5-13-2022

Marriage Change and Fertility Decline in sub-Saharan Africa, 1991-2019

Monica J. Grant
University of Wisconsin-Madison, grantm@ssc.wisc.edu

Hans-Peter Kohler
University of Pennsylvania, HPKOHLER@POP.UPENN.EDU

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Abstract

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Keywords

sub-Saharan Africa, DHS, marriage change, fertility, divorce, remarriage, polygamy

Disciplines

Demography, Population, and Ecology | Family, Life Course, and Society | Gender and Sexuality | Social and Behavioral Sciences | Sociology

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Monica J. Grant*, *University of Wisconsin-Madison*

grantm@ssc.wisc.edu

Hans-Peter Kohler, *University of Pennsylvania*

hpkohler@pop.upenn.edu

*Corresponding author

Acknowledgements

Previous versions of this paper were presented at the University of Colorado-Boulder, the CUNY Institute for Demographic Research, and the Population Association of America annual meeting. Support for the authors was provided by the Eunice Kennedy Shriver National Institute of Child Health and Development P2C HD047873 and the National Science Foundation grant NSF SES1729185 Global Family Change.

Abstract

The institutions of marriage and the family have undergone profound changes over recent decades in sub-Saharan Africa, following differentiated paths across and within countries. These changes, however, have not been systematically related to variation in fertility and its decline over time. We use Demographic and Health Survey data from 29 countries in sub-Saharan Africa to examine how nuptiality patterns have changed over the period 1991-2019, and how these changes are associated with changes in the total fertility rate and ideal family size. Using multi-level linear models, we find that our four marriage indicators are all significantly associated with the total fertility rate, but only the associations with polygyny and remarriage are robust to the inclusion of sub-national region fixed effects. Our results suggest that declines in the prevalence of remarriage and polygyny together may account for 17 percent of total fertility decline in the average sub-national region over the period of study. In addition to these results, we find a significant positive association between the prevalence of polygyny and ideal family size, but no association between ideal family size and divorce, remarriage, or the age at first marriage after including fixed effects.

Marriage Change and Fertility Decline in sub-Saharan Africa, 1991-2019

Considerations of marriage change have not figured prominently in studies of fertility decline in sub-Saharan Africa. For example, a recent special issue of *Population and Development Review* devoted to the African fertility transition (Casterline and Bongaarts 2017) focused on the contributions of health and social development, persistent pronatalism, and variations in national commitments to family planning programs as the primary determinants of fertility change in the region. With the exception of one article that examined the relationship between the onset of fertility decline and changes in the age at first marriage (Hertrich 2017), these articles largely ignored the nuptiality systems in which reproduction is embedded. Changes in marriage practices, however, may be mechanisms for fertility decline, shaping the context and norms of reproductive behavior (Pesando et al. 2019; Castro Torres et al. 2019). Shifts in nuptiality regimes may also be part of larger ideational transformations that guide fertility preferences (Thornton, Dorius, and Swindle 2015; Johnson-Hanks et al. 2011). By examining how macro-level changes in marriage practices are associated with fertility, especially in regions where marriage is widespread but not necessarily stable, we may open new perspectives for understanding the dynamics of fertility decline in sub-Saharan Africa.

Early studies of fertility in sub-Saharan Africa examined the contribution of nuptiality to fertility variation and the prospects for fertility decline in the region (Lesthaeghe 1989). The proportion of women married at any point in time was estimated to have a substantially smaller effect on fertility in sub-Saharan Africa relative to other world regions and the contribution of marriage change to future fertility decline was assumed to be limited to potential increases in the age of first union rather than other changes in marital exposure (Bongaarts, Frank, and Lesthaeghe 1984). Subsequent macro-level analyses of fertility decline in sub-Saharan Africa

have either ignored the role of marriage change (e.g., Shapiro 2012; Bongaarts and Casterline 2013; Casterline and Bongaarts 2017) or have focused exclusively on changes in the age at first marriage and/or the proportion of women currently married (Ezeh, Mberu, and Emina 2009; Machiyana 2010; Shapiro and Gebreselassie 2014, 2008, Garenne 2008, 2004; Cohen 1998). These measures, however, may not capture the changes in marriage systems that are associated with fertility. For example, patterns of union instability—separation, divorce, and repartnering—and their relationship to fertility intentions and childbearing may be more relevant to fertility decline than the proportion of currently married women. Other features of African marriage systems, such as polygyny, may also influence fertility patterns in ways independent from the timing and prevalence of marriage. Only recent research has started to look at family and fertility change through the lens of family configurations to investigate how different dimensions of the family – including marriage and reproduction – are interrelated with each other across time and countries (Castro Torres et al. 2019).

In this paper we first use Demographic and Health Survey data from 29 countries in sub-Saharan Africa to examine how nuptiality patterns have changed over the period 1991-2019. Then, we analyze how changes in nuptiality patterns are associated with changes in the total fertility rate and ideal family size over this period. We focus our analyses at the sub-national level in order to capture sub-national variation in fertility and marriage change. We hypothesize that the prevalence of divorce, remarriage, and polygyny have made important contributions to contemporary fertility decline and examine these relationships alongside the more traditional measure of changes in the age of first marriage. We find that all four nuptiality measures are associated with the total rate even after controlling for other socio-demographic characteristics at the sub-national level, and that associations for the prevalence of remarriage and polygyny are

robust to the inclusion of sub-national region fixed effects; declines in the prevalence of remarriage and polygyny together may account for 17 percent of total fertility decline in the average sub-national region over the period of study. Contrary to our expectations, the association between changes in the prevalence of divorce and the TFR and changes in the median first marriage and the TFR become non-significant after controlling for sub-national region fixed effects. In addition to these results, we find a significant positive association between changes in the prevalence of polygyny and ideal family size, but no association between changes in ideal family size and divorce, remarriage, or the age at first marriage after including sub-national region fixed effects.

Age at First Marriage

Early marriage is one of the defining characteristics of the traditional pronatalist nuptiality regime that was common in many communities in sub-Saharan Africa. In the 1960s, the median age at first marriage for women was less than 18 in a majority of African countries. Historical census data and retrospective information from the World Fertility Surveys (WFS) and Demographic and Health Surveys (DHS) indicate that the age at first marriage began to increase in the 1970s and by the 1980s relatively few countries had a median age at first marriage that was less than 18 (Hertrich 2017; van de Walle 1993). By the 1990s, the standard median age at first marriage for women was closer to 19.5 in many countries and greater than 21 in a number of countries in southern Africa (Hertrich 2017). These general trends, however, mask geographic heterogeneity; a recent evaluation of DHS data found that more than 50 percent of women married before age 18 in four of six countries examined in West Africa, but Malawi was the only country in East Africa with a median age of first marriage that was less than 18 (Koski, Clark, and Nandi 2017). Furthermore, Batyra and colleagues (2021) document increased within-country

heterogeneity in ages at first union for women, driven by concurrent trends of union postponement and the persistence of early unions among a sizable portion of women.

Theories of marriage and the fertility transition posited that a decline in the proportion of women in unions—primarily driven by delayed entry into marriage—would be associated with a fertility decline. Studies of fertility change since the 1970s have suggested that between one-sixth and one-third of the nascent fertility decline in sub-Saharan Africa in the 1980s and 1990s was attributable to a delayed age at first marriage (Harwood-Lejeune 2001; Garenne 2008). This association, however, may narrow over the course of the fertility transition. In low-fertility contexts, the association between fertility and marriage is generally weak (Billari and Kohler 2004). A more recent study of the most recent DHS survey from 15 countries used simulations to estimate how much fertility would decline if all women married after age 18; the authors concluded that total fertility rates today would be 10 percent lower in the absence of marriage before age 18 (Onagoruwa and Wodon 2018). Actual fertility declines may not be as large as simulated changes if the benefits of delayed marriage are offset by increases in premarital fertility. Early in the fertility transition, premarital births only partially offset the fertility averted by rising ages at marriage (Harwood-Lejeune 2001; Lesthaeghe and Jolly 1995). Furthermore, if delayed union formation is associated with declines in adult mortality, a later onset of marriage can also imply much smaller reductions in person-years married (Pesando et al. 2019) and, potentially, little change in exposure to the risk of childbearing within unions. Nonetheless, a positive association between the prevalence of premarital pregnancy and the age at first marriage persists across sub-Saharan Africa, suggesting that this concern is not unwarranted (Clark, Koski, and Smith-Greenaway 2018).

Within the proximate determinants framework, age at first marriage is usually framed as regulating the duration of marital exposure to the risk of childbearing. Changes in age at first marriage may, however, also be associated with changes in fertility rates across the life course if they index a broader pattern of ideational change (Thornton et al. 2014). Shifts to marriage at older ages may transform conjugal relationships, giving women greater decision-making power and agency within unions, including greater control over childbearing and family planning (Hertrich 2017; Onagoruwa and Wodon 2018). Changes in age at first marriage and total fertility rates may also change in tandem if they share the same underlying structural causes, such as women's educational attainment, rising standards of living, and urbanization (Garenne 2004; Hertrich 2017). We expect to find a negative association between the median age at first marriage and the total fertility rate, although we anticipate that this association will be moderated by the inclusion of controls for other structural changes.

Divorce and Remarriage

Union dissolution and subsequent remarriage regulate exposure to the risk of childbearing later in the reproductive life course. Early studies of the prevalence of divorce in sub-Saharan Africa noted that divorce was both common and geographically diverse. One study of six countries (Cameroon, Ghana, Kenya, Lesotho, Senegal, and Sudan) estimated that 17 percent of unions ended in divorce within the first 20 years of marriage (Bongaarts, Frank, and Lesthaeghe 1984), while another study estimated that roughly half of marriages in West Africa ended in divorce relative to almost one-third of marriages in East Africa (Lesthaeghe, Kaufmann, and Meekers 1989). Across all contexts, remarriage was reported to be high and women were estimated to spend more than 90 percent of their reproductive lives in a union (Bongaarts, Frank, and Lesthaeghe 1984).

Since the 1980s, however, there has been relatively little demographic attention directed towards the dynamics of divorce and remarriage in sub-Saharan Africa. This neglect is attributable, in part, to the absence of detailed union history information in nationally representative surveys collected in sub-Saharan Africa, such as Demographic and Health Surveys and national Censuses (Tabutin and Schoumaker 2004). Although a number of country-specific studies have investigated the prevalence of divorce and its correlates (Locoh and Thiriat 1995; Reniers 2003; Tilson and Larsen 2000; Grant and Soler-Hampejsek 2014; Takyi and Gyimah 2007; Takyi and Broughton 2006), only recently have indirect estimation techniques been developed that provide new insights into cross-national patterns of divorce (Clark & Brauner-Otto, 2015). Using data from 33 countries with a DHS survey collected since 2004, Clark and Brauner-Otto estimate that, on average, 25 percent of unions in sub-Saharan Africa end in divorce within their first 20 years. They find that in most countries the prevalence of divorce is either stable or declining, contrary to expectations that modernization would lead to higher rates of divorce (Goode 1963, 1968). Consistent with findings from the 1980s, they also note that the majority of union dissolutions are attributable to divorce rather than widowhood: in 22 of the 33 countries examined, divorce was more than three times more common than widowhood among women of reproductive age (Clark and Brauner-Otto 2015; Bongaarts, Frank, and Lesthaeghe 1984).

Divorce lowers fertility by disrupting unions; the time spent outside of a union, between a divorce and subsequent remarriage, leads to longer interbirth intervals relative to women who have been continuously married (Sear, Mace, and McGregor 2005; Hayford and Agadjanian 2016). In pre-fertility transition populations, these disruptions led women with more than one marriage to have lower cumulative fertility than women who had been continuously married

(Lee and Pol 1988). Nonetheless, early studies of marriage and fertility in sub-Saharan Africa did not attribute a large proportion of fertility regulation to time in union; when marriage change was considered in relation to future fertility decline, attention was focused on the potential for rising ages at first marriage to lower fertility and attention shifted away from the potential roles of changes in divorce and remarriage rates (Bongaarts, Frank, and Lesthaeghe 1984; Lesthaeghe 1989). Remarried women may also have lower cumulative fertility if prior childlessness precipitated the dissolution of prior unions (Fledderjohann 2012; Tilson and Larsen 2000). A recent study of 29 countries in sub-Saharan Africa found that remarried women end their reproductive years with fewer children than women in intact unions, but the magnitude of the difference was smaller in lower fertility countries (John and Adjiwanou 2021).

Divorce and remarriage, however, may influence fertility beyond simple disruption effects. Studies conducted in industrialized, low-fertility settings have found that divorce often increases the heterogeneity of fertility outcomes (van Bavel, Jansen, and Wijckmans 2012); controlling for prior parity, in many contexts remarried couples are more likely to have an additional child than continuously married couples (Thomson et al. 2014, 2012; van Bavel, Jansen, and Wijckmans 2012). These patterns are often motivated by affective desires for a new birth to cement conjugal bonds within a new partnership (Thomson 2004; Griffith et al. 1985; Vikat, Thomson, and Hoem 1999). A handful of studies from sub-Saharan Africa suggest that similar dynamics may also be at play. A study in Mozambique found that remarried women were able to "catch up" to the fertility of their continuously married peers before the end of their reproductive years (Hayford and Agadjanian 2016). Likewise, John (2018) finds that remarried women in Malawi have higher fertility preferences than women in intact unions, suggesting that women may raise their fertility aspirations in response to entering a new union. These findings

suggest that, to the extent that the prevalence of divorce reduces fertility, the prevalence of remarriage will compensate and be positively associated with the total fertility rate.

Polygamy

Polygamy is a common feature of family systems across sub-Saharan Africa. A study that examined the prevalence of polygamy across 260 sub-national regions in 29 African countries found that 27.8 percent of women in the average region reported having at least one co-wife, with substantial within-country heterogeneity (Smith-Greenaway and Trinitapoli 2014). Others have also noted the variation in the prevalence of polygamy across countries, ranging from a low of 3 percent of women in Madagascar to more than half of women in Burkina Faso and Guinea (Reniers and Watkins 2010; Westoff 2003; Tabutin and Schoumaker 2004). Despite the widespread practice of polygamy, a growing body of evidence indicates that the institution has become less common over time. Although an early study found that polygamy declined in only five of 26 African countries over the period 1977-1998 (Timaeus and Reynar 1998), by the early 2000s declines had expanded to a larger pool of countries (Westoff 2003). More recently, a study of 17 African countries with a Demographic and Health Survey collected since 2010 found that the prevalence of polygamy declined over the previous decade in almost all countries examined (Wang et al. 2017). Less clear, however, is whether the decline in polygamy represents an actual shift from polygamous to monogamous marriages or a shift from formal to informal polygamy that is poorly captured by survey data (Meekers 1992; Coast et al. 2011; C. Bledsoe and Pison 1994).

The fertility consequences of polygamy have been long discussed in the demographic literature. At the individual level, women in polygamous unions have lower fertility, on average,

than women in monogamous unions due to a range of factors, including lower coital frequency, larger spousal age differences, a higher prevalence of infecundity, and longer periods of extended breastfeeding and postpartum abstinence (Lardoux and Van De Walle 2003; Pebley and Mbugua 1989; Muldert 1989; Bean and Mineau 1986; Garenne and van de Walle 1989; Reniers and Tfaily 2012; Timaeus and Reynar 1998; Bongaarts, Frank, and Lesthaeghe 1984). In contrast, the prevalence of polygamy is positively associated with fertility at the population level (Pison 1986; Ezeh 1997; Pebley and Mbugua 1989). Polygamy is an important component of the pronatalist nuptiality regimes present in many African contexts. Polygamy facilitates universal marriage by absorbing divorced and widowed women as second and higher-order wives. Furthermore, "high-polygyny regimes," such as those identified by Ezeh (1997), frequently co-occur with early marriage, low marital contraceptive use, and preferences for higher fertility.

Despite the positive correlation between the prevalence of polygyny and the total fertility rate, changes in the prevalence of polygyny have rarely been incorporated into models of fertility decline. Early studies of nuptiality change and fertility decline largely dismissed the potential for changes in polygyny to contribute to the fertility transition; given little observed decline in the prevalence of polygyny, the practice was assumed to be resistant to change (Pebley and Mbugua 1989; Timaeus and Reynar 1998). One analysis of African fertility decline that included measures of polygyny found a significant association between polygyny and fertility change, but concluded that the decline of polygyny had not made a substantive contribution to fertility decline (Garenne 2008). We expect that a decline in the prevalence of polygyny over time will be associated with a decline in the total fertility rate. Declines in the prevalence of polygyny that are also associated with a decline in ideal family size will be interpreted as an ideational shift away pronatalist regimes.

Data and Methods

The first section of this analysis uses Demographic and Health Survey (DHS) data from 29 countries in sub-Saharan Africa with at least two surveys collected since 1991. The Demographic and Health Surveys are standardized, nationally representative surveys of reproductive and child health which have been used extensively to monitor fertility trends in less developed countries. We focus on changes over time in the total fertility rate at the sub-national level. For many countries, sub-national regions correspond with the official districts or provinces within each country. In cases where the DHS has changed the level of geographic units identified in the survey or where regional boundaries within a country have changed over time, we use harmonized regions in our analysis. When available, we use the regional harmonizations provided by the IPUMS-DHS (Boyle, King, and Sobek 2022); for all other countries, we identified the smallest geographic unit that could be consistently defined across DHS survey rounds. We exclude Cote d'Ivoire from our analysis because we were unable to harmonize the sub-national regions across survey rounds, Lesotho because of inconsistent data on polygyny, and Eritrea because of restricted data.

Table 1 includes a list of the countries included in this analysis and identifies the sub-national units used in this analysis. The final analysis of 29 countries yields 187 sub-national regions. Countries such as Burkina Faso, with 13 sub-national regions, contribute more observations than countries such as Malawi, with three sub-national regions. The majority of regions are predominantly rural; the average region is 35 percent urban. Sixteen sub-national regions, however, were exclusively urban at all time points; with three exceptions, these regions represent capital cities.

Dependent Variables

Our primary dependent variable is the total fertility rate at the sub-national region. These values were taken directly from the DHS StatCompiler. If the sub-national estimates were not available from the StatCompiler or the sub-national regions did not correspond with the harmonized regions used in this analysis, we used the tfr2 Stata module (Schoumaker 2013) to estimate the region-level TFR. We also examine changes in the mean ideal family size within regions over time. As with the total fertility rate, we use the mean ideal family size provided by the DHS StatCompiler. When sub-national estimates were not available, we calculated the mean ideal family size for all women by excluding non-numeric responses, following the procedure described in the DHS guidelines (Rutstein and Rojas 2006).

Nuptiality Variables

We use four variables to capture the dynamics of marital exposure to childbearing: median age at first marriage for women, the prevalence of polygyny, the prevalence of divorce, and the prevalence of remarriage following a divorce. As with the total fertility rate, we use the measures of age at first marriage for women aged 25-49 years old and the prevalence of polygyny among all women provided by the StatCompiler when possible. For sub-national regions for which statistics were not provided, we followed the DHS guidelines to calculate these values (Rutstein and Rojas 2006).

The prevalence of divorce and remarriage, however, are not directly measured by the DHS. With few exceptions, it is not possible to examine how an individual woman's marital history is associated with her childbearing.[1] Clark and Brauner-Otto (2015) demonstrated, however, that it is possible to use reports of current marital status to indirectly estimate the proportion of women who were ever divorced within a population. Our key independent variables, therefore, are the proportion of ever divorced 35-39 year old women within each sub-

national region, and the proportion of ever divorced 35-39 year old women who had remarried,[2] calculated from the equations developed by Clark and Brauner-Otto (2015).

In alternate analyses, we ran our models with estimates of divorce and remarriage calculated for women aged 25-29 years old and 45-49 years old. These measures are strongly correlated with the prevalence of divorce and remarriage for 35-39 year old women; the regression results did not differ significantly when the alternate measures were used. The Akaike information criteria and Bayesian information criteria were lowest for the model that used nuptiality measures estimated for 35-39 year old women, indicating that this age group provides the best model fit. Therefore, we only present results using the prevalence of divorce and remarriage estimated for this group.

Other Variables

Our analysis examines the contribution of nuptiality change to fertility decline within a proximate determinants framework. We also include two variables to represent other dimensions of the proximate determinants: the prevalence of contraceptive use among married women and the median duration of predominant breastfeeding.[3] Finally, we add a set of contextual variables, including the percentage of women who ever attended secondary school, the infant mortality rate, and the percentage living in urban areas. All proximate determinant and contextual variables were taken from the StatCompiler when possible, and otherwise calculated following the DHS guidelines (Rutstein and Rojas 2006).

Analysis

First, we use multi-level linear regressions to examine the pattern of association between total fertility rates and our set of nuptiality variables. These models control for the non-

independence of observations, given that observations are nested within sub-national regions that are nested within countries. The analyses are presented as a series of nested models, where the proximate determinants and contextual variables are sequentially added to the base model that is restricted to the nuptiality variables. Second, we re-estimate the full model with sub-national region fixed effects. This approach allows us to control for unobserved time-invariant region-level characteristics that may bias our estimated association between fertility and marriage.

We then repeat the estimation of the full model but substitute ideal family size as the dependent variable. If nuptiality changes are associated with fertility change because they proxy underlying ideational changes, then we would expect to find a similar pattern of association between the nuptiality variables and ideal family size as we find between the nuptiality variables and the total fertility rate. The absence of an association between the nuptiality variables and ideal family size, however, may indicate that the nuptiality variables exert a more mechanistic role in fertility decline, reflecting marital exposure to the risk of childbearing.

Finally, we re-run our full multi-level and fixed-effect models but limited to the 17 countries that included HIV testing in more than one survey round. We add a control for HIV prevalence in each sub-national region to that regression. In three countries (Cameroon, Congo Democratic Republic, and Guinea), the DHS only publishes sub-national estimates of HIV prevalence for the capital district. Similarly, the Mali 2001 DHS only reports the HIV prevalence for the Bamako district. For these countries, only these observations are included in the analysis presented in Table 5.

Results

Descriptive statistics

Our data demonstrate the incredible diversity of fertility and marriage practices found across sub-Saharan Africa (Table 2). The average total fertility rate across all time periods and sub-national regions in our sample was 5.4 births per woman, although this ranges from a minimum of 1.8 in Addis Ababa, Ethiopia, in 2005 to a high of 8.7 in Maradi region, Niger, in 1998. Across the period of analysis, fertility in the average sub-national region declined from 5.8 births in the early 1990s to 4.8 births in the most recent period (2015-2019). Due to differences in the timing of DHS data collection, the composition of countries included at each time point varies. When the comparing the earliest to the most recent survey available in each country, fertility declined in the average region by 0.36 births. Given that our unit of analysis is the sub-national region, and thus does not account for migration and increasing urbanization, the average regional fertility decline is much more modest than changes in national total fertility rates. The average ideal number of children across regions was 5.3 children; although this value is relatively close to the total fertility rate, the two measures are strongly but not perfectly correlated (R=0.6676).

Although most national estimates of the age at first marriage point towards the decline in marriage before age 18 (Koski, Clark, and Nandi 2017; Hertrich 2017), our data show the persistence of early ages at first marriage at the sub-national level. Figure 1a shows the median and interquartile ranges of the regional age at first marriage over time. The median age at first marriage increased steadily, from 17.8 in 1991-1994 to 19.2 in 2015-2019. Over that period, the interquartile range across regions widened, driven by faster increases in the 75th percentile of age at first marriage than at the 25th percentile. Although there is slight variation in the composition

of countries included at each time point, the overall pattern is consistent. Our data also show an initial increase followed by a gradual decline in the median prevalence of polygyny across regions (Figure 1b). The prevalence of polygyny peaked in 1995-1999, when 27.9 percent of women in the median region were in a polygynous union, eventually falling to 17.7 percent in the median region in 2015-2019.

Sub-national estimates of the prevalence of divorce also reveal extreme heterogeneity, such that regions ranged from places such as the Centre-Nord region of Burkina Faso where less than 1.5 percent of 35-39 year old women had ever divorced to the Nampula region of Mozambique where more than three-quarters of women had divorced. In contrast, in the average region about one-quarter of women aged 35-39 years old had ever divorced. Figure 1c shows the time trend in the interquartile range across regions of the prevalence of divorce among women aged 35-39 years. There was a small but steady decline in the median prevalence of divorce from 29.9 percent of women in the median region in 1990-1994 to 28.4 percent in 2000-2004, and then a larger decline to 21.6 percent ever divorced by 2015-2019. Over this observation period, the interquartile range of the prevalence of divorce also narrowed due to a larger decline in the prevalence of divorce at the 75th percentile.

Our final nuptiality variable captures the prevalence of remarriage following a divorce among women aged 35-39 years old (Figure 1d). Remarriage is extremely common across the sample; in the average region, 77.3 percent of women remarried after a divorce. This measure was also relatively stable over the first four time periods, with around 84 percent of women in the median region remarrying after divorce. The median value, however, fell to 76.1 percent in the 2010-2014 period. Although the lowest prevalence of remarriage was observed in Nairobi, Kenya in 2008, overall the prevalence of remarriage was less than 40 percent of women in less

than four percent of regions. Together, the four marriage variables suggest a subtle movement over time away from the classic nuptiality regime that traditionally characterized many communities in sub-Saharan Africa.

Nuptiality and Fertility Change

Across all regions in our analytic sample, three of the four nuptiality variables have relatively strong correlations with the total fertility rate (Figures 2a-d). Figure 2a shows the strong negative correlation (R=-0.5832) between the median age at first marriage and total fertility rate at the sub-national region level. However, a number of observations—all from Namibia—deviate from the overall pattern; for regions where the median age at first marriage is greater than 25, there is no correlation between the median age at first birth and the total fertility rate. These regions have substantial rates of non-marital fertility (Garenne and Zwang 2006; Harwood-Lejeune 2001; Clark, Koski, and Smith-Greenaway 2018), effectively decoupling the timing of marriage from fertility outcomes.

Polygyny (Figure 2b) is positively correlated across regions with the total fertility rate (R=0.5001), although the correlation is not as strong as the correlation between TFR and the median age at first marriage. In contrast, there is no correlation between the prevalence of divorce among women aged 35-39 years old and the TFR at the region level (R=-0.0278).[4] Given the high prevalence of remarriage after divorce, this absence of correlation is not surprising; the speed with which women remarry after a divorce may be more important for fertility than the prevalence of divorce itself. Indeed, Figure 2d shows a positive correlation (R=0.4688) between the prevalence of remarriage after divorce and the TFR.

Table 3 presents the results of the multi-level linear regressions to examine how the nuptiality variables are associated with the total fertility rate at the region level. The first three models are multi-level models that use random intercepts at the region and country level to control for the nesting of region-level observations over time within sub-national regions within countries; the fourth model adds sub-national region fixed effects. Model 1 is restricted to the four nuptiality variables. We find that all four measures are significantly associated with fertility. Each 10 percentage-point increase in the prevalence of divorce is associated with 0.08 fewer births, whereas each 10 percentage-point increase in remarriage is associated with a 0.08 birth increase in the total fertility rate. The median age at first marriage is negatively associated with the total fertility rate; a one-year increase in the median age at first marriage was associated with almost one-quarter of a birth decline in the total fertility rate. Finally, we find a significant positive association between the prevalence of polygyny and the total fertility rate; each 10 percentage-point increase in polygyny is associated with a 0.3 birth increase in the total fertility rate.

The second model is intended to capture the association between the proximate determinants of fertility and the total fertility rate, adding the prevalence of any contraceptive use and the median duration of predominant breastfeeding to the nuptiality variables. With the introduction of these variables, there is almost no change in the associations between fertility and the prevalence of divorce and remarriage. The prevalence of polygyny remains positively associated with the total fertility rate, although the magnitude of the estimated coefficient is smaller than in Model 1. The association between the median age at first marriage and the total fertility rate also remains statistically significant, but the magnitude of the coefficient is almost 40 percent lower than in Model 1. This shift is attributable to the addition of the prevalence of

contraceptive use, which is strongly correlated with the age at first marriage (R=0.5649). As would be expected, the prevalence of any contraceptive use is significantly associated with the total fertility rate, such that a 10 percent increase in contraceptive use was associated with a 0.31 birth decrease in the total fertility rate. Finally, the median duration of breastfeeding is positively associated with the total fertility rate, such that a one-month increase in the duration of breastfeeding is associated with a 0.05 birth increase in the total fertility rate. Given that prolonged breastfeeding increases birth intervals (Jain and Bongaarts 1981; Smith 1985), this ecological association is surprising. However, it is worth noting that the association between median duration of breastfeeding and TFR is only statistically significant when the prevalence of contraceptive use is included in the model.

The third model adds a set of contextual variables to the marriage and proximate determinants variables. All of the nuptiality variables remain significantly associated with the total fertility rate, although the magnitude of the coefficient for age at first marriage is now 80 percent smaller than the coefficient estimated in Model 1 and the coefficient for polygyny is 65 percent smaller than in Model 1. Consistent with expectations, more urban regions and places with higher levels of secondary schooling have lower fertility rates.

Our final model uses sub-national region fixed effects to control for the potential endogeneity of unobserved time-invariant regional characteristics that may influence changes in both fertility and marriage. Neither the prevalence of divorce nor changes in the median age at first marriage were significantly associated with changes in the total fertility rate in the fixed effects model. Changes in the prevalence of remarriage and polygyny, however, remained significantly associated with changes in fertility with magnitudes of association comparable to those estimated in Model 3.

Although the magnitude of the association between our nuptiality variables and the total fertility rate appears to be modest, these measures are associated with a substantial portion of fertility decline over the period of study. From the early 1990s until the most recent survey period, the prevalence of remarriage after divorce declined 5.1 percentage points in the median region, a change associated with a decline of 0.03 births. Likewise, the decline in polygyny in the median region translates into approximately 0.14 fewer births. Together, these changes in marriage practices may account for 17 percent of the fertility decline in the median region. It is unclear, however, whether these changes in marital behavior contributed directly to fertility decline. From a proximate determinants framework, these marital behaviors shape exposure to the risk of childbearing. An alternate interpretation of the pattern of association that we describe would see these changes in fertility and nuptiality as part of a larger pattern of ideational change, evidence of a subtle shift away from pronatalist values.

In order to test this competing interpretation of the data, we substitute the average ideal number of children in a region as our dependent value. If our findings about fertility change reflect a broader ideational change, we would expect to see a similar pattern of association between our nuptiality measures and mean ideal family size. If, on the other hand, our marriage variables are associated with the total fertility rate but not ideal family size, it would suggest that our marriage variables may contribute to fertility change by modulating exposure to the risk of childbearing. The first model presented in Table 4 replicates the full multi-level model presented in Table 3 Model 3, but with the ideal number of children substituted as the dependent variable. Then the second model in Table 4 repeats this analysis with region-level fixed effects.

In contrast to the multi-level analysis of the total fertility rate, we do not find a significant association between mean ideal family size and the prevalence of divorce and remarriage in

Model 1. Ideal family size is, however, significantly associated with the median age at first marriage and the prevalence of polygyny: each one-year increase in the median age at first marriage is associated with 0.07 fewer desired births, whereas each 10 percentage point increase in polygyny is associated with 0.14 more desired births. Once region-level fixed effects are included in Model 2, the association between mean ideal family size and median age at first marriage is no longer statistically significant, but the prevalence of polygyny remains positively associated.

Taken together with the results from Table 3, we make two interpretations. First, we believe that declines in polygyny and declines in the mean ideal number of children at the region level over time are part of a system of related ideational changes; given the patterns of association found in the multi-level models, shifts in the age at first marriage may also be part of this ideational change. In light of these associations, we infer that shifts in the prevalence of polygyny are not causing declines in the total fertility rate but share a common source of ideational change. In contrast, we find that changes in the prevalence of divorce and remarriage are associated with changes in the total fertility rate but are not associated with changes in the ideal number of children. We interpret these results as evidence that changes in divorce and remarriage are less closely related to these ideational shifts and, instead, are more likely to affect fertility by regulating exposure to the risk of childbearing.

Nuptiality Change, Fertility Change, and HIV

Since the 1990s, the HIV epidemic has profoundly shaped the demography of sub-Saharan Africa. The small number of studies that have examined the association between HIV prevalence and changes in aggregate fertility have failed to find evidence of an association (Fortson 2009; Juhn, Kalemli-Ozcan, and Turan 2013). Individual-level studies have found

evidence of lower fertility among HIV-positive women than HIV-negative women (Lewis et al. 2004; Terceira et al. 2003; Juhn, Kalemli-Ozcan, and Turan 2013), a difference attributed to both behavioral and biological differences. HIV-positive women have higher rates of divorce and widowhood, greater condom use, lower coital frequency, and lower desired fertility than HIV-negative women. Biological differences, such as increased amenorrhea and higher co-infection with other sexually transmitted diseases, also lower the fecundity of HIV-positive women (Sneeringer and Logan 2009). These group-level differences may be masked by the aggregate trends, if women with lower fertility are more likely to die than women with higher fertility. Measures such as the total fertility rate may, therefore, be skewed upward by a survivor bias.

In order to test whether trends in HIV prevalence are confounding the association between marriage change and fertility in our data, we restrict our analysis to the set of 17 countries for which the DHS conducted HIV testing in at least two survey rounds. This set of countries differed in significant ways from the main analytic sample: surveys with HIV testing had, on average, lower fertility, older ages at first marriage, lower prevalence of polygyny, and lower prevalence of divorce than the main sample. The average regional HIV prevalence in this sample was 5.3 percent. Across this sample, HIV prevalence declined, on average, by 0.9 percentage points during the period of observation, consistent with other studies of the HIV pandemic (Bongaarts et al. 2008). The first column of Table 5 replicated the full multi-level model from Table 3 for this sub-set of countries, the second column adds a control for region-level HIV prevalence, and the final model adds region-level fixed effects to Model 2. Although the prevalence of remarriage after divorce is still positively associated with the total fertility rate, none of the other nuptiality variables are significantly associated with the total fertility rate in this sub-sample of countries (Model 1). In the second model, the estimated relationship between

remarriage and TFR remains unchanged. HIV prevalence is negatively associated with aggregate fertility, such that a one percentage-point increase in HIV prevalence would be associated with 0.04 fewer births. In the final model, the standard error estimated for remarriage increases and the association with the fertility rate is no longer statistically significant. The association between the TFR and HIV prevalence also becomes non-significant in the fixed effects model.

Discussion

Transformations in family systems occur relatively late in the demographic transition as significant declines of fertility and mortality are preconditions that provide the required "degrees of freedom" for substantial family change (Pesando et al 2019; Castro Torres et al 2021). While a lack of focus on family change might thus have been acceptable during the initial stages of the demographic transition in sub-Saharan countries, this is no longer the case. The preconditions for fundamental transformations of the family and family systems have existed for several decades, and nuptiality and family change has emerged as a central aspect of global social and demographic change. Hence, the institutions of marriage and the family have undergone profound changes over the past decades in SSA, following differentiated paths across and within countries.

This family change has been multidimensional, affecting different parts of the life course: transformations of nuptiality and the family in sub-Saharan Africa included delays in the entry to marriage, changes and declines in patterns of polygamy, and transformations in long-standing patterns of divorce and remarriage. A priori it is not clear which of these dimensions of changes in marriage patterns are most closely related to fertility change. Earlier models assumed that timing of entry into marriage was the most important factor, whereas our findings suggest that

later life movement in and out of unions—particularly the prevalence of remarriage—may be an important component of fertility change.

In this paper we investigate the contribution of nuptiality to fertility variation and the fertility decline in sub-Saharan Africa. The decline of fertility (and to stalls in this decline of fertility) has received considerable attention in the literature, as have changing patterns in the transition to adulthood. Yet the profound changes in nuptiality have not been systematically related to variation in fertility and its decline over time. Using DHS data for 29 countries covering the period 1991-2019, we focused of four indicators of nuptiality patterns--median age at first marriage and the prevalence of divorce, remarriage, and polygyny--and established the associations of these indicators of nuptiality with the total fertility rate and ideal family size. We used multi-level analyses to account for the considerable and persistent heterogeneity in fertility, marriage and socioeconomic contexts that exists across sub-Saharan Africa. We hypothesized that the prevalence of divorce, remarriage, and polygyny have made important and distinctive contributions to contemporary fertility decline in sub-Saharan Africa, and that these contributions would prevail even after controlling for more traditional measures of family change such as the median age of first marriage.

Our analyses document associations between the total fertility rate and all four nuptiality indicators, with particularly robust positive associations between the TFR and the prevalence of remarriage and polygyny even after controlling for other contextual characteristics and sub-national fixed effects. Specifically, declines in the prevalence of remarriage and polygyny together may account for 17 percent of total fertility decline in the average sub-national region over the period of study. Contrary to our hypothesis, we find no association between changes in the prevalence of divorce and the TFR at the sub-national level after controlling for region fixed

effects, and neither do we document an association between changes in the age at first marriage and the TFR after controlling for sub-national characteristics.

Declines in the prevalence of remarriage and polygyny can contribute to declining fertility through at least two mechanisms: first, from a proximate determinants framework, these marital behaviors shape exposure to the risk of childbearing; and second, nuptiality and fertility change could be jointly driven by a larger pattern of ideational or socioeconomic change. While we do not adopt in this paper a causal identification strategy that would allow us to formally distinguish between these mechanisms, our analyses suggest that the former rather than the latter mechanism dominates. Specifically, we document a significant positive association between changes in the prevalence of polygyny and ideal family size, but no association between changes in ideal family size and divorce, remarriage, or the age at first marriage. In the context of our other findings, this pattern indicates that declines in polygyny and declines in the average ideal number of children at the region level over time are part of a system of related ideational or socioeconomic changes; hence, shifts in the prevalence of polygyny are not causing declines in the total fertility rate but share a common source of ideational or socioeconomic change. In contrast, the lack of association between remarriage and ideal number of children suggests that the observed correlation between the prevalence of remarriage and the TFR is more likely due to the implications of divorce and remarriage on the exposure to the risk of childbearing.

Several limitations of our analyses are important to highlight. While our analyses control for time-invariant characteristics of sub-national regions, the lack of data on time-varying contextual characteristics at the sub-national level, such as regional GDP per capita, limits our ability to control for changes in socioeconomic contexts. Our analyses are also restricted to the period after 1990 given data availability and the harmonization of sub-national units over time,

and thus we cannot identify the relationships between marriage or family change and fertility during the period of fertility decline from the 1960s to 1990. The design of the DHS itself also constrains our analysis in several ways. First, with the exception of selected survey years the DHS does not collect full marriage histories. The synthetic measures of ever divorce and ever remarriage conditional on divorce developed by Clark and Brauner-Otto provide useful estimates of prevalence. However, an ideal analysis would include a more dynamic understanding of the duration of time spent unmarried due to union disruption. Second, the sub-national regions coded by the DHS make it difficult to estimate the association between fertility change and urbanization at the sub-national level. In 13 of the 29 countries included in this analysis, the capitol city was coded as its own sub-national region. By definition, these units were 100 percent urban at all points in time, which means that our analyses are unable to capture the impact of urban growth or migration from rural to urban districts. Finally, and perhaps most importantly, we are constrained by the definitions of marriage standardized in the DHS questionnaire. Although the DHS differentiates whether a woman is currently married or living together with a partner, no additional information about union formality is available. The questionnaires do not differentiate between the age at first marriage and the age at first cohabitation, obscuring the process of marriage and how it may be changing over time (Meekers 1992; Bledsoe 1990). Likewise, no information on union formality is collected for formerly married women. Given broader evidence of shifts toward less formal unions across sub-Saharan Africa and variation in the meaning of these categories across time and geography (Shapiro and Gebreselassie 2014; Karanja 1994; van de Walle 1993; Coast et al. 2011), this study is likely underestimating the true relationship between changing marriage practices and fertility.

Moving forward, continued research on the association between marriage change and fertility decline in sub-Saharan Africa is necessary. Our findings suggest that changes in the prevalence of remarriage and polygyny may play a previously underappreciated role in fertility decline in the region. As communities shift away from universal adult marriage, greater understanding is needed about the social and economic determinants of remarriage rates. If a shift toward less formal partnerships is behind the declining prevalence of remarriage and polygamy, these changes may signal greater economic precarity for women and require greater attention to non-marital fertility following a union dissolution. Although increasing educational attainment may expand economic opportunities for women and create alternatives to remarriage, evidence suggests that educated women in most African contexts are underemployed and that female labor force participation is inversely associated with household income and well-being (Filmer and Fox 2014; Klasen et al. 2021). As fertility continues to decline across sub-Saharan Africa, we expect marriage change to be an increasingly salient determinant of reproductive outcomes.

Notes

[1] A limited number of Demographic and Health Surveys collected in the fifth phase of data collection (DHS V) included detailed marital histories for the five years preceding the survey. Furthermore, some surveys collected in the fourth and sixth phases of the DHS include questions about how the respondent's prior union ended, but marital histories are otherwise incomplete.

[2] We focus on women aged 35-39 years old because age-specific fertility rates decline substantially from 35-39 year olds to 40-44 year olds in most African settings; a focus on the prevalence of divorce and remarriage among women aged 35-39 years old therefore captures union instability at reproductively active ages. This pattern is consistent with work by Shapiro and Gebreselassie (2008), who found that age-specific fertility rates were significantly associated with union status for almost all age groups 15-19 through 35-39 years old, but the association was non-significant at older ages. Furthermore, Clark and Brauner-Otto (2015) note that most union dissolutions in sub-Saharan Africa occur within the first 20 years of marriage; the prevalence of divorce and remarriage at ages 35-39 years old captures the majority of union dissolutions experienced in these settings.

[3]Traditional models of the proximate determinants of fertility also include an index of sterility (e.g., Bongaarts et al. 1984). We, however, follow the more recent guidance of Bongaarts (2015) that it is no longer useful to include an index of sterility in models of the proximate determinants on the grounds that there has been minimal variation in primary sterility in populations since the 1980s. Furthermore, he notes that the prevalence of sterility is low across all countries: for the 67 countries with a Demographic and Health Survey since 2000, he found that the average prevalence of sterility was 2.2 percent and that Jordan was the only country where the prevalence of sterility exceeded 5 percent.

[4] Alternate specifications of divorce prevalence estimated for other age groups (not shown) are also not correlated with the total fertility rate (ever divorced, women age 25-29 years old: R=0.0251; ever divorced, women aged 45-49 years old: R=-0.0552).

References

Batyra, Ewa, Hans Peter Kohler, and Frank F. Furstenberg. 2021. "Changing Gender Gaps in the Timing of First Union Formation and Sexual Initiation in Sub-Saharan Africa." *Population and Development Review* 7. https://doi.org/10.1111/padr.12405.

Bavel, Jan van, Mieke Jansen, and Belinda Wijckmans. 2012. "Has Divorce Become a Pro-Natal Force in Europe at the Turn of the 21st Century?" *Population Research and Policy Review* 31 (5): 751–75. https://doi.org/10.1007/s11113-012-9237-6.

Bean, L.L., and G.P. Mineau. 1986. "The Polygyny-Fertility Hypothesis : A Re-Evaluation." *Population Studies* 40 (1): 67–81.

Billari, Francesco C., and Hans Peter Kohler. 2004. "Patterns of Low and Lowest-Low Fertility in Europe." *Population Studies* 58 (2): 161–76. https://doi.org/10.1080/0032472042000213695.

Bledsoe, Caroline. 1990. "Transformations in Sub-Saharan African Marriage and Fertility." *The ANNALS of the American Academy of Political and Social Science* 510 (1): 115–25. https://doi.org/10.1177/0002716290510001009.

Bledsoe, Caroline, and Gilles Pison. 1994. "Introduction." In *Nuptiality in Sub-Saharan Africa: Contemporary Anthropological and Demographic Persepectives*, edited by Caroline Bledsoe and Gilles Pison, 1–24. Oxford, UK: Clarendon Press Oxford.

Bongaarts, John. 2015. "Modeling the Fertility Impact of the Proximate Determinants: Time for a Tune-Up." *Demographic Research* 33 (1): 535–60. https://doi.org/10.4054/DemRes.2015.33.19.

———. 2017. "Africa's Unique Fertility Transition." *Population and Development Review* 43: 39–58. https://doi.org/10.1111/j.1728-4457.2016.00164.x.

Bongaarts, John, Thomas Buettner, Gerhard Heilig, and François Pelletier. 2008. "Has the HIV Epidemic Peaked?" *Population and Development Review* 34 (2): 199–224. https://doi.org/10.1111/j.1728-4457.2008.00217.x.

Bongaarts, John, and John Casterline. 2013. "Fertility Transition: Is Sub-Saharan Africa

Different?" *Population and Development Review* 38 (SUPPL.1): 153–68. https://doi.org/10.1111/j.1728-4457.2013.00557.x.

Bongaarts, John, Odile Frank, and Ron Lesthaeghe. 1984. "The Proximate Determinants of Fertility in Sub-Saharan Africa." *Population and Development Review* 10 (3): 511–37.

Boyle, Elizabeth Heger, Miriam King, and Matthew Sobek. 2022. "IPUMS-Demographic and Health Surveys: Version 9 [Dataset]." https://doi.org/https://doi.org/10.18128/D080.V9.

Casterline, John B., and John Bongaarts. 2017. "Fertility Transition in Sub-Saharan Africa." *Population and Development Review* 43 (Supplement).

Castro Torres, Andrés F., Luca Maria Pesando, Hans-Peter Kohler, and Frank F. Furstenberg. 2019. "Family Change and Variation Through the Lens of Family Configurations in Low- and Middle-Income Countries." *University of Pennsylvania Population Studies Center Working Papers (PSC/PARC)*, no. 31: 10–16.

Clark, Shelley, and Sarah Brauner-Otto. 2015. "Divorce in Sub-Saharan Africa: Are Unions Becoming Less Stable?" *Population and Development Review* 41 (4): 583–605. https://doi.org/10.1111/j.1728-4457.2015.00086.x.

Clark, Shelley, Alissa Koski, and Emily Smith-Greenaway. 2018. "Recent Trends in Premarital Fertility across Sub-Saharan Africa." *Studies in Family Planning*, 1–20.

Coast, Ernestina, Sara Randall, Valerie Golaz, and Bilampoa Gnoumou. 2011. "Problematic Polygamy: Implications of Changing Typologies and Definitions of Polygamy." In .

Cohen, Barney. 1998. "The Emerging Fertility Transition in Sub-Saharan Africa." *World Development* 26 (8): 1431–61. https://doi.org/10.1016/S0305-750X(98)00058-8.

Ezeh, Alex C. 1997. "Polygyny and Reproductive Behavior in Sub-Saharan Africa: A Contextual Analysis." *Demography* 34 (3): 355–68. https://doi.org/10.2307/3038289.

Ezeh, Alex C., Blessing U. Mberu, and Jacques O. Emina. 2009. "Stall in Fertility Decline in Eastern African Countries: Regional Analysis of Patterns, Determinants and Implications." *Philosophical Transactions of the Royal Society B: Biological Sciences* 364 (1532): 2991–3007. https://doi.org/10.1098/rstb.2009.0166.

Filmer, Deon, and Louise Fox. 2014. “Youth Employment in Sub-Saharan Africa.” Africa Development Series. Washington, DC: The World Bank.

Fledderjohann, J. J. 2012. “‘Zero Is Not Good for Me’: Implications of Infertility in Ghana.” *Human Reproduction* 27 (5): 1383–90. https://doi.org/10.1093/humrep/des035.

Fortson, Jane G. 2009. “HIV/AIDS and Fertility.” *American Economic Journal: Applied Economics* 1 (3): 170–94. https://doi.org/10.1257/app.1.3.170.

Garenne, Michel. 2004. “Age at Marriage and Modernisation in Sub-Saharan Africa.” *Southern African Journal of Demography* 9 (2): 59–79. http://www.jstor.org/stable/20853271%5Cnhttp://www.jstor.org/stable/pdfplus/10.2307/20853271.pdf?acceptTC=true.

———. 2008. “Fertility Changes in Sub-Saharan Africa,” no. September.

Garenne, Michel, and Etienne van de Walle. 1989. “Polygyny and Fertility Among the Sereer of Senegal.” *Population Studies* 43 (2): 267–83.

Garenne, Michel, and Julian Zwang. 2006. “Premarital Fertility in Namibia: Trends, Factors, and Consequences.” *Journal of Biosocial Science* 38 (2): 145–67.

Grant, Monica J., and Erica Soler-Hampejsek. 2014. “HIV Risk Perceptions, the Transition to Marriage, and Divorce in Southern Malawi.” *Studies in Family Planning* 45 (3): 315–37. https://doi.org/10.1111/j.1728-4465.2014.00394.x.

Griffith, Janet D, Helen P Koo, Triangle Park, C M Suchindran, and Chapel Hill. 1985. “Childbearing and Family in Remarriage.” *Demography* 22 (1): 73–88.

Harwood-Lejeune, Audrey. 2001. “Rising Age at Marriage and Eastern Africa and Fertility in Southern.” *European Journal of Population* 17 (3): 261–80.

Hayford, Sarah R, and Victor Agadjanian. 2016. “The Impact of Union Disruption and Repartnering on Fertility: A Case Study from Mozambique.” In *Paper Presented at the Population Association of America Annual Meeting*. Washington, DC.

Hertrich, Veronique. 2017. “Trends in Age at Marriage and the Onset of Fertility Transition in Sub-Saharan.” *Population and Development Review* Special Is: 112–37.

https://doi.org/10.1111/padr.12043.

Jain, Anrudh K, and John Bongaarts. 1981. “Breastfeeding: Patterns, Correlates, and Fertily Effects.” *Studies in Family Planning* 12 (3): 79–99.

John, Ben Malinga, and Vissého Adjiwanou. 2021. “Fertility Decline in Sub-Saharan Africa: Does Remarriage Matter?” *Population Studies* 0 (0): 1–21. https://doi.org/10.1080/00324728.2021.1933148.

John, Benson. 2018. “On Marriage Dynamics and Fertility in Malawi: How Does Remarriage Affect Fertility Preferences and Childbearing Behaviour? M.Phil., Demography.” University of Cape Town.

Johnson-Hanks, Jennifer A., Christine A. Bachrach, S. Philip Morgan, and Hans-Peter Kohler. 2011. *Understanding Family Change and Variation: Toward a Theory of Conjunctural Action*. New York, NY: Springer.

Juhn, Chinhui, Sebnem Kalemli-Ozcan, and Belgi Turan. 2013. “HIV and Fertility in Africa : First Evidence from Population Based Surveys.” *Journal of Population Economics*, no. 4473.

Karanja, Wambui Wa. 1994. “The Phenomenon of ‘Outside Wives’: Some Reflections on Its Possible Influence on Fertility.” In *Nuptiality in Sub-Saharan Africa: Contemporary Anthropological and Demographic Persepectives*, edited by Caroline H. Bledsoe and Gilles Pison, 194–214. Oxford: Clarendon Press.

Klasen, Stephan, Tu Thi Ngoc Le, Janneke Pieters, and Manuel Santos Silva. 2021. “What Drives Female Labour Force Participation? Comparable Micro-Level Evidence from Eight Developing and Emerging Economies.” *The Journal of Development Studies* 57 (3): 417–42.

Koski, Alissa, Shelley Clark, and Arijit Nandi. 2017. “Has Child Marriage Declined in Sub-Saharan Africa? An Analysis of Trends in 31 Countries.” *Population and Development Review* 43 (1): 7–29. https://doi.org/10.1111/padr.12035.

Lardoux, Solène, and Etienne Van De Walle. 2003. “Polygyny and Fertility in Rural Senegal.” *Population* 58 (6): 717–43. https://doi.org/10.2307/3246672.

Lee, Bun Song, and Louis G. Pol. 1988. “Effect of Marital Dissolution on Fertility in Cameroon.” *Social Biology* 35 (3–4): 293–306.

Lesthaeghe, Ron. 1989. *Reproduction and Social Organization in Sub-Saharan Africa*. Los Angeles, CA: University of California Press.

Lesthaeghe, Ron, and C. Jolly. 1995. “The Start of the Sub-Saharan Fertility Transition: Some Answers and Many Questions.” *Journal of International Development* 7 (1): 25–45. https://doi.org/10.1002/jid.3380070103.

Lesthaeghe, Ron, Georgia L. Kaufmann, and Dominique Meekers. 1989. “The Nuptiality Regimes in Sub-Saharan Africa.” In *Reproduction and Social Organization in Sub-Saharan Africa*, edited by Ron Lesthaeghe, 238–337. Berkeley and Los Angeles: University of California Press.

Lewis, James J.C., Carine Ronsmans, Alex C. Ezeh, and Simon Gregson. 2004. “The Population Impact of HIV on Fertility in Sub-Saharan Africa.” *Aids* 18 (SUPPL. 2): 35–43. https://doi.org/10.1097/00002030-200406002-00005.

Locoh, Therese, and Marie-Paule Thiriat. 1995. “Divorce et Remariage Des Femmes En Afrique de l’Ouest. Le Cas Du Togo.” *Population (French Edition)* 50 (1): 61. https://doi.org/10.2307/1533793.

Machiyana, Kazuyo. 2010. “A Re-Assessment of Fertility Trends in 17 Sub-Saharan African Countries.” DHS Working Paper No. 68. Calverton, MD. https://doi.org/10.17037/PUBS.00989912.

Meekers, Dominique. 1992. “The Process of Marriage in African Societies: A Multiple Indicator Approach.” *Population and Development Review* 18 (1): 61–78.

Muldert, Monique Borgerhoff. 1989. “Marital Status and Reproductive Performance in Kipsigis Women : Re- Evaluating the Polygyny-Fertility Hypothesis.” *Population Studies* 43 (2): 285–304.

Onagoruwa, Adenike, and Quentin Wodon. 2018. “Measuring the Impact of Child Marriage on Total Fertility: A Study for Fifteen Countries.” *Journal of Biosocial Science* 50 (5): 626–39. https://doi.org/10.1017/S0021932017000542.

Pebley, Anne, and Wariara Mbugua. 1989. “Polygyny and Fertility in Sub-Saharan Africa.” In *Reproduction and Social Organization in Sub-Saharan Africa*, edited by Ron Lesthaeghe, 338–64. Berkeley and Los Angeles: University of California Press.

Pesando, Luca Maria, Andrés F. Castro, Liliana Andriano, Julia A. Behrman, Francesco C. Billari, Christiaan Monden, Frank F. Furstenberg, and Hans Peter Kohler. 2019. “Global Family Change: Persistent Diversity with Development.” *Population and Development Review* 45 (1): 133–68. https://doi.org/10.1111/padr.12209.

Pison, Gilles. 1986. “La Démographie de La Polygamie.” *Population (French Edition)* 41 (1): 93–122.

Reniers, Georges. 2003. “Divorce and Remarriage in Rural Malawi.” *Demographic Research* Special 1 (September): 175–206.

Reniers, Georges, and Rania Tfaily. 2012. “Polygyny, Partnership Concurrency, and HIV Transmission in Sub-Saharan Africa.” *Demography* 49 (3): 1075–1101. https://doi.org/10.1007/s13524-012-0114-z.

Reniers, Georges, and Susan Watkins. 2010. “Polygyny and the Spread of HIV in Sub-Saharan Africa: A Case of Benign Concurrency.” *AIDS* 24 (2): 299–307. https://doi.org/10.1097/QAD.0b013e328333af03.Polygyny.

Rutstein, Shea O., and Guillermo Rojas. 2006. “Guide to DHS Statistics.” Calverton, MD.

Schoumaker, Bruno. 2013. “A Stata Module for Computing Fertility Rates and TFRs from Birth Histories: Tfr2.” *Demographic Research* 28 (May): 1093–1144. https://doi.org/10.4054/DemRes.2013.28.38.

Sear, Rebecca, Ruth Mace, and Ian A. McGregor. 2005. “Determinants of Fertility in the Gambia.” In *Paper Presented at the International Union for the Scientific Study of Population*. Tours, France.

Shapiro, David. 2012. “Women’s Education and Fertility Transition in Sub-Saharan Africa.” *Vienna Yearbook of Population Research* 10 (1): 9–30. https://doi.org/10.1553/populationyearbook2012s009.

Shapiro, David, and Tesfayi Gebreselassie. 2008. “Fertility Transition in Sub-Saharan Africa: Falling and Stalling.” *African Population Studies* 22 (2): 3–23.

———. 2014. “Marriage in Sub-Saharan Africa: Trends, Determinants, and Consequences.” *Population Research and Policy Review* 33 (2): 229–55. https://doi.org/10.1007/s11113-013-9287-4.

Smith-Greenaway, Emily, and Jenny Trinitapoli. 2014. “Polygynous Contexts, Family Structure, and Infant Mortality in Sub-Saharan Africa.” *Demography* 51 (2): 341–66. https://doi.org/10.1007/s13524-013-0262-9.

Smith, David P. 1985. “Breastfeeding, Contraception, and Birth Intervals in Developing Countries.” *Studies in Family Planning* 16 (3): 154–63. https://doi.org/10.2307/1967017.

Sneeringer, Stacy E, and Trevon Logan. 2009. “A Closer Examination of the HIV/Fertility Linkage.” DHS Working Paper No. 63. Calverton, MD.

Tabutin, Dominique, and Bruno Schoumaker. 2004. “The Demography of Sub-Saharan Africa from the 1950s to the 2000s: A Survey of Changes and a Statistical Assessment.” *Population (English Edition)* 59 (3/4): 457-519+522-555.

Takyi, Baffour K., and Christopher L. Broughton. 2006. “Marital Stability in Sub-Saharan Africa: Do Women’s Autonomy and Socioeconomic Situation Matter?” *Journal of Family and Economic Issues* 27 (1): 113–32. https://doi.org/10.1007/s10834-005-9006-3.

Takyi, Baffour K., and S. O. Gyimah. 2007. “Matrilineal Family Ties and Marital Dissolution in Ghana.” *Journal of Family Issues* 28 (5): 682–705. https://doi.org/10.1177/0192513X070280050401.

Terceira, Nicola, Simon Gregson, Baisa Zaba, and Peter R. Mason. 2003. “The Contribution of HIV to Fertility Decline in Rural Zimbabwe, 1985-2000.” *Population Studies* 57 (2): 149–64. https://doi.org/10.1080/0032472032000097074.

Thomson, Elizabeth. 2004. “Step-Families and Childbearing Desires in Europe.” *Demographic Research* 10 (SUPPL. 3): 117–34. https://doi.org/10.4054/demres.2004.s3.5.

Thomson, Elizabeth, Trude Lappegård, Marcia Carlson, Ann Evans, and Edith Gray. 2014.

"Childbearing Across Partnerships in Australia, the United States, Norway, and Sweden." *Demography* 51 (2): 485–508. https://doi.org/10.1007/s13524-013-0273-6.

Thomson, Elizabeth, Maria Winkler-Dworak, Martin Spielauer, and Alexia Prskawetz. 2012. "Union Instability as an Engine of Fertility? A Microsimulation Model for France." *Demography* 49 (1): 175–95. https://doi.org/10.1007/s13524-011-0085-5.

Thornton, Arland, Shawn F. Dorius, and Jeffrey Swindle. 2015. "Developmental Idealism: The Cultural Foundations of World Development Programs." *Sociology of Development* 1 (2): 277–320. https://doi.org/10.1525/sod.2015.1.2.69.

Thornton, Arland, Rachael S. Pierotti, Linda Young-DeMarco, and Susan Watkins. 2014. "Developmental Idealism and Cultural Models of the Family in Malawi." *Population Research and Policy Review* 33 (5): 693–716. https://doi.org/10.1007/s11113-014-9322-0.

Tilson, D, and U Larsen. 2000. "Divorce in Ethiopia: The Impact of Early Marriage and Childlessness." *Journal of Biosocial Science* 32 (3): 355–72.

Timaeus, Ian M, and Angela Reynar. 1998. "Polygynists and Their Wives in Sub-Saharan Africa : An Analysis of Five Demographic and Health Surveys." *Population Studies* 52 (2): 145–62.

Vikat, Andres, Elizabeth Thomson, and Jan M. Hoem. 1999. "Stepfamily Fertility in Contemporary Sweden: The Impact of Childbearing before the Current Union." *Population Studies* 53 (2): 211–25. https://doi.org/10.1080/00324720308082.

Walle, Etienne van de. 1993. "Recent Trends in Marriage Age." In *Demographic Change in Sub-Saharan Africa*, edited by National Research Council, 117–52. Washington, DC: National Academies Press.

Wang, Wenjuan, Sarah Staveteig, Rebecca Winter, and Courtney Allen. 2017. "Women's Marital Status, Contraceptive Use, and Unmet Need in Sub-Saharan Africa, Latin America, and the Caribbean." DHS Comparative Reports No. 44. Rockville, MD.

Westoff, Charles. 2003. "Trends in Marriage and Early Childbearing in Developing Countries." DHS Comparative Report No. 5. Calverton, MD.

Table 1. List of countries, survey years, and sub-national regions in analytic sample

Country	Survey Years	Harmonized Sub-National Regions
Benin	1996, 2001, 2006, 2011, 2017	Atacora/Donga; Atlantique/Littoral; Borgou/Alibori; Mono/Couffo; Ouémé/Plateau; Zou/Collines
Burkina Faso	2003*, 2010*	Boucle de Mouhoun; Cascades; Centre (including Ouagadougou); Centre-Est; Centre-Nord; Centre-Ouest; Centre-Sud; Est; Hauts Bassins; Nord; Plateau Central; Sahel; Sud-Ouest
Burundi	2010*, 2016*	**Bujumbura Mairie**; Centre-Est; North; South; West
Cameroon	1991, 2004*, 2011*, 2018*	Adam/Nord/ExtNord; Centre/Douala/Littoral/Ouest/Sud/Yaounde; NordOuest/SudOuest
Chad	1996, 2004, 2014	**N'djamema**; Lac/Kanem/Bet; Batha/Guera/Salamat; Wadi Fira/Ouaddai; Hadjer Lamis/Chari Baguirmi; Mayo Kebbi Est/Ouest; Tanjile/Logone Occidental/Oriental; Moyen Chari/Mandoul
Congo	2005, 2011	**Brazzaville**; Nord; **Pointe-Noire**; Sud
DRC	2007*, 2013*	**Kinshasa**; Bandundu; Bas-Congo; Equateur; Kasaï Occident; Kasaï Oriental; Katanga; Maniema; Nord-Kivu; Orientale; Sud-Kivu
Ethiopia	2000, 2005*, 2011*, 2016*	**Addis Abeba**; Affar; Amhara; Ben-Gumz; Dire Dawa; Gambela; Harari; Oromiya; SNNP; Somali; Tigray
Gabon	2000, 2012	East; **Libreville/Port-Gentil**; North; South; West
Gambia	2013*, 2019	**Banjul**; Basse; Brikama; Janjanbureh; **Kanifing**; Kerewan; Kuntaur; Mansakonko
Ghana	1993, 1998, 2003*, 2008*, 2014*	Ashanti; Brong-Ahafo; Central; Eastern; Greater Accra; Northern/Upper West/Upper East; Volta; Western
Guinea	1999, 2005*, 2012*, 2018*	Lower/Center; Upper/Forest; **Conakry**
Kenya	1993, 1998, 2003*, 2008*, 2014*	Central; Coast; Eastern; **Nairobi**; Nyanza; Rift Valley; Western
Liberia	2007*, 2013*, 2019	North Central; North Western; South Central; South Eastern A; South Eastern B
Madagascar	1992, 1997, 2003, 2008	Antananarivo; Antsiranana; Fianarantsoa; Mahajanga; Toamasina; Toliary
Malawi	1992, 2000, 2004*, 2010*, 2015*	Central; Northern; Southern
Mali	1995, 2001*, 2006*, 2012*, 2018*	**Bamako**; Kayes/Koulikoro; Mopti/Tombouctou/Gao/Kidal; Sikasso/Ségou
Mozambique	1997, 2003, 2011	Cabo Delgado; Gaza; Inhambane; Manica; **Maputo Cidade**; Maputo Provincia; Nampula; Niassa; Sofala; Tete; Zambézia

Namibia	2000, 2006, 2013	Central; Kunene; Northeast; Northwest; South
Niger	1992, 1998, 2006*, 2012*	Dosso; Maradi; **Niamey**; Tahoua/Agadez; Tillabéri; Zinder/Diffa
Nigeria	2003, 2008, 2013, 2018	North Central; North East; North West; South East; South South; South West
Rwanda	2005*, 2010*, 2014*	East; Kigali; North; South; West
Senegal	1992, 2005*, 2010*, 2014*, 2019	Central; North and East; South; West
Sierra Leone	2008*, 2013*, 2019*	Eastern; Northern; Southern; Western
Tanzania	1991, 1996, 2004, 2010, 2015-16	Central; Eastern; Lake; Northern; South; Southern Highlands; Western; Zanzibar
Togo	1998, 2013	Centrale; Ensemble Maritime; Kara; Plateaux; Savanes
Uganda	1995, 2000, 2006, 2011, 2016	Central, Eastern, Northern, Western
Zambia	1992, 1996, 2001*, 2007*, 2013*, 2018*	Central; Copperbelt; Eastern; Luapula; Lusaka; North-Western; Southern; Western
Zimbabwe	1994, 1999, 2005*, 2010*, 2015*	**Bulawayo; Harare Chitungwiza**; Manicaland; Mashonaland Central; Mashonaland East; Mashonaland West; Masvingo; Matabeleland North; Matabeleland South; Midlands

* Indicates survey years with HIV data

Boldface indicates urban sub-national regions

Table 2. Descriptive characteristics of sub-national regions, sub-Saharan Africa 1991-2019

	Mean (s.d.)	Min	Max	Correlation with TFR
Total fertility rate	5.38 (1.25)	1.4	8.7	
Ideal number children	5.27 (1.52)	2.5	11.1	0.6676
Age at first marriage	18.67 (2.27)	14.2	33	-0.5832
Polygyny	25.27 (13.69)	1.2	67.1	0.5001
Divorce	26.61 (12.88)	1.47	78.79	-0.0278
Remarriage	77.25 (16.79)	2.04	100	0.4643
Any contraceptive use	25.74 (17.50)	0.2	72.8	-0.6475
Predominant Breastfeeding	4.46 (1.98)	0.5	14.5	0.224
Urban	34.77 (27.97)	0	100	-0.5923
Infant mortality rate	73.96 (30.01)	16.9	216	0.4997
Secondary education	28.43 (22.28)	0.2	91.2	-0.6702
Current work	58.24 (18.78)	9.7	97.1	0.1467
HIV	5.32 (5.92)	0.1	22	

Table 3. Linear regression results, total fertility rate, sub-Saharan Africa, 1991-2019

	Model 1			Model 2			Model 3			Model 4		
	Coef.	SE		Coef.	SE		Coef.	SE		Coef.	SE	
Divorce	-0.008	0.003	**	-0.009	0.003	**	-0.007	0.003	*	-0.001	0.004	
Remarriage	0.008	0.002	***	0.007	0.002	***	0.006	0.002	***	0.006	0.002	***
Age at first marriage	-0.237	0.025	***	-0.1461	0.024	***	-0.048	0.024	*	-0.011	0.032	
Polygyny	0.029	0.004	***	0.019	0.004	***	0.01	0.004	**	0.014	0.005	**
Any contraceptive use				-0.031	0.002	***	-0.024	0.002	***	-0.025	0.003	***
Predominant breastfeeding				0.051	0.014	***	0.024	0.014		0.036	0.016	*
Urban							-0.011	0.001	***	-0.001	0.003	
Infant mortality rate							0.001	0.001		0.001	0.001	
Secondary education							-0.011	0.003	***	-0.011	0.003	***
Constant	8.71	0.628	***	7.889	0.571	***	6.866	0.538	***	5.602	0.680	***
Region fixed effects	No			No			No			Yes		
N (obs)	670			670			670			670		
N(regions)	187			187			187			187		
N(countries)	29			29			29			29		
Country-level sd(constant)	0.613	0.1		0.685	0.106		0.568	0.085				
Region-level sd(constant)	0.535	0.0421		0.4737	0.038		0.337	0.03				
sd(residual)	0.505	0.016		0.438	0.014		0.433	0.014				
sigma_u										0.798		
sigma_e										0.428		
rho										0.777		

*p<0.05 **p<0.01 ***p<0.001

Table 4. Linear regression results, ideal family size, sub-Saharan Africa, 1991-2019

	Model 1			Model 2		
	Coef.	SE		Coef.	SE	
Divorce	-0.001	0.003		0.003	0.003	
Remarriage	0.001	0.002		0.001	0.002	
Age at first marriage	-0.067	0.025	**	-0.035	0.027	
Polygyny	0.014	0.004	***	0.010	0.004	*
Any contraceptive use	-0.016	0.002	***	-0.012	0.002	***
Predominant breastfeeding	0.002	0.013		-0.006	0.013	
Urban	-0.005	0.002	**	-0.002	0.002	
Infant mortality rate	0.003	0.001	***	0.004	0.001	***
Secondary education	-0.002	0.002		-0.003	0.002	
Constant	6.495	0.55	***	5.725	0.566	***
Region-level fixed effects	No			Yes		
N (obs)	670			670		
N(groups)	187			187		
N(countries)	29			29		
Country-level sd(constant)	0.795	0.123				
Region-level sd(constant)	0.717	0.045				
SD (residual)	0.358	0.012				
sigma_u				1.183		
sigma_e				0.356		
Rho				0.917		

*p<0.05 **p<0.01 ***p<0.001

Table 5. Linear regression results, total fertility rate, sub-sample of countries with HIV data, sub-Saharan Africa, 2001-2019

	Model 1			Model 2			Model 3		
	Coef.	SE		Coef.	SE		Coef.	SE	
Divorce	-0.002	0.005		-0.004	0.005		0.001	0.007	
Remarriage	0.005	0.002	*	0.005	0.002	*	0.005	0.003	+
Age at first marriage	-0.026	0.040		-0.034	0.039		0.016	0.067	
Polygyny	0.007	0.005		0.007	0.005		0.007	0.009	
Any contraceptive use	-0.028	0.004	***	0.027	0.004	***	-0.028	0.005	***
Predominant breastfeeding	0.053	0.024	*	0.042	0.024	+	0.046	0.032	
Urban	-0.013	0.002	***	-0.011	0.002	***	0.000	0.004	
Infant mortality rate	0.006	0.002	***	0.006	0.002	***	0.007	0.002	**
Secondary education	-0.010	0.005	*	-0.010	0.005	*	-0.013	0.008	
HIV				-0.044	0.014	***	-0.041	0.025	
Constant	6.082	0.848	***	6.376	0.831	***	5.107	1.394	***
Region-level fixed effects	No			No			Yes		
N(obs)	283			283			283		
N(groups)	139			139			139		
N(countries)	17			17			17		
Country-level sd(constant)	0.558	0.111		0.686	0.140				
Region-level sd(constant)	0.278	0.039		0.246	0.040				
SD (residual)	0.369	0.022		0.364	0.021				
sigma_u							0.913		
sigma_e							0.367		
rho							0.861		

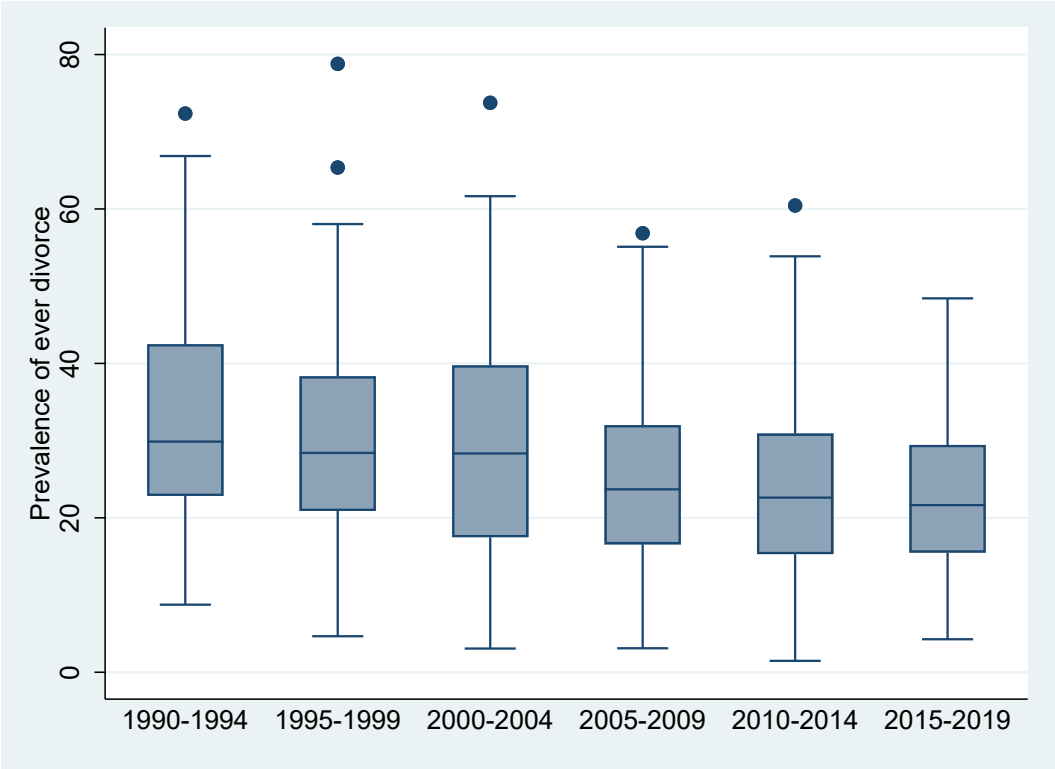
*p<0.05 **p<0.01 ***p<0.001

Figure 1

a. Distribution of median age at first marriage, women, 1990-2019

b. Distribution of percent of women in polygynous unions, 1990-2019

c. Distribution of the prevalence of divorce, women, 1990-2019



d. Distribution of the prevalence of remarriage following divorce, women, 1990-2019

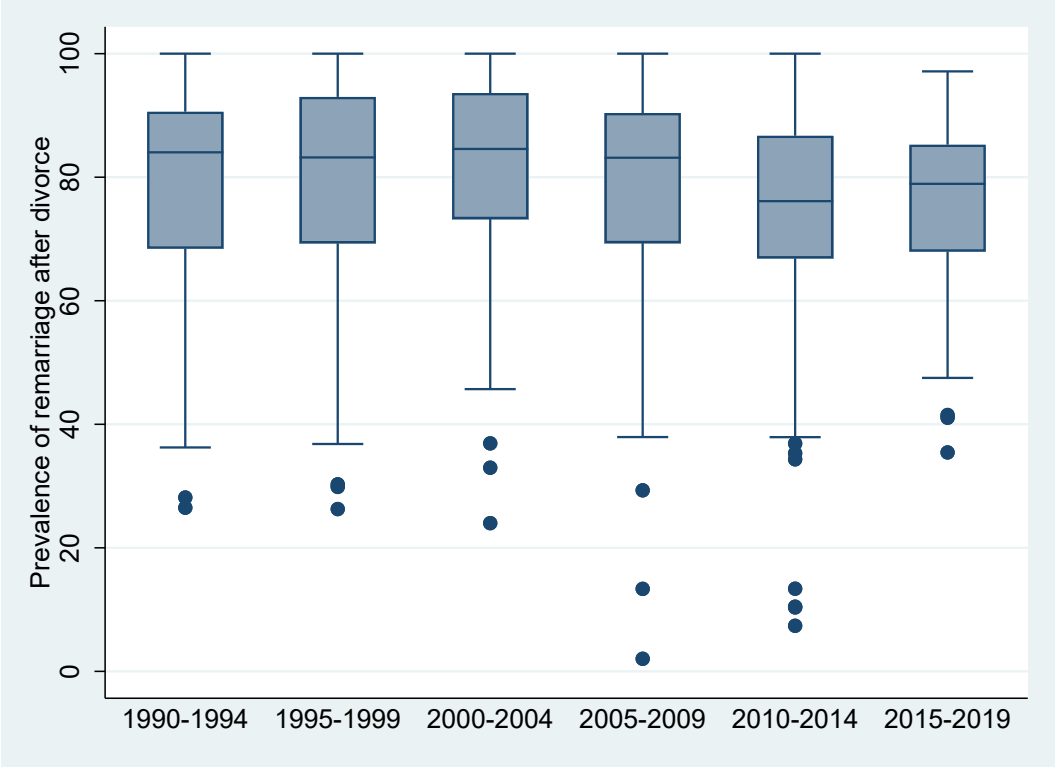
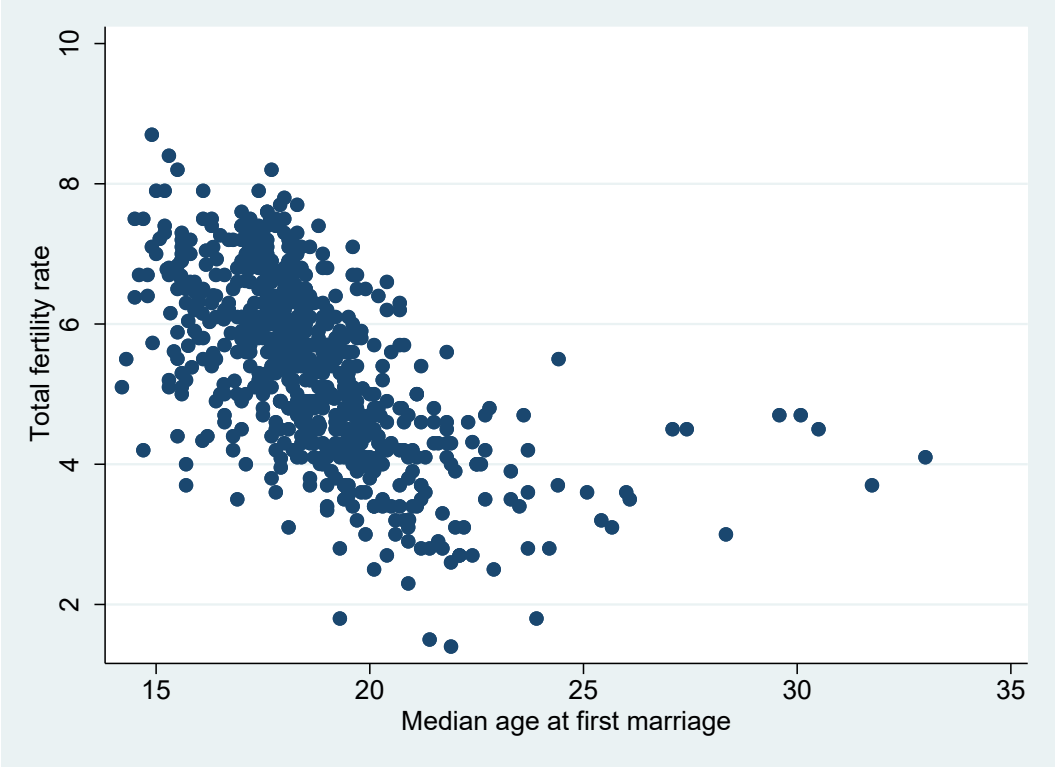
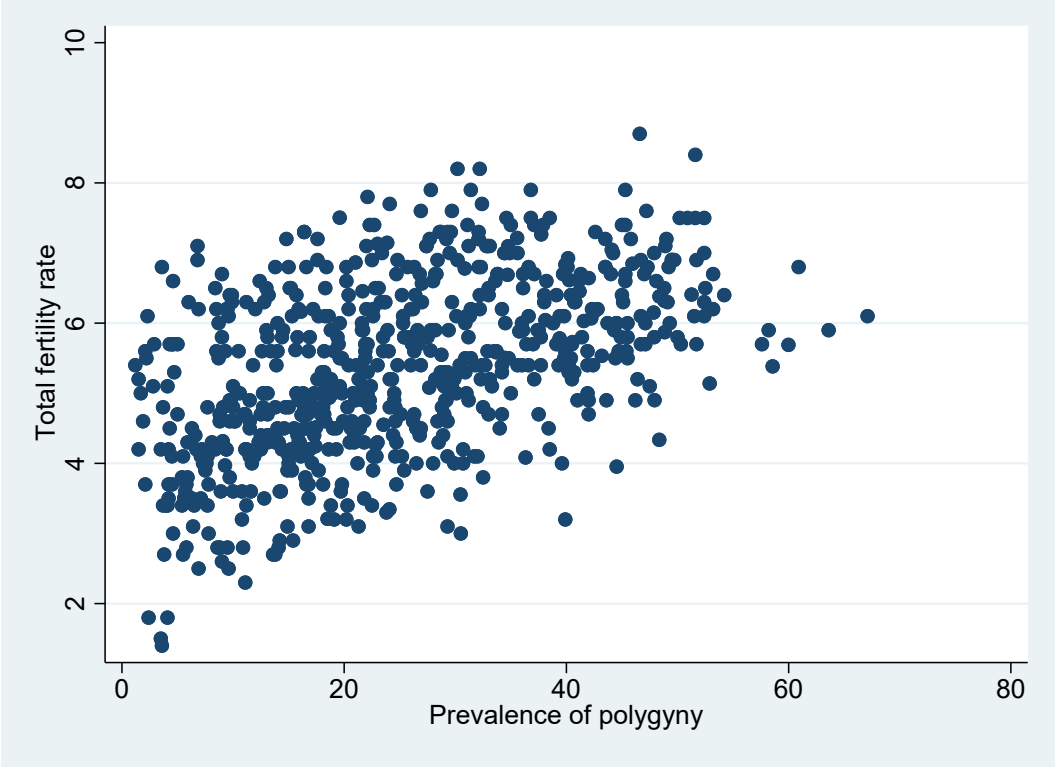


Figure 2

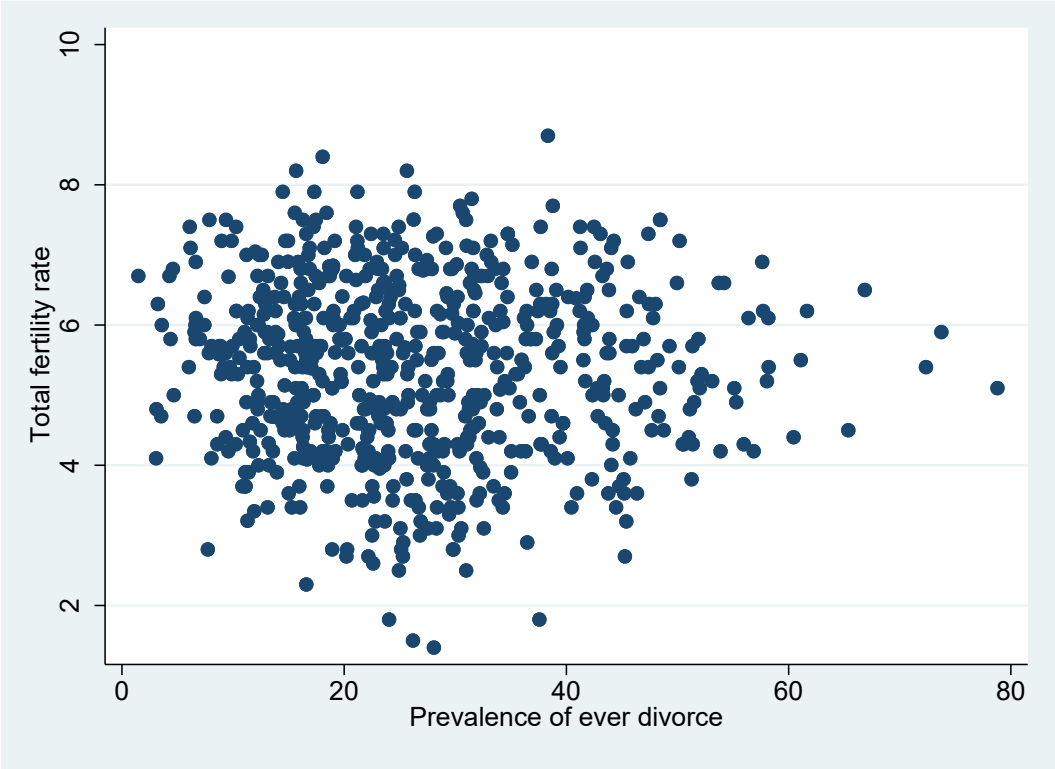
a. Total fertility rate by median age at first women, women, 1990-2019



b. Total fertility rate by percent of women in polygynous unions, 1990-2019



c. Total fertility rate by percent of ever divorced women aged 35-39 years old, 1990-2019



d. Total fertility rate by percent of ever remarried women aged 35-39 years old, 1990-2019