with infant mortality experience than those without (Frankenberg, 1998; Mensch, 1985; Callum et al., 1988). While the physiological effect is more pronounced in populations with extensive breastfeeding patterns such as those of sub-Saharan Africa (Grummer-Strawn, 1998), its magnitude tends to attenuate as a society undergoes transition during which a conscious effort is made to space and limit births(Gyimah, 2001a; Gyimah and Fernando, forthcoming).

The present study goes beyond the short-term physiological effect by examining the long term impact of infant death on reproductive behavior. The question worth answering is whether the survival statuses of previous children significantly increases the risk of birth of a higher order. From a theoretical perspective thus, the long term impact can be couched within the behavioral response hypothesis. In its usual rendition, the behavioral replacement hypothesis refers to deliberate efforts a couple make to bear another child in the hope of replacing the lost one. In most empirical studies, replacement behavior is explored by examining previous infant deaths on contraceptive use, completed fertility and parity progression ratios. These studies attest that the tendency to move to higher parities increases with the number of dead children. Additionally, women with childhood mortality experience tend to have a significantly higher number of children ever born than their counterparts without such experience (e.g., Gyimah, 2001a; Nyarko et al., 1999; Montgomery and Cohen, 1998).

Again, within the framework of the behavioral effect, women with child loss experience are less likely to use contraception but more likely to discontinue if they are already using. A number of empirical studies in sub-Saharan Africa and elsewhere tend to corroborate this hypothesis (see, e.g., Chowdhury et al., 1992; Oheneba-Sakyi and Takyi, 1997). Among Ghanaian women, for example, Nyarko et al. (1999) observed that mothers with previous child death were 57 percent less likely to use contraception compared with mothers with no childhood mortality experience. In rural Bangladesh, Rahman (1998) also found that the risk of discontinuing contraception was 92 percent higher among couples who have experienced child deaths. These findings obviously point to a deliberate and conscious effort among women with childhood mortality experience.

To understand the long term effect in this study, we examined the survival statuses of earlier births on the risk of a higher order births. The model on the risk of a fourth birth, for instance, includes the survival status of the first, second, and third children together with other relevant covariates that associate with the risk of birth. In this context, if a significant relationship is found between the survival status of previous births and the risk of birth of higher order, such effects cannot be attributed to physiological factors associated with infant deaths but to long term volitional replacement behavior. Also, previous research has placed less emphasis on the possibility of differential replacement behavior on the basis of the parity of the dead child. This is particularly relevant in the context of sub-Saharan Africa where first births are deemed special and their birth is often heralded by a cluster of ceremonial events (Kuate-Defo, 1998). As a result, the death of the first born in childhood is usually regarded as a bad omen for the reproductive life of the woman and as such enormous social pressure is put on the couple to have as many children as possible. We therefore expect the death of the first child in particular to have a significant long term effect on reproductive behavior.

## 3.0 Data and methods

The 1998 Demographic and Health Surveys (DHS) for Ghana and Kenya were used for this study. The surveys were conducted by Macro International in conjunction with the Ghana Statistical Service and Kenya's National Council for Population and Development. The survey is a national representative, stratified, self-weighting probability sample of women in the reproductive ages of 15 to 49 years. In addition to country specific modules, there are standard core questionnaires on socio-economic, demographic and health indicators, thus making cross-national comparisons easier.

Data quality is a concern to any study that uses retrospective data to examine the timing of events as this paper does. Although there are non sampling errors on some age-related variables in the DHS, several studies suggest the data compare favorably with other large scale surveys such as the World Fertility Survey (Rustein et al., 1990; Gage, 1995). Since we examine infant deaths on the risk of birth, individual women with at least one birth constitute the unit of analysis. To explore the long term effects of childhood deaths, we focused on two dependent measures, namely the total number of children ever born and the risk of high order birth.

Examining the risk of births using retrospective data introduces the problem of right censoring caused by the incomplete experience of the event studied (Allison, 2000). Censored cases require special treatment in estimating exposure time and for this reason normal regression procedures are unsuitable. The appropriate techniques in the presence of censoring come under the rubric of survival analysis, the oldest being the non-parametric life table technique. To overcome the problem of censoring, survival models make the assumption that censored individuals will eventually experience the event at some future time. Additionally, censoring is assumed to occur randomly over the interval such that censored individuals are assumed to be at risk of experiencing the event at the mid point of the interval. However, while the life table can be used to estimate survival time, it does not readily allow one to control for theoretically meaningful variables that affect survival time in a multivariate context. The best one could do under such circumstances is to estimate survival probabilities for selected heterogenous groups. There is, however, the risk of getting unreliable parameters as a result of disaggregation of the sample into smaller heterogeneous groups of interest.

Hazard models combine aspects of the life table and multiple regression techniques and allow the risk to depend on factors that describe heterogeneity. These models are used when the outcome of interest is a duration until the occurrence of some event, that is, the time elapsed for making the qualitative change from an origin state to a destination state. Cox's (1972) proportional hazard model was used to examine the long term effects of infant deaths on fertility. Unlike parametric models, the proportional hazard model does not make any assumption about the functional distribution of the timing function and therefore appropriate for events whose empirical distribution is unknown. The model is based on the assumption that the ratio of the hazard functions of two individuals is constant throughout the period of observation. Using this model, we estimated the relative risks of higher order births controlling for the survival status of previous children and other theoretically relevant variables. For a more intuitive understanding, the coefficients have been transformed by exponentiation $(e^{\beta})$ and are interpreted as relative risk or hazard ratios. The relative risk is a statistical estimate of the extent to which specific attributes predispose women to differential risk of births. A risk ratio significantly greater than one indicates that women with this attribute have a higher risk of birth than women in the reference category. Conversely, if the relative risk ratio is less than one, women with this attribute are expected to have a significantly lower risk of birth than women in the reference category.

**Control variables**

Besides childhood mortality, there are a number of demographic, socio-economic, and socio-cultural factors that are known to affect fertility (see Table 1 ). The demographic controls include age cohort, age at first marriage and the duration of the previous birth interval. Age cohort, measured by a series of dummy variables, is indicative of socio-cultural and politico-economic contexts that shape the life course experiences of individual women. Given that women in the younger cohorts became adolescents in a period of a more egalitarian gender roles, efficient contraceptives and higher female enrolments in formal education, we expect the risk of births to be lower among the youngest age cohort compared to the older cohorts. Age at first marriage is also important in fertility studies because of its inverse relation to the exposure to the risk of conception (Westoff, 1992). Women who marry early are expected to have a higher risk of births than their counterparts whose first birth occurs late. Further, the length of the preceding interval can be considered a proxy for the combined effects of proximate variables such as length of the voluntary and involuntary abstinence and effective contraceptive use, among others. To capture these differences which might account for differentials in the risk of subsequent births, the length of the preceding interval $I$ is introduced as a categorical covariate in the transition to parity $I+1$. Given the relationship between preceding and succeeding intervals as demonstrated in previous research (e.g., Trussell and Menken, 1988?), shorter preceding intervals are hypothesized to associate with a higher risk of a subsequent birth and vice-versa

Turning to the socio-economic controls, there is considerable empirical evidence that associates urban residence and high levels of maternal education with low fertility. The pathways through which these happen have been explained through late age at marriage, high contraceptive use, and labor force participation (Martin, 1995;Oheneba-Sakyi and Takyi, 1997; Gyimah, 2001b). In this study, maternal education is categorized into three: no education; primary education; secondary education. In line with previous research, we expect the risk of subsequent births to be lower among secondary educated women compared to others. Also, fertility in urban areas of sub-Saharan Africa tend to be substantially lower than what prevails in rural areas, a difference of about 1.8 births per woman (Cohen, 1993). This perhaps sheds light on the differential influence of the socio-economic and cultural factors on reproduction in rural and urban settings. Urban residents are thus hypothesized to have a lower risk of subsequent birth.

Further, there are a number of socio-cultural factors that influence reproduction in sub-Saharan Africa (Lesthaeghe, 1989). Among these are ethnic-specific practices, norms and values that capture both the observable and unobservable behavioral and cultural factors affecting reproductive behavior in the region. In Ghana, we distinguished the predominantly pro-natalist *Akans* from the *Mole-Dagbanis, Gas, Ewes* and *Others* while in Kenya, the distinction was among the *Kikuyus* and the *Kisii, Luhya, Kalenjin* and *Others*. Given the fact that the *Kikuyus* tend to be more educated and urbanized than others in Kenya, we expect to find longer transition times among them compared with the other ethnic groups. In Ghana, the *Ewes* and *Mole-Dagbanis* are hypothesized to have a lower risk of subsequent birth than the *Akans* because of their relatively long post-partum abstinence period and patrilocal residence.

Turning to marriage, some research in sub-Saharan Africa suggests it is often a sequential process involving several steps (Meekers, 1992). For this reason, we included both the married and unmarried women in the sample. Because married couples tend to be more secure in their commitment towards family building than the unmarried, we expect the risk of births to be higher among married women. However, given the complexity of the relationship between the type of marital union and fertility in sub-Saharan Africa at the individual level (e.g., Garenne and van de Walle, 1989; Sichona, 1993; Ahmed,1986), married women were further classified into either monogamous or polygynous unions. Following Garenne and van de Walle (1989), we expect women in polygynous union to associate with a lower risk of birth than those in monogamous unions. The premise is that not only do polygynous wives tend to marry older men whose fertility is much lower but they also spend more time away from their spouses than their monogamous counterparts. Lastly, the sex composition of surviving children has been found to have a significant bearing on fertility particularly in cultures that accord special privileges to sons. While most sub-Saharan African societies do not show a conscious preference for sons compared with those in Asia, some recent studies in the region allude to son preference (e.g., Kuate-Defo, 1998; Nyarko et al., 1999; Mace, 1996). On the basis of these recent findings, women whose surviving children are all daughters are expected to have a higher risk of subsequent births than their counterparts whose surviving children are males.

## 4.0 Findings and Discussion

Preliminary results of the mean number of subsequent births to women at various attained parities by childhood mortality experience are presented in Table 2. The analysis was separately done for all women and older women (above 37 years). At each attained parity, women are grouped according to their prior experience with childhood mortality on the basis of which we estimated the mean number of subsequent births. Women who have given birth to two children, for example, are classified into three categories on the basis of past infant mortality experience– those with one prior infant death; those with two infant deaths, and those without any prior infant death. The results indicate of the 3499 Ghanaian with first births, 80 percent (2798) had second births, 62 percent (2170) had third births, and 47 percent (1642) had fourth births. Similarly, of the 5717 Kenyan women with first births, 81 percent (4618) had second births, 63 percent (3626) had third births and 50 percent (2849) had fourth births. The proportion of women progressing to higher order births seems to be higher among women above 37 years old suggesting that most of women in this cohort are at the end of their childbearing years.

Starting with infant mortality experience, the results suggest that among Ghanaian women who have given birth to two children, 14 percent (399) had experienced one infant death, 1.3 percent (39) had two deaths while the majority (85 percent) have not had any infant death. Among those with four births, however, only 72 percent had not experienced infant deaths with about 6 percent with at least two deaths. The proportion of women with infant mortality experience tends to be slightly higher at all parities in Kenya. Turning to prior infant deaths and the mean number of subsequent births, the results also demonstrate that women with childhood mortality experience tend to have a larger number of subsequent births than those with no child deaths irrespective of the attained parity. Among Ghanaian women who had had first births, for example, those who lost the child before the second birth went on to have 3.7 additional children as against 2.7 among those whose child survived till the second birth. Similarly, Ghanaian women with no prior infant death up till the fourth birth had 1.7 additional children while their counterparts with no surviving children had 6 additional children, a difference of about 4.3 children. A parallel pattern is seen among Kenyan women where at the third parity, for instance, those without any infant death proceed to have 2.5 additional children while those with no surviving children go on to have about 4.5 additional children. At all attained parities thus, the results corroborate the hypothesis that women who have had infant deaths tend to have a higher number of subsequent births than their counterparts without any or with fewer infant deaths. This pattern gives some indiction of a deliberate replacement behavior, although the replacement tends to be incomplete.

**Multivariate hazard models**

To unravel the independent effect of infant death on the risk of higher order births, the demographic, socio-economic and socio-cultural factors are controlled in multivariate hazard models presented in Tables 3 and 4. For the risk of higher order births, three models are presented: Model 1 controls for only the survival statuses of all previous children; Model 2 controls for the survival variables as well as the demographic and socio-economic variables while Model 3, the full effect model, builds upon Model 2 by including the socio-cultural variables. The log likelihood ratios suggests significant improvements from Models 1-3 for both samples.

The results invariably substantiate the argument that infant deaths indeed have substantial long term impact on reproductive behavior. The death of the first child, for instance, tends to associate with a higher risk of a third birth in both countries, the effects being robust and virtually unchanged across models. From Model 3, the risk of a third birth is 32 percent higher among Ghanaian women who lost their first child compared with those whose first child survived. A similar pattern can be seen among Kenyan women where the death of the first child increases the risk of a third birth by 16 percent. Further evidence on the long term effects of childhood deaths on the risk of a higher order births is demonstrated in Table 4. The results also demonstrate that the death of previous children is significantly linked with a higher risk of a fourth birth, the effect being robust across models. Compared with women whose first child survived, the risk of a fourth birth is 60 percent higher among Ghanaian women who lost their first child and 11 percent higher among their Kenyan counterparts as Model 3 illustrates. Similarly, the risk of a fourth birth is 42 percent higher for women who lost their second child in Ghana and 4 percent higher among their Kenyan counterparts although the effects are not significant in the latter case.

The association between the status of previous children and the risk of higher order births as demonstrated in the preceding discussion cannot be due to physiological factors but point in the direction of a behavioral replacement behavior. However, the influence of the physiological effect cannot be discounted as confirmed by the relative magnitude of the risk ratio associated with the status of the index child appears. Significant patterns conspicuous in Model 3 on the risk of a fourth birth in both samples are worth commenting upon. While the death of the first child significantly associates with a higher risk, the effects of the status of the second child is less influential in Ghana and even non significant in Kenya. Consistent with our hypothesis, these findings suggest that besides the index child, the death of the first child exerts a further influence on the risk of birth at higher parities. Given the special privileges accorded to first births in most sub-Saharan African societies, their death is more likely to have a long term impact on reproductive behavior than deaths at other parities as hypothesized. These findings support a recent study Cameroonian study where the death of the first child was found to have a significant positive long term impact on reproductive behavior (Kuate-Defo, 1998).

Finally, we also examined the number of previous infant deaths (but not limited to the status index child) on the risk of births in a multivariate context (Table 5). For the risk of each birth, we present two models: Model 1 controls for only the number of previous infant deaths while Model 2 includes all the covariates. On the basis of previous infant mortality experience, women at the risk of third birth are categorized into three groups (no dead children, one dead child; two dead children) while those at the risk of a fourth birth are classified into four (no dead children, one dead child; two dead children; three dead children). The results suggest that women with high number of infant deaths tend to associate with higher risk of subsequent birth. Compared with Ghanaian women who have not experienced any infant deaths, the risk of a fourth birth is 3.9 times higher among those with no surviving children, 1.54 for those with one surviving child and 1.46 among those with two surviving children as suggested by Model 2. Comparable patterns are seen among Kenyan women as Table 5 illustrates.

**Summary and conclusion**

These findings suggest a fair degree of replacement behaviour. Women at any parity seemed to exhibit higher risk of subsequent fertility when they have experienced child loss. The multivariate models also suggest that childhood mortality have long term impact on reproductive behaviour. In particular, the death of the first child was found to have a long term impact on fertility. From a policy perspective, these results suggest that improvement in child survival programs could significantly improve the reproductive life of women by reducing fertility through both biological and behavioural processes. Thus, any serious effort to address the problem of high fertility in sub-Saharan Africa should seek to improve child survival. While both Ghana and Kenya have somewhat efficient MCH programs, more could be achieved through a socially designed health delivery system. Besides the logistic and administrative constraints of the Expanded Program on Immunization (EPI) campaign in Ghana (see Fish,1986), for example, there are certain socio-cultural practices that have made immunizations unpopular in many rural regions. In many rural communities, there is the genuine fear that immunization would rather make children more vulnerable to infectious and parasitic diseases. Also, as Gyimah (2001b) discusses, newly born infants in some rural communities in Ghana are denied the rich *colostrum* from the mother and rather given some herbal concoctions which are believed to protect the child against diseases and evil spirits. These call for an intensified social campaign on antenatal, delivery and post-natal services as part of MCH and EPI programs. In addition to these, there is also the need for sustained efforts at poverty alleviation and programs aimed at improving the nutritional status of mothers and children.

Besides the infant deaths, other covariates were found to have significant association with the risk of births. The most important among these were age cohort, age at first marriage, education, current place of residence, ethnicity, and the duration of the preceding interval. At all parities, younger women, urban residents and the highly educated were found to have a significantly lower risk of birth. The lower risk of births among the highly educated and urban women have been explained through socio-economic and cultural perspectives. The socio-economic hypothesis examines the lower risk through the high use of modern contraception, education and labor force participation in the modern sector while the cultural perspective focuses on beliefs, values and norms regarding reproduction. From the socio-economic perspective, for instance, secondary educated women are more likely to be employed in formal occupations that generates mother-worker conflict.

The results also suggest that women whose surviving children were all girls had a higher risk of subsequent birth than those whose surviving children were all boys. This finding points to a gender preference and confirms some recent research in sub-Saharan Africa that alludes to son preference (e.g., Kuate-Defo, 1998; Nyarko et al., 1999; Mace and Sear, 1997; Rono, 1998). Also significant were ethnic differences in the risk of births. In Ghana, the *Mole-Dagbanis* and *Ewes* tend to have lower risks compared with the *Akans* while in Kenya, the *Kalenjins* and *Luhyas* were consistently associated with higher risks and the *Kikuyu* a lower risk. The ethnic differences in Ghana may be explained through socio-cultural factors such as the *badu-gwa*n rites, lineage systems, and the length of the postpartum abstinence period. Culturally, the postpartum period tends to be longer among the *Ewes* and the *Mole-Dagban*is compared with the *Akans*. In fact, according to Gaisie (cited in Addai, 1999), a traditional *Ewe* is required to refrain from sex for 156 weeks following birth compared with 12 weeks for an *Akan*. In terms of lineage, the matrilocal residence of the *Akans* ensures more flexibility in childbearing and upbringing than the patrilocal residence of the *Ewe* and *Mole-Dagbani*. Given this flexibility, an *Akan* woman does not not necessarily bear the overall cost of raising her children. As has been found elsewhere, cost-sharing in the up-bringing of children helps sustain high fertility (e.g., Isiugo-Abanihe, 1985; Goody, 1973).

There are additional research questions spurred by these findings. First, the effect of childhood deaths on reproductive behavior has also been theoretically explained through the insurance effect. This involves having births in excess of one's desired family size with the anticipation that the desired number will survive into adulthood by taking the prevailing mortality conditions into consideration. The higher a couple's perception of possible child loss, the greater will be the excess number of births (Lloyd and Ivanov, 1988). Measuring the insurance effect might require some measure of a couple's perception of prevailing childhood mortality conditions which could be achieved through a qualitative approach. Indeed as Montgomery (1998) has pointed out, there is little understanding of the processes through which childhood mortality perceptions are formed. Are childhood mortality perceptions formed through direct personal experience, observed experience, or through social learning? To further this strand of research, there is a need for multi level studies that explore the relationship among aggregate mortality trends, individual child survival experiences and individual reproductive behaviors. Also, large scale surveys such as the DHS are less useful in arriving at explanations of the observed patterns. The replacement hypothesis, for example, is fundamentally based on a micro decision model of action. Given the patriarchal context of the family and also the influence of the extended family in sub-Saharan Africa, it will be important to know who decides on replacement behavior and when such decisions are made? These are issues that future research could examine through a qualitative approach.

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Table 1: Per cent distribution of the covariates associated with the risk of births in Ghana and Kenya

| VARIABLES | | GHANA 2nd birth | GHANA 3rd birth | GHANA 4th birth | KENYA 2nd birth | KENYA 3rd birth | KENYA 4th birth |
|---|---|---|---|---|---|---|---|
| **DEMOGRAPHIC FACTORS** | | | | | | | |
| SEX OF SURVIVING CHILDREN | | | | | | | |
| Males | | 52.7 | 42.0 | 20.0 | 49.7 | 19.6 | 25.0 |
| Females | | 47.3 | 15.8 | 25.0 | 50.3 | 38.5 | 49.0 |
| Mixed | | - | 33.8 | 55.0 | - | 41.8 | 19.0 |
| AGE COHORT | | | | | | | |
| Under 26 years | | 14.0 | 6.2 | 2.5 | 18.4 | 9.6 | 4.1 |
| 26-36 years | | 44.0 | 43.0 | 38.3 | 46.0 | 47.0 | 44.7 |
| Above 36 years | | 42.0 | 50.8 | 59.0 | 35.6 | 43.4 | 49.0 |
| AGE AT FIRST BIRTH | | | | | | | |
| Under 21 years | | 58.0 | 61.0 | 63.2 | 67.3 | 70.0 | 72.0 |
| **SOCIO-ECONOMIC FACTORS** | | | | | | | |
| LEVEL OF EDUCATION | | | | | | | |
| Secondary | | 36.5 | 32.8 | 30.0 | 22.7 | 20.0 | 16.6 |
| CURRENT PLACE OF RESIDENCE | | | | | | | |
| Rural residence | | 72.7 | 74.7 | 77.4 | 84.5 | 87.0 | 90.0 |
| Urban residence | | 27.3 | 25.3 | 22.6 | 14.5 | 13.0 | 10.0 |
| **SOCIO-CULTURAL FACTORS** | | | | | | | |
| ETHNICITY | | | | | | | |
| Ghana | Kenya | | | | | | |
| Akan | Kikuyu | 45.0 | 44.0 | 42.7 | 15.3 | 14.0 | 12.7 |
| Ga | Kisii | 6.4 | 5.9 | 5.5 | 7.6 | 7.7 | 8.0 |
| Ewe | Kalenjin | 12.4 | 11.4 | 11.3 | 17.6 | 18.4 | 19.3 |
| Mole-Dagbani | Luhya | 36.6 | 34.6 | 36.4 | 15.5 | 14.9 | 15.3 |
| Others | Others | 3.6 | 4.0 | 4.0 | 45.0 | 44.7 | 44.5 |
| MARITAL UNION | | | | | | | |
| Polygynous | | 25.0 | 26.6 | 27.8 | 26.4 | 26.5 | 27.0 |
| Monogamous | | 62. | 61.0 | 60.0 | 63.5 | 64.0 | 64.1 |
| Not married | | 13.0 | 12.4 | 12.2 | 10.1 | 9.5 | 9.0 |
| HUSBAND'S LIVING ARRANGEMENT | | | | | | | |
| Co-residence with husband | | 64.0 | 66.4 | 67 | 63.2 | 65.0 | 66.0 |
| LENGTH OF PRECEDING INTERVAL | | | | | | | |
| Under 19 months | | 8.2 | 8.3 | 8.4 | 17.5 | 28.0 | 16.0 |
| 19-36 months | | 48.0 | 49.0 | 52.0 | 53.4 | 56.6 | 56.0 |
| Above 36 months | | 45.0 | 42.6 | 39.6 | 29.0 | 15.4 | 28.0 |
| **TOTAL** | | **2757** | **2123** | **1609** | **4618** | **3626** | **2849** |

Table 2: Mean number of subsequent births to women at various attained parities by child mortality experience at that parity.

| Number of deaths at each attained parity | ALL WOMEN | | | | WOMEN ABOVE 37 YEARS | | | |
|---|---|---|---|---|---|---|---|---|
| | GHANA | | KENYA | | GHANA | | KENYA | |
| | No. of subsequent births | No. of women | No. of subsequent births | No. of women | No. of subsequent births | No. of women | No. of subsequent births | No. of women |
| First parity | | 3499 | | 5717 | | 1140 | | 1657 |
| 0 | 2.70 | 3192 | 3.01 | 5281 | 4.62 | 1029 | 5.44 | 1511 |
| 1 | 3.72 | 307 | 4.00 | 430 | 5.31 | 111 | 6.74 | 146 |
| Difference (0, 1) | 1.02 | | 1.26 | | 0.69 | | 1.13 | |
| Second parity | | 2798 | | 4618 | | 1097 | | 1611 |
| 0 | 2.36 | 2365 | 2.71 | 4029 | 3.76 | 928 | 3.55 | 1932 |
| 1 | 2.96 | 399 | 3.45 | 519 | 4.41 | 150 | 5.72 | 188 |
| 2 | 3.74 | 39 | 4.41 | 70 | 5.11 | 19 | 6.00 | 31 |
| Difference (0,1) | 0.60 | | 0.74 | | 0.65 | | 2.17 | |
| (0,2) | 1.38 | | 1.70 | | 1.35 | | 2.45 | |
| Third parity | | 2170 | | 3626 | | 1079 | | 1544 |
| 0 | 2.00 | 1961 | 2.47 | 2978 | 2.90 | 811 | 3.71 | 1277 |
| 1 | 2.51 | 398 | 3.04 | 524 | 3.60 | 181 | 4.87 | 218 |
| 2 | 2.85 | 71 | 3.56 | 108 | 3.80 | 80 | 5.26 | 39 |
| 3 | 4.70 | 10 | 4.50 | 16 | 5.30 | 7 | 5.50 | 10 |
| Difference (0, 1) | 0.51 | | 0.57 | | 0.70 | | 1.16 | |
| (0,2) | 0.85 | | 1.09 | | 1.00 | | 1.55 | |
| (0,3) | 2.70 | | 2.03 | | 2.40 | | 1.79 | |
| Fourth parity | | 1642 | | 2849 | | 915 | | 1429 |
| 0 | 1.73 | 1183 | 2.14 | 2201 | 2.34 | 673 | 3.0 | 1113 |
| 1 | 2.15 | 361 | 2.71 | 483 | 3.00 | 187 | 3.9 | 244 |
| 2 | 2.50 | 80 | 3.17 | 127 | 3.51 | 11 | 4.6 | 55 |
| 3 | 3.06 | 16 | 3.20 | 31 | 3.60 | 2 | 4.4 | 12 |
| 4 | 6.00 | 2 | 4.14 | 7 | 6.00 | | 8.6 | 5 |
| Difference (0,1) | 0.42 | | 0.57 | | 0.66 | | 0.9 | |
| (0,2) | 0.77 | | 1.03 | | 1.17 | | 1.6 | |
| . (0,3) | 1.33 | | 1.06 | | 1.26 | | 1.4 | |
| (0,4) | 4.27 | | 2.27 | | 3.66 | | 5.6 | |

Notes: 0= women who have not experienced any child death until that parity; 1= women who have experienced one child death until that parity; 2=women who have experienced two child deaths; 3= women who have experienced three child deaths; 4= women who have experienced four child deaths.

Table 3: A Cox model of covariates associated with the risk of third births, Ghana and Kenya

| | | GHANA | | | KENYA | |
|---|---|---|---|---|---|---|
| | Hazard Ratios | | | Hazard Ratios | | |
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| Status of index child | | | | | | |
| First child died in infancy | 1.35*** | 1.28*** | 1.32*** | 1.22*** | 1.12* | 1.16** |
| Survived (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Second child died in infancy | 2.48*** | 1.80*** | 1.93*** | 2.19*** | 1.67*** | 1.72*** |
| Survived (reference) | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Age cohort | | | | | | |
| 15-25 years | | 0.09*** | 0.11*** | | 0.11*** | 0.14*** |
| 26-36 years | | 0.60*** | 0.59*** | | 0.70*** | 0.69*** |
| Above 36 years (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Age at first marriage | | | | | | |
| Under 21 years | | 1.72*** | 1.60*** | | 2.04*** | 1.64*** |
| Above 21 years (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Education | | | | | | |
| Secondary education | | 0.61*** | 0.62*** | | 0.82*** | 0.78*** |
| Below Secondary (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Residence | | | | | | |
| Urban | | 0.79*** | 0.83*** | | 0.66*** | 0.74** |
| Rural (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Ethnicity | | | | | | |
| **GHANA** **KENYA** | | | | | | |
| Ga Kikuyu | | | 1.00 | | | 0.89* |
| Ewe Kisii | | | 0.91 | | | 1.01 |
| Mole-Dagbani Kalejin | | | 0.75*** | | | 1.14** |
| Others Luhya | | | 1.04 | | | 1.14 |
| Akan (reference) Others (ref) | | | 1.00 | | | 1.00 |
| Type of marital union | | | | | | |
| Polygynous | | | 0.84* | | | 0.93 |
| No married | | | 0.80*** | | | 0.64*** |
| Monogamous (reference) | | | 1.00 | | | 1.00 |
| Spouse's residence | | | | | | |
| co-residence | | | 1.20*** | | | 0.97 |
| Lives elsewhere (reference) | | | 1.00 | | | 1.00 |
| Length of preceding birth interval | | | | | | |
| Under 19 months | | | 1.07 | | | 1.19*** |
| Above 36 mnonths | | | 0.55*** | | | 0.49*** |
| 19-36 months | | | 1.00 | | | 1.00 |
| Sex composition of surviving children | | | | | | |
| All girls | | | 1.41*** | | | 1.28*** |
| Mixed | | | 1.32*** | | | 1.26*** |
| All boys | | | 1.00 | | | 1.00 |
| -2 Log Likelihood | 32882 | 31605 | 31304 | 59392 | 56932 | 56357 |
| Chi-square | 125 | 1403 | 1704 | 137 | 2547 | 3172 |
| Degrees of freedom | 2 | 7 | 18 | 2 | 7 | 18 |
| Significance | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Significance: *** = 0.00; ** 0.01; * = 0.05; ! = 0.10

Table 4: A Cox model of covariates associated with the risk of fourth births, Ghana and Kenya

| | | GHANA | | | KENYA | |
|---|---|---|---|---|---|---|
| | Hazard Ratios | | | Hazard Ratios | | |
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| Status of index child | | | | | | |
| First child died in infancy | 1.32*** | 1.29*** | 1.60*** | 1.24*** | 1.15* | 1.11* |
| Survived (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Second child died in infancy | 1.72*** | 1.49*** | 1.42* | 1.46*** | 1.14! | 1.04 |
| Survived (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Third child died in infancy | 3.14*** | 1.89*** | 1.94*** | 2.88*** | 1.81*** | 1.62*** |
| Third chidl survived (reference) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Age cohort | | | | | | |
| 15-25 years | | 0.03*** | 0.05*** | | 0.04*** | 0.10*** |
| 26-36 years | | 0.40*** | 0.45*** | | 0.55*** | 0.62*** |
| Above 36 years (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Age at first marriage | | | | | | |
| Under 21 years | | 2.02*** | 1.76*** | | 2.15*** | 1.60*** |
| Above 21 years (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Education | | | | | | |
| Secondary education | | 0.58*** | 0.68*** | | 0.72*** | 0.75*** |
| Below Secondary (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Residence | | | | | | |
| Urban | | 0.71*** | 0.75** | | 0.53*** | 0.66** |
| Rural (reference) | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Ethnicity | | | | | | |
| **GHANA** / **KENYA** | | | | | | |
| Ga / Kikuyu | | | 1.00 | | | 0.87* |
| Ewe / Kisii | | | 0.96 | | | 1.15* |
| Mole-Dagbani / Kalejin | | | 0.90* | | | 1.24*** |
| Others / Luhya | | | 0.97 | | | 1.07 |
| Akan (reference) / Others (ref) | | | 1.00 | | | 1.00 |
| Type of marital union | | | | | | |
| Polygynous | | | 0.97 | | | 0.99 |
| No married | | | 0.80*** | | | 0.93* |
| Monogamous (reference) | | | 1.00 | | | 1.00 |
| Spouse's residence | | | | | | |
| co-residence | | | 1.32*** | | | 1.12* |
| Lives elsewhere (reference) | | | 1.00 | | | 1.00 |
| Length of preceding birth interval | | | | | | |
| Under 19 months | | | 1.32*** | | | 1.10* |
| Above 36 mnonths | | | 0.42*** | | | 0.45*** |
| 19-36 months | | | 1.00 | | | 1.00 |
| Sex composition of surviving children | | | | | | |
| All girls | | | 1.65*** | | | 3.17*** |
| Mixed | | | 1.61*** | | | 2.66*** |
| All boys | | | 1.00 | | | 1.00 |
| -2 Log Likelihood | 25202 | 23797 | 23335 | 47166 | 44433 | 43317 |
| Chi-square | 285 | 1592 | 2054 | 212 | 2944 | 4061 |
| Degrees of freedom | 3 | 8 | 19 | 3 | 8 | 19 |
| Significance | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Significance: *** = 0.00; ** 0.01; * = 0.05; ! = 0.10

Table 5: A Cox model on the risk of births by number of surviving children and other covariates

| | | GHANA (HAZARD RATIOS) | | | | KENYA (HAZARD RATIOS) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | THIRD BIRTHS | | FOURTH BIRTH | | THIRD BIRTHS | | FOURTH BIRTH | |
| | | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| Number of dead children | | | | | | | | | |
| Only one dead child | | 1.63*** | 1.54*** | 1.91*** | 1.46*** | 1.45*** | 1.34*** | 1.51*** | 1.18*** |
| Two dead children | | 3.92*** | 2.71*** | 2.68*** | 1.54** | 3.17*** | 2.07*** | 3.08*** | 1.55*** |
| Three dead children | | - | - | 8.42*** | 3.91*** | - | - | 4.04*** | 1.60! |
| No dead child | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Age cohort | | | | | | | | | |
| 15-25 years | | | 0.10*** | | 0.048*** | | 0.14** | | 0.10*** |
| 26-36 years | | | 0.59*** | | 0.44*** | | 0.69*** | | 0.63*** |
| Above 36 years (reference) | | | 1.00 | | 1.00 | | | | |
| Age at first marriage | | | | | | | | | |
| Under 21 years | | | 1.59*** | | 1.80*** | | 1.64*** | | 1.62*** |
| Above 21 years (reference) | | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Education | | | | | | | | | |
| Secondary education | | | 0.79*** | | 0.71*** | | 0.79*** | | 0.75*** |
| Below Secondary (reference) | | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Residence | | | | | | | | | |
| Urban | | | 0.82*** | | 0.75*** | | 0.75*** | | 0.67*** |
| Rural (reference) | | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Ethnicity | | | | | | | | | |
| **GHANA** | **KENYA** | | | | | | | | |
| Ga | Kikuyu | | 0.91 | | 0.98 | | 0.89*** | | 0.87* |
| Ewe | Kisii | | 0.75*** | | 0.89! | | 1.01 | | 1.15* |
| Mole-Dagbani | Kalejin | | 0.92! | | 0.98 | | 1.15*** | | 1.24*** |
| Others | Luhya | | 1.08 | | 1.03 | | 1.14*** | | 1.08 |
| Akan (reference) | Others (ref) | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Type of marital union | | | | | | | | | |
| Polygynous | | | 0.98 | | 0.97 | | 0.93 | | 0.99 |
| No married | | | 0.83*** | | 0.76*** | | 0.64*** | | 0.92 |
| Monogamous (reference) | | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Spouse's residence | | | | | | | | | |
| co-residence | | | 1.23*** | | 1.23*** | | 0.97 | | 1.12** |
| Lives elsewhere (reference) | | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Length of preceding birth interval | | | | | | | | | |
| Under 19 months | | | 1.04 | | 1.23* | | 1.18*** | | 1.07 |
| Above 36 mnonths | | | 0.54*** | | 0.37*** | | 0.49*** | | 0.45*** |
| 19-36 months | | | 1.00 | | 1.00 | | 1.00 | | 1.00 |
| Sex composition of surviving children | | | | | | | | | |
| All girls | | | 1.42*** | | 1.16* | | 1.28*** | | 3.12*** |
| Mixed | | | 1.32*** | | 1.12* | | 1.26*** | | 2.65*** |
| All boys | | | | | | | | | |
| -2 Log Likelihood | | 32909 | 31331 | 25242 | 23396 | 59530 | 56373 | 47225 | 43334 |
| Chi-square | | 99 | 1676 | 147 | 1993 | 106 | 3156 | 153 | 4044 |
| Degrees of freedom | | 2 | 18 | 3 | 19 | 2 | 18 | 3 | 19 |
| Significance | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3.000 | 0.000 |

Significance: *** = 0.00; ** 0.01; * = 0.05; ! = 0.10