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Polygynous Contexts, Family Structure, and Infant Mortality in sub-Saharan Africa

Emily Smith-Greenaway[1] and
Department of Sociology, Population Research Institute, Penn State University

Jenny Trinitapoli
Department of Sociology, Population Research Institute, Penn State University

Abstract

Contextual characteristics influence infant mortality above and beyond family-level factors. The widespread practice of polygyny is one feature of many sub-Saharan African contexts that may be relevant to understanding patterns of infant mortality. Building on evidence that the prevalence of polygyny reflects broader economic, social, and cultural features, and has implications for how families engage in the practice, we investigate whether and how the prevalence of polygyny (1) spills over to elevate infant mortality for all families, and (2) conditions the survival disadvantage for children living in polygynous families (i.e., compared to monogamous families). We use data from Demographic and Health Surveys to estimate multilevel hazard models that identify associations between infant mortality and region-level prevalence of polygyny among 236,336 children in 260 subnational regions across 29 sub-Saharan African countries. We find little evidence that the prevalence of polygyny influences mortality for infants in non-polygynous households net of region-level socioeconomic factors and gender inequality. However, the prevalence of polygyny significantly amplifies the survival disadvantage for infants in polygynous families. Our findings demonstrate that considering the broader marital context reveals important insights into the relationship between family structure and child wellbeing.

Keywords

Family Structure; Context; Polygyny; Infant Mortality; sub-Saharan Africa

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Introduction

Polygyny, the practice of one man being married to multiple wives at the same time, is a common family structure in many parts of sub-Saharan Africa. A growing literature exploring the child health implications of living in polygynous families has linked polygyny to both positive (Amankwa 1997; Amankwa, Eberstein, and Schmertmann 2001) and negative (Gage 1997; Gyimah 2003; Westoff 2003) determinants of child survival; however, generally speaking, children in polygynous families experience poor health and high mortality.[1] Compared to children in monogamous families, they are more likely to be nutritionally deficient (Gibson and Mace 2007; Hadley 2005) and their risk of mortality before age five is elevated by about 16 percent (Amey 2002; Gyimah 2009; Omariba and Boyle 2007; Strassman 1997).

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[1]Department of Sociology, The Pennsylvania State University, 211 Oswald Tower, University Park, PA 16802, USA, egs136@psu.edu.

[1]One study using the 1990 Nigerian DHS shows that while polygyny is not associated with survival during the neonatal and childhood periods, it is *positively* associated with child survival during the post-neonatal period (Ukwuani, Cornwell, and Suchindran 2002).

The existing literature on polygyny and child health treats the practice exclusively as a characteristic of families. But polygyny is more than an individual family structure; it represents a specific cultural approach to marriage, family, and reproduction. Researchers often describe the entire region of sub-Saharan Africa as polygynous (e.g., Timæus and Reynar 1998), but in reality, there is tremendous variation in the prevalence of the practice both within and between countries (Lesthaeghe 1989; Murdock 1967; Reniers and Watkins 2010). Settings in which polygyny is widespread tend to be economically, socially, and culturally distinct from those in which the practice is rare. For example, polygyny is most common in rural, agrarian contexts (Boserup 1985; Jacoby 1995). Beyond these socioeconomic differences, widespread polygyny also reflects a distinct set of cultural customs (Bradley 2004; Hayase and Liaw 1997; Tobias 2001), which are evident in the unique demographic patterns (Cahu, Falilou, and Pongou 2011; Ezeh 1997) and gender norms that characterize highly polygynous settings (Agadjanian and Ezeh 2000; Cahu, Falilou, and Pongou 2011).

The distinct economic, social, and cultural features of highly polygynous settings suggest that, beyond its implications for the families that practice it, the contextual prevalence of polygyny may be relevant to understanding patterns of infant mortality in sub-Saharan Africa. The contextual prevalence of polygyny could be associated with infant mortality spuriously, through its relationship with socioeconomic disadvantage (Boserup 1985; Jacoby 1995). Alternately, the shared experience of living in a setting where polygyny is culturally normative, reflecting widespread gender inequality (Agadjanian and Ezeh 2000; Cahu, Falilou, and Pongou 2011), may lead to a more direct association between the contextual prevalence of polygyny and infant mortality. Furthermore, because polygyny in highly polygynous settings is socially and economically distinct from polygyny where the practice is uncommon (Gwako 1998; Kilbride and Kilbride 1990; Zeitzen 2008), the contextual prevalence of polygyny may condition the survival disadvantage associated with living in a polygynous family.

In this paper, we investigate whether and how the prevalence of polygyny may (1) spill over to elevate infant mortality for all families or (2) condition the survival disadvantage for infants in polygynous families (i.e., compared to monogamous families). We use data from Demographic and Health Surveys (DHS) to estimate a series of multilevel discrete-time hazard models among 236,336 children in 260 subnational regions in 29 sub-Saharan African countries. Our findings suggest that known relationships between family structure and child wellbeing vary according to the broader marital and cultural context.

BACKGROUND

Polygyny is practiced in contemporary societies on all continents (Zeitzen 2008). Although the practice is declining worldwide, it remains particularly resilient in parts of sub-Saharan Africa (Van de Walle 2006). Demographers have long recognized polygyny’s salience to multiple aspects of Africa’s demographic landscape (Dorjahn 1959; Muhsam 1956) and have studied its implications for the individuals in such unions and their children. Research on the implications of polygyny for children, in particular, demonstrates that children in polygynous families experience significant health and survival disadvantages (Amey 2002; Gage 1997; Gibson and Mace 2007; Gyimah 2009; Hadley 2005; Omariba and Boyle 2007; Strassman 1997).

Why do children in polygynous unions experience health disadvantages compared to their peers in monogamous families? The principal hypothesis for the polygyny-child health disadvantage is resource dilution (Desai 1995). According to this perspective, even if polygynous men are wealthier than their monogamously married counterparts, the greater number of women and children in polygynous households dilutes the per capita resources and, in turn, increases children's susceptibility to poor nutrition, illness, and ultimately, mortality. But empirical support for the resource dilution hypothesis is mixed. Polygynous children in Ethiopia and Tanzania, for example, experience poorer nutritional outcomes (Hadley 2005; Sellen 1999); however in other contexts, there is no meaningful difference in nutritional status by family structure (Desai 1992; Strassman 1997). A second explanation centers on the fact that utilization of maternal and child healthcare services tends to be lower among polygynous women (Stephenson, Baschieri, Clements, Hennink, and Madise 2006), which, in turn, increases children's risk of mortality. A third explanation argues that gender asymmetry is especially acute in polygynous families, reflecting gender inequalities and power differentials within the household (Bove and Valeggia 2009; Zeitzen 2008) that have negative consequences for child health and survival (Kravdal 2004).

Polygynous Contexts and Infant Mortality

The demographic literature on polygyny and child health has focused exclusively on the consequences for those children who live in polygynous families; however, anthropological and sociological research on polygynous groups concurs that the practice is more than an individual family structure—widespread polygyny represents a unique cultural environment and a distinct approach to marriage, family, and reproduction (Bradley 2004; Hayase and Liaw 1997; Tobias 2001). We extend this insight, highlighting two distinct ways that the contextual prevalence of polygyny may be associated with infant mortality above and beyond children's own family structure. First, the association may be spurious: the correlation between polygyny and infant mortality may be driven by the fact that polygyny is most common in the poorest, least developed areas of sub-Saharan Africa (Boserup 1985; Jacoby 1995), where the disease burden is high and access to healthcare is limited (Benefo and Schultz 1994; Sastry 1996). Second, if widespread polygyny reflects accentuated institutionalized gender inequalities (Agadjanian and Ezeh 2000; Goody 1973; White and Burton 1988), the broader cultural milieu may produce a direct association between the contextual prevalence of polygyny and infant mortality (Bose 2011; Kravdal 2004).

Polygyny is most widespread in rural, agrarian areas of sub-Saharan Africa (Boserup 1985; Jacoby 1995; Kishor and Neitzel 1996). In these settings, human labor (particularly female labor) yields high economic value, and men use polygyny as a strategy to increase their family's productivity (Klomegah 1997).[2] Additionally, polygyny is most prevalent in settings where women's education levels are low (Bove and Valeggia 2009; Lesthaeghe, Kaufmann, and Meekers 1986). Existing research shows that children in least developed, rural settings experience severe health disadvantages (Benefo and Schultz 1994; Fotso 2006; Sastry 1996; Van de Poel, O'Donnell, and Van Doorslaer 2007); thus, highly polygynous settings may feature high levels of infant mortality simply because of these other shared characteristics. From this perspective, the contextual prevalence of polygyny may, indeed, be correlated with infant mortality, but the association should be fully explained by the absence of socioeconomic development that characterizes these (primarily rural) areas.

A second line of reasoning posits that the contextual prevalence of polygyny could be related to infant mortality through the gender inequality widespread polygyny reflects. Highly polygynous settings are typically patrilineal and patrilocal (Goody 1973; Lesthaeghe 1989; White and Burton 1988), wherein the dominant marital, lineage, and residential customs reflect a broader system of social stratification that privileges men—particularly older men (Zeitzen 2008). These gender and age inequalities solidify men's dominance in

[2]Some anthropologists (notably Goody 1973) refute that economic factors motivate widespread polygyny and point to the importance of social and cultural features. Although we do not discuss this disagreement, we describe the social and cultural elements of polygyny below.

social, economic, educational, political, and reproductive domains (Agadjanian and Ezeh 2000; Cahu, Falilou, and Pongou 2011), extending beyond the families that practice polygyny themselves. In highly polygynous societies, for example, women's access to land, inheritance, and formalized power tends to be constrained (Goody 1973; White and Burton 1988). Furthermore, qualitative research shows that in these settings both women and men tend to view wives as "property" of the husband and believe that men should have full control over reproductive decisions—views that are far less common in settings where polygyny is rare (Agadjanian and Ezeh 2000). Highly polygynous settings in sub-Saharan Africa feature greater acceptance of domestic violence and preference for sons across both monogamous and polygynous unions (Cahu, Falilou, and Pongou 2011), offering further evidence that polygyny is bound up with gendered attitudes that are deeply embedded in the local culture and more widespread than the practice itself. Combined with evidence that children in communities where women lack social status and power experience acute health disadvantages (Bose 2011; Kravdal 2004), widespread polygyny may reflect gender inequalities that exacerbate the risk of infant mortality.

Related to gender inequality, the distinctive gender relations that characterize highly polygynous settings may further lead to an association with infant mortality by, for example, discouraging paternal involvement and investment in children. According to Caldwell and Caldwell (2002), polygyny is often associated with men maintaining financial and social distance from their wives and children. This creates separation between mothers and fathers, illustrated by the fact that women in highly polygynous settings—regardless of their own family structure—are less likely to discuss reproductive decisions with their husbands than are wives in settings where polygyny is rare (Agadjanian and Ezeh 2000). Distant gender relations and infrequent spousal communication are associated with low paternal engagement (McBride and Rane 1998), which poses known risks to children's health and wellbeing (Lamb 2004). According to this line of thought, settings where polygyny has "cultural, normative, and numeric strength" (Zeitzen 2008:39) are settings in which women both lack social status and power and carry the overwhelming responsibility for childcare, making these especially risky environments for infant health and survival.

Polygynous Contexts and Elevated Infant Mortality for Polygynous Families

Beyond elevating infant mortality across all family structures, the contextual prevalence of polygyny may accentuate the known survival gap between infants in polygynous versus monogamous families. There are at least two reasons to expect the risk associated with living in a polygynous family (compared to a monogamous family) to be exacerbated where the practice is widespread. The first relates to *how* the family structure differs as a function of the marital and gender context. In settings where polygyny is uncommon, families engaged in the practice tend to resemble their monogamous counterparts (Kilbride and Kilbride 1990). In other words, the negative beliefs about and taboos associated with the practice (Gwako 1998) could lead polygynous families to adapt (consciously or subconsciously) a cultural approach to marriage, family, and childrearing that mirrors the overwhelmingly monogamous local context. For instance, in contemporary sub-Saharan African societies where polygyny is rare, most polygynous men visibly conform to the monogamous culture by having one "public wife" and other "outside" wives (Bledsoe 1990; Bledsoe 1995). Furthermore, qualitative work finds that where the practice is rare, polygynously married women expect to be more involved in marital decisions than their polygynously married counterparts in contexts where the practice is widespread (Agadjanian and Ezeh 2000).

Just as the marital context influences *how* families practice polygyny, it may likewise influence the associated infant mortality disadvantage. In settings where polygynous culture is anomalous, greater levels of spousal communication and equality, each of which are known to benefit women's and children's health (Furuta and Salway 2006), may elevate the survival of children in polygynous unions to levels that resemble the experience of their peers in monogamous families. Conversely, although we expect the broad-based gender inequality reflected in polygynous culture to elevate infant mortality for *all* families, its customary and normative strength may be associated with intensified gendered hierarchies within polygynous families in particular (Nyblade and Menken 1989; Zeitzen 2008). Thus, the prevalence of polygyny and its accompanying characteristics may exacerbate the survival disadvantage of infants living in polygynous families where it is prevalent and dampen the survival disadvantage where the practice is rare.

A second perspective emphasizes the economic heterogeneity between polygynous families in settings where it is more versus less widespread. As previously discussed, the primary hypothesis for why children in polygynous families experience poorer health is that the practice increases the number of wives and siblings, thereby diluting the family's per capita resources (Desai 1995). But the extent of resource dilution in polygynous families may vary as a function of its concentration. Although polygyny is generally practiced among relatively wealthier men, in areas where it is widespread (typically rural, least developed environments), the practice offers a unique set of economic benefits. The predominantly rural and agrarian economies of highly polygynous contexts incentivize men—perhaps even those who are unable to adequately provide for a larger family—to augment their family's labor supply by marrying additional wives (Boserup 1985; Jacoby 1995; Klomegah 1997). From this perspective, the general socioeconomic deprivation that characterizes highly polygynous settings, matched with polygyny's normative nature and the economic benefits it offers, may be distinctive in featuring large numbers of economically disadvantaged men who practice polygyny. This combination of disadvantages could render children in polygynous unions in highly polygynous settings particularly susceptible to the deleterious health consequences of diluted resources.

Conversely, the economic systems of African settings where polygyny is rare tend to be distinct (e.g., urban, more monetized), providing men with little economic incentive to have multiple wives. The ever-increasing cost of living (e.g., housing shortages, unemployment, weak kinship support, and cost of childrearing) makes large, polygynous families an economic liability (Gwako 1998; Solway 1990). In these settings, the socioeconomic environment, combined with polygyny's non-normative nature, discourages the overwhelming majority of men from becoming polygynous. Because it may be relatively wealthy men who become polygynous in such settings, the families who do practice polygyny could be buffered from the deleterious effects of resource dilution. If this is indeed the case, differences in the risk of infant mortality between polygynous and monogamous families should be minimal in settings where polygyny is less common and more sizable in areas where polygyny is widespread.

Hypotheses

In light of (1) the economic, social, and cultural factors associated with the contextual prevalence of polygyny, and (2) evidence that the nature of polygyny varies in accordance with its concentration, we hypothesize the following:

> **H1a**: The contextual prevalence of polygyny will be positively associated with infant mortality, regardless of individual family structure.
>
> **H1b:** Contextual socioeconomic development (e.g., rurality, lack of infrastructure) and social and cultural norms (e.g., gender inequality) will explain this association.

H2: The contextual prevalence of polygyny will condition the survival disadvantage between polygynous and monogamous families. The survival disadvantage will be smallest where polygyny is rare and largest where it is widespread.

DATA

We use data from the Demographic and Health Surveys (DHS) to analyze associations between the contextual prevalence of polygyny, family structure, and infant mortality in sub-Saharan Africa. We use data from all 29 sub-Saharan African countries in which the DHS fielded surveys between 2000 and 2010.[3] In each survey, response rates are consistently above 90 percent.[4] Because the DHS collects nearly identical data on family structure, reproductive histories, and infant mortality across countries, we are able to harmonize and leverage them for multinational analyses.

In each country, the DHS uses a stratified random sampling approach, with clusters providing the primary sampling unit. Within each selected cluster, the DHS randomly samples families. Household heads complete a full roster of members, from which the DHS identifies eligible men and women. Women are asked if they have children, and if so, to provide detailed information on each live birth (e.g., date of birth, whether the child is still alive, and the month and year of death for all deceased children), from which the DHS generates the birth-oriented datasets we use here.

Analytic Sample

We restrict our sample to births that occurred within the five years prior to the survey. This restriction minimizes recall error for birth and death reports and ensures that current family characteristics (discussed below) correspond reasonably well with a child's environment since birth. This restriction also ensures that infants of older mothers, relative to those of younger mothers, are not disproportionately represented in the sample. We exclude approximately 2% of births with missing data on study variables. Our final analytic sample consists of 236,336 births in the five years preceding the survey. See Appendix A for information on the surveys and countries included.

In response to the fact that the prevalence of polygyny varies tremendously within and between African countries (Lesthaeghe 1989; Murdock 1967; Reniers and Watkins 2010), our contextual unit of focus is the subnational region.[5] In some countries, subnational regions represent political districts, and in other countries they represent administrative or geographical boundaries. To characterize the 260 regions in our sample, we use DHS data from the women's, men's, and household questionnaires. On average, there are 1,145 women, 488 men, and 964 households sampled in each region. Given the large number of cases in each region, we include the index family when creating the region-level measures (described below) and confirm (via sensitivity analyses, not shown) that this does not alter our estimates.[6] Appendix B contains a complete list of subnational regions, as well as information for each on the size of the household, female, and male samples.

[3]Of the 48 countries in sub-Saharan Africa, we exclude 13 countries from our study because the DHS did not operate in these countries between 2000 and 2010 (Angola, Botswana, Central African Republic, Comoros, Cote D'Ivoire, Djibouti, Equatorial Guinea, Guinea-Bissau, Mauritius, Seychelles, Somalia, South Sudan, and Togo). Furthermore, we exclude five countries because the data are not publically available (Cape Verde, Eritrea, The Gambia, Mauritania, South Africa) and one country (Lesotho) because polygyny data was not collected, resulting in a final sample of 29 countries.

[4]Response rates are published in the survey documentation reports for each country. These are available from: http://www.measuredhs.com/.

[5]Although the DHS does include smaller aggregate units (i.e., "clusters"), they are not intended for contextually-focused analyses, but instead are enumeration areas that are drawn only for the purpose of sampling.

ANALYTIC APPROACH

Key Measures

Infant Mortality—In light of evidence that polygyny does not affect mortality uniformly across the childhood period (Gyimah 2009; Ukwuani, Cornwell, and Suchindran 2002), we focus on mortality during the first year of life. The outcome variable in our analyses is the hazard of mortality before age one. More specifically, the outcome is the risk of death between birth and one year (0–11 months) or between birth and the survey date, in the case of children who were not yet one year old at the time of the survey.

Age of Child—To accommodate our discrete-time hazard modeling strategy (described in more detail in the following section), we restructure the data from an individual-based dataset, in which every birth contributes a unique observation, to a time-based dataset, in which observations refer to a unit of time (i.e., months) and each birth contributes multiple records.

Family Structure—We leverage three survey questions to create our four-category measure of family structure. First, all mothers reported their marital status: currently married, divorced, separated, widowed, or never married. Second, married mothers were asked if there are co-wives present in the marital union; third, all unmarried mothers were asked if they are cohabiting with a male partner. With this information, we characterize children as having monogamously married (reference group), polygynous, cohabiting, or single mothers.[7]

Region-level Prevalence of Polygyny—We use the DHS women's data files for each country (i.e., nationally representative samples of women) to aggregate women's reports of polygyny by region. More specifically, we create an indicator of the percentage of women (15–49 years old) in each region who reported being in a polygynous union. Because we operationalize polygyny utilizing a female-centered approach, our estimates of region-level prevalence of polygyny are higher than a male-centered approach would yield. However, male- and female-centered approaches are highly correlated (Timæus and Reynar 1998), and since our argument rests not on absolute levels of polygyny but on the relative prevalence of the practice, we adopt the conventional approach of utilizing women's reports.

Region-level Socioeconomic Development—To help explain a potential association between the contextual prevalence of polygyny and infant mortality (H1b), we control for socioeconomic development, which is known to be associated with infant health and survival (Barrera 1990; Sastry 1996). First, using the household data files, we calculated the percentage of households in each region that the DHS lists as "rural" (versus "urban," see Kravdal and Kodzi 2011 for a similar approach). Second, to account for differential access to basic infrastructure, which is known to influence infant health and survival (Wang 2003),

[6]Due to the large samples for each region—on average they contain 964 households (ranging from 266 to 7,091); 1,145 women (ranging from 306 to 7,297); 488 men (ranging from 80 to 3,358)—the inclusion vs. omission of the index household from the aggregate analyses makes no difference. For instance, in the Kigal region of Mali—the smallest sample of women (N=306) for any of our regions—7.19 % of women are in polygynous unions. If we omitted the index family when creating this index, the value would vary across families by less than one-third of 1 %. Thus, given that it makes little difference, we include the index family because (1) we prefer having a uniform value for each region and (2) removing the index family alters, but does not fully eliminate, the correlation between the aggregate- and individual- level (Raudenbush and Byrk 2002).

[7]The cross-sectional nature of the data prohibits us from accounting for changes in family structure between a child's birth and the time of the survey or, in the case of deceased children, the time of their death. Thus, it is possible that monogamous unions became polygynous *after* the child's birth and/or death. In fact, entry into a polygynous family could be a direct response to the death of a child. We reduce the likelihood of misclassifying families' structure by limiting the analyses to births that occurred in the five years prior to the survey; however, this bias is still possible and should be kept in mind when interpreting results.

we aggregated the household data by region to estimate the percentage of households that report having electricity (see Sastry 1996 and Kravdal 2002 for similar approaches).

Region-level Gender Inequality—To further explain a potential association between the contextual prevalence of polygyny and infant mortality (H1b), we constructed a female-to-male ratio of the average educational attainment in each region to account for the extent of gender inequality. The female-to-male educational attainment ratio is commonly leveraged in the development literature as an indicator of gender inequality (e.g., United Nation's Gender Inequality Index (http://hdr.undp.org/en/statistics/gii/)).[8] We used the representative datasets to estimate average educational attainment in each region, separately for women and for men. We then converted these averages into a ratio that captures the average educational attainment of women relative to men in each region.

Cross-level Interaction between Contextual Prevalence of Polygyny and Family Structure—We interact the region-level prevalence of polygyny with family structure to create a continuous by categorical cross-level interaction. This allows us to assess whether the contextual prevalence of polygyny conditions the relationship between family structure and infant mortality (H2).

Controls

Country-level—Because a host of country-level factors may influence the associations among the contextual prevalence of polygyny, family structure, and infant mortality, our multilevel hazard models include a set of dummy variables representing each of the 29 countries in our sample. This country-level fixed-effects approach allows us to control for constant, unobserved factors that vary across sub-Saharan African countries and that may be associated with infant mortality.

Family-level and Child-level Controls—Based on the established literature on infant mortality in sub-Saharan Africa, we include a robust set of controls that are standard in infant mortality research. In terms of family characteristics, we control for the number of household members, whether the mother is Muslim (=1), mother's completed years of formal education[9], and total sibship size (number of siblings with the same mother). To account for socioeconomic inequality across families, we control for the DHS-constructed wealth index.

A set of child-specific controls focus on measuring the established correlates of infant mortality that could vary by family structure: maternal age at the time of the focal child's birth (19 years or younger, 20–34 [reference group], or 35 and older), duration of the preceding birth interval (none: child is first birth [reference group], 24 months or less, and more than 25 months). Finally, we control for the child's gender (female=1), birth order, and whether the child is a multiple (=1).

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[8]A limitation of the female-to-male education ratio is that it reflects only one dimension of gender inequality (i.e., educational attainment). However, because education is a central determinant of individuals' income, occupation, and health, it is an ideal measure for capturing inequalities between women's and men's life chances more broadly. The DHS also measures gender inequality through a series of questions about women's involvement in household decision-making, however these questions are asked in only two-thirds of the countries in our study, and are similarly limited by their focus on a single dimension of inequality.

[9]Because of the study's multinational framework, our use of completed years of formal schooling facilitates meaningful comparisons across countries and addresses the well-known problems of grade repetition (Grant & Hallman 2008).

METHODS

We estimate infant mortality using multilevel discrete-time hazard models, which are ideal for working with censored observations. Infants who are still alive at the end of the observation period or who have not yet reached their first birthday are right censored. In addition to the issue of censoring, our data are structured hierarchically: some infants share the same family, and as a result of overlapping genetic, behavioral, and socioeconomic factors, they may share similar levels of mortality (Curtis, Diamond, and McDonald 1993; Omariba, Beaujot, and Rajulton 2007; Sastry 1997). Children are also nested within subnational regions (N=260) and within countries (N=29).

To address censoring and the hierarchical nature of our data, we estimate a series of random-effects discrete-time logit models:

$$\text{logit}(h_{tijkl}) = \alpha_t + \beta_1 \boldsymbol{X}_{ijkl} + \beta_2 \boldsymbol{Y}_{jkl} + \beta_3 \boldsymbol{Z}_{kl} + \beta_4 \boldsymbol{C}_l + u_j + \nu_k$$

where h_{tijkl} is the hazard that infant i in family j in region k in country l dies at time t; $\boldsymbol{X}_{ijkl}$ is a vector of child-level covariates; $\boldsymbol{Y}_{jkl}$ is a vector of family-level covariates; $\boldsymbol{Z}_{kl}$ is a vector of region-level covariates; $\boldsymbol{C}_l$ are country dummy variables that allow us to control for unobserved confounders at the country-level[10]; u_j is the family-level random effect; ν_k is the subnational region-level random effect; and the βs represent the corresponding coefficients. We account for the effect of age on mortality (α_t) by including a dummy variable for each month.

To test our hypotheses of whether (H1a) and how (H1b) the contextual prevalence of polygyny is associated with infant mortality, and whether the contextual prevalence of polygyny conditions the relationship between family structure and infant mortality (H2), we specify five multilevel hazard models:

1. $\text{logit}(h_{tijkl}) = \alpha_t + \beta_1 \text{Region-levelPolygyny}_{kl} + \beta_2 \text{FamilyStructure}_{jkl} + \beta_3 \boldsymbol{X}_{ijkl} + \beta_4 \boldsymbol{Y}_{jkl} + \beta_5 \boldsymbol{C}_l + u_j + \nu_k$
2. $\text{logit}(h_{tijkl}) = \alpha_t + \beta_1 \text{Region-levelPolygyny}_{kl} + \beta_2 \text{FamilyStructure}_{jkl} + \beta_3 \text{Rurality}_{kl} + \beta_4 \text{Infrastructure}_{kl} + \beta_5 \boldsymbol{X}_{ijkl} + \beta_6 \boldsymbol{Y}_{jkl} + \beta_7 \boldsymbol{C}_l + u_j + \nu_k$
3. $\text{logit}(h_{tijkl}) = \alpha_t + \beta_1 \text{Region-levelPolygyny}_{kl} + \beta_2 \text{FamilyStructure}_{jkl} + \beta_5 \text{GenderInequality}_{kl} + \beta_6 \boldsymbol{X}_{ijkl} + \beta_7 \boldsymbol{Y}_{jkl} + \beta_8 \boldsymbol{C}_l + u_j + \nu_k$
4. $\text{logit}(h_{tijkl}) = \alpha_t + \beta_1 \text{Region-levelPolygyny}_{kl} + \beta_2 \text{FamilyStructure}_{jkl} + \beta_3 \text{Rurality}_{kl} + \beta_4 \text{Infrastructure}_{kl} + \beta_5 \text{GenderInequality}_{kl} + \beta_6 \boldsymbol{X}_{ijkl} + \beta_7 \boldsymbol{Y}_{jkl} + \beta_8 \boldsymbol{C}_l + u_j + \nu_k$
5. $\text{logit}(h_{tijkl}) = \alpha_t + \beta_1 \text{Region-levelPolygyny}_{kl} + \beta_2 \text{FamilyStructure}_{jkl} + \beta_3 \text{Rurality}_{kl} + \beta_4 \text{Infrastructure}_{kl} + \beta_5 \text{GenderInequality}_{kl} + \beta_6 (\text{Region-levelPolygyny}_{kl} * \text{FamilyStructure}_{jkl}) + \beta_7 \boldsymbol{X}_{ijkl} + \beta_8 \boldsymbol{Y}_{jkl} + \beta_9 \boldsymbol{C}_l + u_j + \nu_k$

Model (1) estimates the association between the region-level prevalence of polygyny and infant mortality net of family structure for infant i in family j in subnational region k in country l; where $\boldsymbol{X}_{ijkl}$ is a vector of child-level covariates; $\boldsymbol{Y}_{jkl}$ is a vector of family-level covariates; $\boldsymbol{C}_l$ are country dummy variables; u_j is the family-level random effect; ν_k is the subnational region-level random effect; and the βs represent the corresponding coefficients. Model (2) includes region-level indicators of socioeconomic development (i.e., rurality, access to infrastructure) to determine whether these factors explain the association between the prevalence of polygyny and infant mortality in Model (1). Model (3) includes a region-

[10]A country-level fixed-effects approach allows us to control for constant, unobserved factors that vary across sub-Saharan African countries. Because a fixed-effects approach is less efficient, our analyses will yield more conservative estimates.

level gender inequality indicator (i.e., female-to-male education ratio) to determine whether and to what extent it helps explain the association observed in Model (1). Model (4) includes both the socioeconomic and gender inequality indicators to test whether the association between the contextual prevalence of polygyny and infant mortality is fully explained. To examine our second hypothesis, Model (5) extends Model (4) by including a cross-level interaction term between the region-level prevalence of polygyny and family structure to determine whether the infant survival disparity between polygynous and monogamous families is conditional on the broader marital context.

RESULTS

Of the 236,336 births in our analytic sample, 16,323 infants died during their first year of life, representing 6.9% of the analytic sample.

Figure 1 provides a visual representation of the distribution of polygyny across the 260 subnational regions within the 29 selected sub-Saharan African countries. Corroborating findings from previous research, Figure 1 demonstrates considerable heterogeneity in the prevalence of polygyny (i.e., percentage of women in a polygynous unions) both within and across sub-Saharan African countries (Lesthaeghe 1989; Reniers and Watkins 2010). For instance, in the West African country of Mali, the percent of women in polygynous unions ranges from as low as 7.2% in one region to 50.9% in another. In general, countries with an overall lower prevalence of polygyny (e.g., Congo [Brazzaville], Namibia, and Rwanda) have less heterogeneity across regions.

Table 1 provides a descriptive overview of the characteristics of infants, families, and subnational regions in our sample. Among the full sample, the average region-level prevalence of polygyny is 27.8%. The majority of families live in predominantly rural regions (71.2%) where relatively few families (19.8%) have electricity. Overall, the majority of infants live in monogamous families, but approximately one-fourth live in polygynous ones. On average, infants in our sample live with approximately seven people, have mothers who completed three years of formal education, and have four siblings. A sizable minority have mothers who identify as Muslim (37.5%).

Table 1 further demonstrates the contextual and compositional differences between subnational regions with varying levels of polygyny. In these descriptive analyses, we categorize regions that are more than one standard deviation below the regional mean of polygyny as “low prevalence” (<=13 %), regions one standard deviation below/above the mean as “average prevalence” (14%—43 %),” and regions more than one standard deviation above the mean as “high prevalence” (>=44 %).” In terms of contextual differences, we find that, as hypothesized, socioeconomic disadvantage and gender inequality are concentrated in highly polygynous settings. In settings where polygyny is below average, only 60.9% of households are rural and 24.6% are electrified compared to over 84.3% rural and only 9.9% electrified in high polygyny settings. Furthermore, while women in low polygyny regions have completed more than three-fourths as much formal schooling as men, on average, women in highly polygynous regions have completed less than half as much formal schooling compared to their male counterparts. In addition to these contextual differences, the composition of families varies as a function of the prevalence of polygyny. As expected, sibship size is larger and household wealth is lower among infants in higher prevalence settings. Furthermore, mothers in high polygynous settings are more likely to identify as Muslim and have completed fewer years of formal education.

Table 2 shows estimates from hazard models of mortality during infancy (0–11 months). Results in Model 1 support H1a: net of individual family structure and a standard set of controls at the family- and child-levels, infants living in regions where polygyny is more prevalent experience higher mortality risk. In fact, each unit increase in the prevalence of polygyny is associated with an approximately one-half percent higher risk of infant mortality (p<.001). Given that the prevalence of polygyny ranges from as low as 1.0% to as high as 64.8% across the 260 regions in our sample, the magnitude of this association is substantial — a 32 % difference across the marital context spectrum.

In addition to the contextual prevalence of polygyny, a number of family- and child-level characteristics are significantly associated with infant mortality. Each of these falls in line with previous research on infant mortality in developing contexts. Each year of mother's formal schooling is associated with 2% lower risk of infant mortality. Children born to very young or to older mothers experience particularly elevated mortality risk (8% and 32%, respectively) compared to children born to women between the ages of 20 and 34 years. Furthermore, female infants experience 16% lower risk of infant mortality, and those of twin births experience 22% higher risk of infant mortality. With regard to family structure, infants in polygynous families experience 42% higher mortality than infants in monogamous families. Additionally, children in cohabiting unions have a 20% higher risk of mortality compared to children in monogamous unions, and infants in lone-mother families have the highest risk of mortality (59%). The results further show that there is substantial between-family and between-region variation in the risk of infant mortality, as indicated by the variance estimates of 0.233 and 0.151, respectively.

Model 2 extends Model 1 to assess whether region-level socioeconomic characteristics help to explain the association between the contextual prevalence of polygyny and infant mortality (H1b). Controlling for a region's rurality and access to infrastructure reduces the association between the contextual prevalence of polygyny and infant mortality by half (from .005 to .003) and lowers it to non-significance. In other words, the association between the contextual prevalence of polygyny and infant mortality is attributable to other regional characteristics: polygyny is widespread in sub-Saharan Africa's most rural and socioeconomically disadvantaged settings in which infant mortality is highest. As shown by the reduction in the region-level variance component from Model 1 to Model 2 (0.151 to 0.149), accounting for region-level socioeconomic development explains a portion of the between-region differences in infant mortality risk.

Examining whether and to what extent differences in gender inequality explain the association between the prevalence of polygyny and infant mortality, Model 3 shows that infants in more gender-equal settings have a marginally significant survival advantage. That is, each unit increase in women's completed education relative to men's is associated with a 22% lower risk of infant mortality. Furthermore, in comparison to Model 1, the association between the contextual prevalence of polygyny and infant mortality is attenuated (from .005 to .004), suggesting that a portion of the risk associated with living in a region where polygyny is more prevalent is attributable to corresponding levels of gender inequality.

Simultaneously controlling for regional differences in socioeconomic development and gender-inequality (Model 4), we find that these, admittedly crude, contextual indicators explain the generalized elevated risk of infant mortality associated with living in a region where polygyny is more prevalent. Only residence in settings with greater socioeconomic development (i.e., electricity) remains independently associated with infant mortality (p<.1): each percentage increase in electrified households is associated with a 1% lower risk of infant mortality.

In Model 5, we assess whether the risk associated with living in a polygynous family is conditional on the contextual prevalence of polygyny (H2) by adding cross-level interaction terms (i.e., between region-level prevalence of polygyny and family structure). The positive interaction between region-level prevalence of polygyny and family-level polygyny indicates that the survival disadvantage associated with polygyny (compared to monogamy) is exacerbated in settings where the practice is widespread (p<.001). For infants in polygynous families, their already elevated risk of mortality, compared to children in monogamous families, increases by approximately 1% per percentage increase in region-level polygyny. Thus, children in polygynous families (versus monogamous ones) in regions where polygyny is seldom practiced (about 1%), experience 13% higher risk of infant mortality, while children in polygynous families in the most highly polygynous contexts (about 65%) experience approximately 77% higher risk of infant mortality than their peers in monogamous families.

To illustrate the disparities in infant mortality by family structure and region-level prevalence of polygyny, Figure 2 depicts Kaplan-Meier hazard estimates of infant mortality risk that hold all other covariates (shown in Model 5) at their mean value. For ease of presentation, we categorize subnational regions as we did in the descriptive analyses: subnational regions more than one standard deviation below the regional mean of polygyny are classified as "low prevalence," regions one standard deviation above/below the mean are "average prevalence," and regions more than one standard deviation above the mean are "high prevalence." The central finding from Figure 2 is that the region-level prevalence of polygyny influences the size of the survival gap *between* family structures. In all contexts, infant mortality is higher in polygynous families than in monogamous families (log-rank test p<.05), but as shown, the size of this disparity increases with the region-level prevalence of polygyny. That is, in support of H2, the polygyny-infant survival disadvantage is *amplified* in high polygyny settings and *dampened* in low polygyny settings—net of the household wealth index and a robust set of additional confounders. This provides suggestive, although not conclusive, evidence of a process of cultural convergence, whereby polygynous families in low prevalence areas more closely mirror the overarching monogamous culture, as supported by their converging rates of infant mortality.

DISCUSSION

Although polygyny is declining worldwide, the practice continues to thrive in many parts of sub-Saharan Africa (Bove and Valeggia 2009; Van de Walle 2006). Building on evidence that the prevalence of polygyny reflects a complex bundle of economic, social, and cultural features, and that its prevalence has implications for *how* polygynous families engage in the practice, we explore whether the prevalence of polygyny is associated with elevated infant mortality. We further examine the extent to which the marital context conditions the known survival disadvantage for children in polygynous families (i.e., compared to monogamous families) in particular.

Our multilevel fixed-effects approach controls for unobserved country-level influences on infant mortality and confirms that polygyny is associated with higher infant mortality at both the family and contextual level. Recent multinational research has documented a link between polygyny and mortality in early childhood (i.e., before age five) in sub-Saharan Africa (Omariba and Boyle 2007), and our paper further confirms the survival disadvantage during infancy using a more rigorous methodological approach. At the family level, we show that children in polygynous families have a 42% higher likelihood of mortality than their counterparts in monogamous ones.

In addition to the sizeable survival disadvantage for infants in families that practice polygyny, our results reveal that the contextual prevalence of polygyny is associated with infant mortality. The association is, however, largely spurious, explained by the concentrated socioeconomic disadvantage and, to some extent, the widespread gender inequality that characterizes highly polygynous settings.

Although the contextual prevalence of polygyny is not independently associated with infant mortality for all families, the contextual prevalence of polygyny has significant implications for the morality risk of infants in polygynous families. Net of the same regional confounders that explain the direct association between contextual polygyny and infant mortality, the infant mortality disparities between polygynous and monogamous families are *significantly* amplified where polygyny is widely practiced—the 13% elevated risk of mortality in low polygyny settings increases six fold in settings with the highest prevalence of polygyny.

Because of data limitations, we are unable to formally test hypotheses about why this is the case; however we offer a possible theoretical explanation. The differences in the mortality disadvantage associated with polygyny across marital contexts could be driven by variability in *how* families practice polygyny. That is, the smaller mortality gap between children in monogamous and polygynous families in low polygyny settings may be due to the fact that polygynously married men and women in these contexts adapt their interpersonal dynamics and relationships to fit the surrounding culture of monogamy. In other words, although there is little evidence that polygyny has a deleterious effect on infant mortality for children in monogamous families, monogamous culture appears to dampen the infant mortality disadvantage of children in polygynous families.

This explanation brings us squarely into the territory of analyzing cultural processes, which is distant from the terrain most demographers regularly explore (Bachrach Forthcoming). Demographic data to test whether and how interpersonal dynamics vary within polygynous relationships across marital contexts—and, in turn, whether these processes explain differences in the size of the mortality gap between polygynous and monogamous families—simply do not exist. The absence of data on the family dynamics that may contribute to children's health experiences reflect the tendency of demographic surveys to focus on tracking events and discrete statuses rather than on processes. Echoing Hobcraft's (2006) call for more demographic research that accounts for dynamic processes within families, our findings underscore the need for demographic data sources that are suitable for exploring the interpersonal and relational aspects of family life. In sub-Saharan Africa, such data could facilitate a richer understanding of the regional variation in gender relations and cultural practices of polygynous families, and enable us to better understand whether and how these distinctions ultimately influence children's health.

Although we suspect that cultural processes underlie the differential mortality risk associated with polygyny across marital contexts, we also acknowledge that our analyses do not fully capture the role of economic heterogeneity between polygynous families across contexts. While the differential risk of mortality among polygynous families persists net of household wealth (Model 5), the DHS's wealth index reflects a family's shared household assets and material resources but does not capture consumable resources (e.g., cash, crops). Because these are exactly the resources at greatest risk of dilution across multiple co-wives and sibling groups, the question of whether polygynous families' access to such resources varies across marital contexts is both an important and an outstanding one. In supplementary descriptive analyses (not shown), we find that household wealth disparities between polygynous and monogamous families are consistent across marital contexts; additional multivariate models confirm that the inclusion of household wealth as a control does not attenuate the differential risk of infant mortality associated with polygyny. While these analyses suggest that economic processes are *not* the primary drivers of the differential infant mortality risk associated with polygyny, more detailed data on multiple dimensions of polygynous families' resources would allow researchers to more rigorously explore the role of economic disparities across marital contexts.

Although we still do not know precisely *why* the polygyny–infant mortality association differs as a function of polygyny's concentration, our study convincingly demonstrates that marriage and family have important implications for infant mortality in sub-Saharan Africa. On the one hand, our findings could be read optimistically, as evidence that the infant mortality gap between polygynous and monogamous families may shrink over time. Social changes like rising female education, urbanization, and migration are lowering the practice of polygyny across sub-Saharan Africa (Timæus and Reynar 1998). As these changes continue, polygyny will become increasingly rare in most of sub-Saharan Africa, thereby reducing the number of children exposed to this particular mortality risk. On the other hand, if socioeconomic development occurs unevenly across subnational regions, polygyny may become an even more spatially concentrated practice. The mortality disparity for children in polygynous families could persist— or even be magnified—in these settings of concentrated disadvantage. Therefore, even as polygyny continues to decline across sub-Saharan Africa as a whole, or within particular subnational regions, marriage patterns will remain critical for understanding infant health and survival in this part of the world.

Beyond polygyny and infant survival in sub-Saharan Africa, our study highlights, more generally, the relevance of the broader marital context for understanding how family characteristics influence children's wellbeing. Our study advances the idea that marital practices are contextual and cultural phenomena and not merely characteristics of families themselves. That the polygyny disadvantage is largest in contexts where the practice is widespread parallels evidence from the West that the educational disadvantage associated with having a single-parent (compared to a two-parent family) is amplified where single-parent families are most common (Pong, Dronkers, and Hampden-Thompson 2004). This evidence demonstrates that research linking family-level processes to their contextual conditions produces valuable insights into child wellbeing.

Demography has a rich history of linking family-level processes to structural conditions (e.g., poverty, urbanicity), and our focus on the marital context extends this tradition in new ways. Marital practices are closely related to structural conditions, as we show here; however, the marital context also taps into more nebulous cultural factors (e.g., gender relations) that are critically relevant to demographic outcomes. Our approach exemplifies how demographers can link families to their contexts in ways that extend beyond the measurement of material conditions, shifting the focus to factors that simultaneously encompass material and cultural phenomena that cannot be easily disentangled. Further expanding standard notions of the aspects of context that are demographically salient may be a fruitful avenue for generating further insights into demographic patterns and processes.

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APPENDICES

Appendix A

List of Selected Countries, DHS Survey Year, and Sample Information

Countries	Final N	% Final Analytic Sample	Total Infant Deaths	% Children Died (0–11 months)
Benin (2006)	15,548	6.58	992	6.38
Burkina Faso (2003)	10,628	4.50	770	7.25
Burundi (2010)	7,676	3.25	404	5.26
Cameroon (2004)	8,069	3.41	570	7.06
Chad (2004)	5,618	2.38	478	8.51
Congo (Brazzaville) (2005)	4,811	2.04	303	6.30
Dem. Rep. of Congo (2007)	8,911	3.77	748	8.39
Ethiopia (2005)	9,855	4.17	667	6.77
Gabon (2000)	4,001	1.69	197	4.92
Ghana (2003)	3,834	1.62	235	6.13
Guinea (2005)	6,348	2.69	519	8.18
Kenya (2003)	5,676	2.40	403	7.10
Liberia (2007)	5,736	2.43	382	6.66
Madagascar (2003/04)	5,400	2.28	251	4.65
Malawi (2004)	10,889	4.61	803	7.37
Mali (2006)	14,093	5.96	1,192	8.46
Mozambique (2003)	8,279	3.50	773	9.34
Namibia (2006–07)	5,135	2.17	226	4.40
Niger (2006)	9,155	3.87	579	6.32
Nigeria (2003)	28,587	12.10	2,034	7.12
Rwanda (2005)	8,566	3.62	657	7.67
Sao Tome Principe (2008)	1,929	0.82	67	3.47
Senegal (2005)	10,912	4.62	604	5.54
Sierra Leone (2008)	5,603	2.37	458	8.17
Swaziland (2008)	2,799	1.18	226	8.07
Tanzania (2004–05)	8,540	3.61	522	6.11
Uganda (2006)	8,355	3.54	562	6.73
Zambia (2007)	6,150	2.60	403	6.55
Zimbabwe (2005–06)	5,233	2.21	298	5.69
Total	236,336	100	16,323	6.91

Source: Demographic and Health Survey

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Appendix B

Information on 260 Subnational Regions, by country

Country	Total # of Regions	List of Regions	Range in Sample Size		
			Household	Female	Male
Benin	12	Alibori, Atacora, Atlantique, Borgou, Collines, Couffo, **Donga**, Littoral, Mono, Quémé, *Plateau*, Zou	810 – 2,252	862 – 2,142	271 – 606
Burkina Faso	14	Ouagadougou, Boucle de Mouhoun, ***Centre***, Centre-Sud, Plateau Central, Centre-East, Centre-Nord, Centre-Ouest, Est, Nord, Cascade, Hauts Bassins, Sahel, Sud-Ouest	266 – 718	351 – 1,305	109 – 377
Burundi	5	**Bujumbura**, North, Centre-East, *West*, South	912 – 2,406	1,212 – 2,578	655 – 1,030
Cameroon	12	Adamaoua, Centre, Douala, **Est**, Extreme Nor, *Littoral*, Nord, Nord Ouest, Ouest, Sud, Sud Ouest, Yaounde	749 – 1,022	723 – 1,097	406 – 512
Chad	9	Bar Azoum, B.E.T., ***Centre East***, Chari Baguirmi, Logone Occidental, Mayo Kebbi, Moyen Chari, Ouaddai, Est N'Djaména	496 – 1,169	531 – 1,324	128 – 549
Congo (Brazzaville)	4	Brazzaville, Pointe Noire, Sud, ***Nord***	1,293 – 1,648	1,338 – 2,165	645 – 976
Dem. Rep. of Congo	11	Kinshasa, Bas-Congo, Bandundu, Equateur, Orientale, Nord-Kivu, Maniema, ***Sud-Kivu***, Katanga, Kasai Oriental, Kasai Occident	707 – 1,065	727 – 1,666	344 – 735
Ethiopia	11	Tigray, Afar, Amhara, Oromiya, *Somali*, Ben-Gumz, SNNP, Gambela, Harari, Addis Abeba, **Dire Dawa**	757 – 2,155	669 – 2,230	281 – 1,041
Gabon	5	Libreville (Port-Gentil), **North**, East, West, *South*	1,025 – 1,717	868 – 1,957	306 – 590
Ghana	10	Western, *Centra*, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper West, **Upper East**	381 – 1,069	352 – 927	300 – 785
Guinea	8	**Boké, Conakry**, Faranah, Kankan, Kindia, *Labé*, Mamou, N'Zérékoré	736 – 813	826 – 1,154	256 – 519
Kenya	8	Nairobi, Central, Coast, Eastern, Nyanza, Rift Valley, Western, ***North Eastern***	469 – 1,536	608 – 1,278	219 – 543
Liberia	6	Monrovia, *North Western*, South Central, **South Eastern (a)**, South Eastern (b), North Central	949 – 1,457	765 – 1,858	654 – 1,428
Madagascar	6	Antananarivo, Fianarantsoa, Toamasina, **Mahajanga**, Toliary, *Antsiranana*	947 – 2,929	771 – 2,965	237 – 912
Malawi	3	***Northern***, Central, Southern	1,620 – 7,091	1,597 – 5,902	456 – 1,544
Mali	9	Kayes, Koulikoro, Sikasso, Segou, Mopti, Tombouctou, Gao, ***Kidal***, Bamako	330 – 2,471	306 – 2,345	83–769
Mozambique	11	**Niassa**, Cabo, Delgado, Nampula, Zambezia, Tete,	994 – 1,355	819 – 1,396	176 – 379

Country	Total # of Regions	List of Regions	Range in Sample Size		
			Household	Female	Male
		Manica, Sofala, *Inhambane*, Gaza, Maputo Provincia, Maputo Cidade			
Namibia	13	**Caprivi**, Erongo, Hardap, Kara, Kavango, Khomas, *Kunene*, Ohangwena, Omaheke, Omusati, Oshana, Oshikoto, Otjozondjupa	354 – 692	433 – 1,018	162 – 485
Niger	8	**Agadez**, *Diffa*, Dosso, Maradi, Tahoua, Tillaberi, Zinder, Niamey	684 – 1,151	730 – 1,415	308 – 681
Nigeria	6	North Central, North East, North West, *South East*, South West, **South South**	1,010 – 1,576	3,667 – 6,366	1,427 – 3,358
Rwanda	12	City of Kigali, Kigali Ngali, **Gitarama**, Butare, *Gikongoro*, Cyangugu, Kibuye, Gisenyi, Ruhengeri, Byumba, Umutara, Kibungo	843 – 870	885 – 1,085	371 – 511
Sao Tome Principe	4	Regiao Centro, Regiao Sul, Regiao Norte, ***Regaio de Principe***	600 – 1,095	418 – 935	447 – 664
Senegal	11	Dakar, Diourbel, Fatick, Kaolack, Kolda, *Louga*, **Matam**, Saint-Louis, Tambacounda, Thiés, Zuguinchor	552 – 883	1,005 – 1,625	235 – 497
Sierra Leone	4	Eastern, Northern, Southern, ***Western***	1,549 – 2,055	1,615 – 2,165	701 – 904
Swaziland	4	HHohho, Manzini, ***Shiselweni***, Lubombo	967 – 1,363	1,083 – 1,475	838 – 1,186
Tanzania	26	Dodoma, Arusha, Kilimanjaro, Tanga, Morogoro, Pwani, Dar es Salam, **Lindi**, Mtwara, Ruvuma, *Iringa*, Mbeya, Singida, Tabora, Rukwa, Kigoma, Shinyanga, Kagera, Mwanza, Mara, Manyara, Zanzibar North, Zanzibar South, Town West, Pemba North, Pemba South	362 – 389	324 – 537	80 – 135
Uganda	9	Central 1, Central 2, Kampala, East Central, Eastern, North, ***West Nile***, Western, Southwest	725 – 1,866	726 – 1,664	201 – 460
Zambia	9	**Central**, Copperbelt, Eastern, *Luapula*, Lusaka, Northern, North Western, Southern, Western	665 – 1,003	672 – 940	560 – 962
Zimbabwe	10	Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Matebeleland North, ***Matebeleland South***, Midlands, Masvingo, Harare, Bulawayo	685 – 1,269	630 – 1,395	464 – 1,032

Source: Demographic and Health Survey

* **Region with Smallest Household Sample Size;** Region with Smallest Female Sample Size; *Region with Smallest Male Sample Size*

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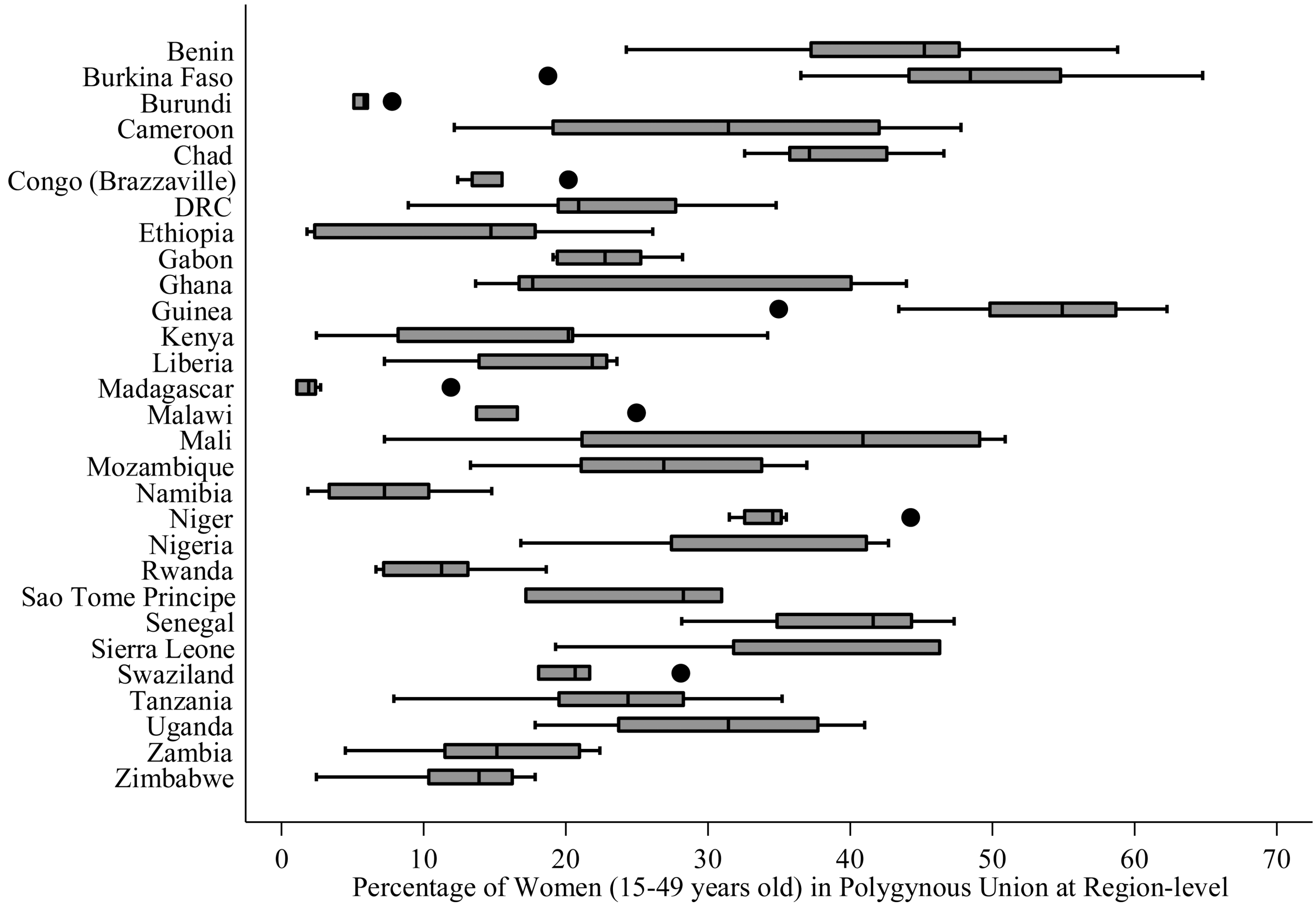

Figure 1.
Distribution of Region-level Percentage of Women (15–49 years old) in Polygynous Unions among 29 Selected sub-Saharan African Countries
Source: Demographic & Health Survey

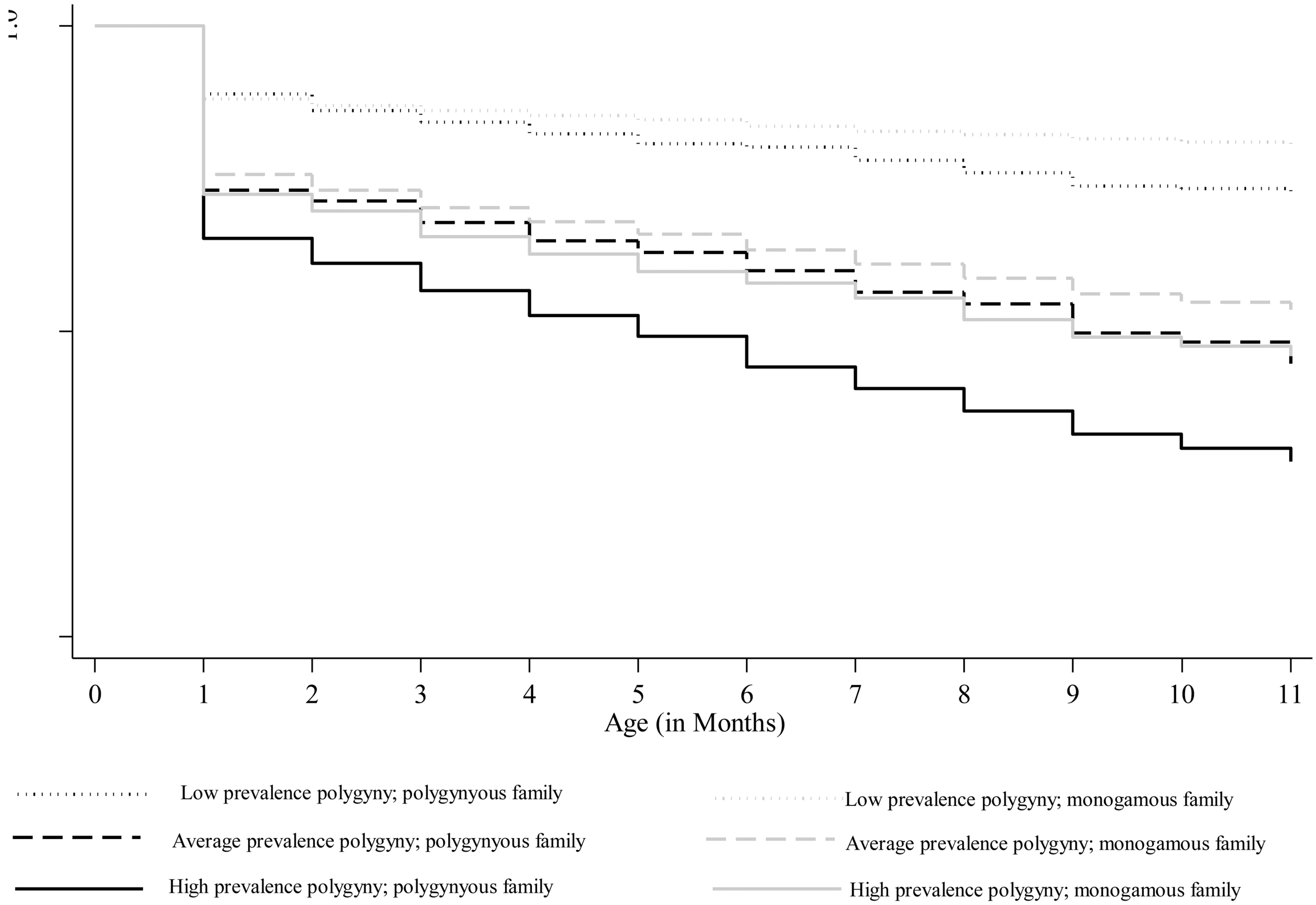

Figure 2.
Kaplan-Meier Hazard Estimates of Infant Mortality Risk, by Family Structure and the Percentage of Women (15–49 years old) in Polygynous Unions at Region-level
Source: Demographic and Health Survey; N=236,336 births

Table 1

Descriptive statistics

		Prevalence of polygyny		
Variable	**Full Sample**	**Low**	**Average**	**High**
	%/Mean (SD)			
Region-level				
Prevalence of polygyny (%)	27.83 (14.98)	6.43 (3.51)	25.65 (7.53)	46.93 (5.77)
Socioeconomic factors				
Rurality (%)	71.26 (23.76)	60.95 (33.86)	69.63 (24.68)	84.34 (8.16)
Access to electricity (%)	19.81 (21.12)	24.62 (25.88)	21.13 (22.84)	9.92 (7.37)
Gender inequality				
Female-to-male education ratio	0.67 (0.22)	0.89 (0.17)	0.73 (0.18)	0.44 (0.08)
Family-level				
Family structure				
Monogamous (ref)	54.62	58.73	55.24	50.3
Polygynous	24.47	4.86	21.56	43.75
Cohabiting	10.40	18.17	11.89	2.29
Lone mother	10.51	18.24	11.31	3.65
Household size	7.34 (4.37)	6.12 (2.70)	7.16 (4.14)	8.73 (5.43)
Mother is Muslim	37.51	6.00	32.53	70.13
Mothers' age at child's birth				
<20 years old	18.88	16.12	19.04	19.57
20–34 (ref)	67.56	69.85	67.82	66.02
35+	13.56	14.03	13.14	14.41
Sibship size	4.17 (2.54)	3.74 (2.38)	4.13 (2.53)	4.56 (2.64)
Mothers' education	3.31 (4.01)	4.90 (4.20)	3.92 (4.09)	1.07 (2.62)
Household wealth factor score	−0.14 (0.90)	0.07 (1.03)	−0.06 (.93)	−0.40 (.72)
Individual-level				
Preceding birth interval				
First born (ref)	20.72	24.87	21.07	17.13
<36 months	44.53	40.48	44.92	47.53
36+ months	34.75	34.65	34.01	35.34
Female	49.46	49.31	49.48	49.54
Birth order	3.78 (2.51)	3.40 (2.34)	3.74 (2.49)	4.16 (2.63)
Child is twin	3.32	2.38	3.49	3.53

Source: Demographic and Health Survey

N=236,336 births

Table 2

Results from the Multilevel Discrete-Time Hazard Models of Infant Mortality

	Model 1				Model 2				Model 3				Model 4				Model 5			
Variable	Coeff.	*SE*	Odds Ratio		Coeff.	*SE*	Odds Ratio		Coeff.	*SE*	Odds Ratio		Coeff.	*SE*	Odds Ratio		Coeff.	*SE*	Odds Ratio	
Region-level																				
Polygyny (%)	0.005	0.002	1.005	*	0.003	0.002	1.003		0.004	0.002	1.004	†	0.003	0.002	1.003		0.001	0.002	1.001	
Socioeconomic factors																				
Rurality (%)					0.000	0.001	1.000						0.000	0.001	1.000		0.000	0.001	1.000	
Access to electricity (%)					−0.003	0.001	0.997	†					−0.003	0.001	0.997	†	−0.003	0.001	0.997	†
Gender-based inequality																				
Female-to-male education ratio									−0.248	0.138	0.780	†	−0.127	0.138	0.881		−0.002	0.145	0.998	
Cross-level interactions																				
Prevalence of polygyny (%) * monogamous[a]																				
Prevalence of polygyny (%) * polygynous																	0.007	0.002	1.007	***
Prevalence of polygyny (%) * cohabiting																	0.002	0.002	1.002	
Prevalence of polygyny (%) * lone mother																	−0.001	0.002	0.999	
Family-level																				
Family structure																				
Monogamous[a]																				
Polygynous	0.353	0.021	1.423	***	0.354	0.021	1.424	***	0.353	0.021	1.424	***	0.354	0.021	1.424	***	0.123	0.055	1.131	*
Cohabiting	0.180	0.031	1.198	***	0.182	0.031	1.199	***	0.181	0.031	1.198	***	0.182	0.031	1.199	***	0.127	0.061	1.135	*
Lone mother	0.465	0.028	1.592	***	0.466	0.028	1.593	***	0.466	0.028	1.593	***	0.466	0.028	1.593	***	0.479	0.056	1.614	***
Household size	−0.098	0.003	0.906	***	−0.098	0.003	0.906	***	−0.098	0.003	0.906	***	−0.098	0.003	0.906	***	−0.101	0.003	0.904	***
Household wealth factor score	−0.023	0.013	0.977	†	−0.017	0.013	0.983		−0.022	0.013	0.978	†	−0.017	0.013	0.983		−0.017	0.013	0.983	
Mother is Muslim	−0.039	0.026	0.961		−0.039	0.026	0.962		−0.040	0.026	0.960		−0.039	0.026	0.962		−0.039	0.026	0.962	
Mothers' education	−0.021	0.003	0.980	***	−0.021	0.003	0.980	***	−0.020	0.003	0.980	***	−0.021	0.003	0.980	***	−0.021	0.003	0.979	***
Mothers' age at child's birth																				
<20 years old	0.080	0.025	1.084	**	0.080	0.025	1.084	**	0.080	0.025	1.084	**	0.080	0.025	1.084	**	0.082	0.025	1.086	**
20–34[a] (ref)																				

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Variable	Model 1 Coeff.	Model 1 *SE*	Model 1 Odds Ratio		Model 2 Coeff.	Model 2 *SE*	Model 2 Odds Ratio		Model 3 Coeff.	Model 3 *SE*	Model 3 Odds Ratio		Model 4 Coeff.	Model 4 *SE*	Model 4 Odds Ratio		Model 5 Coeff.	Model 5 *SE*	Model 5 Odds Ratio	
35+	0.277	0.029	1.320	***	0.277	0.029	1.320	***	0.277	0.029	1.320	***	0.277	0.029	1.320	***	0.278	0.029	1.320	***
Sibship size	0.657	0.012	1.929	***	0.657	0.012	1.929	***	0.657	0.012	1.929	***	0.657	0.012	1.929	***	0.658	0.012	1.931	***
Individual-level																				
Preceding birth interval																				
First born[a]																				
<36 months	−0.199	0.027	0.820	***	−0.199	0.027	0.820	***	−0.199	0.027	0.820	***	−0.199	0.027	0.820	***	−0.197	0.027	0.821	***
36+ months	−0.636	0.029	0.529	***	−0.636	0.029	0.529	***	−0.636	0.029	0.529	***	−0.636	0.029	0.529	***	−0.635	0.029	0.530	***
Female	−0.168	0.016	0.845	***	−0.168	0.016	0.845	***	−0.168	0.016	0.845	***	−0.168	0.016	0.845	***	−0.168	0.016	0.845	***
Birth order	−0.595	0.012	0.552	***	−0.595	0.012	0.552	***	−0.595	0.012	0.551	***	−0.595	0.012	0.552	***	−0.595	0.012	0.551	***
Child is twin	1.171	0.028	3.227	***	1.172	0.028	3.228	***	1.172	0.028	3.227	***	1.172	0.028	3.228	***	1.173	0.028	3.230	***
Month dummies (0–11) (not shown)																				
Country dummies (not shown)																				
Constant																				
Random effects[e]																				
Level 2																				
Between-family variance	0.233				0.233				0.233				0.233				0.233			
Level 3																				
Between-region variance	0.151				0.149				0.151				0.149				0.148			
Model fit																				
LR test	135.33***				128.35***				135.28***				128.33***				126.59***			

Source: Demographic and Health Survey,

† $p<0.1$;

* $p<0.05$;

** $p<0.01$;

*** $p<0.001$

[a] Reference Group

[e] Variances are estimated parameters

N= 236,336 obs=2,212,761