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ABSTRACT

A key limitation of existing research on the influence of family structure on child outcomes in cultures characterized by widespread polygamy is the implicit view of marriage as monolithic and by default monogamous. In the African context, there is the need to make a distinction between polygamous and monogamous mothers since these marital circumstances imply varying levels of parental support necessary for optimum child outcomes. Using data from the 1998 and 2003 Ghana Demographic and Health Surveys, this paper assesses the effects of polygamy on child survivorship. The study is guided by competing theses on the interconnectedness between polygamy and child survival. These findings are discussed in relation to the main theoretical paradigms.

KEYWORDS: MARITAL STRUCTURE, POLYGAMY, CHILD SURVIVAL, SUB-SAHARAN AFRICA, GHANA.

In recent years, social scientists have increasingly emphasized the substantial impact of family structure on children's health (Alam, Saha, Razzaque & Van Ginneken, 2001; Amato, 1993; Bennet, 1992; Bennet, Breveman, Egerter & Kiely, 1994; Bhuiya & Chowdhruy, 1997; Brown, 2004; Heaton, Forste, Hoffman & Flake, 2005; Manderbacka et al., 1992; Mauldon, 1990; McLanahan & Sandefur, 1994; Rantakallio & Oja, 1990; United Nations, 1985). In general, children in non traditional families have been found to have poorer outcomes compared with those in intact families with both biological parents. Differential resources have been identified as the main process through which family structure affects child outcomes (Ross, Mirowsky, & Goldsteen, 1990; White and Rogers, 2000). With respect to child health and survival in particular, the presence of a spouse is believed to increase a family's resources necessary for optimal child outcomes.

Despite the considerable work on the influence of family structure on child outcomes, most analyses have been restricted to comparisons between children in married families on one hand and those in other families. A key limitation of this line of research in societies characterized by widespread polygamy is the implicit view of marriage as monolithic and by default monogamous as found in Western industrialized societies. Although some progress has been made toward understanding family structures in various cultures, the scholarship has been dominated by knowledge of Western societies (Adams, 2004). Polygamy in particular constitutes one of the distinctive features of the African marriage and while its frequency may be declining, it is still widely practiced (Westoff, 2003). Indeed, sub-Saharan Africa is the only major global region where the practice remains widespread, accounting for about 20-50 percent of all marriages (Caldwell & Caldwell, 1990). A recent comparative study suggests that for the

most part, there has only been a modest decline in the proportion of women in polygamous marriages in the last 25 years (Timaues & Reynar, 1998). Homogenizing married women in such cultures may conceal subtle but important factors that impact on child outcomes. In the context of sub-Saharan Africa thus, there is the need to make a distinction between polygamous and monogamous mothers since these marital circumstances imply varying levels of parental support necessary for optimum child outcomes. There is evidence, for example, that per capita resource differs remarkably between polygamous and monogamous households (Gage, 1997), which may significantly bear on child health and survival. The question of interest therefore is whether the presence of other women in the conjugal unit could mediate the presumed health advantages of marriage.

Given the centrality of polygamy in shaping family life in the region, it is not surprising that the literature is replete with studies that have assessed its link with reproductive-related outcomes such as fertility and contraception (e.g., Effah, 1998, Ezeh, 1997; Dodoo, 1998; Isaac & Feinberg, 1982; Pebley & Mbugua, 1987). Unfortunately, the polygamy-child survival nexus has garnered less attention. Understanding this link may however enhance our comprehension of the differential effect of marriage forms on child outcomes in a non Western society.

Although some work has been done on the link between polygamy and child survival (Borgerhoff & Mulder, 1990; Chilsom & Burbank, 1991; Chojnacka, 1980; Isaac & Feinberg, 1982; Roth & Kurup, 1988; Strassmann, 1997), they are mostly based on localized studies and

rigorous empirical assessments have not been done in most cases (for exceptions, see Amankwa, Eberstein, & Schmertmann, 2001; Amey, 2002). Additionally, prior empirical work has given little consideration to the possibility that the effects of polygamy may not be uniform over the entire childhood period. Extant research may not fully assess the effect of polygamy on child survival if the interactional dynamics are ignored. It is the aim of this study to address these concerns and contribute to the limited empirical studies on the subject in sub-Saharan Africa. In this paper, we assess the nature of the association between marital type and child survivorship in Ghana, a society historically characterized by widespread polygamy. Recent data indicate only a modest decline in the prevalence of polygamy in Ghana in the last quarter century (see Timaues & Reynar, 1998) making it an ideal setting for this study. Using data from the 1998 and 2003 Demographic and Health Survey, we not only examine the effects of polygamy but also investigate whether this relationship is consistent over time net of other characteristics.

Theoretical perspectives on polygamy and child survival

Although there is little substantive theory linking polygamy and child survival in particular, the mostly anthropological literature contains suggestions on the underlying mechanisms (Amankwa, 1997; Amankwa et al., 2001; Borgerhoff & Mulder, 1990; Chilsom &

Burbank, 1991; Gage, 1997; Hames, 1996; Isaac & Feinberg, 1982). Drawing from this literature, two competing paradigms can be identified. The first posits that polygamy impairs the survival chances of children while the other premises that it enhances survivorship. While these pathways cannot be directly tested given the limitation of data, they nonetheless provide the organizing framework for our ideas.

The first school links polygamy with high child mortality through resource constraints, paternal investment, and selectivity. The resource constraint thesis is premised on the notion that the usually large polygamous households are associated with low resource per head which adversely impacts on child health and survival. Notwithstanding the conflicting views on the fertility implications of polygamy for individual women (see Ezeh, 1997), the overall family size of polygamous households tends to be larger than their monogamous counterparts. Exploratory analysis of currently married women from 2003 Ghana Demographic and Health Survey, for example, indicates a mean household size of 8.6 for those in polygamous marriages compared with 5.6 for their counterparts in monogamous marriages. Similar differences are discernible in the mean number of children (under five years) which is considerably higher in polygamous households (2.3) than in the monogamous ones (1.67).

Thus, while wealth may be a decisive factor for a man in securing multiple wives in many polygamous cultures, few may have sufficient resources to effectively support multiple conjugal units (Mulder, 1992). As a result, the husband's resources may be thinly spread among his wives and children such that wealth per capita may not follow the same pattern as household wealth. This is substantiated by qualitative studies that indicate fewer assets for women in polygamous marriages compared to their counterparts in monogamous marriages (Chonjacka,

1980; Hames, 1996). The resource stress may lead to overcrowding and poor living conditions which could potentially increase the vulnerability of children in polygamous families to diseases and perhaps death. In a recent study in Ghana, for example, the risk of diarrhea was found to be 43 percent higher among children in polygamous households compared with their monogamous counterparts (Gyimah, 2003). The lack of resources can also limit access to modern health care particularly with the cash-and-carry system introduced in much of sub-Saharan Africa as part of the World Bank/IMF sponsored Structural Adjustment Program of the 1980s.

Strassmann (1997) has also theorized a harmful effect of polygamy on child survival through the idea of paternal investment. She argues that because polygamous fathers produce many offspring, each particular child is less important to his life time reproductive success unlike monogamous fathers who have a greater stake in the survival of their children. Thus, emotional attachment which is important in promoting active childcare may be lacking. The implication is that children in polygamous households may be less catered for and therefore exposed to a higher risk of death than their monogamous counterparts. In a prospective study of the Dogon of Mali, for example, she found that the odds of childhood deaths were 7-11 times higher in groups with polygamy. Similar findings have come from studies in Uganda (Brambhatt et al, 2002; Ntozi & Nakanabi, 1997).

The main tenet of the selectivity thesis is that rural residents and less educated women are more likely to be in polygamous marriages (see Hayase & Liaw, 1997; Westoff, 2003). Women with these characteristics, however, tend to be more traditional in outlook and traditionalism is associated with low status of women. Such women are often less likely to participate in modern health care including maternal and child health programs. In Kenya, for

example, Gage (1997) found that children in polygamous marriages were less likely to be fully immunized than their counterparts in monogamous unions. Such mothers could thus be holding to customarily childcare practices that may be inimical to the welfare of their children. This is particularly true in Ghana where there are customs and rituals that impinge negatively on children's nutritional status and health (Adongo et al., 1997; Ghana and UNICEF, 1990; Gyimah, 2002).

The other school associates polygamy with an enhanced child survivorship primarily through proximate factors such as longer breastfeeding patterns and inter-birth intervals as well as co-wife social and economic cooperation. Amankwa and colleagues (2001), for example, contend that polygamy represents indigenous population adaptation with presumed positive effects on maternal and child health. Amankwa (1997) argues that polygyny reduces the risk of infant mortality through a complex web of intermediate factors such as prolonged breastfeeding and longer durations of the inter-birth intervals which are relevant for child health and survival.

Longer birth spacing has a positive impact on maternal and child health through the dynamics of *sibling competition* and *maternal depletion* hypotheses (Hobcraft, McDonald, & Rsutein, 1985; Palloni & Millman, 1986; Pedersen, 2000; Rafalimanana & Westoff, 2000). A short birth interval is strongly correlated with mortality. Also, children close in age often must compete for resources and maternal care and lastly, short birth spacing is associated with an increased exposure to infectious disease by the younger child. Given these empirical regularities, it is reasonable to expect polygamy to enhance survival from a theoretical stand

point. There is also some anthropological evidence that co-wives often cooperate in supporting each other in polygamous households which could bear positively on child health (Chisholm & Burbank, 1990; Isaac & Feinberg, 1982). With multiple mothers, children in polygamous families have the advantage of being catered for by an adult in the absence of the biological mother. It has also been argued that rivalry and competition among co-wives in polygamous marriages ensure that considerable efforts are made to ensure the survival of their own children

Hypotheses

While these theoretical paradigms seem to offer contradictory views on the nature of the association between polygamy and child survival, available evidence generally supports the view that polygamy is deleterious to survival. Indeed, some studies suggest that the presumed positive pathways through which polygamy enhances child survival are not empirically supported. In a study in Nigeria, for example, Adewuyi (1987) found no dramatic difference in the mean length of the inter-birth interval and breastfeeding duration between women in monogamous and polygamous marriages. With respect to co-wive co-operation, some recent work suggests that such support may be waning due to the increasing tendency of spousal separation (Gage, 1995). Even in contexts where there is co-residence, the relationship is often unfriendly as a result of the preferential treatment of particular spouses and their children by the husbands. In such contexts, women generally tend to support their own children rather than those of their co-wives (see Oni,1996). Consistent with existing work thus, we expect children in polygamous households to have a higher risk of death than their monogamous counterparts.

There is also a relative dearth of research assessing whether the effect of polygamy is uniform over the entire childhood period. It is plausible to argue that the effects may not be consistent over the entire childhood period. This is the approach we take in this paper by contending that the effects of polygamy may depend on the segment of the childhood mortality curve considered. Specifically, we expect the effects of polygamy to be more pronounced in later childhood primarily because the presumed protective effect would have less impact on survivorship at this stage while the harmful effect could be more pronounced. Given the limitation of the data, however, we are not interested in testing any particular pathway linking polygamy with lower survival probabilities.

METHODS

Data

The 1998 and 2003 Ghana Demographic and Health Surveys (GDHS) were used for the study. These surveys respectively represent the third and fourth in the series of similar surveys undertaken by the Ghana Statistical Service in collaboration with Macro International. Both surveys are nationally representative, stratified, self-weighting probability sample of women in the reproductive ages of 15 to 49 years. While the surveys were not specifically designed to evaluate a polygamy-child mortality nexus, information on personal, household, birth and

marital characteristics was obtained from respondents and can thus be used to examine our research question.

The sample sizes were 4843 and 5691 women in1998 and 2003 respectively. The 1998 sample contributed a total of 3298 children while the 2003 sample had 3488 births in the five years preceding the survey. This study is restricted to these recent births for the following reasons. First, the quality of information on such births is better than births that occurred years ago which are associated with a higher likelihood of displacement of vital events such as age at death for deceased children. Again, focusing on recent births reduces the problems associated with period effects of child mortality and lastly, it also ensures that maternal and household characteristics relate to current conditions. As will be discussed shortly, the last objective in particular has methodological relevance regarding the measurement of polygamy.

Measurement issues

Table 1 presents the operationalization of the variables used for the study. Polygamy, the main independent variable, is measured by self reports of married women to a question on the number of additional spouses their husbands had. Women who indicated that their husbands had no other wives were coded as monogamous while those whose husbands had other wives were coded as polygamous. Theoretically, a more coherent approach to understanding the effect of polygamy on child survivorship is to measure type of marital union at the birth and upbringing of the child. This derives from the fluidity of marriages in the African context as every

monogamous marriage is potentially polygamous and vice-versa (Ezeh, 1997). The major methodological hurdle then is whether a mother's marital type reflects the conditions under which her children were born and raised. To circumvent the problem and potentially minimize this bias, we followed the approach adopted by Amey (2002) by further restricting the analysis to only children of currently married women in their first union. This restriction yielded effective sample sizes of 2214 and 2735 children for the 1998 and 2003 samples respectively.

The outcome variable is the risk of death in childhood (0-59 months) measured as duration from birth to the age at death or censored. Since most children were censored at the time of the survey, an event history model was used to account for censoring in the estimation of exposure time in the multivariate analysis. Children contributed data records for each time unit from birth until they died or were censored. In the DHS, age at death, reported in days and months, is subject to heaping at certain ages. Given this, a discrete formulation of time was preferred to a continuous one. Discrete time models require that episodes be split into periods of risks (Singer & Willet, 2003). Because the risk of death fluctuates less by age in later childhood period, time was unevenly split into five risk groups as 0-3months, 4-6 months, 7-11 months, 12-23 months; 24 months and above, with dummies for each duration. Each child contributed one observation for each time period through which she survived. This resulted in a total of 8864 observations from the 2214 children in the 1998 sample, and 10,940 observations from the 2735 children in the 2003 sample. The discrete time hazard model is specified as

$$\log e\left(\frac{h_{ij}}{1-h_{ij}}\right) = (\alpha_1 D_{1ij} + \alpha_2 D_{2ij} + \cdots \alpha_j D_{jij}) + (\beta_1 Z_{1ij} + \beta_2 Z_{2ij} + \cdots \beta_p Z_{pij})$$

where,

$\log e \frac{h_{ij}}{1 - hi_j}$ is log odds of dying at period j,

are the sequence of dummies indexing the five time periods; and

$(\alpha_1 D_{1ij} + \alpha_2 D_{2ij} + \cdots \alpha_j D_{jij})$

$(\beta_1 Z_{1ij} + \beta_2 Z_{2ij} + \cdots \beta_p Z_{pij})$

are the regression coefficients for observed heterogeneity. The coefficients in the multivariate models are to be interpreted as the effects of a given variable on the log odds of dying. For categorical variables, negative coefficients suggest a lower risk while positive coefficients imply a greater risk. The coefficients can also be exponentiated and interpreted as odds ratio.

DHS data typically have a hierarchical structure due mainly to randomly sampling naturally occurring groups in the population with children nested within mothers. Most women contributed more than one child to the sample and such children are expected to be more alike at least in part because they share common characteristics thus violating the independence assumption of conventional regression models. Unless some allowance is made for clustering, standard statistical methods are no longer valid as they generally underestimate the variance. To account for heterogeneity and possible clustering within households, we used the Huber-White sandwich estimator to produce robust variance estimates (StataCorp, 2003; White, 1980; Williams, 2000). This approach allows observations to independent between but not within households.

Besides polygamy, controls were incorporated for bio-demographic, socio-economic and household factors traditionally known to affect child mortality. These included maternal age at birth, single or multiple birth, birth order of child, breastfeeding duration, length of the birth interval, mother's education, household size and facilities, place of residence, religion, place of

delivery and the use of prenatal services (Hobcraft, McDonald & Rustein, 1985; Kuate Defo,1996; Palloni & Millman,1986; Pebley & Millman,1986; Pedersen,2000; Majumder et al., 1997; Rafalimanana & Westoff, 2000).

RESULTS

Table 2 presents descriptive statistics of the samples by marital type. Although descriptive, these percentages highlight some differences between polygamous and monogamous families. On one hand, there is evidence that children whose mothers are highly educated, live in urban areas and have better household facilities are less likely to be in polygamous marriages than monogamous ones, confirming the selectivity thesis. The differences by maternal education are quite striking. In both sample, more than 80 percent of the children in polygamous households have mothers with less than secondary school education. Also, more than 60 percent of those in polygamous families live in households without toilet facilities compared with about a third of those in monogamous families. On the other hand, children in polygamous families tend to have wider birth spacing and are breastfed for longer duration than their monogamous counterparts although the differences are not significant. Prevalence of polygamy is also higher

among Moslems than non Moslems. It needs to be noted that these differences between polygamous and monogamous families would have significant bearing on child survival.

Figure 1 shows the survival functions of children distinguished by type of marital union for the 1998 and 2003 samples. Evidence from the both graphs provides some support for the hypothesis that the effect of polygamy may not be uniform over the entire childhood period. While children in polygamous households tend to have lower survival probabilities than their monogamous counterparts, the differences are more pronounced in later childhood for both the samples. This duration-dependence could not be due to sampling variability but points to interactional dynamics. Perhaps the non-significant findings in recent work in Ghana (Amankwa et al, 2001) which only examined the neonatal and the infant stage may be attributed to the failure to model the interactional dynamics.

In the multivariate models, we will explore if the marital difference in survivorship could be attributed to the control variables. The association between marital type and child survival as shown in Figure 1 may be spurious due to the confounding effects of the control variables. The gross effects of the control variables on under five mortality as shown in Table 3 are consistent with extant research. The risk of death is highest in the 0-3 months period but declines with age although non linearly. Also, lower mortality rates are discernible among children of highly educated mothers as well as those in households with better facilities. In particular, children of highly educated mothers are about 30 percent less likely to die in childhood compared with those of less educated mothers in both samples. Survival probabilities are lower among rural residents than their urban counterparts. Among the 2003

sample, for example, children of rural residents are about 57 percent more likely to die than their urban counterparts. Similar consistent patterns are discernible on household facilities.

The effects of the bio-demographic variables are also in consonance with theoretical predictions. For both samples, the risk of death is considerably higher among children of teenagers as well as first order births. In the 1998 sample, for example, the risk of death is about 92 percent higher among children of teenage mothers compared with mothers aged 20-29 years. Breastfeeding duration and the length of the inter-birth interval have significant positive effects on survivorship. For breastfeeding in particular, the risk of death reduces by 17 percent and 24 percent for each additional month of breastfeeding for the 1998 and 2003 samples respectively. With respect to the use of health facilities, the results suggest that the risk of death is significantly higher among children whose mothers did not attend prenatal services.

Overall, the bivariate results suggest significant associations between the control variables and child survivorship. However, given the associations between the control variables and marriage type as discussed in Table 2, the question arises as to whether polygamy has an independent effect on survival net of these variables. In the multivariate analysis thus, the risk of death is modeled as a function of polygamy net of the control variables. Model 1 which tests the null hypothesis that polygamy does not have an independent effect net of the control variables can be rejected. In both samples, there is considerable evidence that children in polygamous families have a significantly higher risk of death than their monogamous counterparts net of the control variables. For the 2003 sample in particular, the risk of death is about 90 percent higher (exp b) in polygamous households than

monogamous ones after controlling for the observed characteristics. Model 1, however, constrains the effects of polygamy to be identical in each time period in childhood, yielding a hazard function that is equidistant on a logit scale. Revisiting our second hypothesis and aided by the survival plots in Figure 1, there are reasons to believe that the effects of polygamy may not be identical at all time periods as Model 1 suggests.

In Model 2 therefore, we test the hypothesis that the effect of polygamy is not consistent across all periods by including interaction between polygamy and time. This allows the effects of polygamy to differ in each time period. The results of this unconstrained model support the hypothesis that the effect of polygamy is not consistent over the entire childhood period. The significance of the interactions terms suggests that the while polygamy generally associates with higher mortality in childhood, the risk is highest in the later childhood. In both samples, the effect is more pronounced in periods after 24 months of age confirming the duration-dependence. Without accounting for the interaction with time, one will be tempted to conclude that polygamy uniformly affects the risk of death in childhood while this is clearly not the case. Perhaps the less pronounced effects of polygamy in early childhood can be attributed to the protective effect of the proximate factors (breastfeeding duration) which tend to ameliorate the deleterious effect. In later childhood, however, the proximate factors of breastfeeding duration and the inter-birth interval have less impact on survivorship and may therefore not provide the protective effect they offer in early childhood.

Turning to the control variables, while their effects are consistent with previous work, some are insignificant due perhaps to sample size.

CONCLUSION

A major limitation of previous research on the effects of family structure on child outcomes in the context of sub-Saharan Africa is the implicit view of marriage as monogamous. We argue that in societies characterized by widespread polygamy, it is useful to distinguish between monogamous and polygamous marital structures to unravel their effects on child outcomes. Among others, the need for this distinction derives from the remarkable differences in household resources which could significantly impact on child outcomes. Although previous studies have assessed the link between polygamy and child survival in sub-Saharan Africa, they have been mostly based on qualitative work without controlling for potential confounders.

In this paper thus, we pursued the question of whether there are child survival differences between monogamous and polygamous families using data from the 1998 and 2003 Ghana Demographic and Health Surveys. Guided by previous research, we expected children in polygamous households to be at a higher risk of death than their monogamous counterparts primarily through the resource constraint, paternal investment and selectivity.

Additionally, given that the presumed protective effects of polygamy are age dependent, we expected the effects of polygamy to be more pronounced in later childhood.

Overall, the empirical results support the arguments made that it is important to distinguish between two types of marriage forms in cultures characterized by polygamy. In the multivariate analyses, children in polygamous marriages were consistently found to be at a higher risk of death compared to those in monogamous families. In models with interactions, the effect of polygamy was also found to time-dependent with the effect being more pronounced in the later childhood. In much of the literature, differential household resources have been identified as the major pathway through which family structure affects child outcomes. It has been argued that children in married families have a larger pool of resource than those in other families, hence the better outcomes for such children. The results presented here is consistent with this reasoning given the differential resources between polygamous and monogamous households. While several indicators of selectivity and parental resources such as maternal education, household size, place of residence and household facilities were controlled in the multivariate models, polygamy was found to exert an independent effect on survival. It is important to note, however, that the limitation of the data make it impossible to attribute the lower survival probabilities in polygamous households directly to any of the pathways discussed.

This study extends research on family structure and child well being by making a distinction between polygamous and monogamous marriages. The findings presented here suggest that such a distinction is necessary in unraveling the complexities characterizing the relationship between family structure and child outcomes in societies with widespread

polygamy. It appears that residing in a polygamous household is associated with lower child survival probabilities regardless of parental and household resources. The interpretation is at best conservative because it is likely that the effects of unmeasured factors such as parental monitoring and support not available in the data may alter the effects of marital type reported here. Although this is a limitation, the present study nonetheless provides the base from which further studies can be designed. Future work may also assess if the rank of a wife in a polygamous marriage affects the survival chances of her children. The need derives from studies that suggest that wives in polygamous marriages are preferentially treated by their husbands based on rank. Questions of whether such differential treatment filters down to the children and whether that impacts on their survival chances are issues future research could examine.

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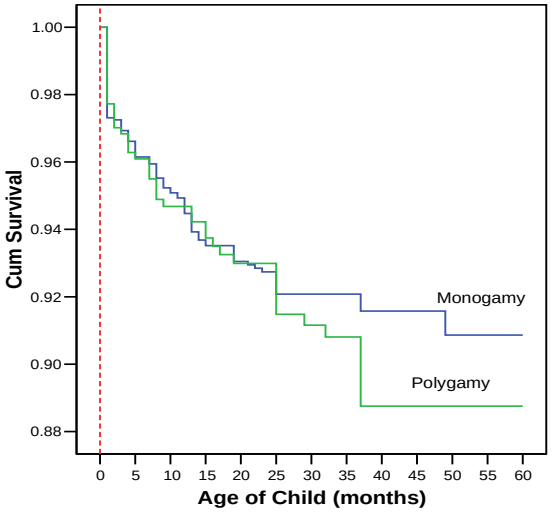
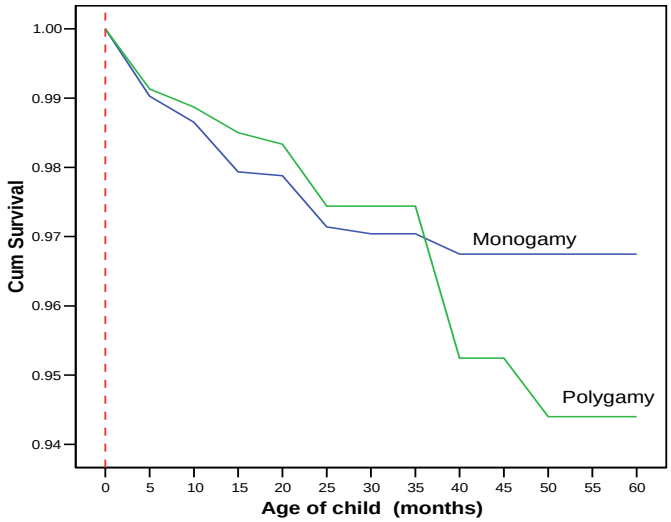
Figure 1: Child Survival Plot by Marital Type in Ghana, 1998 and 2003.

(a) 1998 Ghana Demographic and Health Survey





(b) 2003 Ghana Demographic and Health Survey

Table 1: Operationalization and Description of Variables

VARIABLE	**OPERATIONALIZATION**
Type of marital union	Dummy variable coded 1 if the child's mother is in a polygamous union
Age of child	Age of child at interview categorized into five groups as 0-3 months, 4-6 months; 7-11 months; 12-23 months; 24 months and above
Singleton birth	Dummy variable coded 1 if child is a singleton
Mother's age at birth of child	Age of mother at the birth of child categorized into three groups as under 20 years, 20-29 years; 30 years and above.
Birht order of child	The birth order of child grouped as first birth, 2-3 birth orders, 4-6 birth orders, 7+ birth order.
Length of the inter-birth interval	Measured as the duration (in months) between successive births.
Duration of breatfeeding	Measured as months of breatfeeding. Missing data were imputed by EM method.
Mother's education	A dummy coded 1 if the mother has at least secondary education.
Household toilet facilities	A dummy coded 1 if child lives in a house with a toilet.
Household drinking water facilities	Household water grouped as piped water, well/bore hole; river/dam/lake.
Place of current residence	A dummy coded 1 if child lives in a rural area.
Religion	A dummy coded 1 if mother is a Moslem.
Prenatal care	A dummy coded 1 if mother did not attend prenatal care.
Delivered at home	A dummy coded 1 if mother delivered at home.

Table 2: Percentage Distribution of Children (0-59 months) by Marital type and selected characteristics

VARIABLES	1998			2003		
	Monogamy	Polygamy	Total	Monogamy	Polygamy	Total
Type of marital union						
Monogamous	-	-	74.0	-	-	75.9
Polygamous	-	-	26.0	-	-	24.1
Mother' education						
Less than secondary	61.0	83.0	67.0	63.4	90.8	70.1
Secondary and above	39.0	17.0	33.0	36.4	9.2	29.9
Place of current residence						
Urban	23.0	12.0	20.0	30.5	14.5	26.7
Rural	77.0	88.0	80.0	69.5	85.5	73.3
Household water facilities						
Piped water	29.5	11.9	24.9	26.7	12.1	23.2
Household toilet facilities						
None	36.0	63.0	43.0	34.6	69.7	43.0
Had toilet	64.0	37.0	57.0	65.4	30.3	57.0
Mother's age at birth						
Under 20 years	14.0	9.0	12.0	12.9	7.0	11.4
20-29 years	57.0	45.0	13.0	54.7	43.3	51.9
30 years and above	30.0	45.0	45.0	32.5	49.7	36.9
Birth order of child						
First	27.0	15.0	24.0	27.1	12.9	23.7
2-3	37.0	33.0	36.0	36.3	31.2	35.1
4-7	26.0	37.0	29.0	27.2	37.4	29.7
7 and above	10.0	15.0	11.0	9.4	18.5	11.6
Singleton births	96.0	97.0	96.0	96.2	97.3	96.5
Median birth interval (months)	35	36	39	35.00	38.00	36.00
Median breastfeeding (months)	16	18	16	18.00	18.00	18.00
Mean number of children under 5 years	1.66	2.46	1.87	5.60	8.60	6.90
Moslem	13.8	24.3	16.5	18.60	37.90	23.20
Did not have prenatal care from a prefessional	12.5	26.2	16	5.30	10.20	6.50
Delivered baby at home	57	80	63	53.40	75.50	58.70
Mean number of children under 5 years	1.66	2.46	1.87	1.67	2.35	1.83
Total sample	1642	572	2214	2075	660	2735

Notes: Based on children of currently married women in their first unions.

Table 3: Bivariate Discrete Time Hazard Models of Child Morttality and the Control Variables, Ghana, 1998 & 2003

Variables	1998		2003	
	B	EXP B	B	EXP B
Age of child (11-23 months as reference)				
0-3 months	0.75**	2.12	1.36***	3.90
4-6 months	-0.86**	0.42	-0.60!	0.55
7-11 months	-0.24	0.79	-0.90**	0.41
24 months and above	0.18	1.20	0.18	1.20
Singleton (twin birth as reference)				
Singleton	-0.61!	0.54	-1.47***	0.23
Mother's age at birth (20-29 years as reference)				
Under 20 years	0.65**	1.92	0.41*	1.51
30 years and above	0.13	1.14	0.08	1.08
Birth order of child (First born as reference)				
2-3	-0.63**	0.52	-0.42*	0.66
4-7	-0.29	0.75	-0.10	0.90
7 and above	-0.47	0.63	0.10	1.11
Length of inter-birth interval (months)	-0.03***	0.97	-0.03***	0.97
Duration of breatfeeding (months)	-0.19***	0.83	-0.27***	0.76
Mother' education (Below secondary as reference)				
Secondary and above	-0.39*	0.68	-0.34*	0.71
Household toilet facilities (None as reference)				
Flush toilet	-0.43**	0.65	-0.64!	0.53
Other toilets			-0.09	1.09
Household water facilities (Borehole/well as reference)				
Treated water	-0.87**	0.42	-0.36!	0.70
Otherwise	-0.44*	0.64	-0.01	0.99
Place of current residence (Urban residence as reference)				
Rural	0.69**	1.99	0.45***	1.57
Religion (Non Moslems as reference)				
Moslem	0.21	1.23	0.27!	1.31
Did not attend prenatal care (Had prenatal care as reference)	0.52**	1.68	1.04***	2.83
Delivered at home (Delivered at health institution as reference)	0.31!	1.36	0.01	1.09
Number of children under 5 years in household	-0.85**	0.43	-1.13***	0.32

Statistical significance: ***p<0.001. **p<0.01. *p<0.05. !p<0.10.

Table 4: Parameter Estimates from a Discrete Time Hazard Models of Child Mortality in Ghana, 1998 and 2003

Variables in the Model	1998		2003	
	Model 1	Model 2	Model 1	Model 2
Type of marital union (Monogamy: reference)				
Polygamous	0.80***	-	0.64 (0.24)**	-
Age of child (time)				
0-3 months	3.95***	3.92***	2.14 (0.75)***	2.14 (0.75)***
4-6 months	3.00***	3.01***	0.78 (0.80)	0.80 (0.80)
7-11 months	3.97 ***	4.16***	0.84 (0.91)	0.81 (0.90)
12-23 months	4.58 ***	4.62***	2.19 (0.79)***	2.24 (0.78)***
24 months and above	4.85***	4.40***	2.50 (0.77)***	1.97 (0.76)**
Singleton (reference twin)				
Singleton	-1.67***	-1.68***	-1.57 (0.31)***	-1.57 (0.31)***
Mother's age at birth (20-29: reference)				
Under 20 years	0.21	0.22	0.18	0.16
30 years and above	0.56 *	0.58*	-0.11	-0.11
Birth order of child (First: reference)				
2-3	0.28	0.28	0.4	0.39
4-7	0.55*	0.54*	0.61	0.63
7 and above	0.13	0.13	0.96!	0.92!
Length of inter-birth interval (months)	-0.05***	-0.05***	-0.02***	-0.02***
Duration of breatfeeding (months)	-0.21***	-0.21***	-0.25***	-0.26***
Mother' education (Below secondary:reference)				
Secondary and above	-0.14	-0.13	-0.12	-0.12
Household toilet facilities (None: reference)				
yes	-0.43!	-0.43!	-0.23	-0.19
Household water facilities				
Treated water	-1.04**	-1.05**	0.22	0.22
Otherwise	-0.70 *	-0.69*	-0.05	-0.06
Place of current residence (Urban: reference)				
Rural	0.46	0.48	0.65	0.67
Religion (Non Moslem as reference)				
Moslem	0.32	0.36	0.50*	0.51*
Did not attend prenatal care	0.46!	0.48!	1.88***	1.88***
Delivered at home	0.09	0.09	0.06	0.06
Number of children in household	-1.48***	-1.48***	-1.67***	-1.67***
Polygamy-Age (time) interaction				
Polygamy*0-3 months		0.8		0.33
Polygamy*4-6 months		0.67		0.38
Polygamy*7-11 months		-0.09		0.59
Polygamy*12-23 months		0.57		0.19
Polygamy*24 months+		1.90**		2.21***
Number of observations	8864	8864	10940	10940
Deviance	1068	1060	947	937
Prob > LR	0.000	0.000	0.000	0.000

Notes: Statistical significance: ***p<0.001. **p<0.01. *p<0.05. !p<0.10.