

Twenty-year trends in child marriage in Sub-Saharan Africa

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Abstract

Child marriage, defined as marriage before 18 years of age, has concerning implications for girls' personal development and health. Trends in child marriage in Africa have not been quantified over the past decade.

We pooled data from all standard Demographic and Health Surveys conducted within each of 31 Sub-Saharan African countries. Our sample was limited to women born between 1965-89 and aged 20-24 years at the time they were interviewed. Using these data, we estimated the prevalence of child marriage within five-year birth cohorts in each country and plotted these estimates to visualize trends over a twenty-year period. We also quantified heterogeneity in the prevalence of child marriage across sub-national regions.

The prevalence of child marriage has declined in most countries, largely among girls between the ages of 15-17. The pattern of decline varies between countries and the rate of decline appears to have stagnated in some countries.

Child marriage has been considered a violation of human rights for decades. Various human rights instruments including the Universal Declaration of Human Rights (1948), the Convention on Consent to Marriage, Minimum Age for Marriage, and Registration of Marriage (1962), and the Convention on the Elimination of All Forms of Discrimination against Women (1979) make statements regarding the right to marriage and the need for countries to establish a minimum age at marriage. However, it wasn't until the adoption of the Convention on the Rights of the Child in 1989, and its complement, the African Charter on the Rights and Welfare of the Child in 1990, that the term 'child' was explicitly defined as any person less than 18 years of age. These documents set the stage for current global efforts to eliminate the practice of child marriage. Since their adoption the issue has received increasing attention from international institutions, national governments, and advocacy organizations as a threat to development and health.

Sub-Saharan Africa has some of the highest rates of child marriage in the world. Previous studies have reported that half of girls aged 20-24 years marry before the age of 18 in many African countries despite programmatic and legislative efforts to prevent child marriage (Mensch, Singh, et al. 2006; Singh & Samara 1996). As of 2010 nearly every country in the region had legally defined a minimum age at marriage of 18 years in keeping with international standards for human rights, though legislation in most countries permits multiple exceptions to the minimum (United Nations 2011a) (United Nations 2011b) (WORLD Policy Analysis Center n.d.).

Consequences of child marriage

Women who marry as children have fewer years of schooling than their peers married as adults. The directionality of this relationship is uncertain and likely varies across development contexts. Child marriage may limit girls' educational opportunities where schooling systems are relatively strong and girls' education is socially supported (Field & Ambrus 2008). In areas where schools are unavailable and/or girls' education is considered unimportant or even undesirable, this lack of opportunities may lead to child marriage. Such is the case in Niger where over 75% of women between 20-24 years of age had no formal schooling in 2012 (Institut National de la Statistique ICF International 2013). It is unlikely that marriage prevents women who have never attended school from beginning their education.

More recently, child marriage is also considered a public health issue. Most of the health concerns regarding child marriage are related to women's reproductive and maternal health. This is unsurprising given the changes in sexual behavior that accompany marriage: girls who marry as children have more frequent unprotected sex than their sexually active, unmarried peers and their partners are older, on average (Clark 2004). It follows that child marriage is strongly associated with the early onset of childbearing, short inter-pregnancy intervals, unwanted pregnancies, and high lifetime fertility, all of which are associated with poor obstetric outcomes (Raj et al. 2009). Obstetric complications are the leading cause of death among women aged 15-19 years in low and middle income countries (Patton et al. 2009). Young married women also have higher rates of HIV infection than their unmarried, sexually active peers (Glynn et al. 2001). This is plausibly the result of limited ability to negotiate condom use, but may also result from having older partners who are already infected at the time of marriage (Clark 2004; Bracher et al. 2003; Kelly et al. 2003).

Measuring the prevalence of child marriage is essential to understanding where the practice is common, the factors that drive it, and for evaluating the effectiveness of efforts to eliminate it. Reliable estimates also aid in the efficient targeting of policies and programs related to child marriage. However, measuring age at marriage is a challenging task in Sub-Saharan Africa. Unlike Western marriages, which are often unambiguously dated by a religious ceremony or the signing of legal documents, marriage in Sub-Saharan Africa is often referred to as a process consisting of multiple stages including legitimized sexual relations, cohabitation, and ceremonies. The process can be lengthy and the various stages can occur in different sequence across ethnic and social groups (van de Walle & Meekers 1994; Locoh 1994; Arnaldo 2004). For example, cohabitation may be preceded by a period of socially legitimate sexual relations that may give rise to children. If several events are required to legitimize a union it may be unclear when exactly the union was formalized. This raises profound difficulties for measuring age at marriage in the region.

Measures of age at marriage/union available in the DHS

The Demographic and Health Surveys (DHS) and their precursor, the World Fertility Surveys, were developed to measure fertility rates in a comparable manner across

developing countries. The surveys aim to estimate the total number of women at risk of childbearing and therefore use a broad definition of marital status in order to identify stable unions that may result in children. All female respondents are asked to self-report their marital status and the month and year they were married or began cohabiting with a partner. Women who self-identify as married or indicate that they are cohabiting with a partner are considered in union. These questions result in imperfect data on age at marriage. Where union formation is a process consisting of multiple stages, it is unclear which point in the process corresponds to the reported month and year of marriage. Moreover, union formation processes differ across social groups within countries and internationally, potentially leading to systematically different reporting behaviors and biased estimates.

Despite these considerable limitations, the DHS are the most widely available, nationally representative source of information on age at marriage in Sub-Saharan Africa and the most commonly used data source in studies of age at first marriage throughout the developing world. The DHS program's focus on international comparability has facilitated multiple studies that compare changes in age at marriage across developing regions (Singh & Samara 1996; Mensch, Singh, et al. 2006; Jensen & Thornton 2003; Westoff 2003). Numerous studies have used DHS data to examine trends in age at marriage specific to Sub-Saharan Africa (Harwood-Lejeune 2001; Shapiro & Gebreselassie 2013; Mensch, Grant, et al. 2006; Garenne 2004).

The majority of these studies have used the same methodology to estimate trends: using a single DHS wave, the authors compared the proportion of women who reported being married across different age groups, a method we refer to as age-based comparison (Singh & Samara 1996; Mensch, Singh, et al. 2006; Shapiro & Gebreselassie 2013; Harwood-Lejeune 2001; Mensch, Grant, et al. 2006; Westoff 2003). For example, Mensch et al. (2006) estimated the proportion of women aged 20-24 and 40-44 who reported being married before the age of 18 in 27 Sub-Saharan African countries using the most recent survey waves available. A few studies have presented estimates of trends in age at marriage across birth cohorts rather than age groups. Jensen and Thornton (2003) reported trends in age at marriage over birth cohorts from 1950-1970, likely using a single DHS wave in each country. However, Westoff (2003) and Garenne (2004) pooled data from World Fertility

Surveys and DHS waves within countries to estimate trends in age at marriage over birth cohorts between 1925-1979. Only a handful of studies have estimated trends in marriage before the age of 18 and only two have focused explicitly on measuring trends in child marriage (Singh & Samara 1996; Mensch, Grant, et al. 2006; Mensch, Singh, et al. 2006; Jensen & Thornton 2003).

Measuring change in age at marriage by comparing of the reports of women of different ages leads to concerns regarding measurement error. Older respondents to the DHS report less complete information on age at marriage, meaning that such data is more frequently imputed than that for younger women (Gage 1995). Older women are also known to report that events occurred closer to the time of the survey than they actually did, a phenomenon referred to as forward displacement and well recognized within studies using DHS data (Blanc & Rutenberg 1990; Mensch, Grant, et al. 2006; Gage 1995). If forward displacement of age at marriage affects DHS data we would expect measures of change over time based on the comparison of women of different ages to systematically underestimate the magnitude of the change. For example, if women aged 40-44 years tend to report that their first union took place closer to the date of the interview than it actually did, this could plausibly result in fewer women in this age group being classified as married before the age of 18 than actually were. This would lead to artificially small estimates of change over time when compared with reports from 20-24 year old women. Moreover, child marriage is strongly associated with poverty and maternal mortality at a national level (Raj & Boehmer 2013). Concerns regarding the validity of age-based comparisons for estimating change deepen if women married as girls are more likely to die from maternal or poverty-related causes earlier than their peers married as adults. This differential probability of survival would also lead to underestimates of change in the prevalence of child marriage over time.

In this analysis we employ a novel estimation technique to measure trends in the prevalence of child marriage in Sub-Saharan Africa. Our measurement approach builds upon previous studies that pooled DHS data within countries to obtain estimates of prevalence across birth cohorts and compares women who were of the same age at the time they were interviewed. In this way, we avoid potential biases arising from forward displacement and selective survival. We compare our results to those obtained from age-based comparisons.

We also expand our analysis beyond the measurement of national trends and explore sub-national heterogeneity in the prevalence of child marriage. Nuptiality processes vary markedly across ethnic and social groups within countries, heterogeneity that may be masked by national estimates (van de Walle & Meekers 1994). This knowledge has led to increasing programmatic focus on sub-national “hotspots” thought to have particularly high rates of child marriage (Erulkar & Muthengi 2009; Nanda et al. 2015; United Nations Fund for Population Activities UNFPA 2012; Jain & Kurz 2007). Although programmatic efforts to delay marriage seem to be moving beyond national measures we are unaware of any previous exploration of sub-national heterogeneity published in academic literature.

Data and Statistical Analyses

Sample

We began by obtaining Demographic and Health Survey (DHS) data from thirty-one Sub-Saharan African countries that had conducted at least two survey waves. We pooled data from all available standard DHS waves within each country. We then limited our sample to women born between 1965 and 1989 and aged 20-24 years at the time they were interviewed. This was done for two reasons. First, including only women aged 20-24 avoids the censoring of women below the age of 18 who reported never being married at the time they were interviewed and is consistent with the age cohorts used in previous studies. Second, our method avoids potential biases due to forward displacement of age at marriage and selective survival as all women were in the same age group at the time they were interviewed. We limited our sample to women born between 1965 and 1989 because women aged 20, 21, 22, 23, and 24 years were represented in each of these birth cohorts. There is some variation in the relative distribution of age across birth cohorts within countries but this is unlikely to affect our results because there is no right censoring in our data: all women included in our sample were able to report on their experience over the full period of time at risk for child marriage.

We estimated trends in the prevalence of child marriage among 20-24 year old women born in consecutive, five-year birth cohorts beginning in 1965 and ending in 1989. Between two and six survey waves were available in each country and survey waves were conducted between 4 and 26 years apart. There were very small sample sizes in some birth cohorts in countries that conducted a small number of survey waves far apart in time. In order to obtain stable estimates of prevalence we dropped birth cohorts that contained fewer than 100 women from our analyses. This resulted in the loss of 73 observations from Cote d'Ivoire, 19 observations from Guinea, and 23 observations from Lesotho. Six women were missing data on age at first marriage and were also dropped from the analysis. Our final sample included a total of 163,566 women. Sample sizes by country are listed in Table 1.

Table 1. Countries and DHS surveys included in this analysis. Sample size includes only women born between 1965-1989 and aged 20-24 years at the time of the survey.

Country	DHS survey waves included	Total sample size across all surveys
<i>West Africa</i>		
Benin	1996, 2001, 2006, 2011-12	6,844
Burkina Faso	1992-93, 1998-99, 2003, 2010	7,184
Cote d'Ivoire	1994, 1998-99, 2011-12	3,197
Ghana	1988, 1993-94, 1998-99, 2003, 2008, 2014	4,209
Guinea	1999, 2005, 2012	2,749
Liberia	1986, 2006-07, 2013	2,178
Mali	1987, 1995-96, 2001, 2006, 2012-13	7,498
Niger	1992, 1998, 2006, 2012	5,097
Nigeria	1990, 2003, 2008, 2013	10,838
Senegal	1986, 1992-93, 1997, 2005, 2010-14 ^a	8,987
Sierra Leone	2008, 2013	1,631
Togo	1988, 1998, 2013-14	2,249
<i>East Africa</i>		
Burundi	1987, 2010-11	1,775
Comoros	1996, 2012	932
Ethiopia	2000, 2005, 2011	7,388
Kenya	1988-89, 1993, 1998, 2003, 2008-09, 2014	8,218
Madagascar	1992, 1997, 2003-04, 2008-09	6,921
Malawi	1992, 2000, 2004-05, 2010	10,566
Mozambique	1997, 2003-04, 2011	5,817
Rwanda	1992, 2000, 2005, 2010-11	7,651
Tanzania	1991-92, 1996, 1999, 2004-05, 2009-10	8,024
Uganda	1988-89, 1995, 2000-01, 2006, 2011	6,586
Zambia	1992, 1996-97, 2001-02, 2007, 2013-14	6,839
Zimbabwe	1988-89, 1994, 1999, 2005-06, 2010-11	6,490

Central and Southern Africa

Cameroon	1991, 1998, 2004, 2011	6,190
Chad	1996-97, 2004	2,463
Congo	2005, 2011-12	2,520
Dem. Rep. of Congo	2007, 2013-14	2,743
Gabon	2000, 2012	2,033
Lesotho	2004, 2009	2,988
Namibia	1992, 2000, 2006-07, 2013	4,761
Total		163,566

^a Senegal began a continuous DHS in 2012.

Statistical analysis

We used logistic regression to estimate the weighted prevalence of child marriage among women aged 20-24 years within each of five consecutive five-year birth cohorts spanning a total of twenty-five years between 1965-1989. In countries that conducted DHS surveys approximately every five-years between the late 1980s and early 2000s we were able to obtain estimates within each birth cohort. In countries that had longer delays between surveys we were only able to obtain data for some of the birth cohorts. We plotted these estimates within each country to visualize trends over time. We also calculated prevalence ratios that compared the prevalence of child marriage over twenty and ten-year periods. Women born between 1965-69 and 1985-89 were compared to estimate changes over a twenty-year period; women born between 1975-79 and 1985-89 were compared to estimate changes over a ten-year period.

In order to examine sub-national heterogeneity in the prevalence of child marriage we coded all women born between 1985-89 according to the DHS-defined sub-region in which they were interviewed. In most countries the sub-regional classifications correspond to provincial or other administrative boundaries; in Nigeria the sub-regions correspond to larger geopolitical zones. We then conducted chi-squared tests to determine whether the estimated prevalence differed significantly between any two regions within each country. We estimated the prevalence of child marriage within sub-regions in each country that showed evidence of significant heterogeneity based on the results of the chi-squared tests. We also estimated socioeconomic characteristics of the sub-regions based on the full sample of women included in the DHS waves from which our sample of women born between 1985-89 was drawn. When women born between 1985-89 were drawn from two different waves we pooled data from those waves and estimated regional characteristics for the full sample of women surveyed.

Finally, we compared estimates of change in the prevalence of child marriage over a twenty-year period obtained from our estimation technique with estimates obtained by comparing the proportion of women aged 20-24 and 40-44 who reported being married before 18 using a single DHS wave in each country. The comparison was limited to a sample of 11 countries in which we were able to estimate the prevalence of child marriage among women born in 1965-69 and 1985-89 and that had conducted a DHS between 2008-

2010 to ensure estimation over a similar time span. For example, women aged 40-44 years and interviewed in a 2010 survey would have been born between 1966-1970; those aged 20-24 would have been born between 1986-1990. These birth cohorts are very similar to the comparisons we present using pooled data.

All of the estimates presented are weighted using de-normalized sampling weights. We de-normalized the sampling weights provided in each survey wave following guidelines for the use of pooled data published in the DHS Sampling and Household Listing Manual (ICF International 2012). The de-normalization procedure requires estimates of the target population in each country at the time of each survey. We obtained estimates of the population of women aged 15-49 in each survey year in each country from the United Nations World Population Prospects 2015 (United Nations 2015).

Results

Trends in child marriage

Figures 1-3 illustrate trends in the prevalence of child marriage in 31 countries by geographic region. There is striking heterogeneity between and within regions. West African countries have some of the highest rates of child marriage in the world. Over half of women born in the most recent cohort were married before the age of 18 in 4 of 12 countries in this region: Burkina Faso, Guinea, Mali, and Niger. In Niger, 75% of women in this birth cohort were married as children. The prevalence is lower in East Africa, where Malawi was the only country with an estimated prevalence of child marriage greater than 50% among women born between 1985-89. The prevalence drops below 10% in Rwanda in the same birth cohort. Data are sparse in Central and Southern Africa, but prevalence estimates range from a high of 68% among women born between 1980-84 in Chad to 9% in Namibia among women born between 1985-89.

There is clear visual evidence of a decline over time in many countries but the pattern of decline differs markedly. In Mali, Senegal, Malawi, and Kenya early declines in child marriage appear to have stagnated among more recent birth cohorts. Burkina Faso and

Ghana show evidence of slow but steady decline over time. Child marriage appears to have declined only recently in Mozambique, Rwanda, Uganda, and Zambia. There doesn't appear to have been much change in Tanzania, Zimbabwe or Namibia, though the prevalence in Namibia has been relatively low throughout this period compared to the rest of Sub-Saharan Africa.

Prevalence ratio estimates presented in Figures 4 and 5 support these conclusions. Figure 4 illustrates change in the prevalence of child marriage over a twenty-year period in 19 countries for which we were able to estimate the prevalence among women born between 1965-69 and 1985-89. The prevalence of child marriage declined significantly over this period in 15 of these countries. We find no evidence that the prevalence of child marriage has declined in Tanzania or Zimbabwe. The prevalence of child marriage has increased by 31% over this period in Madagascar. Figure 5 illustrates change in the prevalence of child marriage over a ten-year period in 22 countries for which we were able to estimate prevalence among women born between 1975-79 and 1985-89. These results indicate that the prevalence of child marriage declined over this period in most countries. However, in five countries, Benin, Mali, Senegal, Nigeria, and Niger, the prevalence declined by less than 5% over this ten-year period and the estimates are not significantly different from zero. Four of these countries, Mali, Senegal, Nigeria, and Niger, experienced significant declines between 1965-69 and 1989, indicating that declines have stagnated in the more recent decade. This is particularly distressing in Mali and Niger, the two countries with the highest estimated prevalence of child marriage in the world. There is weak evidence that the prevalence of child marriage may be slowly creeping back up in some countries: the prevalence increased by 6% in Malawi and 8% in Kenya during the most recent ten years, though these estimates are not statistically significant.

Trends in very early child marriage

Trends in very early child marriage, before the age of 15, are shown in red in Figures 1-3. These graphs illustrate patterns of heterogeneity very similar to those found for marriage before the age of 18. Mali and Niger have the highest prevalence of very early marriage among women in the most recent birth cohort with 25% and 28% married before the age of 15, respectively. Almost no girls were married this young in Rwanda or Namibia and less

than 5% of women born between 1985-89 were married before 15 years of age in Ghana, Burundi, and Lesotho.

These figures indicate that the vast majority of girls married as children are married between the ages of 15-17. Although levels of very early marriage are much lower than levels of marriage before the age of 18, there is less evidence of a decline in marriage among very young girls. As a result, the proportion of child marriages that occur before the age of 15 has increased slightly over time in some countries. For example, in Senegal the proportion of women married below the age of 18 has fallen over time but there has been little change in the proportion of women married before 15 years of age. Girls married very young made up 28% of child marriages among women born between 1960-64, but 31% of women born between 1985-89 and married as children were married before their 15th birthday. The opposite appears to be true in Niger, where the proportion of girls married very young has declined at a faster rate than the proportion of girls married before the age of 18: 64% of child marriages were to girls under 15 among the 1960-64 birth cohort while that proportion dropped to 43% among women born in the most recent cohort.

Figure 1. Weighted estimates of the prevalence of child marriage among women aged 20-24 years in West Africa. Bars represent 95% confidence intervals.

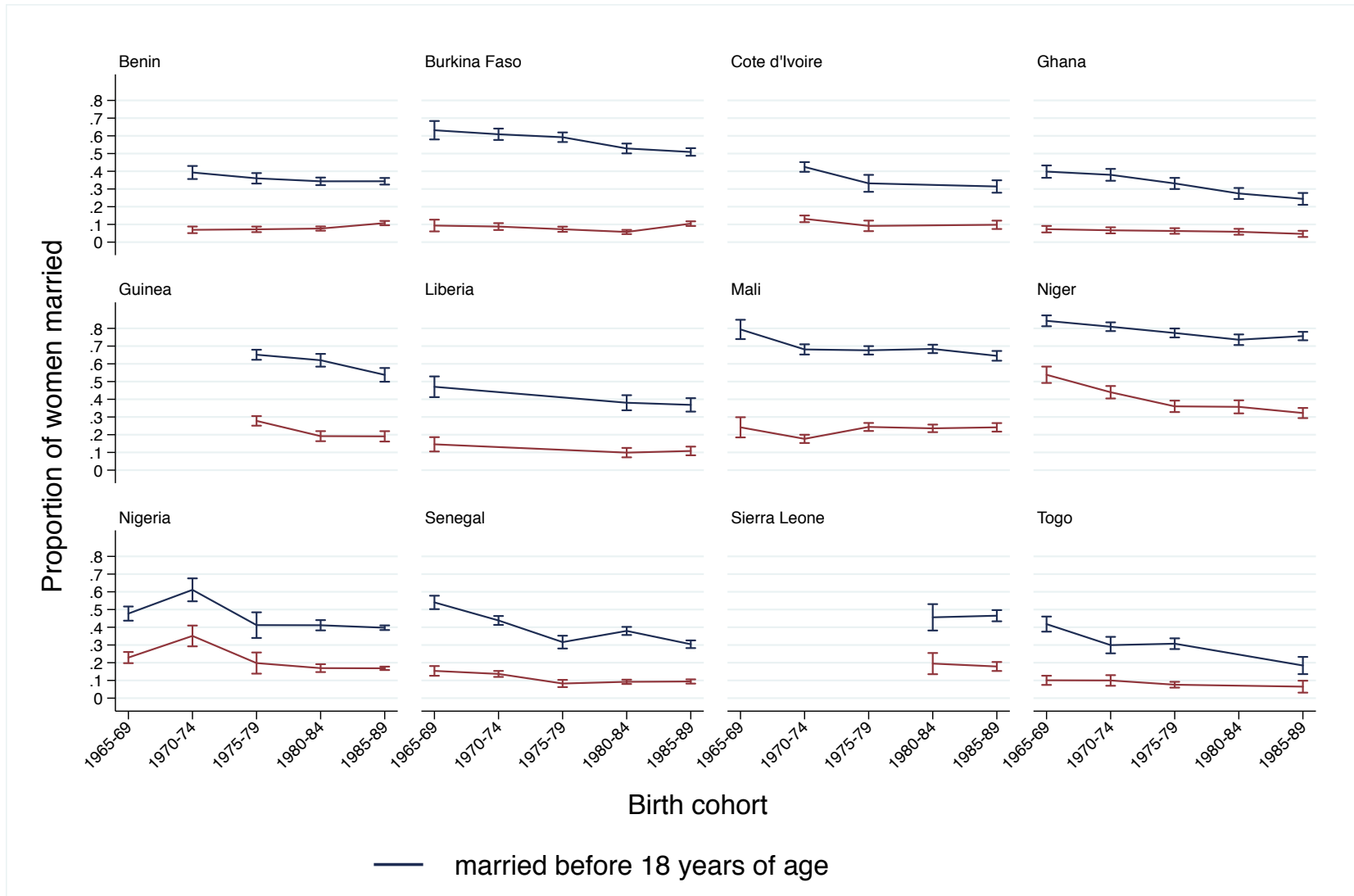


Figure 2. Weighted estimates of the prevalence of child marriage among women aged 20-24 years in East Africa. Bars represent 95% confidence intervals.

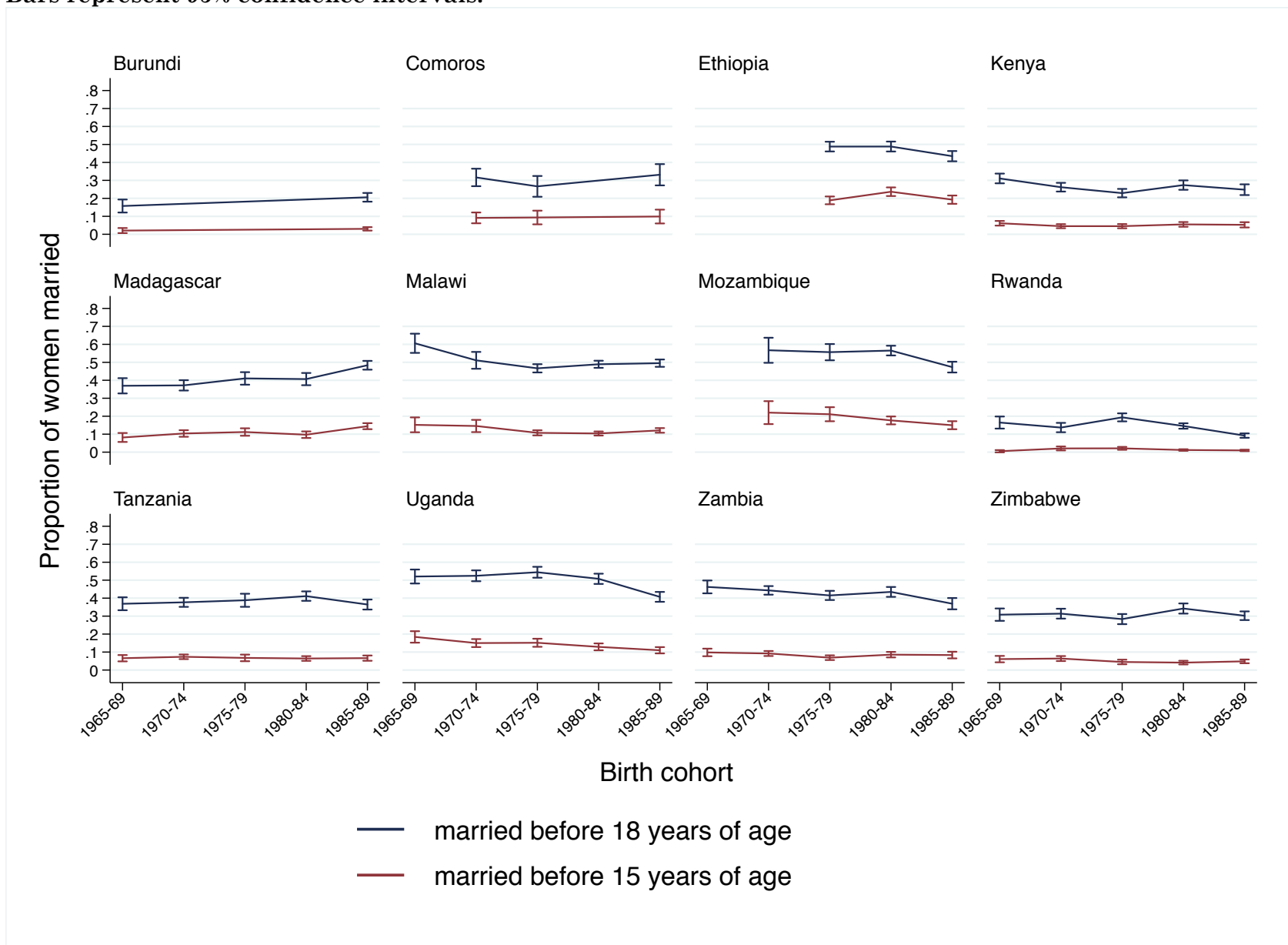


Figure 3. Weighted estimates of the prevalence of child marriage among women aged 20-24 years in Central and Southern Africa. Bars represent 95% confidence intervals.

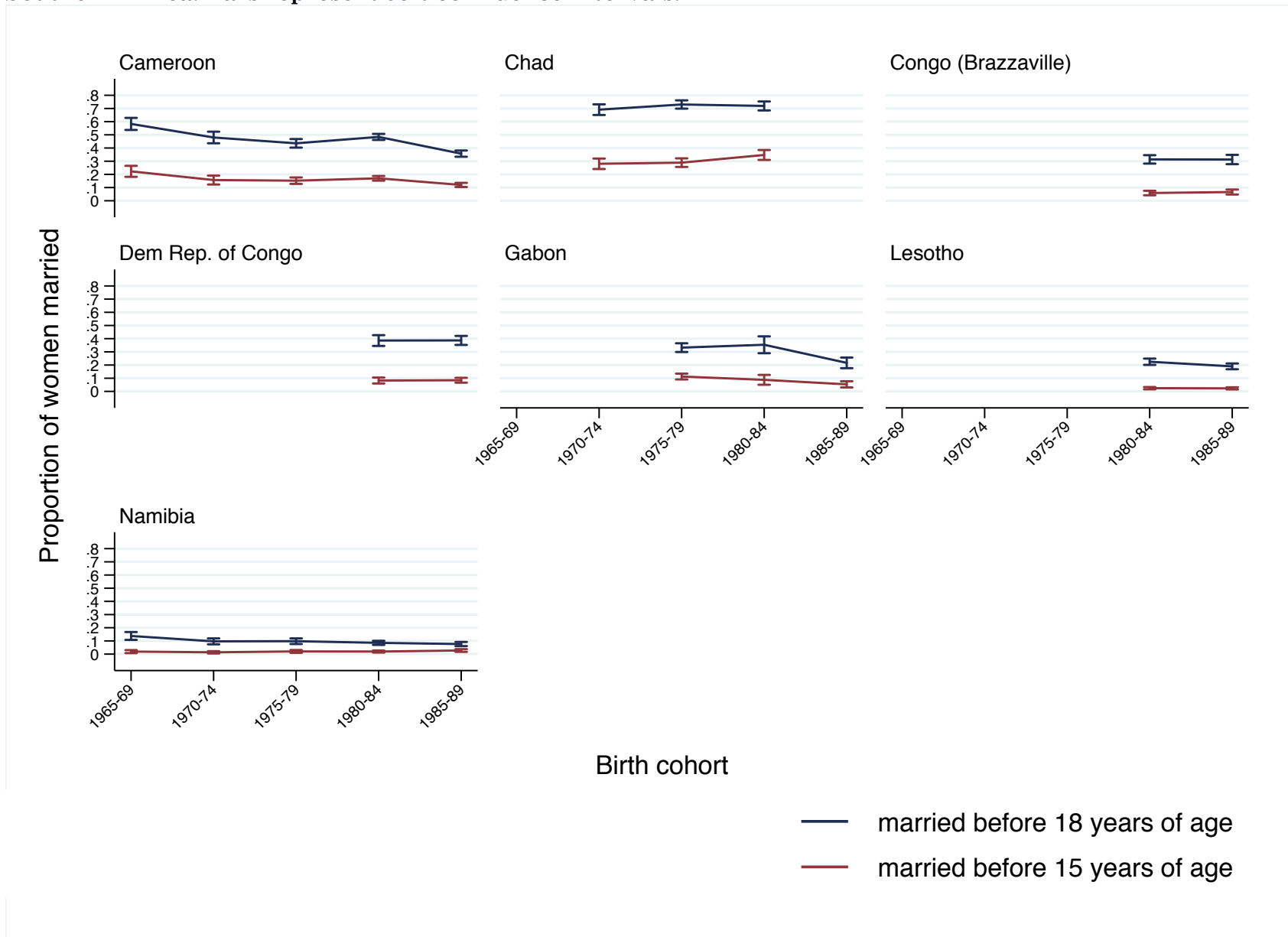


Figure 4. Weighted prevalence ratio estimates comparing the prevalence of child marriage among women born between 1965-69 to the prevalence among women born between 1985-89.

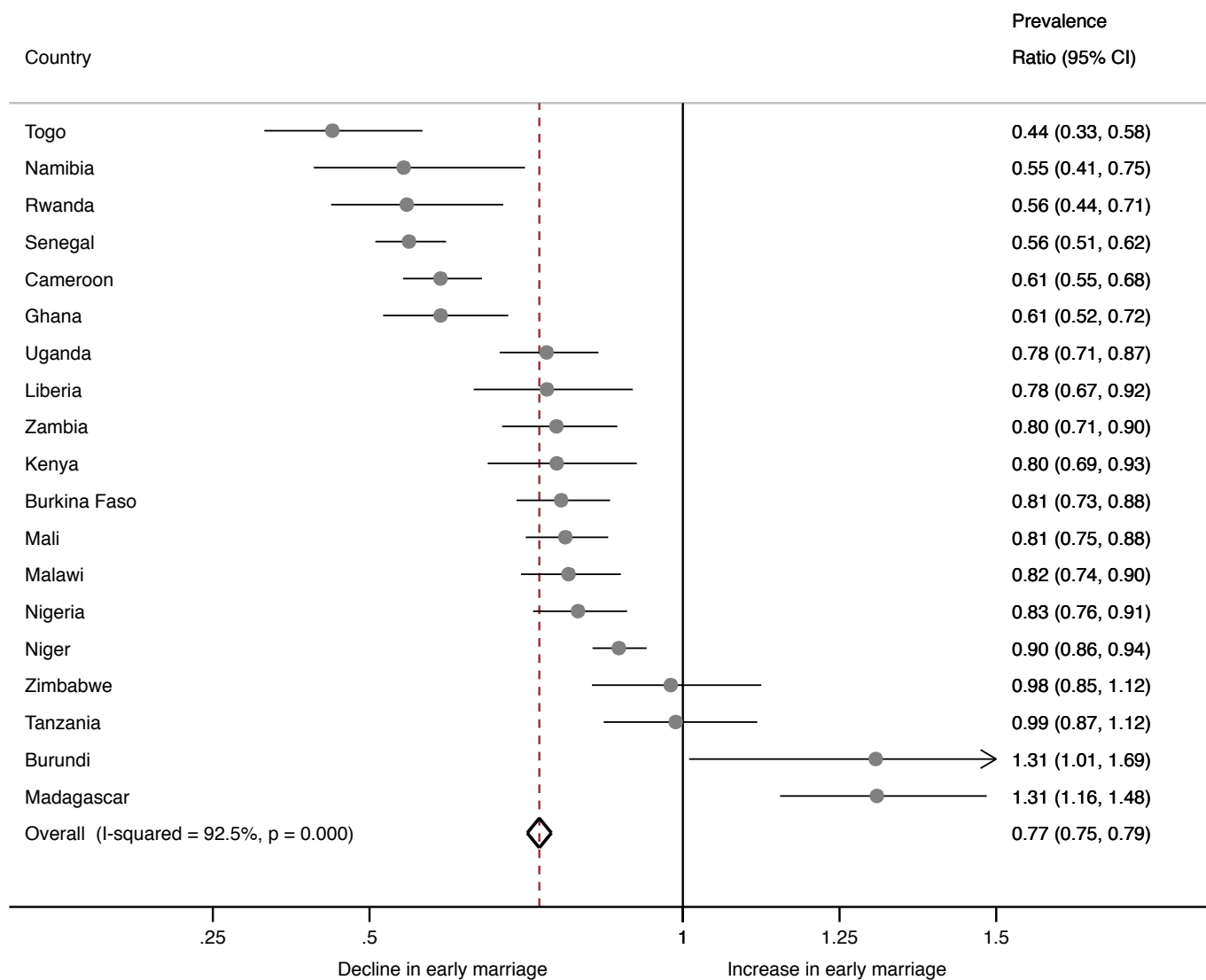
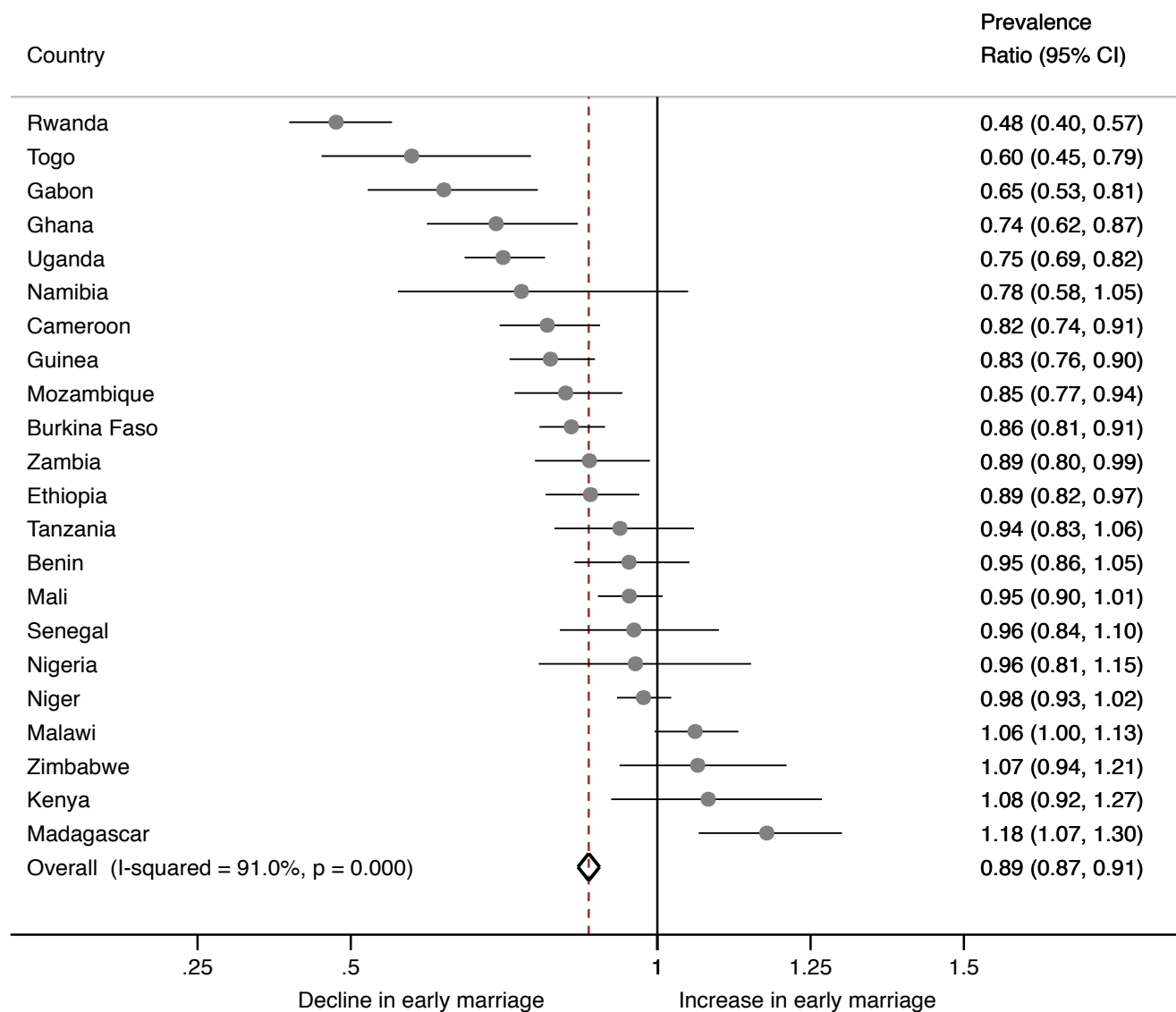


Figure 5. Weighted prevalence ratio estimates comparing the prevalence of child marriage among women born between 1975-69 to the prevalence among women born between 1985-89.



Sub-national trends

We were able to classify all women born between 1985-89 according to sub-regions in 24 of 31 countries. In six countries sub-regional classification differed across surveys used to compile this birth cohort and in Chad no women born in this cohort were surveyed. We found evidence of significant heterogeneity between regions in 22 of these 24 countries. In order to limit our manuscript to a reasonable length, we present results from a selection of 12 countries in which at least 100 women were interviewed in each sub-region and in which the estimated prevalence differed by more than 25 percentage points across regions. Table 2 indicates the prevalence of child marriage across sub-regions in these 12 countries. Sub-regions are listed according to increasing prevalence. The table also indicates the proportion of women sampled in each region who were living in rural areas and in households belonging to the poorest wealth quintile. These estimates were calculated based on women of all ages included in the DHS waves from which the 1985-89 birth cohort was drawn.

The prevalence of child marriage varies dramatically within countries. In nearly every country included in Table 2, child marriage is least prevalent in capital cities or regions/provinces that contain capital cities. In many countries the highest prevalence is found in rural regions with a relatively high proportion of households in the poorest wealth quintile but these two factors don't account for all of the variation in prevalence within countries. In countries like Niger where most of the population resides in rural areas and child marriage is common in every province this relationship isn't as strong. Even outside the capital, Niamey, the prevalence of child marriage varies from 52.6 % in Agadez to over 90% in Maradi. In Nigeria, national prevalence of child marriage is clearly driven by significantly higher rates in the North East and North West zones. It is important to note that woman interviewed in one region may have been born and/or married in a different region; using DHS data we are unable to determine which region a woman was born or married in.

The region-specific estimates of the prevalence of child marriage presented in Table 2 have wide confidence intervals. This was expected given the division of the sample between many regions. What this means in practice is that many of the regionally specific estimates are not statistically different from one another. In Amhara, Ethiopia, 62.0% of girls aged 20-24 years and born between 1985-89 were married as children. However, the 95% confidence interval (CI) (55.8, 68.1) indicates that this point estimate is not statistically different from prevalence estimates in Benishangul-

Gumuz (58.0, 95% CI 49.9, 66.0), Afar (54.2, 95% CI 45.8, 62.6), Somali (50.4, 95% CI 39.1, 61.7), or Gambela (49.3, 95% CI 38.9, 59.6) regions.

Table 2. Prevalence of child marriage among 20-24 year old women born between 1985-89 within sub-regions of selected countries. Estimates are weighted with de-normalized weights when pooled across multiple surveys and with DHS-provided survey weights when only a single survey was used.

Country	Regions/ Provinces	Proportion rural	Proportion of households in lowest quintile	Proportion married before 18 years % (95% CI)
<i>West Africa</i>				
Benin (2006, 2011-12)	Littoral	0	0.2	13.2 (9.3, 17.0)
	Ouémé	53.5	10.2	27.3 (22.5, 32.2)
	Plateau	69.9	18.6	31.7 (23.6, 39.8)
	Kouffo	76.7	21.4	32.0 (25.0, 38.8)
	Atlantique	56.9	12.6	32.2 (26.7, 37.7)
	Mono	75.9	21.4	38.2 (30.2, 46.2)
	Donga	67.9	13.0	39.1 (31.0, 47.1)
	Collines	74.1	15.1	39.5 (32.2, 46.8)
	Zou	68.2	17.5	40.4 (34.4, 46.4)
	Borgou	49.5	21.4	44.3 (37.2, 51.3)
	Atakora	58.7	44.4	50.8 (43.5, 58.0)
Alibori	79.4	34.5	63.6 (56.7, 70.5)	
Cameroon (2011)	Douala	0	0	12.4 (8.1, 16.8)
	Sud-Ouest	48.2	1.3	12.5 (6.4, 18.5)
	Nord-Ouest	57.4	7.8	21.3 (15.2, 27.3)
	Yaoundé	0	0	21.7 (16.1, 27.2)
	Littoral	31.2	2.3	28.6 (20.0, 37.2)
	Ouest	53.7	1.6	34.1 (25.2, 42.9)
	Sud	58.4	1.0	40.2 (31.6, 48.9)
	Centre	61.9	1.6	41.3 (32.7, 49.9)
	Est	53.8	16.7	48.9 (40.1, 57.7)
	Adamaoua	51.7	14.9	58.8 (51.4, 66.3)
	Nord	63.2	47.8	65.7 (57.8, 73.5)
Extrême-Nord	77.4	51.2	68.3 (61.1, 75.5)	
Niger (2006, 2012)	Niamey	0	0	29.0 (22.6, 35.4)
	Agadez	42.2	20.7	52.6 (42.4, 62.9)
	Tillabéri	95.3	16.3	66.6 (59.3, 73.8)
	Dosso	89.7	12.8	72.8 (66.3, 79.3)
	Tahoua	88.1	24.4	79.3 (73.5, 85.1)
	Diffa	84.1	16.4	79.9 (73.0, 86.8)
	Zinder	88.4	24.3	88.1 (83.5, 92.8)
	Maradi	89.4	17.2	90.4 (86.6, 94.1)

Nigeria (2008, 2013)	South East	42.4	4.2	10.6 (8.1, 13.1)
	South West	31.2	1.5	15.8 (13.2, 18.4)
	South South	64.3	0.4	17.5 (15.0, 19.9)
	North Central	71.8	10.2	34.2 (31.3, 37.0)
	North East	73.1	38.6	67.2 (64.3, 70.1)
	North West	74.7	34.0	74.9 (72.5, 77.4)
Senegal (2005, 2010-14)	Ziguinchor	47.5	5.6	8.8 (5.0, 12.6)
	Dakar	2.5	0	14.4 (9.9, 19.0)
	Thiès	45.4	3.8	22.5 (16.1, 29.0)
	Saint-Louis	51.4	17.0	24.5 (17.7, 31.3)
	Fatick	83.6	40.4	29.1 (21.6, 36.5)
	Kaolack	64.3	22.6	37.9 (31.3, 44.5)
	Diourbel	82.5	17.0	39.9 (33.6, 46.1)
	Louga	77.8	12.8	41.8 (35.1, 48.6)
	Sédhiou	79.8	53.5	42.1 (33.3, 50.9)
	Tambacounda	69.7	45.0	51.1 (42.3, 60.0)
	Kaffrine	85.6	57.6	54.7 (46.4, 63.0)
	Matam	75.5	15.3	55.1 (48.0, 62.2)
	Kolda	72.3	55.8	63.1 (55.9, 70.4)
Kédougou	75.3	31.8	70.6 (60.9, 80.2)	
Sierra Leone (2008, 2013)	Western	7.6	1.0	24.7 (19.7, 29.7)
	Southern	78.9	31.2	48.1 (41.9, 54.3)
	Eastern	70.6	23.7	49.2 (42.7, 55.8)
	Northern	81.8	17.6	58.8 (53.2, 64.3)

East Africa

Ethiopia (2005, 2010-11)	Addis Ababa	0.5	0.3	12.8 (9.1, 16.4)
	Dire Dawa	27.8	5.2	28.1 (21.1, 35.0)
	SNNP	88.1	20.3	32.9 (27.4, 38.3)
	Harari	35.9	1.4	36.9 (29.2, 44.7)
	Oromiya	84.6	14.6	41.1 (35.6, 46.6)
	Tigray	75.8	23.0	42.9 (36.8, 49.1)
	Gambela	75.3	26.1	49.3 (38.9, 59.6)
	Somali	71.2	38.3	50.4 (39.1, 61.7)
	Afar	76.5	51.5	54.2 (45.8, 62.6)
	Benishangul-Gumuz	82.5	26.2	58.0 (49.9, 66.0)
Madagascar (2008-09)	Amhara	82.9	20.9	62.0 (55.8, 68.1)
	Antananarivo	74.0	2.8	35.4 (30.6, 40.3)
	Toamasina	78.4	10.3	41.5 (35.4, 47.5)
	Fianarantsoa	84.1	34.5	50.5 (45.6, 55.4)
	Antsiranana	80.1	13.0	57.5 (49.0, 66.1)
	Mahajanga	83.1	30.9	58.3 (52.2, 64.3)
Toliary	82.7	46.1	70.1 (65.0, 75.2)	

Mozambique (2011)	Maputo City	0	0	14.9 (10.4, 19.4)
	Maputo	26.2	0.7	27.6 (20.1, 35.1)
	Inhambane	70.8	4.0	36.5 (26.8, 46.2)
	Gaza	69.5	2.2	39.9 (31.4, 48.3)
	Sofala	55.3	13.9	46.1 (37.9, 54.3)
	Zambezia	83.1	42.3	49.2 (39.3, 59.1)
	Niassa	74.7	8.5	49.4 (39.4, 59.3)
	Tete	88.3	23.5	54.2 (44.3, 64.1)
	Cabo Delgado	84.8	25.6	57.7 (48.6, 66.7)
	Manica	63.4	5.0	59.8 (51.6, 68.0)
	Nampula	64.8	27.5	60.6 (51.1, 70.0)
Zambia (2007, 2013-14)	Lusaka	12.4	1.1	25.1 (18.2, 31.9)
	Western	81.0	42.3	26.6 (17.0, 36.2)
	Copperbelt	15.9	2.6	29.3 (21.1, 37.5)
	Central	71.2	13.9	33.1 (23.7, 42.5)
	Southern	73.4	11.1	33.5 (25.5, 41.5)
	North-Western	74.9	23.3	41.0 (31.4, 50.6)
	Luapula	79.8	30.0	45.2 (34.6, 55.8)
	Northern	79.1	41.3	46.4 (36.3, 56.6)
	Eastern	84.5	32.2	61.5 (52.9, 70.0)
Zimbabwe (2005-06, 2010-11)	Bulawayo	0	0	11.0 (5.8, 16.2)
	Matabeleland South	82.6	23.0	16.7 (9.9, 23.5)
	Harare	0	0	19.2 (13.3, 25.2)
	Matabeleland North	83.8	55.4	26.0 (17.2, 34.8)
	Midlands	69.5	23.4	27.0 (20.5, 33.5)
	Manicaland	79.0	15.5	31.9 (24.8, 38.9)
	Mashonaland East	85.0	8.9	36.4 (28.4, 44.5)
	Masvingo	91.7	31.1	37.5 (29.7, 45.3)
	Mashonaland West	70.0	17.0	43.1 (35.6, 50.6)
		Mashonaland Central	93.0	24.1

Central Africa

Dem. Rep. of Congo (2007, 2013)	Kinshasa	0	0	18.2 (13.0, 23.4)
	Nord-Kivu	57.7	12.0	21.8 (11.6, 31.9)
	Bas-Congo	67.4	5.8	23.1 (13.8, 32.4)
	Bandundu	79.6	22.3	28.8 (18.3, 39.4)
	Katanga	46.1	16.2	36.9 (28.1, 45.8)
	Sud-Kivu	79.4	7.2	39.8 (26.1, 53.5)
	Kasai-Occidental	64.9	30.4	44.5 (33.7, 55.3)
	Kasai-Oriental	53.6	19.2	44.9 (34.7, 55.1)
	Maniema	61.0	19.6	56.4 (45.4, 67.5)
	Oriental	78.3	24.3	56.9 (45.3, 68.6)
	Équateur	76.3	37.4	56.9 (46.3, 67.5)

Comparison with age group method

We compared the trend estimates shown in Figures 1-3 with estimates obtained by comparing the proportion of women who reported being married before 18 years of age among different age groups using a single DHS wave, as done in earlier studies. For the age-group comparison we subtracted the proportion of 20-24 year old women married before 18 from the proportion of 40-44 year old women married before 18. We compared these estimates of change to estimates obtained by subtracting the same proportion among of 20-24 year old women born between 1984-89 from that among women born between 1965-69.

The estimates obtained from both measurement techniques are remarkably similar, as shown in Table 3. Estimates of change in the proportion of women married as children over this twenty-year period differed by more than 5 percentage points in only three countries: Burkina Faso, Nigeria, and Burundi. We estimated a modest 2.5 percentage point decline in the prevalence of child marriage in Burkina Faso by comparing the proportion of women aged 20-24 and 40-44 who reported being in union before 18 years of age. When we compared the prevalence of child marriage among 20-24 year old women born between 1965-69 and 1985-89 we estimated a decline of 12.3 percentage points. Differences in the estimates of change result primarily from different estimates of prevalence among 40-44 year old women interviewed in 2010 (54.1%) and 20-24 year old women born between 1965-69 and surveyed in 1992-93 (63.2%). The larger prevalence estimate among the women born between 1965-69 and the resulting larger estimate of change using the birth cohort comparison is consistent with concerns regarding forward displacement bias and higher mortality rates among women married as children. However, in Nigeria we found the opposite: estimates of change were larger using the age-group comparison method, largely because the estimated prevalence among women aged 40-44 was larger than that estimated among women aged 20-24 born between 1965-69.

Table 3. Percentage of women married before 18 years in each country as estimated by comparing across age groups using a single DHS survey and by comparing among 20-24 year old women across birth cohorts. Delta (Δ) indicates change over time.

Country	% Women married before 18 by age at interview			% Women married before 18 by birth cohort		
	20-24 (n)	40-44 (n)	Δ	1985-89 (n)	1965-69 (n)	Δ
<i>West Africa</i>						
Burkina Faso (2010)	51.6 (3242)	54.1 (1660)	-2.5	50.9 (2537)	63.2 (389)	-12.3
Ghana (2008)	24.6 (869)	37.6 (485)	-13.0	24.4 (729)	39.8 (763)	-15.4
Nigeria (2008)	39.4 (6103)	52.8 (3043)	-13.4	39.7 (6506)	47.7 (1219)	-8.0
Senegal (2010)	28.8 (1302)	48.0 (542)	-19.2	30.4 (3300)	54.0 (666)	-23.6
<i>East Africa</i>						
Burundi (2010)	20.4 (1854)	24.3 (783)	-3.9	20.6 (1357)	15.7 (418)	4.9
Kenya (2008-09)	26.4 (1744)	31.8 (730)	-5.4	24.8 (1814)	31.1 (1717)	-6.3
Madagascar (2008-09)	48.2 (2901)	38.4 (1720)	9.8	48.4 (2413)	36.9 (569)	11.5
Malawi (2010)	49.6 (4392)	56.0 (1777)	-6.4	49.5 (3778)	60.6 (422)	-11.1
Rwanda (2010)	8.1 (2692)	18.6 (1155)	-10.5	9.2 (2383)	16.5 (526)	-7.3
Tanzania (2009-10)	36.9 (1860)	40.9 (983)	-4.0	36.5 (1774)	36.9 (1005)	-0.4
Zimbabwe (2010)	30.5 (1815)	32.5 (727)	-2.0	30.2 (1767)	30.8 (699)	-0.6

Discussion

We found that the prevalence of child marriage has declined over time throughout most of Sub-Saharan Africa, a result consistent with previous studies that have concluded age at marriage is rising in the region. However, we found evidence that the rate of decline has stagnated in recent years in four West African countries: Mali, Niger, Nigeria, and Senegal. This is distressing given that Mali and Niger have the highest prevalence of child marriage in the world and Nigeria, as the most populous country in Sub-Saharan Africa, contributes a large number of child brides. We also note that the rate of child marriage appears to have remained stable in Zimbabwe and Tanzania throughout this twenty-year period.

The youngest girls, those under 15 years of age at the time of their union, are marrying at approximately the same rate they were twenty years ago in many countries, indicating that most of the reduction in child marriage is due to delayed marriage among 15-17 year old girls. This finding suggests that there are stubborn pockets of very early child marriage that have been unresponsive to efforts to curb the practice. The marriage of very young girls warrants greater concern from a public health perspective because their physiological immaturity may put them at greater risk for HIV infection (Moss et al. 1991). Giving birth at a young age may also increase the risk of obstetric complications, though evidence is mixed (Nove et al. 2014). Regardless of whether young age increases risk for complications relative to older women, obstetric complications are the leading cause of death among 15-19 year old girls in developing countries (Patton et al. 2009). Although the prevalence of marriage before the age of 15 is relatively low, in the range of 10% in many countries, this represents a large absolute number of girls.

Madagascar stands out in our analysis: it is the only country in which we found significant increases in the prevalence of marriage among girls less than 15 and less than 18 years of age over this twenty-year period. The increase is evident using both techniques for estimating trends (Table 2) and is in line with findings from another recent study by Shapiro and Gabreselassie (2013). All six provinces in the country were represented in each of the survey waves used in this analysis making it unlikely that the increase is attributable to differences in the sample of women interviewed across survey waves. Examination of trends over time by province shows that the prevalence has increased steadily over time in some provinces, suggesting that the increase does

not result from differential questioning in the most recent DHS wave (see Appendix). Notably, the legal minimum age at marriage in Madagascar was 14 years for girls until 2007 when it was raised to 18 years in keeping with international human rights documents (Repoblikan'i Madagasikara 2007). If our estimates reflect a true increase in the prevalence of child marriage in Madagascar it is important for future studies to explore the reasons behind this rise.

The prevalence of child marriage varies dramatically within countries. The practice is more common in rural areas, but we observe striking differences between regions even in countries that are predominantly rural such as Niger, Ethiopia, and Madagascar. Further exploration of the reasons for this heterogeneity is warranted and may inform programmatic efforts to limit the practice.

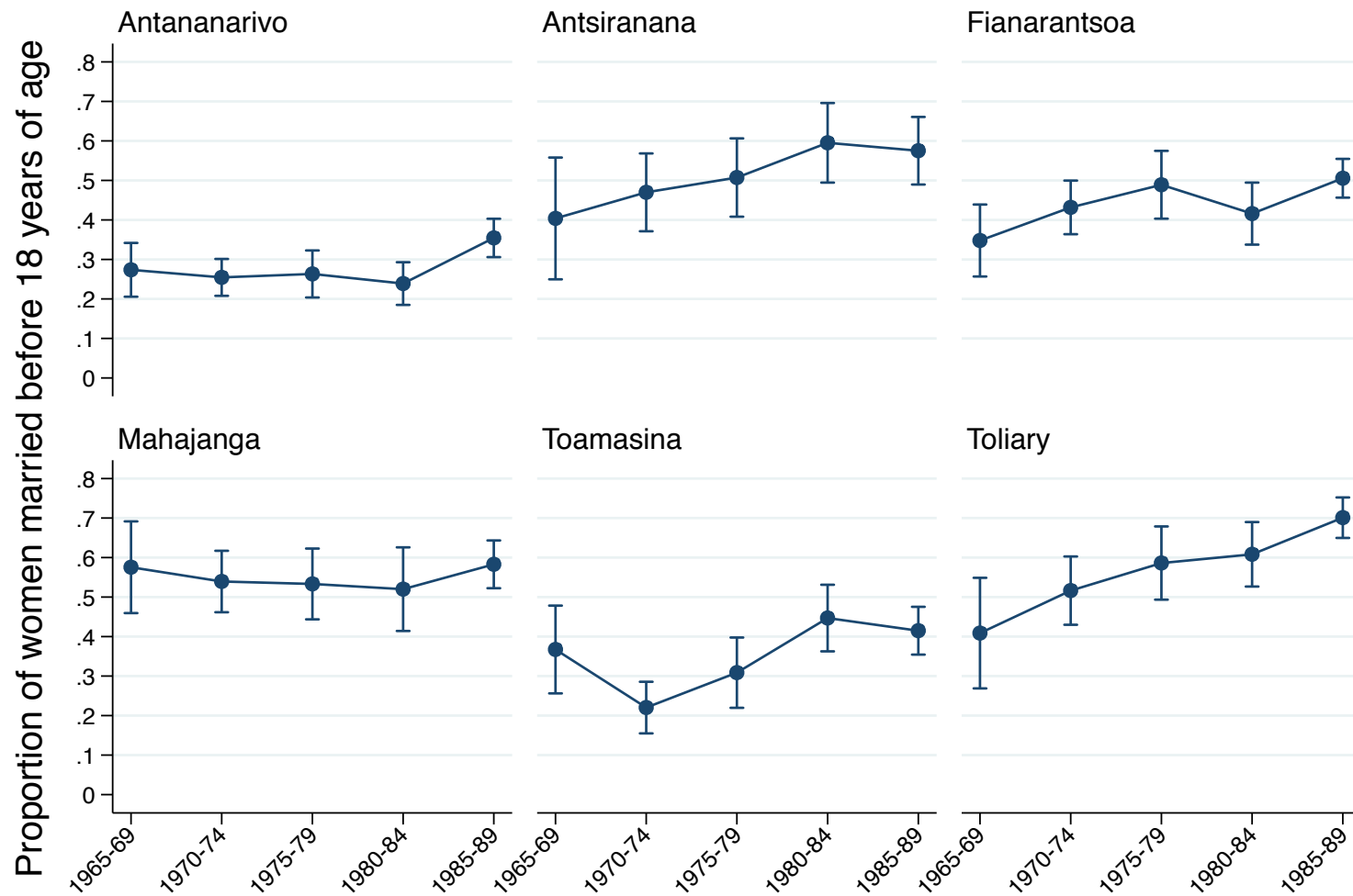
We attempted to limit known sources of bias in the measurement of trends in age at marriage by comparing women of the same age across birth cohorts. Even so, the processional nature of marriage in the Sub-Saharan African context poses many challenges for the measurement of trends over time. Perceptions of marriage are unlikely to have remained stable over the twenty-year period examined in this study. Rapid social change has taken place: national economies are growing, schooling opportunities for girls have increased in many areas and minimum age at marriage laws have been introduced or updated. Additional legislative changes increasingly protect women's rights within marriage and have been covered in the media (Mwesigwa 2015). Both estimation techniques discussed in this analysis are affected by changes in the perception of marriage over time. If marriage is a process that includes many distinct stages, it is plausible that the point in the process at which women consider themselves formally in union has changed. Women interviewed at the same age but born in different years may have systematically different reporting behaviors. However, the same bias is likely present among women of different ages surveyed at the same point in time. In order to conclude that the bias is greater in the birth-cohort comparison, one would have to believe that all women surveyed at a given point in time consider the same point in the marriage process to be the point at which they were first in union, regardless of age. In other words, one would have to believe that older women have adjusted their views of marriage over time and applied these modern perceptions to their own self-reported date of marriage.

Conclusions

Child marriage is a pervasive human rights violation in Sub-Saharan Africa that may hinder progress toward development and public health goals. During the time period over which we measured trends in child marriage 25 of the 31 countries included in our analysis had set the minimum legal age at marriage at 18 years or above (United Nations 2011b). Exceptions are Guinea (17), Niger (15), Togo (17), Chad (15), Democratic Republic of Congo (15), and Zimbabwe (16), which set the legal minimum age at marriage between 15 and 17 years in direct conflict with the African Charter on the Rights and Welfare of the Child. Our estimates suggest that such laws are inadequate to stop the practice of child marriage. Calls for better enforcement of minimum age at marriage laws have been made for at least a decade but given the numerous exceptions even enforcement of existing laws is unlikely to eliminate the practice (Singh & Samara 1996; Santhya & Jejeebhoy 2003). There is increasing evidence that intervening on the drivers of child marriage such as poverty and lack of educational opportunities effectively delays marriage (Baird et al. 2012; Güneş 2013; Duflo et al. 2006). These interventions have the potential to bring about benefits far beyond delayed age at marriage and should be strongly considered by governments serious about addressing the issue of child marriage.

Appendix

Figure 1. Trends in the prevalence of child marriage by province in Madagascar.



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