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Assessing sex differentials in under-five mortality in sub-Saharan Africa: A cross-national comparative analysis

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Abstract

This paper investigates and compares country-specific sex differentials in childhood mortality in thirty sub-Saharan African countries. Data from the Demographic and Health Surveys (DHS) were analyzed to assess sex differentials in U5M rates before and after adjustment for individual, household, and community-level factors, using multilevel discrete-time hazard models. The findings show a systematically higher mortality for male children compared to female in all countries except Sierra Leone and Swaziland. The relationship is significant in nineteen of the thirty countries. Across the region, males have 17–54 per cent higher odds of dying before age five. These patterns remained when controls were added for individual and community-level factors, as well as unobserved community-level effects.

Keywords: Sex differences, mortality, hazard analysis, cross-national comparison, sub-Saharan Africa.

Résumé

Cet article examine et compare les différentiels de la mortalité des enfants selon le sexe dans 30 pays d'Afrique au sud du Sahara. Les données nationales des dernières Enquêtes Démographiques et de Santé ont été analysées au moyen des modèles multi-niveaux de régression logistique de survie en temps discret pour estimer le risque relatif de la mortalité infanto-juvénile selon le sexe, avant et après contrôle des facteurs individuels et communautaires. Les résultats indiquent une surmortalité masculine dans la quasi-totalité des pays, sauf au Sierra Leone et au Swaziland. Les garçons de moins de cinq ans présentent un risque de décès de 17% – 54% plus élevé, comparés aux filles de même âge. Les résultats sont robustes des facteurs de control mesurés au niveau individuel et communautaire, aussi bien pour l'hétérogénéité inobservée.

Mots-clés : Mortalité différentielle selon le sexe, analyse de survie, comparaison transnationale, Afrique subsaharienne.

Introduction

In sub-Saharan Africa (SSA), disparities in childhood mortality have been consistently reported, with males bearing an excess risk of dying before age five (United Nations 2011; Sawyer 2012; Wang et al. 2012). The latest annual report of the United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) shows that on average in 2012, 103 boys under five die for each 1,000 live births, compared with only 92 girls (UN IGME 2013: 27). The basic research question posed here is

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what factors explain the sex differentials in childhood mortality? The challenge of sex-based disparities in childhood mortality remains one of the greatest public health research challenges and is of special importance for policies and programs targeting children's well-being and survival in SSA, the region with the highest childhood mortality in the world (Whitehead 1992; LeGrand 2000; Ashorn et al. 2002; United Nations 2011).

Sex differences in childhood mortality have been the subject of extensive investigation over the past two decades in less developed countries (LDC)—especially in Asia, where son preference often results in daughter neglect (Miller 1981; Kishor 1993; Hill and Upchurch 1995; Ren 1995; Filmer et al. 1998; Pollard and Hyatt 1999; Yount 2001; Arokiasamy 2004; Li et al. 2004; Sawyer 2012; Monden and Smits 2013; Pham et al. 2013; Rosenstock et al. 2013). The issue has not as often been addressed in SSA (Desgrées du Loû et al. 1995; LeGrand and Mbacké 1995; Tabutin et al. 2001; Ashorn et al. 2002; Garenne 2003; Aaby et al. 2007; Pongou 2013). Most research examining sex differences in childhood mortality has noted increased frailty among male infants, although that is mitigated as male children grow older (Pollard and Hyatt 1999; Kalben 2000; DeWitte 2010; Handa et al. 2010; United Nations 2011; Pongou 2013). Some previous research suggests that sex differentials in the mortality of young children result from a complex interplay of biological/genetic and social/environmental factors that impact mortality at different stages in the life course (Biaye 1994; Trovato and Lalu 1996; Waldron 1998; Kalben 2000; Luy 2003; Vallin 2006; Drevenstedt et al. 2008; Rogers et al. 2010; United Nations 2011; Pongou 2013).

Although the association between the sex of the child and risk of death has been examined, the mechanisms by which sex uniquely influences childhood mortality are not well understood or empirically documented. A major limitation of previous studies examining sex differences in childhood mortality is lack of adequate controls for other relevant biological, social, and environmental factors (see Garenne 2003; United Nations 2011). Analysis of mortality differentials requires examining the interactions of characteristics influencing mortality. Controlling potential confounding variables in the analytic models is needed to identify the relative effects of child's sex net of the effects of other variables (Mishra et al. 2004; Monden and Smits 2013; Pongou 2013; Rosenstock et al. 2013). In addition, most prior research has relied on either individual-level explanations or ecological approaches to the determinants of gender inequality in childhood mortality (e.g., Hill and Upchurch 1995; Garenne 2003; Fuse and Crenshaw 2006; Aaby et al. 2007). Such studies have often not accounted for individual, household, or community-level factors in tandem. This limitation can be addressed with a multilevel design that integrates individual and group-level data (Monden and Smits 2013). Multilevel modeling is an effective strategy for assessing compositional (individual characteristics) and contextual (area or group properties) effects on health (Duncan et al. 1998; Diez Roux 2003). It is now well established that the development of multilevel modeling techniques has created a mechanism for measuring the influence of community factors and unobserved community effects on health outcomes, while providing a robust method for analyzing hierarchically clustered data (Stephenson et al. 2006: 84; Goldstein 2010).

A few multinational studies of sex differentials in childhood mortality in sub-Saharan Africa have done multivariate analysis, particularly using a comparative perspective. Pongou tested the "pre-conception origins hypothesis" to explain the excess infant mortality (<1 year) of boys with respect to girls by decomposing the sex differences in infant mortality into the effects of the pre-conception environment (e.g. parental exposure to chemicals, parental illnesses) and child biology (Pongou 2013). Using pooled data from the Demographic and Health Surveys (DHS) collected in 31 sub-Saharan African countries (between 1986 and 2005) to compare sex differences in infant mortality across singletons, all twins, same-sex twins, and opposite-sex twins, Pongou found that both pre-conception environment and child biology increase the mortality among male infants, but the effect of biology is substantially smaller than the literature suggests (Pongou 2013). Monden and Smits (2013), too, have analyzed the DHS data to find that increasing maternal education is associated with reduced female disadvantages in U5M in sub-Saharan Africa and southern Asia. However, Pongou (2013), and Monden and Smits (2013) indicate a regional pattern in sex differences in childhood mortality based on the pooled coefficients of sex differences in infant and child mortality from multiple countries. This approach may mask significant disparities among countries (Rousham 1999:50; Garenne 2003:601). Thus, the consistency of findings across countries over different periods needs to be examined. Under a cross-national comparative perspective, this study is thus able to highlight the heterogeneity in sex differentials in childhood mortality. In particular, this paper provides a detailed multi-country, multivariate analysis of the patterns of country-specific sex differences in childhood mortality in SSA. Gaps by sex in childhood mortality vary cross-nationally, suggesting that differences are affected by country-specific conditions (UN IGME 2013). Due to their different historical, cultural, economic, and political situations, SSA countries form an important source of variation in attitudes, preferences, and practices in the domains of reproductive and population health and related policies. To date, there has been limited research exploring the effect of these contexts on sex differences in childhood mortality.

The present study expands on previous work by systematically testing a variety of factors, including biological indicators of health, attitudes toward gender preference, and household and community level socio-economic and environmental factors. In order to build a multi-country understanding of sex differentials in childhood in SSA, this paper seeks to investigate and compare the male-to-female ratios in under-five mortality (U5M) in thirty countries that have Demographic and Health Surveys (DHS). Especially, data from the latest surveys were analyzed to assess country-specific sex differentials in U5M rates before and after adjustment for measures of individual- and community-level factors, using a multilevel discrete-time hazard model.

Theoretical framework and hypothesis

Despite the fact that sex gaps in mortality have been observed, explanatory models and theories that account for them vary widely. Two major theoretical perspectives emerge in the literature on the determinants of sex differences in childhood mortality (Waldron 1983; Hazzard 1986; Hill and Upchurch 1995; Pollard and Hyatt 1999; Kalben 2000; Wells 2000; Rieker and Bird 2005; Fuse and Crenshaw 2006; Vallin 2006; Pongou 2013; Rosenstock et al. 2013). The first is the *biological advantage/ disadvantage* theory and the second is the *environmental mechanisms* approach.

The biological advantage/disadvantage perspective maintains that excess mortality of male children is due to their weaker biological makeup (Pongou 2013: 436). Crediting the work of Waldron (1998) and United Nations (2011), Sawyer (2012: 2) claims that "newborn girls have a biological advantage in survival over newborn boys, with lesser vulnerability to perinatal conditions (including birth trauma, intrauterine hypoxia and birth asphyxia, prematurity, respiratory distress syndrome, and neonatal tetanus), congenital anomalies, and such infectious diseases as intestinal infections and lower respiratory infections." However, some studies note that the strong effect of biological factors in early infancy (<1 year) is alleviated in childhood (1–4 years) (Garenne and Lafon 1998; United Nations 2011; Sawyer 2012). Waldron (1987), in investigating overall neonatal mortality rates by sex in developing countries, suggests that biological factors may be more important in the early neonatal period, and environment may play a larger role in the late neonatal period. In general, biological factors refer to immutable factors specific to both the newborn and parents (Masuy-Stroobant 2006; Rosenstock et al. 2013). These include maternal age, parity, gestational age, birth weight, twin status, and genetic factors (Masuy-Stroobant 2006). However, in recent work, Pongou (2013) suggests a hypothesis that distinguishes between the effects of pre-conception or prenatal environment and child biology on sex differences in infant mortality. The *pre-conception environment* involves factors that are external to a child and that occur around the time of conception. These factors might be *pure environmental hazards* (such as parental exposure to chemicals) or medical factors (such as parental illnesses).

The environmental mechanisms approach focuses on mutable external factors that impact morbidity and mortality in the first five years of life (Rosenstock et al. 2013). Examples include maternal and newborn nutrition, sex preference, newborn care practices, breastfeeding practices, care-seeking behaviour, household environmental health hazards, and household- and community-level socioeconomic factors (Rosenstock et al. 2013). A number of previous studies have observed the roles of maternal and neonatal care, breastfeeding, appropriate complementary feeding, and quality of drinking water and sanitation in the continuum from child birth to child survival (Rousham 1999; Caulfield et al. 2004; Bhutta et al. 2008; Debes et al. 2013). In addition, it is now generally accepted that the physical and social environment, and other neighbourhood characteristics, can have a significant effect on life chances over and above the effect of their individual characteristics (Bernard et al. 2007; van Ham et al. 2012). Studies have found that community-level factors such as antenatal care coverage (percentage of mothers receiving antenatal care by trained health personnel), availability of basic infrastructure, average education of women in the community, and family structures are associated with infant and child mortality in LDCs (Sastry 1996; Kravdal 2004; Boyle et al. 2006; Chen et al. 2007; Omariba and Boyle 2007; Van de Poel et al. 2009). Empirical research has shown that neighbourhood poverty reduces the likelihood of safe delivery in several countries in SSA (Stephenson et al. 2006; Gage 2007). As noted, the determinants of childhood mortality may lie at different levels, i.e., macro, meso, and micro.

Mosley and Chen (1984) propose a comprehensive analytical framework for the study of child survival determinants in LDCs that has been used widely (Hill 2003). The framework combines sociological and biological explanatory models in a single conceptual framework by sorting independent variables as distal socio-economic determinants, followed by proximate determinants, creating an analytical hierarchy (Malqvist et al. 2012). Mosley and Chen (1984) include among the socioeconomic determinants community-, household-, and individual-level characteristics. In this theoretical framework, social and economic determinants of infant and child survival operate through a common set of biological mechanisms or proximate determinants which are categorized as follows: (1) maternal factors (age, parity, birth interval); (2) environmental factors (air, water, food, etc); (3) nutrient supply (calories, proteins and micronutrients); (4) injury; and (5) personal illness control (preventive and curative; Mosley and Chen 1984: 27). Most of these variables have been found to be associated with infant and child mortality in LDCs (see Madise et al. 2003; Boyle et al. 2006; Van de Poel et al. 2009; Singh et al. 2012).

In this paper, the analytical model draws on the Mosley-Chen framework to examine the determinants of sex differences in under-five mortality rates. Sex at birth is considered a proximate factor, and refers to the permanent and immutable biological characteristics common to individuals in all societies and cultures (Pollard and Hyatt 1999; FAO 2001). By integrating the biological and environmental perspectives on sex differences in early age mortality in human populations, this paper seeks to test whether individual or community-level factors explain sex disparities in the mortality of children aged 0 to 5 across SSA.

Data source and sample

This analysis relies on the Demographic and Health Surveys (DHS) from thirty countries in sub-Saharan Africa surveyed between 2004 and 2012 (Table 1). The DHS are nationally representative household surveys that provide detailed information on child mortality, health, and fertility (Hancioglu and Arnold 2013). The surveys are led by ICF International /MEASURE DHS, in collaboration with local institutions (DHS n.d.). In each survey, a two-stage probabilistic sampling design is used to select clusters or census enumerations areas (EAs) at the first stage and households at the second stage. All sub-Saharan African countries with a standard DHS after the year 2000 are eligible for inclusion in this analysis. For each country, data from the latest available survey at the time of the study are used (Table 1). The analyses are limited to more recent surveys to have the same control variables available across all datasets.

DHS uses a standardised questionnaire to facilitate between-country comparisons. The Individual Questionnaire for eligible women aged 15–49 includes a complete birth history (DHS 2012). Full birth histories are the primary material collected through the DHS since 1984, and the quality is generally acknowledged to be as among the best for data on births and infant and child deaths in resource-limited settings (Arnold 1990: 83–111; Pullum 2008), and comparable in accuracy to prospectively gathered data (Garenne and van Ginneken 1994; Byass et al. 2007). Typically, information is collected on the date of birth of each child, whether the child is still alive, and, if the child has died, the age at death (Rutstein 2008; Hill et al. 2012). The DHS surveys also include questions on women's basic socio-demographic characteristics, household ownership, and antenatal and delivery care, thus offering a rich source of information to study childhood mortality (Madise et al. 2003; Van de Poel et al. 2009; Pamuk et al. 2011). In addition, the DHS incorporates questions about child gender preferences since 1992, and is currently the only data source for conducting a cross-national comparison of attitudinal measures of child gender preference in sub-Saharan African countries (Fuse 2010).

In this study, the sample includes all singleton births occurring to women in the five years prior to the interview. Twins or other multiple birth children are excluded, due to possible survival issues associated with multiples (Guo and Grummer-Strawn 1993; Justesen and Kunst 2000; Heaton et al. 2005). In addition, limitation to only the most recent births allowed to include the healthcare access variables (e.g., the type of person who assisted with the delivery of the child, a key determinant of infant and child mortality) that are available only for births during the five years preceding the survey. Given these restrictions, the present analysis is based on 272,003 children (137,658 boys and 134,345 girls) born between 1998 and 2012. The number of children by country included ranges from 2,755 in Swaziland to 27,141 in Nigeria (Table 1).

Variables and measurement

The dependent variable in this study is the risk of under-5 death (0–59 months), defined as the probability of dying between birth and the fifth birthday. U5M was estimated for the 5 years preceding the survey.

The independent variable of interest is the sex of the child, defined as a binary variable that equals 1 if male and 0 if female. A number of biological and environmental variables associated with U5M in the literature were included as control variables (Mosley and Chen 1984; Hobcraft et al. 1985; Sastry 1996; Van de Poel et al. 2009; Pamuk et al. 2011). In the multivariate models, it is estimated whether inclusion of these variables attenuates the association between the sex of child and the risk of mortality. Control variables are then categorized as either individual-level or community-level.

Individual-level control variables include maternal attributes as well as the child's. Child variables include birth weight of child (large, very small, and smaller than average), "birth order" and "previous birth interval" combined to create a new variable with five categories (birth order one; birth order two or three, and birth interval less than or equal to 23 months; birth order two or three, and birth interval greater than 23 months; birth order four or greater, and birth interval less than or equal to 23 months; birth order four or greater, and birth interval greater than 23 months). Maternal covariates include mother's age at each birth (less than 20 years, 20–34 years, greater than 35 years), mother's education (no education, primary, secondary or higher), trained attendant at delivery (whether or not birth was attended by a doctor, a nurse or a midwife), and gender preference for children (no gender preference, balance preference, daughter preference, son preference). The latter variable is constructed from responses to three fertility preference questions, which are included in every survey. Women with living children were asked, "If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?" Women without living children were asked, "If you could choose exactly the number of children to have in your whole life, how many would that be?" Women were then asked, "How many of these children would you like to be boys, how many would you like to be girls, and for how many would the sex not matter?" (Fuse 2010: 1035). Studies show excess female child mortality in cultures with son preference, such as China, South Korea, Bangladesh, and India (Hill and Upchurch 1995; Larsen et al. 1998; United Nations 1998; Li et al. 2004). This increased risk of child mortality for girls is explained in terms of discrimination against girls, socioeconomically as well as through health-related behavioural factors (Yount 2001; Arokiasamy 2004; Li et al. 2004). A number of studies report that parents' beliefs about gender roles are a key determinant to their involvement in the child's health and healthcare (see Garfield and Isacco Iii 2012; Zvara et al. 2013). Gender ideologies represent what are seen as appropriate roles for men and women, and these beliefs affect behaviours (McHale and Huston 1984; Zvara et al. 2013). In sub-Saharan Africa, gender-based social inequality is a structural force that may condition the association between the sex of newborns and the risk of mortality (Wamani et al. 2007; Dodoo and Frost 2008).

Household-level variables include socio-economic status, measured by a household wealth quintile. Household wealth is captured in DHS through a composite index for relative standard of living derived from country-specific indicators of asset ownership, housing characteristics and water and sanitation facilities (Houweling et al. 2003; Rutstein and Kiersten 2004).

Community-level variables included here are place of residence (urban/rural areas), the community's socioeconomic status (mean wealth index quintile score, categorized as low or high); proportion of women in the community with secondary or higher education, proportion of births delivered in health facilities, and an index measuring the extent of son preference (the proportion of women who reported a son as the type of gender preference). These variables are constructed by aggregating individual-level and household-level characteristics at the cluster level (i.e., the primary sampling units, PSU) for the DHS. The DHS surveys use a stratified cluster sample design. Within each province, a number of PSUs are selected. These units typically encompass one or a few villages, or part of a town (Hancioglu and Arnold 2013). On average, about 25 households are randomly selected in each primary sampling unit, and women of reproductive age in the household are interviewed (Aliaga and Ren 2006; ICF International 2012). The average number of children per cluster in this sample ranges from 7.0 (range 1–28, SD 0.20) in Ghana to 30.2 (range 6–67, SD 12.0) in Senegal (Appendix Table 1). Appendix Table 2 shows the operationalization of independent variables used in this study.

Analytical model

A multilevel discrete-time hazard model, that is, a combination of discrete-time hazard model (i.e., an analytic technique that deals correctly with right-censoring) and multilevel modeling (i.e., an analytic technique that considers the clustering of children into communities) is employed in this study (Allison 1982; Kuate-Defo 2001; Sear et al. 2002; Snijders and Bosker 2012). The outcome variable is children's risk of mortality at any time between birth and 59 months of age or between birth and the survey date for children who had not yet reached age five at time of interview. Children who were still alive at the interview date were right-censored. Since in the DHS age at death (reported in days and months) is subject to heaping at certain ages, a discrete formulation of time is preferred to a continuous one (Gyimah 2009). Discrete-time hazard models require that episodes be split into periods of risk (Singer and Willett 2003). Three exposure periods are defined here: the first month of life (age 0 months), months 1–11, and months 12–59. These intervals cover the components of the U5M, and are based on excepted categorization into neonatal mortality (in the first month), postneonatal mortality (months 1–11), and child mortality (months 12–59), respectively (Ren 1995; Bicego and Ahmad 1996; Sear et al. 2002:48; Hill and Choi 2006; Rajaratnam et al. 2010).

Relying on standard discrete-time hazard techniques, however, ignores the fact that children are clustered in families/communities. Previous studies in LDCs have shown that mortality risks are clustered in that even after controlling for community and household characteristics, mortality risks differ systematically across communities or households (Das Gupta 1997; Sear et al. 2002; Heaton et al. 2005; Campbell and Lee 2009; Van de Poel et al. 2009; Saha and van Soest 2011; Edvinsson and Janssens 2012; Van Bodegom et al. 2012).

The primary motivation for a multilevel analysis stems from the hierarchically clustered nature of the DHS data (Mazumdar 2012). Typically, children are nested into mothers, mothers are nested into households, households into PSUs, and PSUs into regions/provinces. Hence, factors affecting health outcomes in general, and child survival in particular, can arise from different levels of aggregation (Sastry 1996; Manda 1998; Bingenheimer and Raudenbush 2004; Omariba and Boyle 2007; Gyimah 2009; Corsi et al. 2011; Mazumdar 2012). Apart from individual bio-demographic and health attributes (such as age, sex, birth order, birth weight), which are independently determined for every child, siblings share certain common characteristics of the mother and the household (e.g., mother's education and household economic status), and children from a particular community have in common community factors such as availability of health facilities and outcomes (Mazumdar 2012). As a result, many scholars assert that unobserved heterogeneity in the outcome variable is also correlated at the cluster levels (see Manda 1998; Bingenheimer and Raudenbush 2004; Mazumdar 2012: 3). The use of multilevel modeling accommodates the hierarchical nature of the data, and corrects estimated standard errors to allow for clustering of observations within units (Goldstein 2010; Snijders and Bosker 2012).

Studies using fixed effects models to investigate determinants of child mortality and to control for unobservable variables at the cluster level lead to the difficulty that if the fixed effect is assumed away, then the effect of those variables that do not vary in a cluster will be lost in the process (Frankenberg 1995; Desai and Alva 1998; Campbell and Lee 2009). With such an approach, the effect of any variable that does not vary among children in the cluster (for example, urban/rural residence) cannot be estimated. Instead, the variance-component model corrects for the problem of correlated observations in a cluster, by introducing a random effect at each cluster (Snijders and Bosker 2012). In other words, subjects in the same cluster have a shared random intercept in the model. In this analysis, given that the number of children per mother and mother per household is very small, then children, mothers, and households are considered as part of a same level (level 1), as nested within communities (level 2). Thus, two-level random-effects discrete-time hazard models were fitted to assess sex differences in mortality among under-five children. The models had the following general specification (Wong and Mason 1985; Sear et al. 2002):

$$\text{Log}[(p_{tij}/(1-p_{tij})] = \alpha_t + ɱ\mathbf{M}_{ij} + \beta\mathbf{X}_{ij} + \mu_j$$

where p_{tij} is the probability that child i in community j observed in the time interval t dies within that interval; M_{ij} is a dummy variable indicating whether the sex at birth of child is male, ɱ represents the vector of the coefficients associated with the sex of the child; X_{ij} represents a vector of individual- and community-level explanatory variables; β is a vector of regression parameters associated with X_{ij}; α_t is a function of time and denotes the effect of age on mortality; and μ_j is the community-level random effect assumed to be normally distributed with mean equal to zero and variance $\sigma^2{}_{\mu}$.

The variance can also be interpreted in terms of intra-class correlation (ICC) in a latent variable, reflecting a number of unobserved factors that are shared among children from the same community. For the binary logit model, ICC is estimated as $\rho=\sigma_{\mu}{}^2/(\sigma_{\mu}{}^2+\pi^2/3)$, where $\sigma^2{}_{\mu}$ is the estimated community-level variance and $\pi^2/3$ (equal to 3.29) represents the variance of a standard logistic distribution (Snijders and Bosker 2012: 305). The fixed and random parameter estimates (along with their standard errors) for the multilevel binomial logit link model were estimated using the method of marginal quasi-likelihood (MQL) with a first-order Taylor series expansion, as implemented within the MLwiN (version 2.28, University of Bristol; Rasbash et al. 2012; Leckie and Charlton 2013). The results are shown as odds ratios (ORs) with 95 per cent confidence intervals (CIs). The sex differential in mortality is measured as the boy/girl ratio of the five-year probabilities of dying between birth and exact age five years. $\text{Exp}(\beta_k)$ is the estimated ORs for those who are a unit apart on X_k, net of other predictors in the model. If the odds ratio for U5M is greater than one, it can be interpreted as $(\text{OR}-1)*100\%$ increased odds of dying before reaching the age of five. If the odds ratio is smaller than one, it can be interpreted as $(1/\text{OR}-1)*100\%$ decreased odds of dying under age five. All analyses were conducted using Stata 12.1 and MLwiN (Leckie and Charlton 2013).

Following previous studies, a model-building strategy is employed that begins with the baseline model and progressively adds covariates for different sets of biological and environmental characteristics that are measured at the individual- and community-levels (e.g., Rogers et al. 2010; Bharadwaj and Lakdawala 2013). Four models are systematically estimated for each of the thirty countries studied. More specifically, I start with a baseline model that includes child sex and age (Model 1). The next model (Model 2) adds to the base model the individual-level control variables (child characteristics, maternal variables, and household wealth). Model 3 adds to Model 2 community-level variables, which include place of residence, community wealth index, level of mother's education in the community, level of facility delivery in the community, as well as index for the extent of son preference.

The focus of the analysis is change in the coefficient of the child's sex with the introduction of successive blocks of variables. Since the primary goal is to evaluate the effect of the child's sex on the risk of U5M, the approach here examines what this effect is before and after controlling for other factors, so as to determine whether such an effect is direct or mediated through other predictors (Baron and Kenny 1986; Moffitt 2005). If the coefficient for the sex variable is reduced by the addition of other variables, then part of the dynamic underlying the effect of the child's sex is presumed to be due to relationships between sex and other variables (see Rogers et al. 2010).

Finally, Model 4 adds to Model 3 an interaction term between sex of the newborn and the child's age. The Wald test is run to compare whether the model with interaction terms as predictors fits significantly better than a model without interaction terms (Singer and Willett 2003). Because major causes of death differ substantially at different ages, the sex differential in childhood mortality may be quite different at different ages of children (Retherford et al. 1989; Forste 1994; Ren 1995; Manda 1999). To test whether the sex of the child has a differential impact on the risk of dying by age 5 by duration of exposure, a series of dichotomous control variables is included to capture the interaction between exposure to the risk of dying before age 5 (0–1 months, 1–11 months, and 12–59 months) and the child's sex. Instead of running the hazard models generating estimates for three age intervals separately—the neonatal period (first month), post-neonatal period (exact ages, 1 to 12 months), and childhood period (exact ages, 12 to 60 months)—this analysis provides the odds of under-5 death within each discrete period, given that death has not already occurred. Furthermore, it is possible that at least some of the control variables interact with the child's sex, inasmuch as the effect of child's sex on mortality risk may vary by the category of a control variable (Mishra et al. 2004: 275). However, using a large sample of pooled DHS data from Sub-Saharan African countries, Pongou found that infant mortality (<1 year) by sex is not affected by the interactions between biology and climate, or between biology and social status (e.g., maternal education), after controlling for the effects of unobserved pre-conception factors (Pongou 2013). Since the justification for including the control variables is to hold them constant in the models, Mishra et al. (2004: 1652) are followed, and no interactions between child's sex and the control variables are included.

Results

Country profiles

Table 1 presents the countries, survey years, number of clusters, and sample births included in the analysis. It also shows the U5M rate for the five-year period preceding the survey, sex ratio at birth, and the percentage of child males in the sample. The DHS sampling weights are used to produce nationally representative estimates. As expected, in most countries, more than half of children born are boys. The sex ratios at birth—number of male births divided by female births times 100—show that in the samples, the number of boys born outnumbers girls born in most of the countries, ranging between 101 in Benin and 109 in Ethiopia. Exceptions to this pattern are found in Cameroon, Congo Democratic Republic, Congo (Brazzaville), Malawi, Sierra Leone, and Zambia. In these countries, the sex ratio is less than 100, indicating that there are more girls at birth. The lowest level of sex ratios at birth was recorded in Cameroon, with 96 male births per 100 female births (Table 1). Despite focusing the analysis on low-income countries in the SSA region, heterogeneity is observed in national U5M. Niger had the highest U5M, with 198 under-5 death deaths per thousand live births. The lowest U5M rate of 65 per thousand was found in Gabon.

Comparability of data between sexes

Appendix Table 2 compares the distribution of the selected characteristic for males and females for every country studied. Cross-tabulations and Pearson's *chi-squared* (χ^2) analyses are used to evaluate differences in the association between the sex and covariates. This table reveals remarkable differences in the distribution of the covariates by child's sex. In particular, differences between male and female children by child's birth weight are significant in all countries (Chi-square p-values (p) < 0.050)

Table 1. Survey year, number of sample clusters and sample births, and selected characteristics[1] for thirty sub-Saharan Africa countries.

Country	Survey year	Number of sample clusters	Sample births (all singleton births in the five years before the survey)	Sex ratio at birth in the sample (number of male births divided by female births times 100)	Percentage of the children males in sample	U5M rate (per 1000 live births)*
Benin	2006	750	15033	101.4	50.3	125
Burkina Faso	2010	573	14776	102.8	50.7	129
Burundi	2010	376	7798	103.9	51.0	96
Cameroon	2011	578	11251	96.4	49.1	122
Chad	2004	196	5840	103.8	50.9	191
Congo (Brazzaville)	2011–12	384	7842	98.3	49.6	117
Congo Democratic Republic	2007	300	8689	96.5	49.1	148
Côte d'Ivoire	2011–12	351	7141	100.3	50.1	108
Ethiopia	2011	596	11597	108.7	52.1	88
Gabon	2012	334	4908	106.6	51.6	65
Ghana	2008	406	2783	106.9	51.7	80
Guinea	2005	295	6034	107.8	51.9	163
Kenya	2008–09	398	5698	107.1	51.7	74
Lesotho	2009	399	3616	104.1	51.0	117
Liberia	2007	298	5372	108.2	52.0	110
Madagascar	2008–09	594	12449	104.0	51.0	72
Malawi	2010	849	18850	99.4	49.8	112
Mali	2006	407	13941	102.5	50.6	191
Mozambique	2011	610	11265	102.8	50.7	97
Namibia	2006–07	495	4832	104.5	51.1	69
Niger	2006	342	9557	104.3	51.1	198
Nigeria	2008	886	27141	103.5	50.9	157
Rwanda	2010	492	8868	103.7	50.9	76
Senegal	2010–11	391	11014	105.3	51.3	72
Sierra Leone	2008	352	5601	97.5	49.4	140
Swaziland	2006–07	274	2755	102.0	50.5	120
Tanzania	2010	475	7939	99.6	49.9	81
Uganda	2006	404	7813	100.7	50.2	90
Zambia	2007	319	6156	99.2	49.8	119
Zimbabwe	2010–11	406	5444	101.9	50.5	84

1. Number and percentages were calculated using appropriate individual country weights.
* U5M rate for the five-year period preceding the survey. (Source: ICF International, 2012. MEASURE DHS STATcompiler - http://www.statcompiler.com - November 10 2013 http://www.statcompiler.com/).

except the Congo Democratic Republic ($p = 0.420$) and Tanzania ($p = 0.110$). On average, the proportion of births where mothers have deemed their infants as being average or larger than average was significantly higher for boys. Gender preference for children was investigated, using fertility preference, to determine whether there is son preference. The findings reveal that the proportion of births among mothers who have a son preference was significantly higher for boys ($p <= 0.005$). There is no difference between boys and girls by delivery care provider (in all countries but Burundi, Guinea, Malawi, and Mozambique). The proportion of newborns with deliveries assisted by doctor or nurse/midwife was statistically significantly higher for boys (31.4%) than girls (26.9%) in 2010 in Burundi (p = 0.044). A similar pattern is found in 2005 in Guinea (boys 29.9% compared to girls 26.8%, p = 0.012); in 2010 in Malawi (boys 72.3%, girls 70.7%, p = 0.072), and in 2011 in Mozambique (boys 19.2%, girls 17.6%, p = 0.057).

Cross-national comparison of sex differentials in under-five mortality

Results from the multilevel discrete-time hazard models are shown in Table 2. In the interest of space, coefficients for other covariates are not displayed but are available on request. Country-specific sex differentials in U5M are expressed as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). Model 1 presents a baseline model showing only the effects of sex of child and age. Model 2 adds the effect of individual-level control variables. Model 3 includes both individual and community-level variables. Model 4 adds the interaction terms between sex and age. Comparison of the four models yields assessments of how the effect of child's sex on U5M is affected by each block of covariates and by all covariates simultaneously.

The results show systematically higher mortality for male children compared to females in all countries except Sierra Leone and Swaziland. Model 1 reveals that the male/female odds ratio for U5M ranges from 1.07 (95% CI = 0.97−1.18; p = 0.199) in Mali to 1.54 (95% CI = 1.29−1.83; p = 0.000) in Côte d›Ivoire. In some countries (Madagascar, Chad, Niger, Congo Democratic Republic, Benin, Mali, Burundi, Rwanda, Congo (Brazzaville), Ghana, Swaziland) the differences are small or not significant at the five per cent significance level. Males have 25–54 per cent higher odds of dying before age five in the countries where the association between sex of the child and risk of mortality is significant. The countries with the widest male disadvantages in U5M tend to be found in Southern (e.g., Lesotho) and Western (e.g., Côte d'Ivoire) Africa. The risk of U5M was not different between males and females (OR = 1.00; 95% CI = 0.78−1.29, p = 0.987) in Swaziland. On the contrary, in Sierra Leone, males have 14 per cent lower odds than females of dying before age five (OR = 0.86; 95% CI = 0.71−1.03; p = 0.091). Overall, sex gaps in U5M are found to vary cross-nationally.

As seen in Model 2, adjustment for individual-level factors slightly increases the ORs male to female mortality from the baseline models (age-adjusted sex differences; Model 1) in most of those thirty countries. Exceptions to this pattern are found in only three countries (Ethiopia, Tanzania, and Uganda), where the coefficients were reduced.

After adjusting for both individual-level and community-level factors together (Model 3), the sex ratio in U5M (excess mortality of males with respect to females) remains significant at the 5% level of significance in seventeen countries: Côte d'Ivoire, Nigeria, Malawi, Guinea, Mozambique, Lesotho, Zambia, Kenya, Senegal, Ethiopia, Gabon, Cameroon, Zimbabwe, Burkina Faso, Uganda, Namibia, and Madagascar. In many cases, effect sizes do not change markedly when adjusting for the additional covariates. The individual-level and community-level controls explain less than two percent of the sex differentials in U5M in Uganda, Senegal, and Lesotho. For only two countries (Sierra Leone and Swaziland) the male U5M rate is lower than that for females. But the ORs for the association were not statistically significant.

The full model (Model 3) was examined for evidence of interaction between sex and age of children to determine whether sex disparities in U5M are affected by age. Wald tests showed that the addition of the interaction terms [male X age (1–11 months); (male X age (12–59 months)] to the full model yields a significantly improved model in twelve countries. No significant interaction between sex and age emerges in eighteen countries: Benin (p = 0.476), Burkina Faso (p = 0.918), Burundi (p = 0.320), Congo (Brazzaville) (p = 0.1741), Ethiopia (p = 0.303), Gabon (p = 0.717), Ghana

Table 2. Odds ratios (OR), 95% confidence intervals (CI), and p-values of dying before age five by sex of child (males versus females) in thirty sub-Saharan Africa countries, all singleton births born within the five years preceding the survey, by country, Demographic and Health Surveys, 2004–2012.

	Model 1			Model 2			Model 3		
Country	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Benin	1.09	0.96–1.22	0.176	1.11	0.98–1.25	0.103	1.11	0.98–1.25	0.094
Burkina Faso	1.13	1.00–1.27	0.044	1.13	1.00–1.28	0.043	1.13	1.01–1.28	0.039
Burundi	1.11	0.93–1.34	0.245	1.15	0.96–1.39	0.135	1.16	0.96–1.39	0.131
Cameroon	1.15	1.00–1.33	0.050	1.17	1.01–1.34	0.034	1.17	1.01–1.35	0.031
Chad	1.13	0.96–1.32	0.141	1.13	0.97–1.33	0.119	1.14	0.97–1.33	0.109
Congo (Brazzaville)	1.08	0.89–1.32	0.432	1.12	0.91–1.37	0.283	1.12	0.91–1.37	0.282
Congo Democratic Republic	1.10	0.96–1.27	0.157	1.12	0.97–1.29	0.121	1.12	0.97–1.29	0.122
Côte d'Ivoire	1.54	1.29–1.83	0.000	1.57	1.32–1.88	0.000	1.58	1.32–1.89	0.000
Ethiopia	1.22	1.05–1.42	0.008	1.20	1.03–1.39	0.018	1.20	1.03–1.40	0.018
Gabon	1.28	0.99–1.65	0.056	1.37	1.05–1.80	0.023	1.37	1.05–1.80	0.023
Ghana	1.10	0.80–1.50	0.563	1.10	0.80–1.52	0.557	1.09	0.79–1.50	0.595
Guinea	1.27	1.08–1.50	0.004	1.30	1.10–1.53	0.002	1.30	1.10–1.54	0.002
Kenya	1.31	1.04–1.64	0.020	1.33	1.05–1.67	0.017	1.33	1.06–1.68	0.016
Lesotho	1.38	1.11–1.72	0.004	1.38	1.10–1.72	0.004	1.38	1.10–1.72	0.005
Liberia	1.22	1.00–1.49	0.055	1.21	0.98–1.48	0.072	1.21	0.98–1.49	0.071
Madagascar	1.14	0.97–1.34	0.115	1.17	1.00–1.38	0.057	1.18	1.00–1.39	0.053
Malawi	1.21	1.09–1.35	0.000	1.23	1.10–1.37	0.000	1.23	1.10–1.37	0.000
Mali	1.07	0.97–1.18	0.199	1.08	0.97–1.20	0.159	1.08	0.97–1.20	0.158
Mozambique	1.16	1.00–1.35	0.049	1.26	1.07–1.47	0.004	1.26	1.08–1.48	0.004
Namibia	1.25	0.98–1.58	0.072	1.28	1.00–1.65	0.053	1.28	1.00–1.65	0.051
Niger	1.11	0.96–1.27	0.157	1.13	0.98–1.30	0.090	1.13	0.98–1.30	0.091
Nigeria	1.18	1.09–1.28	0.000	1.20	1.11–1.29	0.000	1.20	1.11–1.29	0.000
Rwanda	1.11	0.92–1.34	0.256	1.15	0.95–1.40	0.140	1.16	0.96–1.40	0.135
Senegal	1.23	1.05–1.45	0.013	1.23	1.04–1.45	0.017	1.23	1.04–1.45	0.016
Sierra Leone	0.86	0.71–1.03	0.091	0.86	0.72–1.04	0.126	0.87	0.72–1.05	0.139
Swaziland	1.00	0.78–1.29	0.987	0.97	0.75–1.26	0.824	0.97	0.74–1.26	0.817
Tanzania	1.25	1.03–1.52	0.027	1.22	0.99–1.49	0.058	1.22	0.99–1.49	0.057
Uganda	1.24	1.03–1.48	0.024	1.22	1.01–1.47	0.038	1.22	1.01–1.47	0.041
Zambia	1.28	1.06–1.53	0.009	1.29	1.07–1.55	0.008	1.29	1.07–1.55	0.008
Zimbabwe	1.26	1.01–1.58	0.040	1.29	1.02–1.63	0.032	1.28	1.01–1.61	0.039

Note: control variables (not shown). Model 1—baseline model including only sex of the child (female (ref.), male) and the age (0 months (ref.) 1–11 months, 12–59 months). Model 2—adjusting Model 1 for individual-level variables: child size at birth (average or larger than average (ref.), very small and smaller than average); birth order and preceding birth interval (first birth ((ref.), 2–3 and < 24 months, 2–3 and 24+ months, 4+ and < 24 months, 4+ and 24+ months), mother's age at child birth (less than 20 years (ref.), 20–34 years, greater than 35 years), skilled attendant at delivery (other (incl. none) (ref.), doctor, nurse, or midwife), type of gender preference (no gender preference (ref), balance preference, daughter preference, son preference), maternal education (no education (ref.) primary, secondary or higher), household wealth index (1st quintile (poorest) (ref.), 2nd quintile, 3rd quintile, 4th quintile, 5th quintile (richest)). Model 3 includes individual- and community-level control (urban-rural area of residence (rural (ref.), urban), women with secondary or higher (%) (low (ref.), high), women delivering in a health facility (%) (low (ref.), high), women who have a son preference (%) (low (ref.), high), mean wealth index quintile score (low (ref.), high)). Model 4—adjusting for all of the studied independent variables and interaction terms between sex and age group. All models are multivariate multilevel logit hazards model regression (Ref. = referent).

($p = 0.246$), Kenya ($p = 0.218$), Liberia ($p = 0.140$), Madagascar ($p = 0.786$), Malawi ($p = 0.354$), Niger ($p = 0.117$), Rwanda ($p = 0.313$), Sierra Leone ($p = 0.652$), Swaziland ($p = 0.899$), Uganda ($p = 0.362$), Zambia ($p = 0.261$), Zimbabwe ($p = 0.969$) (see Wald test (Prob > chi2) in Model4 of Table 2).

Table 2 (cont'd): Model 4 and Wald test.

	Model 4 Male (Main effect)			Male X age: 1–11 months			Male X age: 12–59 months			Wald test (Prob > chi²)*
Country	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value	
Benin	1.24	1.00–1.54	0.054	1.04	0.86–1.27	0.670	1.07	0.87–1.32	0.533	0.476
Burkina Faso	1.13	0.90–1.42	0.290	1.17	0.96–1.42	0.118	1.10	0.90–1.35	0.345	0.918
Burundi	1.32	0.98–1.77	0.064	1.15	0.85–1.56	0.354	0.90	0.60–1.35	0.605	0.320
Cameroon	1.46	1.13–1.89	0.004	1.22	0.95–1.56	0.113	0.93	0.73–1.18	0.541	0.035
Chad	1.59	1.17–2.16	0.003	1.02	0.79–1.31	0.868	0.98	0.74–1.29	0.876	0.037
Congo (Brazzaville)	1.37	0.97–1.95	0.076	1.15	0.83–1.60	0.405	0.84	0.58–1.23	0.378	0.174
Congo D.R.	1.44	1.11–1.88	0.007	0.98	0.79–1.22	0.877	1.05	0.81–1.37	0.707	0.076
Côte d'Ivoire	2.16	1.59–2.94	0.000	1.38	1.02–1.85	0.035	1.27	0.91–1.76	0.162	0.037
Ethiopia	1.36	1.09–1.70	0.007	1.11	0.85–1.46	0.447	1.04	0.76–1.41	0.805	0.303
Gabon	1.40	0.90–2.18	0.133	1.19	0.76–1.89	0.447	1.58	0.95–2.63	0.078	0.717
Ghana	1.43	0.90–2.28	0.132	0.94	0.53–1.65	0.821	0.75	0.38–1.48	0.404	0.246
Guinea	1.73	1.28–2.32	0.000	1.26	0.96–1.65	0.094	1.00	0.74–1.36	0.975	0.039
Kenya	1.60	1.12–2.30	0.010	1.32	0.90–1.93	0.152	0.93	0.57–1.53	0.788	0.218
Lesotho	1.94	1.33–2.82	0.001	1.12	0.81–1.55	0.497	1.17	0.70–1.98	0.547	0.076
Liberia	1.62	1.13–2.33	0.009	1.01	0.74–1.38	0.941	1.12	0.73–1.70	0.605	0.140
Madagascar	1.14	0.88–1.48	0.325	1.26	0.97–1.63	0.081	1.09	0.76–1.56	0.623	0.786
Malawi	1.37	1.13–1.67	0.001	1.18	0.98–1.41	0.074	1.13	0.92–1.39	0.228	0.354
Mali	1.34	1.11–1.61	0.002	0.96	0.81–1.15	0.682	0.98	0.83–1.17	0.854	0.019
Mozambique	1.79	1.38–2.32	0.000	1.05	0.82–1.35	0.708	0.95	0.68–1.33	0.775	0.003
Namibia	1.95	1.25–3.05	0.003	1.11	0.75–1.65	0.588	0.93	0.56–1.52	0.762	0.059
Niger	1.46	1.09–1.94	0.011	1.11	0.87–1.41	0.418	1.00	0.80–1.24	0.968	0.117
Nigeria	1.45	1.26–1.66	0.000	1.12	0.97–1.28	0.131	1.07	0.94–1.21	0.328	0.003
Rwanda	1.36	1.02–1.82	0.036	1.05	0.77–1.43	0.761	0.97	0.63–1.47	0.874	0.313
Senegal	1.64	1.27–2.11	0.000	0.81	0.60–1.08	0.154	1.26	0.88–1.80	0.217	0.002
Sierra Leone	0.81	0.59–1.11	0.187	0.96	0.72–1.28	0.790	0.80	0.55–1.18	0.260	0.652
Swaziland	0.86	0.49–1.53	0.615	1.01	0.72–1.41	0.960	0.97	0.53–1.77	0.920	0.899
Tanzania	1.78	1.29–2.45	0.000	0.73	0.52–1.03	0.072	1.36	0.89–2.07	0.155	0.001
Uganda	1.44	1.05–1.96	0.022	1.16	0.86–1.58	0.332	1.03	0.71–1.48	0.891	0.362
Zambia	1.08	0.79–1.49	0.623	1.55	1.15–2.10	0.004	1.22	0.86–1.74	0.262	0.261
Zimbabwe	1.32	0.89–1.94	0.164	1.28	0.88–1.87	0.195	1.22	0.78–1.91	0.381	0.969

* Wald test (Prob > chi²) indicates whether the model with interaction terms as predictors (Model 4) fits significantly better than a model without interaction terms (Model 3).

The analysis set out to examine the main effect of child's sex on U5M and the underlying mechanisms at work across sub-Saharan African countries. The introduction of interaction terms does not change the magnitude and the direction of effects. Even after accounting for key covariates, including biological indicators of health (e.g., birth weight, birth order, and preceding birth interval), gender preference, and household and community socio-economic and environmental characteristics, as well as interaction of sex with age, there was a very strong association between child's sex and risk of dying before age five.

Excess male U5M persists and remains significant in nineteen countries (Nigeria, Côte d'Ivoire, Mozambique, Senegal, Guinea, Tanzania, Lesotho, Malawi, Mali, Chad, Namibia, Cameroon, Ethiopia, Congo Democratic Republic, Liberia, Kenya, Niger, Uganda, and Rwanda) ($p < 0.05$)(see the ORs of the main effects in Model 4 of Table 2). The change in sex differentials in U5M observed across models (Model 1 to Model 4) is very small or insignificant. Overall, cross-national differences do not disappear after the introduction of the control variables in Models 2, 3, and 4. The adjusted ORs for the sex of newborns on U5M remain largely unchanged, or increased. This suggests that the child's sex is an independent predictor of U5M in these countries. The individual-level (child, mother, and household characteristics) and community-level control variables in this study do not explain the sex differentials in U5M in many countries in sub-Saharan Africa.

Discussion and conclusion

The issue of sex differentials in childhood mortality in LDCs has recently generated considerable interest. Sex-disparities in childhood mortality may be explained by various factors, and previous studies are limited in examining the role of individual, household, and community-level factors. Using multilevel discrete time-hazard modeling to analyze the Demographic and Health Survey data for thirty Sub-Saharan Africa countries, this article empirically assesses country-specific sex differentials in U5M rates, while controlling for observed individual, household, and community-level characteristics as well as community-level effects.

The results show that male children have systematically higher mortality risks than female children. In particular, boys' U5M was about 17–54 per cent higher than girls'. These patterns were found even with controls for individual and community-level factors, as well as heterogeneity. Overall, the results are consistent with long-established findings of higher infant mortality in males, which have persisted for many years and occur among most world populations, and have been explained in part by differences in genetic gender susceptibility to disease (Drevenstedt et al. 2008; Pongou 2013). These findings suggest the pattern of male excess childhood mortality is present across countries in SSA. Some studies have highlighted sex differences despite the fact that this was not the principal aim of the study (Madise et al. 2003). Excess male infant mortality has been previously observed in Africa (see LeGrand and Mbacké 1995; United Nations 2011). In analysis of the contributing determinants of wealth-related inequality in U5M in thirteen African countries, Van Malderen et al. (2013) have revealed an independent effect of the sex of the child; mortality was higher in males in Lesotho, Malawi, Nigeria and São Tomé and Príncipe. On the other hand, a community-based cohort study in rural Malawi has documented a twofold mortality risk among 1-year-old to 2-year-old boys compared with girls of the same age (Ashorn et al. 2002).

Most of the literature claims that the poorer health of boys may reflect biological factors (see Waldron 1983; Pollard and Hyatt 1999; Kalben 2000; Vallin 2006). Indeed, male disadvantage in mortality is most likely explained by biological factors such as lower resistance to infection, higher risk of premature birth, and larger average birthweight and head circumference leading to difficult labour (Wells 2000; Van Malderen 2013: 4332). Waldron notes that male infants have "inherently lower levels of certain components of immune resistance, and this may contribute to a higher mortality risk of some types of infectious disease" (Waldron 1983, 1987). In this study, however, it was difficult to attribute to the effect of hidden biological factors on residual sex differences in U5M, after controlling for heterogeneity at individual levels (due to known environmental and biological factors) and for heterogeneity at community levels (due to unknown environmental and biological factors). In many countries, the individual and community-level factors do not account for sex differentials in U5M risk. It is hard to explain completely the sex gap in U5M that varies nationally. Many scholars have highlighted that determinants of sex differences in mortality are far from being certain, and their combination into integrated biological models continues to be inadequate. A particular difficulty is to distinguish between environmental factors that occur around the time of conception and purely biological factors (e.g., genetics; Bharadwaj and Lakdawala 2013; Pongou 2013). In addition, it is almost impossible in population-based data (e.g., DHS) to control directly for all biological factors. The literature further suggests that sex differences in childhood mortality may be attributable to differences in socio-cultural, political, and economic systems that influence discrimination against girls. However, inadequate measurement of these variables has limited their consideration in previous comparative research.

The origin of sex differences in childhood mortality is complex. This study highlights the importance of the need to incorporate additional contextual variables in future analyses. One limitation of this paper is that several important causes of under-5 death could not be included in this analysis, due to the lack of data. These include genetic causes or biological characteristic such as anemia and infection with HIV in pregnancy (Volberding et al. 2004) and cultural factors such as ethnicity (Gyimah 2006). Details of the circumstances of the individual child (breastfeeding, immunization, number of siblings who died during their first five years of life) or specific practices of the mother regarding child care and hygiene (changes, if any, in the food or water given to children when they suffered from fever or diarrhea, regularity in use of soap, frequency of bathing) could not be included. Children under 5 can be highly susceptible to infectious illnesses, accounting for nearly two-thirds of deaths (Tsai 2012; Campbell et al. 2013). A recent UNICEF report notes that pneumonia, diarrhea, malaria, meningitis, tetanus, and measles are common childhood illnesses, and these are deaths which can be easily prevented by prioritizing the poorest children. Many deaths from infectious diseases occur in children who are already weakened by undernutrition (UNICEF 2012). It should also be noted that in this study, multilevel modeling takes account of unobserved heterogeneity at the community level. In addition, to ensure comparability and consistency, only a limited number of variables are used in this study. As the comparability between surveys is more important than the model selection process, all variables that are comparable in all thirty datasets are included in the analysis. It is possible, however, that others observable mechanisms lead to excess male U5M across the Sub-Saharan region. Notwithstanding these limitations, the findings from this study represent a further step towards an improved understanding of the complex determinants of child survival in sub-Saharan Africa.

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Appendix Table 1. Average number of children (all singleton births born within the five years preceding the survey) per cluster in thirty sub-Saharan Africa countries, Demographic and Health Survey (DHS), 2004–2012.

Country	Number of sample clusters	Mean	Std. Dev.	Min	Max
Benin	750	20.22	10.17	2	80
Burkina Faso	573	25.25	9.63	4	62
Burundi	376	20.10	5.53	5	37
Cameroon	578	19.36	9.06	1	53
Chad	196	28.07	9.69	7	59
Congo (Brazzaville)	384	23.27	8.92	4	66
Congo Democratic Republic	300	29.01	8.70	7	61
Côte d'Ivoire	351	21.13	10.09	3	61
Ethiopia	596	18.96	9.34	1	52
Gabon	334	17.40	8.64	1	53
Ghana	406	7.04	4.08	1	28
Guinea	295	20.45	9.02	4	49
Kenya	398	14.81	7.76	1	44
Lesotho	399	9.72	4.60	1	38
Liberia	298	18.70	7.68	1	43
Madagascar	594	20.56	8.43	5	49
Malawi	849	22.50	7.85	3	49
Mali	407	33.84	11.45	7	68
Mozambique	610	17.47	6.93	2	48
Namibia	495	10.13	4.84	1	26
Niger	342	25.83	9.98	4	57
Nigeria	886	31.25	15.40	1	101
Rwanda	492	17.75	5.06	5	33
Senegal	391	30.27	12.01	6	67
Sierra Leone	352	15.42	7.02	1	40
Swaziland	274	9.99	5.03	1	26
Tanzania	475	16.38	8.00	2	45
Uganda	404	18.88	7.31	2	43
Zambia	319	19.23	8.85	3	60
Zimbabwe	406	13.35	6.03	1	33

Appendix Table 2. Measurement of independent variables included in analyses.

Names	Description
Individual-level variable	
Sex	Whether the child is male or female (1 = male; 0 = female).
Age of the child in months	Number of months from time of birth until time of death or censoring (interview) (categorized as 0 = 0 months; 1 = 1 to 11 months; 2 = 12 to 59 months).
Child size at birth	Mothers' perception of child size at birth recorded as (1=Very small, Smaller than average; 0=Average Larger than average, Very large)
Birth order and preceding birth interval	Birth order and preceding birth interval were combined in one variable and is classified as follows: first birth, birth order 2–4 with short birth interval (< 24 months), birth order 2–4 with medium birth interval (24–47 months), birth order 2–4 with long birth interval (48+ months), birth order 5+ with short birth interval (< 24 months), birth order 5+ with medium birth interval (24–47 months), birth order 5+ with long birth interval (48+ months).
Mother's age at child birth	Respondent's age (in years) at child birth (1 = less than 20 years; 2 = 20–34 years; 3 = greater than 35 years.
Type of gender preference	Mother's gender preference for children (1=no gender preference; 2=balance preference; 3=daughter preference; 4=son preference).
Mother's education	Categorical variable indicating highest educational level that respondents completed (1 = no education; 2 = primary; 3 = secondary or higher education).
Household wealth Index	Index provided with the dataset is used. DHS program provides a composite index of household amenities based on the principal component analysis (PCA) and classified the population into quintiles: (1st quintile (Poorest); 2nd quintile; 3rd quintile; 4th quintile and 5th quintile (Richest). A quintile is assigned to each household as a measure of its relative socioeconomic level (for details see Rutstein and Johnson, 2004).
Skilled attendant at delivery	Deliveries assisted by either doctor, nurse/midwife categorized as 1; if other (incl. none) then categorized as 0.
Community-level variable	
Urban	Whether the cluster is urban community according the definition of the country categorized as 1; if cluster is rural community then categorized as 0.
Community-level socio-economic status	Dichotomous variables indicating whether the weighted mean wealth quintile score for all households within the community is low or high (split at the median representing high and low mean).
Community-level education	Dichotomous variables indicating whether the proportion of women aged 15–49 in the community with secondary or higher education is high or low (cut-off at median proportion).
Community hospital delivery	Dichotomous variables indicating whether the percentage of mothers who delivered their children in the hospital in the community is low or high (cut-off at median proportion).
Women who have a son preference (%)	Dichotomous variables indicating whether the proportion of women who reported a son as the type of gender preference for children in the community is low or high (cut-off at median proportion).

Appendix Table 3. Sample characteristics by sex (all singleton births born within the five years preceding the survey) in thirty sub-Saharan Africa countries, Demographic and Health Survey (DHS), 2004–2012.

Variables	Benin				Burkina Faso			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				0.004
Average or larger than average	84.8	87.7	86.2		86.7	88.6	87.7	
Very small and smaller than average	15.2	12.3	13.8		13.3	11.4	12.3	
Birth order and preceding birth interval				0.75				0.11
First birth	20.0	19.9	20.0		18.5	19.8	19.1	
2–3 and < 24 months	5.0	5.2	5.1		4.3	4.0	4.1	
2–3 and 24+ months	30.4	30.8	30.6		29.5	28.6	29.1	
4+ and < 24 months	6.5	6.3	6.4		6.5	5.9	6.2	
4+ and 24+ months	38.1	37.8	38.0		41.2	41.7	41.5	
Mother's age at child birth				0.16				0.55
Less than 20 years	12.0	12.5	12.3		15.0	15.3	15.2	
20–34 years	75.8	74.5	75.2		69.5	69.1	69.3	
Greater than 35 years	12.2	13.0	12.6		15.5	15.6	15.6	
Skilled attendant at delivery				0.27				0.20
Other (incl. none)	26.6	25.8	26.2		91.2	90.6	90.9	
Doctor, nurse, or midwife	73.4	74.2	73.8		8.8	9.4	9.1	
Type of gender preference				<0.001				<0.001
No gender preference	29.9	30.1	30.0		21.3	22.7	22.0	
Balance preference	45.8	45.7	45.7		35.6	34.7	35.2	
Daughter preference	11.2	7.0	9.1		12.5	9.4	10.9	
Son preference	13.2	17.2	15.2		30.6	33.2	31.9	
Maternal education				0.57				0.94
No education	75.3	74.6	75.0		84.5	84.3	84.4	
Primary	17.5	17.8	17.6		10.5	10.8	10.6	
Secondary or higher	7.2	7.5	7.4		5.1	4.9	5.0	
Household wealth Index				<0.001				0.48
1st quintile (Poorest)	23.6	21.2	22.4		20.8	20.8	20.8	
2nd quintile	20.7	20.1	20.4		22.1	21.5	21.8	
3rd quintile	20.5	21.1	20.8		21.9	21.7	21.8	
4th quintile	20.0	20.4	20.2		20.6	20.7	20.6	
5th quintile (Richest)	15.3	17.2	16.2		14.7	15.2	15.0	
Urban-rural area of residence				0.013				0.28
Rural	66.7	64.6	65.7		83.5	83.1	83.3	
Urban	33.3	35.4	34.3		16.5	16.9	16.7	
Women with secondary or higher (%)				0.001				0.51
Low	58.4	55.8	57.1		61.6	61.3	61.5	
High	41.6	44.2	42.9		38.4	38.7	38.5	
Women birthing in a health facility (%)				0.30				0.12
Low	49.0	47.9	48.5		53.4	51.8	52.6	
High	51.0	52.1	51.5		46.6	48.2	47.4	
Women who have a son preference (%)				0.066				0.17
Low	53.4	51.9	52.6		52.5	51.6	52.0	
High	46.6	48.1	47.4		47.5	48.4	48.0	
Mean wealth index quintile score				<0.001				0.013
Low	49.7	46.0	47.8		54.0	52.0	53.0	
High	50.3	54.0	52.2		46.0	48.0	47.0	
Number of children (N: weighted)	7466	7567	15033		7285	7490	14776	

Appendix Table 3 (cont'd).

Variables	Burundi Female (%)	Burundi Male (%)	Burundi Total (%)	p-values	Cameroon Female (%)	Cameroon Male (%)	Cameroon Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	81.3	85.5	83.4		78.6	84.4	81.4	
Very small and smaller than average	18.7	14.5	16.6		21.4	15.6	18.6	
Birth order and preceding birth interval				0.66				0.31
First birth	21.1	20.4	20.8		23.1	23.5	23.3	
2–3 and < 24 months	8.3	8.0	8.1		7.7	7.4	7.5	
2–3 and 24+ months	25.5	25.7	25.6		26.3	27.8	27.0	
4+ and < 24 months	8.5	7.5	8.0		9.1	9.1	9.1	
4+ and 24+ months	36.5	38.4	37.5		33.9	32.2	33.1	
Mother's age at child birth				0.059				0.42
Less than 20 years	9.0	8.7	8.9		19.8	20.1	19.9	
20–34 years	71.8	73.3	72.6		68.9	68.5	68.7	
Greater than 35 years	19.2	18.0	18.6		11.3	11.4	11.4	
Skilled attendant at delivery				0.044				0.11
Other (incl. none)	41.2	38.5	39.8		44.9	42.4	43.7	
Doctor, nurse, or midwife	58.8	61.5	60.2		55.1	57.6	56.3	
Type of gender preference				<0.001				<0.001
No gender preference	19.2	17.7	18.4		33.0	33.1	33.0	
Balance preference	39.9	39.4	39.6		30.1	30.0	30.1	
Daughter preference	18.0	14.1	16.0		18.6	15.2	16.9	
Son preference	22.9	28.8	25.9		18.4	21.7	20.0	
Maternal education				0.52				0.42
No education	52.3	52.2	52.2		29.3	28.6	29.0	
Primary	41.7	41.5	41.6		39.8	38.7	39.3	
Secondary or higher	6.0	6.3	6.1		30.9	32.7	31.8	
Household wealth Index				0.59				0.93
1st quintile (Poorest)	21.1	19.6	20.3		24.0	24.0	24.0	
2nd quintile	20.4	21.6	21.0		21.5	21.4	21.4	
3rd quintile	21.3	20.3	20.8		20.3	19.6	20.0	
4th quintile	20.0	20.1	20.0		18.8	19.0	18.9	
5th quintile (Richest)	17.3	18.5	17.9		15.4	16.0	15.7	
Urban-rural area of residence				0.81				0.48
Rural	91.8	91.7	91.8		57.8	57.9	57.8	
Urban	8.2	8.3	8.2		42.2	42.1	42.2	
Women with secondary or higher (%)				0.18				0.61
Low	64.5	66.7	65.6		54.9	53.4	54.2	
High	35.5	33.3	34.4		45.1	46.6	45.8	
Women birthing in a health facility (%)				0.39				0.098
Low	56.2	54.3	55.2		50.9	48.9	49.9	
High	43.8	45.7	44.8		49.1	51.1	50.1	
Women who have a son preference (%)				0.39				0.44
Low	49.4	48.4	48.9		48.7	48.6	48.6	
High	50.6	51.6	51.1		51.3	51.4	51.4	
Mean wealth index quintile score				0.28				0.39
Low	53.7	54.4	54.0		50.3	49.4	49.9	
High	46.3	45.6	46.0		49.7	50.6	50.1	
Number of children (N: weighted)	3824	3975	7798		5728	5523	11251	

Appendix Table 3 (cont'd).

Variables	Chad				Congo (Brazzaville)			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	66.7	73.1	70.0		86.5	90.2	88.3	
Very small and smaller than average	33.3	26.9	30.0		13.5	9.8	11.7	
Birth order and preceding birth interval				0.83				0.21
First birth	17.1	18.0	17.6		25.2	26.4	25.8	
2–3 and < 24 months	7.4	7.6	7.5		6.4	5.2	5.8	
2–3 and 24+ months	24.0	22.8	23.4		35.3	35.5	35.4	
4+ and < 24 months	12.8	13.8	13.3		5.2	4.7	5.0	
4+ and 24+ months	38.6	37.9	38.2		27.8	28.1	28.0	
Mother's age at child birth				0.27				0.77
Less than 20 years	20.2	22.5	21.4		19.7	19.9	19.8	
20–34 years	68.7	65.6	67.1		68.2	65.8	67.0	
Greater than 35 years	11.1	11.9	11.5		12.1	14.2	13.1	
Skilled attendant at delivery				0.31				0.86
Other (incl. none)	97.7	97.5	97.6		19.6	19.4	19.5	
Doctor, nurse, or midwife	2.3	2.5	2.4		80.4	80.6	80.5	
Type of gender preference				<0.001				<0.001
No gender preference	31.5	33.1	32.3		19.1	21.0	20.1	
Balance preference	33.4	34.0	33.7		37.2	35.1	36.2	
Daughter preference	13.0	8.8	10.8		29.3	22.3	25.9	
Son preference	22.1	24.1	23.2		14.4	21.5	17.9	
Maternal education				0.61				0.12
No education	77.6	75.4	76.5		7.1	7.4	7.2	
Primary	18.6	20.2	19.4		30.5	30.6	30.6	
Secondary or higher	3.8	4.4	4.1		62.4	62.0	62.2	
Household wealth Index				0.16				0.51
1st quintile (Poorest)	16.9	17.2	17.0		22.3	23.4	22.8	
2nd quintile	23.9	21.1	22.5		24.1	23.0	23.5	
3rd quintile	18.5	20.9	19.7		19.6	19.3	19.5	
4th quintile	22.5	22.3	22.4		19.3	17.8	18.6	
5th quintile (Richest)	18.2	18.5	18.3		14.7	16.5	15.6	
Urban-rural area of residence				0.65				0.42
Rural	81.2	81.1	81.2		38.3	40.2	39.3	
Urban	18.8	18.9	18.8		61.7	59.8	60.7	
Women with secondary or higher (%)				1.00				0.64
Low	64.1	62.3	63.2		29.5	30.8	30.1	
High	35.9	37.7	36.8		70.5	69.2	69.9	
Women birthing in a health facility (%)				0.72				0.69
Low	69.1	69.6	69.4		29.9	30.7	30.3	
High	30.9	30.4	30.6		70.1	69.3	69.7	
Women who have a son preference (%)				0.70				0.97
Low	48.3	49.7	49.0		48.1	46.8	47.4	
High	51.7	50.3	51.0		51.9	53.2	52.6	
Mean wealth index quintile score				0.37				0.71
Low	67.5	67.5	67.5		24.5	25.4	24.9	
High	32.5	32.5	32.5		75.5	74.6	75.1	
Number of children (N: weighted)	2865	2975	5840		3954	3887	7842	

Appendix Table 3 (cont'd).

Variables	Congo Democratic Republic				Cote d'Ivoire			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				0.42				0.061
Average or larger than average	91.2	90.8	91.0		84.5	86.3	85.4	
Very small and smaller than average	8.8	9.2	9.0		15.5	13.7	14.6	
Birth order and preceding birth interval				0.20				0.15
First birth	20.7	21.2	21.0		23.9	22.2	23.0	
2–3 and < 24 months	8.6	7.2	7.9		5.3	4.7	5.0	
2–3 and 24+ months	23.5	25.4	24.5		32.1	31.3	31.7	
4+ and < 24 months	12.4	12.6	12.5		6.4	6.3	6.4	
4+ and 24+ months	34.8	33.5	34.2		32.4	35.5	33.9	
Mother's age at child birth				0.17				0.19
Less than 20 years	16.5	16.6	16.5		19.1	16.1	17.6	
20–34 years	68.4	67.0	67.7		68.3	70.2	69.3	
Greater than 35 years	15.1	16.5	15.8		12.6	13.7	13.1	
Skilled attendant at delivery				0.92				0.85
Other (incl. none)	56.7	58.6	57.6		42.9	42.9	42.9	
Doctor, nurse, or midwife	43.3	41.4	42.4		57.1	57.1	57.1	
Type of gender preference				<0.001				<0.001
No gender preference	31.2	29.8	30.5		24.3	25.0	24.7	
Balance preference	30.7	29.4	30.1		37.3	37.0	37.1	
Daughter preference	17.2	12.8	15.1		22.3	17.0	19.7	
Son preference	20.9	28.0	24.4		16.1	21.0	18.5	
Maternal education				0.81				0.28
No education	23.3	23.9	23.6		64.1	63.7	63.9	
Primary	42.6	41.1	41.9		24.5	27.2	25.9	
Secondary or higher	34.1	35.0	34.5		11.4	9.1	10.2	
Household wealth Index				0.075				0.007
1st quintile (Poorest)	21.3	20.5	20.9		23.2	23.7	23.4	
2nd quintile	23.5	21.1	22.3		21.7	20.8	21.2	
3rd quintile	20.0	22.1	21.0		23.2	20.1	21.7	
4th quintile	19.5	21.3	20.4		16.4	20.8	18.6	
5th quintile (Richest)	15.7	15.0	15.3		15.5	14.7	15.1	
Urban-rural area of residence				0.28				0.89
Rural	61.5	60.4	61.0		62.0	62.5	62.2	
Urban	38.5	39.6	39.0		38.0	37.5	37.8	
Women with secondary or higher (%)				0.59				0.93
Low	45.3	45.7	45.5		47.6	48.5	48.1	
High	54.7	54.3	54.5		52.4	51.5	51.9	
Women birthing in a health facility (%)				0.71				0.45
Low	49.6	49.6	49.6		48.0	48.0	48.0	
High	50.4	50.4	50.4		52.0	52.0	52.0	
Women who have a son preference (%)				0.065				0.60
Low	47.6	46.4	47.0		50.8	51.5	51.2	
High	52.4	53.6	53.0		49.2	48.5	48.8	
Mean wealth index quintile score				0.25				0.86
Low	51.3	51.2	51.2		51.4	51.6	51.5	
High	48.7	48.8	48.8		48.6	48.4	48.5	
Number of children (N: weighted)	4423	4266	8689		3565	3575	7141	

Appendix Table 3 (cont'd).

Variables	Ethiopia				Gabon			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	67.1	74.6	71.0		81.2	85.5	83.5	
Very small and smaller than average	32.9	25.4	29.0		18.8	14.5	16.5	
Birth order and preceding birth interval				0.064				0.20
First birth	19.1	19.7	19.4		29.4	29.1	29.3	
2–3 and < 24 months	6.3	7.3	6.8		7.2	6.7	6.9	
2–3 and 24+ months	26.0	22.9	24.4		30.2	32.7	31.5	
4+ and < 24 months	9.3	10.0	9.6		6.6	5.9	6.3	
4+ and 24+ months	39.4	40.1	39.8		26.6	25.6	26.1	
Mother's age at child birth				0.093				0.19
Less than 20 years	13.3	13.0	13.1		23.9	18.1	20.9	
20–34 years	73.0	72.9	72.9		63.5	69.6	66.6	
Greater than 35 years	13.7	14.2	14.0		12.7	12.3	12.5	
Skilled attendant at delivery				0.90				0.78
Other (incl. none)	89.9	90.2	90.0		82.0	82.2	82.1	
Doctor, nurse, or midwife	10.1	9.8	10.0		18.0	17.8	17.9	
Type of gender preference				<0.001				<0.001
No gender preference	27.6	29.3	28.5		14.6	16.1	15.4	
Balance preference	48.8	44.7	46.7		50.2	47.0	48.6	
Daughter preference	7.5	4.5	6.0		25.4	19.5	22.3	
Son preference	16.0	21.4	18.8		9.8	17.4	13.7	
Maternal education				0.50				0.49
No education	69.4	69.3	69.3		6.1	7.1	6.6	
Primary	26.6	27.5	27.1		27.5	25.4	26.4	
Secondary or higher	4.0	3.3	3.6		66.4	67.5	67.0	
Household wealth Index				0.52				0.39
1st quintile (Poorest)	23.1	22.4	22.7		21.9	20.7	21.3	
2nd quintile	22.5	22.6	22.6		23.5	22.0	22.7	
3rd quintile	20.1	21.2	20.7		21.9	20.0	20.9	
4th quintile	18.7	19.1	18.9		17.1	20.7	18.9	
5th quintile (Richest)	15.5	14.7	15.1		15.6	16.8	16.2	
Urban-rural area of residence				0.50				0.052
Rural	87.0	87.2	87.1		16.9	14.5	15.7	
Urban	13.0	12.8	12.9		83.1	85.5	84.3	
Women with secondary or higher (%)				0.65				0.23
Low	76.3	77.6	77.0		25.5	24.2	24.8	
High	23.7	22.4	23.0		74.5	75.8	75.2	
Women birthing in a health facility (%)				0.54				0.37
Low	54.6	56.5	55.6		29.4	28.0	28.7	
High	45.4	43.5	44.4		70.6	72.0	71.3	
Women who have a son preference (%)				0.15				0.047
Low	54.2	54.3	54.2		47.9	41.1	44.4	
High	45.8	45.7	45.8		52.1	58.9	55.6	
Mean wealth index quintile score				0.10				0.059
Low	45.6	46.1	45.9		21.9	19.5	20.6	
High	54.4	53.9	54.1		78.1	80.5	79.4	
Number of children (N: weighted)	5558	6040	11597		2376	2532	4908	

Appendix Table 3 (cont'd).

Variables	Ghana Female (%)	Ghana Male (%)	Ghana Total (%)	p-values	Guinea Female (%)	Guinea Male (%)	Guinea Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	84.7	89.1	87.0		84.1	87.4	85.8	
Very small and smaller than average	15.3	10.9	13.0		15.9	12.6	14.2	
Birth order and preceding birth interval				0.11				0.45
First birth	25.3	23.9	24.6		17.8	18.0	17.9	
2–3 and < 24 months	5.9	5.2	5.5		3.8	3.0	3.4	
2–3 and 24+ months	30.4	35.2	32.8		27.2	28.5	27.9	
4+ and < 24 months	5.9	4.6	5.2		5.6	6.2	5.9	
4+ and 24+ months	32.5	31.2	31.8		45.7	44.2	44.9	
Mother's age at child birth				0.42				0.22
Less than 20 years	12.2	11.8	12.0		19.0	17.8	18.3	
20–34 years	70.6	72.5	71.6		63.1	65.6	64.4	
Greater than 35 years	17.2	15.7	16.5		17.9	16.7	17.3	
Skilled attendant at delivery				0.63				0.012
Other (incl. none)	46.6	44.8	45.7		73.2	70.1	71.6	
Doctor, nurse, or midwife	53.4	55.2	54.3		26.8	29.9	28.4	
Type of gender preference				<0.001				0.005
No gender preference	16.4	13.9	15.1		26.4	28.0	27.3	
Balance preference	46.2	46.3	46.3		38.7	38.6	38.6	
Daughter preference	22.9	15.3	19.0		10.9	8.3	9.5	
Son preference	14.5	24.5	19.6		24.0	25.1	24.6	
Maternal education				0.85				0.45
No education	32.4	32.9	32.6		87.5	86.0	86.7	
Primary	24.2	25.3	24.7		7.9	8.8	8.4	
Secondary or higher	43.4	41.9	42.6		4.6	5.2	4.9	
Household wealth Index				0.38				0.77
1st quintile (Poorest)	25.5	25.6	25.6		25.2	24.0	24.6	
2nd quintile	23.4	21.2	22.2		21.3	21.6	21.5	
3rd quintile	17.4	19.8	18.6		21.3	20.7	21.0	
4th quintile	20.6	18.6	19.6		17.6	18.3	18.0	
5th quintile (Richest)	13.2	14.8	14.0		14.5	15.3	14.9	
Urban-rural area of residence				0.91				0.13
Rural	62.4	62.4	62.4		78.5	76.5	77.5	
Urban	37.6	37.6	37.6		21.5	23.5	22.5	
Women with secondary or higher (%)				0.17				0.15
Low	43.6	47.7	45.7		66.5	64.7	65.5	
High	56.4	52.3	54.3		33.5	35.3	34.5	
Women birthing in a health facility (%)				0.68				0.25
Low	46.4	45.6	46.0		50.4	49.0	49.6	
High	53.6	54.4	54.0		49.6	51.0	50.4	
Women who have a son preference (%)				0.019				0.84
Low	58.9	54.6	56.7		50.8	50.3	50.5	
High	41.1	45.4	43.3		49.2	49.7	49.5	
Mean wealth index quintile score				0.41				0.38
Low	42.9	41.4	42.1		49.4	48.1	48.8	
High	57.1	58.6	57.9		50.6	51.9	51.2	
Number of children (N: weighted)	1345	1438	2783		2904	3130	6034	

Appendix Table 3 (cont'd).

Variables	Kenya Female (%)	Kenya Male (%)	Kenya Total (%)	p-values	Lesotho Female (%)	Lesotho Male (%)	Lesotho Total (%)	p-values
Child size at birth				<0.001				0.018
Average or larger than average	82.0	86.6	84.4		85.9	89.5	87.7	
Very small and smaller than average	18.0	13.4	15.6		14.1	10.5	12.3	
Birth order and preceding birth interval				0.50				0.73
First birth	23.7	22.0	22.8		39.6	39.7	39.7	
2–3 and < 24 months	8.2	9.1	8.7		5.0	5.5	5.2	
2–3 and 24+ months	29.5	29.8	29.7		34.2	33.4	33.8	
4+ and < 24 months	8.2	9.8	9.0		1.9	2.5	2.2	
4+ and 24+ months	30.4	29.3	29.8		19.2	19.0	19.1	
Mother's age at child birth				0.35				0.57
Less than 20 years	17.6	15.6	16.6		21.9	21.3	21.6	
20–34 years	71.0	73.9	72.5		67.2	67.5	67.3	
Greater than 35 years	11.4	10.5	10.9		10.9	11.2	11.1	
Skilled attendant at delivery				0.31				0.46
Other (incl. none)	56.8	56.1	56.4		38.1	38.4	38.2	
Doctor, nurse, or midwife	43.2	43.9	43.6		61.9	61.6	61.8	
Type of gender preference				<0.001				<0.001
No gender preference	25.7	27.6	26.7		9.7	9.4	9.5	
Balance preference	46.2	45.1	45.6		54.9	53.1	54.0	
Daughter preference	14.6	9.3	11.9		17.7	13.7	15.6	
Son preference	13.5	17.9	15.8		17.7	23.8	20.8	
Maternal education				0.67				0.81
No education	12.6	13.3	13.0		1.8	1.6	1.7	
Primary	63.4	64.1	63.8		56.7	55.9	56.3	
Secondary or higher	24.1	22.6	23.3		41.5	42.4	42.0	
Household wealth Index				0.96				0.25
1st quintile (Poorest)	24.6	24.7	24.7		21.6	23.8	22.7	
2nd quintile	20.0	20.8	20.4		21.6	18.1	19.8	
3rd quintile	18.6	18.1	18.3		17.8	19.1	18.5	
4th quintile	17.9	17.7	17.8		21.2	21.3	21.3	
5th quintile (Richest)	18.9	18.8	18.8		17.8	17.7	17.8	
Urban-rural area of residence				0.63				0.025
Rural	81.6	81.7	81.7		75.7	77.8	76.7	
Urban	18.4	18.3	18.3		24.3	22.2	23.3	
Women with secondary or higher (%)				0.84				0.76
Low	45.2	44.3	44.7		44.3	44.0	44.2	
High	54.8	55.7	55.3		55.7	56.0	55.8	
Women birthing in a health facility (%)				0.80				0.82
Low	49.4	47.3	48.3		43.6	45.3	44.5	
High	50.6	52.7	51.7		56.4	54.7	55.5	
Women who have a son preference (%)				0.084				0.036
Low	53.6	51.5	52.5		52.5	49.5	51.0	
High	46.4	48.5	47.5		47.5	50.5	49.0	
Mean wealth index quintile score				0.47				0.72
Low	48.1	49.7	48.9		38.0	39.5	38.7	
High	51.9	50.3	51.1		62.0	60.5	61.3	
Number of children (N: weighted)	2751	2947	5698		1772	1844	3616	

Appendix Table 3 (cont'd).

Variables	Liberia				Madagascar			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	74.5	79.7	77.2		78.0	83.2	80.7	
Very small and smaller than average	25.5	20.3	22.8		22.0	16.8	19.3	
Birth order and preceding birth interval				0.32				0.81
First birth	23.0	23.8	23.4		23.1	22.3	22.7	
2–3 and < 24 months	6.1	5.9	6.0		7.8	7.7	7.7	
2–3 and 24+ months	29.9	26.5	28.1		27.0	26.6	26.8	
4+ and < 24 months	7.3	8.4	7.8		10.0	10.0	10.0	
4+ and 24+ months	33.8	35.5	34.7		32.2	33.3	32.7	
Mother's age at child birth				0.12				0.93
Less than 20 years	17.9	17.2	17.5		21.1	21.4	21.3	
20–34 years	67.2	65.2	66.2		63.8	62.8	63.3	
Greater than 35 years	15.0	17.6	16.3		15.1	15.8	15.4	
Skilled attendant at delivery				0.48				0.85
Other (incl. none)	54.5	53.8	54.1		56.0	56.2	56.1	
Doctor, nurse, or midwife	45.5	46.2	45.9		44.0	43.8	43.9	
Type of gender preference				<0.001				<0.001
No gender preference	13.4	13.4	13.4		11.0	10.3	10.6	
Balance preference	48.4	46.6	47.5		62.0	64.1	63.0	
Daughter preference	22.8	18.0	20.3		13.1	8.0	10.5	
Son preference	15.3	22.1	18.9		13.9	17.7	15.9	
Maternal education				0.095				0.51
No education	46.7	50.9	48.9		25.0	25.8	25.4	
Primary	36.5	33.2	34.8		56.0	54.7	55.3	
Secondary or higher	16.8	15.9	16.3		19.1	19.5	19.3	
Household wealth Index				0.11				0.036
1st quintile (Poorest)	22.0	22.6	22.3		24.6	27.0	25.8	
2nd quintile	24.6	22.8	23.6		23.0	21.7	22.4	
3rd quintile	20.8	22.3	21.5		20.3	19.8	20.1	
4th quintile	21.2	19.3	20.2		17.9	17.6	17.7	
5th quintile (Richest)	11.3	13.1	12.3		14.2	13.9	14.0	
Urban-rural area of residence				0.45				0.91
Rural	68.7	70.3	69.5		89.4	89.0	89.2	
Urban	31.3	29.7	30.5		10.6	11.0	10.8	
Women with secondary or higher (%)				0.50				0.078
Low	51.3	52.8	52.0		50.2	48.5	49.3	
High	48.7	47.2	48.0		49.8	51.5	50.7	
Women birthing in a health facility (%)				0.29				0.90
Low	49.6	51.7	50.7		50.0	50.8	50.4	
High	50.4	48.3	49.3		50.0	49.2	49.6	
Women who have a son preference (%)				0.002				0.20
Low	50.6	45.9	48.1		50.5	50.4	50.5	
High	49.4	54.1	51.9		49.5	49.6	49.5	
Mean wealth index quintile score				0.96				0.94
Low	50.4	49.7	50.0		46.9	47.4	47.2	
High	49.6	50.3	50.0		53.1	52.6	52.8	
Number of children (N: weighted)	2580	2792	5372		6101	6348	12449	

Appendix Table 3 (cont'd).

Variables	Malawi				Mali			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	83.8	87.0	85.4		78.3	84.2	81.3	
Very small and smaller than average	16.2	13.0	14.6		21.7	15.8	18.7	
Birth order and preceding birth interval				0.88				0.14
First birth	20.8	21.8	21.3		17.7	18.4	18.1	
2–3 and < 24 months	5.5	5.8	5.7		6.9	7.2	7.1	
2–3 and 24+ months	31.2	31.2	31.2		24.1	23.6	23.9	
4+ and < 24 months	6.4	6.2	6.3		11.0	10.7	10.9	
4+ and 24+ months	36.1	35.0	35.6		40.3	40.0	40.2	
Mother's age at child birth				0.10				0.45
Less than 20 years	18.4	18.9	18.6		20.2	20.7	20.5	
20–34 years	69.0	69.2	69.1		65.8	65.2	65.5	
Greater than 35 years	12.6	11.8	12.2		14.0	14.1	14.0	
Skilled attendant at delivery				0.072				0.44
Other (incl. none)	29.3	27.7	28.5		74.1	72.4	73.2	
Doctor, nurse, or midwife	70.7	72.3	71.5		25.9	27.6	26.8	
Type of gender preference				<0.001				<0.001
No gender preference	11.3	10.5	10.9		25.3	24.8	25.1	
Balance preference	54.7	54.1	54.4		35.9	36.0	35.9	
Daughter preference	24.1	17.4	20.8		11.7	7.5	9.6	
Son preference	9.9	18.1	14.0		27.1	31.7	29.4	
Maternal education				0.92				0.23
No education	17.4	17.5	17.5		85.0	86.0	85.5	
Primary	68.2	67.6	67.9		10.3	9.9	10.1	
Secondary or higher	14.4	14.9	14.6		4.7	4.2	4.4	
Household wealth Index				0.047				0.14
1st quintile (Poorest)	21.3	22.0	21.6		20.5	20.4	20.5	
2nd quintile	21.7	22.4	22.0		20.6	20.3	20.5	
3rd quintile	22.4	20.9	21.6		20.6	21.4	21.0	
4th quintile	18.9	17.9	18.4		20.8	20.2	20.5	
5th quintile (Richest)	15.7	16.9	16.3		17.5	17.6	17.6	
Urban-rural area of residence				0.28				0.49
Rural	85.8	85.6	85.7		73.0	72.6	72.8	
Urban	14.2	14.4	14.3		27.0	27.4	27.2	
Women with secondary or higher (%)				0.30				0.74
Low	49.3	48.3	48.8		60.8	61.0	60.9	
High	50.7	51.7	51.2		39.2	39.0	39.1	
Women birthing in a health facility (%)				0.79				0.16
Low	49.1	48.6	48.9		48.7	49.2	48.9	
High	50.9	51.4	51.1		51.3	50.8	51.1	
Women who have a son preference (%)				0.007				0.10
Low	50.7	47.6	49.1		49.8	48.2	49.0	
High	49.3	52.4	50.9		50.2	51.8	51.0	
Mean wealth index quintile score				0.57				0.18
Low	48.6	49.1	48.9		51.3	51.7	51.5	
High	51.4	50.9	51.1		48.7	48.3	48.5	
Number of children (N: weighted)	9454	9396	18850		6886	7055	13941	

Appendix Table 3 (cont'd).

Variables	Mozambique Female (%)	Male (%)	Total (%)	p-values	Namibia Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				0.003
Average or larger than average	86.0	88.5	87.3		83.5	85.9	84.7	
Very small and smaller than average	14.0	11.5	12.7		16.5	14.1	15.3	
Birth order and preceding birth interval				0.38				0.83
First birth	22.5	22.2	22.4		32.7	32.9	32.8	
2–3 and < 24 months	4.7	4.3	4.5		5.6	5.5	5.6	
2–3 and 24+ months	28.9	30.8	29.9		35.3	36.5	35.9	
4+ and < 24 months	6.6	6.8	6.7		3.8	3.5	3.7	
4+ and 24+ months	37.2	35.9	36.6		22.5	21.5	22.0	
Mother's age at child birth				0.42				0.74
Less than 20 years	20.6	19.8	20.2		16.1	16.3	16.2	
20–34 years	64.9	65.2	65.1		70.1	69.3	69.7	
Greater than 35 years	14.5	14.9	14.7		13.8	14.5	14.1	
Skilled attendant at delivery				0.057				0.14
Other (incl. none)	82.4	80.8	81.6		19.1	17.9	18.5	
Doctor, nurse, or midwife	17.6	19.2	18.4		80.9	82.1	81.5	
Type of gender preference				<0.001				<0.001
No gender preference	8.6	8.8	8.7		13.6	12.9	13.2	
Balance preference	57.1	56.1	56.6		48.6	50.6	49.6	
Daughter preference	18.8	16.5	17.6		26.4	18.2	22.2	
Son preference	15.4	18.7	17.1		11.5	18.2	14.9	
Maternal education				0.22				0.53
No education	36.9	36.7	36.8		11.1	11.0	11.0	
Primary	52.4	51.4	51.9		28.7	28.5	28.6	
Secondary or higher	10.7	11.9	11.3		60.2	60.5	60.4	
Household wealth Index				0.16				0.37
1st quintile (Poorest)	24.9	22.4	23.7		21.7	20.9	21.3	
2nd quintile	21.1	21.8	21.4		18.4	19.7	19.1	
3rd quintile	19.9	20.3	20.1		22.2	22.7	22.5	
4th quintile	19.3	19.8	19.5		21.1	20.9	21.0	
5th quintile (Richest)	14.7	15.7	15.3		16.6	15.7	16.2	
Urban-rural area of residence				0.21				0.65
Rural	73.0	71.8	72.4		57.3	59.3	58.3	
Urban	27.0	28.2	27.6		42.7	40.7	41.7	
Women with secondary or higher (%)				0.91				0.21
Low	59.1	57.9	58.5		47.3	46.8	47.1	
High	40.9	42.1	41.5		52.7	53.2	52.9	
Women birthing in a health facility (%)				0.43				0.43
Low	58.2	57.5	57.8		48.3	48.2	48.3	
High	41.8	42.5	42.2		51.7	51.8	51.7	
Women who have a son preference (%)				0.81				0.16
Low	50.4	50.8	50.6		54.0	51.2	52.6	
High	49.6	49.2	49.4		46.0	48.8	47.4	
Mean wealth index quintile score				0.27				0.82
Low	61.0	59.5	60.2		50.4	50.5	50.4	
High	39.0	40.5	39.8		49.6	49.5	49.6	
Number of children (N: weighted)	5554	5711	11265		2363	2469	4832	

Appendix Table 3 (cont'd).

Variables	Niger				Nigeria			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				
Average or larger than average	75.1	79.1	77.2		84.5	87.2	85.9	<0.001
Very small and smaller than average	24.9	20.9	22.8		15.5	12.8	14.1	
Birth order and preceding birth interval				0.70				
First birth	16.0	15.9	16.0		19.3	19.9	19.6	0.39
2–3 and < 24 months	6.9	5.7	6.3		8.7	8.3	8.5	
2–3 and 24+ months	21.6	22.3	22.0		24.7	25.4	25.0	
4+ and < 24 months	10.9	11.8	11.4		10.8	10.8	10.8	
4+ and 24+ months	44.6	44.4	44.5		36.4	35.7	36.1	
Mother's age at child birth				0.96				
Less than 20 years	18.9	18.9	18.9		14.9	15.4	15.2	0.068
20–34 years	66.9	66.8	66.8		70.3	69.2	69.7	
Greater than 35 years	14.3	14.3	14.3		14.8	15.5	15.1	
Skilled attendant at delivery				0.93				
Other (incl. none)	82.4	82.7	82.5		65.2	66.0	65.6	0.51
Doctor, nurse, or midwife	17.6	17.3	17.5		34.8	34.0	34.4	
Type of gender preference				<0.001				
No gender preference	40.7	42.1	41.4		33.7	34.6	34.2	<0.001
Balance preference	24.2	22.0	23.1		36.0	35.0	35.5	
Daughter preference	11.1	8.4	9.7		9.8	7.2	8.4	
Son preference	23.9	27.4	25.7		20.5	23.2	21.9	
Maternal education				0.81				
No education	87.7	87.2	87.4		46.5	47.0	46.7	0.43
Primary	9.3	9.6	9.4		23.3	22.8	23.0	
Secondary or higher	3.0	3.2	3.1		30.2	30.2	30.2	
Household wealth Index				0.30				
1st quintile (Poorest)	20.6	22.6	21.6		23.2	23.6	23.4	0.42
2nd quintile	20.6	19.3	19.9		22.4	23.1	22.8	
3rd quintile	18.5	19.3	18.9		19.3	19.0	19.1	
4th quintile	21.7	20.8	21.2		17.6	17.9	17.7	
5th quintile (Richest)	18.6	18.0	18.3		17.5	16.4	16.9	
Urban-rural area of residence				0.96				
Rural	84.6	85.1	84.9		69.9	70.6	70.3	0.45
Urban	15.4	14.9	15.1		30.1	29.4	29.7	
Women with secondary or higher (%)				0.97				
Low	76.6	76.5	76.5		46.2	46.6	46.4	0.84
High	23.4	23.5	23.5		53.8	53.4	53.6	
Women birthing in a health facility (%)				0.69				
Low	60.8	60.5	60.7		45.8	46.6	46.2	0.25
High	39.2	39.5	39.3		54.2	53.4	53.8	
Women who have a son preference (%)				0.64				
Low	55.0	55.6	55.3		51.9	50.5	51.2	0.062
High	45.0	44.4	44.7		48.1	49.5	48.8	
Mean wealth index quintile score				0.53				
Low	58.9	60.7	59.8		44.6	45.7	45.2	0.13
High	41.1	39.3	40.2		55.4	54.3	54.8	
Number of children (N: weighted)	4677	4880	9557		13339	13801	27141	

Appendix Table 3 (cont'd).

Variables	Rwanda				Senegal			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	83.0	87.9	85.5		69.1	74.9	72.1	
Very small and smaller than average	17.0	12.1	14.5		30.9	25.1	27.9	
Birth order and preceding birth interval				0.33				0.13
First birth	26.1	24.6	25.3		23.2	23.8	23.5	
2–3 and < 24 months	8.3	8.7	8.5		7.2	6.1	6.6	
2–3 and 24+ months	25.4	26.0	25.7		26.3	28.3	27.3	
4+ and < 24 months	6.8	6.2	6.5		7.4	7.1	7.2	
4+ and 24+ months	33.5	34.6	34.0		36.0	34.8	35.4	
Mother's age at child birth				0.42				0.27
Less than 20 years	6.5	5.9	6.2		14.9	15.6	15.3	
20–34 years	75.2	76.3	75.8		71.1	69.7	70.4	
Greater than 35 years	18.3	17.7	18.0		14.0	14.6	14.3	
Skilled attendant at delivery				0.21				0.42
Other (incl. none)	32.0	30.5	31.2		41.7	42.4	42.1	
Doctor, nurse, or midwife	68.0	69.5	68.8		58.3	57.6	57.9	
Type of gender preference				<0.001				<0.001
No gender preference	28.1	27.6	27.8		28.7	27.5	28.1	
Balance preference	39.6	38.4	39.0		30.4	28.1	29.2	
Daughter preference	13.5	8.3	10.8		6.7	3.9	5.3	
Son preference	18.9	25.7	22.3		34.2	40.6	37.5	
Maternal education				0.67				0.34
No education	18.9	19.2	19.0		70.8	71.0	70.9	
Primary	72.6	71.8	72.2		20.8	20.6	20.7	
Secondary or higher	8.5	9.0	8.8		8.3	8.4	8.4	
Household wealth Index				0.36				0.12
1st quintile (Poorest)	23.7	22.9	23.3		23.3	23.2	23.2	
2nd quintile	21.4	21.9	21.7		21.1	22.8	22.0	
3rd quintile	20.1	19.6	19.8		19.3	19.3	19.3	
4th quintile	18.9	18.0	18.4		19.9	19.2	19.5	
5th quintile (Richest)	16.0	17.5	16.7		16.5	15.5	16.0	
Urban-rural area of residence				0.062				0.43
Rural	88.7	87.3	88.0		61.3	61.9	61.6	
Urban	11.3	12.7	12.0		38.7	38.1	38.4	
Women with secondary or higher (%)				0.82				0.59
Low	51.1	51.2	51.2		43.7	43.8	43.8	
High	48.9	48.8	48.8		56.3	56.2	56.2	
Women birthing in a health facility (%)				0.36				0.68
Low	52.0	50.8	51.3		38.9	39.6	39.2	
High	48.0	49.2	48.7		61.1	60.4	60.8	
Women who have a son preference (%)				0.24				0.27
Low	50.7	49.4	50.0		50.6	49.1	49.8	
High	49.3	50.6	50.0		49.4	50.9	50.2	
Mean wealth index quintile score				0.016				0.86
Low	52.0	49.3	50.6		38.8	39.1	38.9	
High	48.0	50.7	49.4		61.2	60.9	61.1	
Number of children (N: weighted)	4354	4514	8868		5364	5650	11014	

Appendix Table 3 (cont'd).

Variables	Sierra Leone				Swaziland			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				0.002
Average or larger than average	78.2	81.5	79.8		84.1	88.3	86.3	
Very small and smaller than average	21.8	18.5	20.2		15.9	11.7	13.7	
Birth order and preceding birth interval				0.50				0.69
First birth	19.9	20.5	20.2		33.3	30.8	32.0	
2–3 and < 24 months	5.7	7.0	6.3		5.5	6.1	5.8	
2–3 and 24+ months	31.2	30.7	31.0		31.5	33.3	32.4	
4+ and < 24 months	8.0	7.6	7.8		4.7	5.3	5.0	
4+ and 24+ months	35.2	34.1	34.7		25.1	24.5	24.8	
Mother's age at child birth				0.30				0.76
Less than 20 years	16.0	17.8	16.9		24.4	23.1	23.7	
20–34 years	69.9	67.8	68.8		64.3	66.1	65.2	
Greater than 35 years	14.1	14.4	14.2		11.4	10.8	11.1	
Skilled attendant at delivery				0.30				0.36
Other (incl. none)	69.4	68.1	68.8		30.6	31.5	31.1	
Doctor, nurse, or midwife	30.6	31.9	31.2		69.4	68.5	68.9	
Type of gender preference				<0.001				<0.001
No gender preference	17.8	15.0	16.4		13.2	13.2	13.2	
Balance preference	50.8	52.7	51.8		51.7	51.4	51.5	
Daughter preference	18.2	14.5	16.4		17.2	11.2	14.2	
Son preference	13.2	17.8	15.5		18.0	24.3	21.1	
Maternal education				0.40				0.68
No education	76.7	76.3	76.5		8.9	9.3	9.1	
Primary	12.7	11.6	12.2		35.7	34.2	35.0	
Secondary or higher	10.6	12.0	11.3		55.4	56.5	55.9	
Household wealth Index				0.26				0.036
1st quintile (Poorest)	21.9	23.7	22.8		18.8	21.9	20.4	
2nd quintile	22.5	19.9	21.2		20.5	21.3	20.9	
3rd quintile	22.4	21.5	22.0		19.5	19.9	19.7	
4th quintile	18.1	19.7	18.9		21.0	17.7	19.3	
5th quintile (Richest)	15.1	15.1	15.1		20.2	19.1	19.6	
Urban-rural area of residence				0.15				0.38
Rural	73.7	72.0	72.8		76.9	78.4	77.7	
Urban	26.3	28.0	27.2		23.1	21.6	22.3	
Women with secondary or higher (%)				0.11				0.40
Low	59.1	57.5	58.3		50.2	48.4	49.3	
High	40.9	42.5	41.7		49.8	51.6	50.7	
Women birthing in a health facility (%)				0.043				0.91
Low	56.7	53.4	55.1		49.0	48.9	49.0	
High	43.3	46.6	44.9		51.0	51.1	51.0	
Women who have a son preference (%)				0.31				0.93
Low	51.5	49.8	50.7		55.1	55.2	55.2	
High	48.5	50.2	49.3		44.9	44.8	44.8	
Mean wealth index quintile score				0.33				0.18
Low	56.9	55.9	56.4		49.2	52.2	50.7	
High	43.1	44.1	43.6		50.8	47.8	49.3	
Number of children (N: weighted)	2836	2764	5601		1364	1391	2755	

Appendix Table 3 (cont'd).

Variables	Tanzania				Uganda			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				0.11				<0.001
Average or larger than average	91.6	92.8	92.2		76.4	82.4	79.4	
Very small and smaller than average	8.4	7.2	7.8		23.6	17.6	20.6	
Birth order and preceding birth interval				0.098				0.45
First birth	19.9	22.2	21.0		18.6	17.4	18.0	
2–3 and < 24 months	5.5	5.5	5.5		8.4	8.3	8.4	
2–3 and 24+ months	31.3	28.5	29.9		22.0	24.1	23.1	
4+ and < 24 months	7.0	6.5	6.7		12.7	12.7	12.7	
4+ and 24+ months	36.2	37.4	36.8		38.2	37.4	37.8	
Mother's age at child birth				0.18				0.27
Less than 20 years	15.2	16.8	16.0		17.1	16.7	16.9	
20–34 years	69.4	69.4	69.4		68.1	71.1	69.6	
Greater than 35 years	15.4	13.8	14.6		14.8	12.3	13.5	
Skilled attendant at delivery				0.014				1.00
Other (incl. none)	53.7	51.2	52.4		42.9	42.7	42.8	
Doctor, nurse, or midwife	46.3	48.8	47.6		57.1	57.3	57.2	
Type of gender preference				<0.001				<0.001
No gender preference	25.2	24.9	25.1		17.0	16.8	16.9	
Balance preference	42.4	44.1	43.3		54.3	57.1	55.7	
Daughter preference	18.8	12.4	15.6		19.5	13.8	16.7	
Son preference	13.6	18.5	16.1		9.2	12.2	10.7	
Maternal education				0.046				0.72
No education	26.8	24.8	25.8		14.8	13.9	14.3	
Primary	67.1	68.7	67.9		64.0	64.1	64.1	
Secondary or higher	6.1	6.6	6.3		21.2	22.0	21.6	
Household wealth Index				0.68				0.76
1st quintile (Poorest)	21.8	20.4	21.1		22.8	22.2	22.5	
2nd quintile	23.9	23.4	23.7		21.2	21.9	21.6	
3rd quintile	21.9	23.0	22.4		20.7	19.3	20.0	
4th quintile	18.7	18.7	18.7		17.7	17.5	17.6	
5th quintile (Richest)	13.7	14.5	14.1		17.5	19.1	18.3	
Urban-rural area of residence				0.34				0.59
Rural	79.3	80.1	79.7		86.0	86.0	86.0	
Urban	20.7	19.9	20.3		14.0	14.0	14.0	
Women with secondary or higher (%)				0.45				0.31
Low	61.0	59.9	60.5		52.1	50.5	51.3	
High	39.0	40.1	39.5		47.9	49.5	48.7	
Women birthing in a health facility (%)				0.84				0.30
Low	48.5	49.0	48.8		54.5	53.7	54.1	
High	51.5	51.0	51.2		45.5	46.3	45.9	
Women who have a son preference (%)				0.005				0.50
Low	57.8	55.8	56.8		50.5	51.1	50.8	
High	42.2	44.2	43.2		49.5	48.9	49.2	
Mean wealth index quintile score				0.066				0.64
Low	55.6	54.1	54.9		50.7	48.9	49.8	
High	44.4	45.9	45.1		49.3	51.1	50.2	
Number of children (N: weighted)	3978	3961	7939		3892	3920	7813	

Appendix Table 3 (cont'd).

Variables	Zambia				Zimbabwe			
	Female (%)	Male (%)	Total (%)	p-values	Female (%)	Male (%)	Total (%)	p-values
Child size at birth				<0.001				<0.001
Average or larger than average	88.3	90.9	89.6		86.9	89.7	88.3	
Very small and smaller than average	11.7	9.1	10.4		13.1	10.3	11.7	
Birth order and preceding birth interval				0.40				0.49
First birth	19.7	21.0	20.3		33.1	32.4	32.8	
2–3 and < 24 months	5.8	5.2	5.5		3.6	4.0	3.8	
2–3 and 24+ months	30.1	28.7	29.4		40.8	41.2	41.0	
4+ and < 24 months	6.5	6.7	6.6		2.3	1.9	2.1	
4+ and 24+ months	38.0	38.4	38.2		20.1	20.5	20.3	
Mother's age at child birth				0.85				0.47
Less than 20 years	17.4	17.7	17.6		19.2	20.5	19.9	
20–34 years	69.4	69.3	69.4		71.8	70.4	71.1	
Greater than 35 years	13.1	13.0	13.1		9.1	9.1	9.1	
Skilled attendant at delivery				0.33				0.76
Other (incl. none)	55.7	53.8	54.7		64.4	65.2	64.8	
Doctor, nurse, or midwife	44.3	46.2	45.3		35.6	34.8	35.2	
Type of gender preference				<0.001				<0.001
No gender preference	27.0	25.4	26.2		17.8	18.2	18.0	
Balance preference	40.2	41.2	40.7		49.4	49.3	49.4	
Daughter preference	23.1	16.2	19.7		19.3	13.4	16.4	
Son preference	9.8	17.2	13.5		13.4	19.1	16.3	
Maternal education				0.69				0.24
No education	14.4	13.0	13.7		1.8	1.6	1.7	
Primary	62.7	63.9	63.3		32.7	31.5	32.1	
Secondary or higher	22.9	23.1	23.0		65.6	66.9	66.2	
Household wealth Index				0.70				0.60
1st quintile (Poorest)	23.8	23.3	23.5		23.1	22.7	22.9	
2nd quintile	23.0	22.4	22.7		21.1	20.8	21.0	
3rd quintile	21.2	20.6	20.9		19.8	18.9	19.3	
4th quintile	19.0	19.7	19.3		20.3	22.1	21.2	
5th quintile (Richest)	13.0	14.1	13.6		15.7	15.6	15.6	
Urban-rural area of residence				0.064				0.36
Rural	72.1	69.6	70.8		70.5	70.0	70.3	
Urban	27.9	30.4	29.2		29.5	30.0	29.7	
Women with secondary or higher (%)				0.51				0.87
Low	53.7	52.8	53.2		49.9	50.5	50.2	
High	46.3	47.2	46.8		50.1	49.5	49.8	
Women birthing in a health facility (%)				0.17				0.031
Low	54.5	52.3	53.4		50.0	47.7	48.9	
High	45.5	47.7	46.6		50.0	52.3	51.1	
Women who have a son preference (%)				0.49				0.003
Low	50.4	49.3	49.8		52.9	48.8	50.8	
High	49.6	50.7	50.2		47.1	51.2	49.2	
Mean wealth index quintile score				0.079				0.30
Low	55.8	53.4	54.6		48.2	47.8	48.0	
High	44.2	46.6	45.4		51.8	52.2	52.0	
Number of children (N: weighted)	3090	3066	6156		2697	2747	5444	