Association between Child Marriage and Reproductive Health Outcomes: A Multi-Country Study of Sub-Saharan Africa

Deepali Godha, *Tulane University*; Anastasia J. Gage, *Tulane University*; David Hotchkiss, *Tulane University*

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Correspondence may be addressed to:

Deepali Godha, PhD, M.B.B.S.; Independent Consultant; 16/1 South Tukoganj, 201 Sukh-Sheetal II; Indore, MP, India 452001; Mobile: +91-96854-53955
Email: deepali.godha@gmail.com

Co-authors' contact information:

Anastasia J. Gage, PhD, Associate Professor; Department of Global Health Systems and Development; Tulane University School of Public Health and Tropical Medicine; 1440 Canal Street, Suite 2200 TB-46; New Orleans, LA 70112; Tel.: 504-988-3647; Fax: 504-988-3653; E-mail: agage@tulane.edu; agage11961@aol.com.

David Hotchkiss, PhD, Professor; Department of Global Health Systems and Development; Tulane University School of Public Health and Tropical Medicine; 1440 Canal Street, Suite 2200 TB-46; New Orleans, LA 70112; Tel.:504-988-3289; Fax: 504-988-3653;
Email: hotchkis@tulane.edu

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Abstract

Although sub-Saharan Africa has seven of the nine countries in the world with more than 50% prevalence of child marriage, there is relatively little empirical evidence of association between child marriage and health outcomes in Africa. Multivariate logistic models are used to assess the association of child marriage with fertility and maternal health care utilization outcomes among currently married women aged 20-24 in four African countries – Niger, Guinea, Mali, and Ethiopia. Findings show that the strength of the association between child marriage and reproductive health outcomes varies from country to country. In all countries, child marriage is significantly associated with high fertility and a history of rapid repeat childbirth. Child marriage is associated with early fertility, lack of fertility control, and pregnancy termination in three countries and with unintended pregnancy in two countries. In Niger, child marriage is negatively associated with adequate antenatal visits, skilled birth attendance, and institutional delivery.

Introduction

Child marriage, defined as marriage under age 18, is a serious problem detrimental to the social, mental and physical health of girls. Despite a decline in global prevalence of child marriage, its pervasiveness in the poorest nations accounts for one in three girls becoming a child bride and if this practice continues another 100 million girls under age 18 will become child brides in the next decade [1]. Though Sub-Saharan Africa ranks second after South Asia with 42% of child marriage globally [2], of greater concern is the fact that seven of the nine hotspot countries with child marriage prevalence of 50% or more are in sub-Saharan Africa [3]. Of these, Niger has the highest prevalence of child marriage in the world with a whopping 75% of 20-24 year olds marrying before age 18 [3]. Furthermore, in some hotspot countries, the prevalence of child marriage has declined very slowly or not at all. For example, the prevalence rate of child marriage among women 20-24 year old in Niger has decreased by less than one percent point per year in fourteen years (from 83.52% in 1992 to 74.45% in 2006) whereas in Guinea it declined by a mere 1.38 percent points in six years (from 64.51% in 1999 to 63.13% in 2005) [4]. In addition, the prevalence has shown no substantial change in Mali (69.87% in 1995-96 to 70.56% in 2006) and in Ethiopia (from 49.13% in 2000 to49.25% in 2005) [4]. Not only this, a particularly disturbing finding was revealed by an online program scan of child marriage programs conducted by ICRW [5]. Out of a total of 66 programs identified online around the world, some of which were multi-country programs, only one program per country was identified in six high prevalence countries of sub-Saharan Africa- Guinea, Liberia, Mali, Mozambique, Niger, and Zambia [5].

Not only is child marriage considered a human rights violation [6, 7, 8], it also has adverse health consequences especially for girls. Past research has linked child marriage to a higher risk for HIV infection, cervical cancer, intimate partner violence, maternal morbidity and mortality [5, 6, 8, 9, 10, 11]. While Bruce et al. argue that early marriage among girls may be the pathway to progression of HIV/AIDs in countries like Burkina Faso, Dominican Republic, India, and Zambia [1], Santhya et al. proclaim mixed results from recent researches- some showing a protective effect of early marriage on HIV infection and others concluding no difference in likelihood of HIV infection due to early marriage [12]. Yet another study has found child

marriage to be a significant risk factor for cervical cancer in Morocco [13]. Other researchers have found significant association of younger age at marriage (less than 18 years of age) with experience of intimate partner violence [14] as compared to women who had married later [15, 16, 17].

Early pregnancy among girls who marry as children can lead to maternal mortality. The maternal mortality rate (MMR) among girls 15-19 years is appallingly high in Sub-Saharan Africa. For example, in Mali the MMR is 178 per hundred thousand live births for girls 15-19 years as compared to 32 per hundred thousand for women aged 20-34 years whereas in Togo, these numbers are 286 and 39 respectively [18]. There have been several studies of the adverse effects of teenage pregnancy in this region, irrespective of marriage, ranging from eclampsia/pre-eclampsia, obstetric fistula, and malaria in pregnancy to maternal mortality [11, 18, 19, 20, 21]. Tracing these outcomes to poor fertility control and maternal health care behavior, UNFPA describes the births as either "too soon, too close, too many, or too late" [22]. However, most of the studies on reproductive health in relation to child marriage have been done in India and there is relatively little empirical evidence available on this issue in Sub-Saharan Africa. Raj et al., using the India Demographic and Health Survey from 2005-06 (NFHS III) found significant association between child marriage and poor fertility control leading to unwanted pregnancy, rapid repeat pregnancies, and pregnancy terminations [23]. Similarly, Santhya et al., using survey data from married young women in six states of India, concluded that young women married at age 18 or older were less likely to endorse a husband's right to beat his wife, to use fertility control measures, and undergo institutional delivery and less likely to experience violence in marriage [24]. In another study using NFHS III, A. Raj found that with decreasing age at marriage the likelihood of obtaining antenatal care and spacing of pregnancies showed a gradient decline whereas the likelihood of infant and child mortality showed an ascending trend [25].

Studies have attributed several pathways leading to these consequences including restricted mobility and social interaction, limited opportunities for education, the age gap between spouses, and limited access to health information and care among child brides [18]. Most of these pathways hint at low levels of female empowerment in this subpopulation [5, 18, 26]. There is a

growing literature on the role of women's empowerment in sexual behavior, maternal health care utilization, and child health [27, 28, 29]. However, to date, no empirical evidence explicitly relates poor empowerment among child brides to fertility control and maternal health care utilization outcomes.

The purpose of the study is to assess the influence of child marriage on fertility control and maternal health care utilization outcomes, after controlling women's empowerment variables and background characteristics, in four African countries. We hypothesize that some of the effects of child marriage on the aforementioned outcomes can be explained by low levels of female empowerment. We further hypothesize that some effects of child marriage can also be explained by women's background characteristics and the effects of marriage among females first married at age 15-17 is significantly different from those first married at age 14 or younger, after controlling for other characteristics.

Data

The study utilizes data from the recent Demographic and Health Surveys (DHS) in four African countries –Ethiopia (2005), Guinea (2005), Mali (2006), and Niger (2006). The selection was conducted using data generated from Stat-compiler. We chose those countries with a) the highest prevalence rates of marrying by ages 15 and 18 among 20-24 year olds in countries of sub-Saharan Africa and b) a DHS in the year 2005 or later. Analyses have been restricted to women aged 20-24 who are currently married or living together and who have no missing data on any of the variables included in the analysis. The final sample sizes for reproductive health outcome models are 1,430 in Ethiopia, 837 in Guinea, 2,180 in Mali, and 1,234 in Niger. For models on maternal health care utilization outcomes, analyses have also been restricted to women age 20-24 that gave birth in the past five years and to the most recent birth. As such, the final sample sizes for these models are 1,170, 668, 1,799, and 1,071 in Ethiopia, Guinea, Mali, and Niger, respectively.

Outcomes

Child marriage, defined in this study as a woman's first marriage prior to 18 years of age, is further categorized into two groups: first marriage at age 15-17 years (married in middle adolescence) and first marriage at age 14 years or younger (married in early adolescence or childhood). This study explores the association of child marriage with several reproductive health and maternal health care utilization outcomes. The reproductive health outcomes of interest include the following:

1. **Early fertility** measures whether the woman had given birth within the first year of marriage.
2. **High fertility** is established if the woman has ever had three or more than three children.
3. **Lack of fertility control** before first child birth indicates whether a woman had a living child or children prior to first use of contraception if she had ever used contraception or if a woman has never used contraception.
4. **Low lifetime fertility control** refers to a history of rapid repeat child birth, operationalized as having had at least one birth within two years of previous childbirth. This definition includes all past births in a woman's history. Those who have a single birth or no birth have been classified as not having a history of rapid repeat childbirth.
5. **Ever had a terminated pregnancy** is a binary variable indicating whether a woman reports having had a pregnancy termination
6. **Unintended pregnancy** indicates if a woman reports having had at least one pregnancy in the past five years that was wanted later or not wanted at all.

Maternal health care utilization outcomes include:

1. **Four or more antenatal care visits** which refers to whether the woman had four or more antenatal visits during her most recent pregnancy in the past five years, as recommended by WHO.
2. **Skilled attendance at birth** which indicates if the woman was assisted by a skilled health care worker in her last birth. The definition has been operationalized based on WHO guidelines and country specific categorization. Accordingly, it includes health professionals in Ethiopia; doctor, nurse/midwife, and auxiliary midwife in Guinea; doctor and nurse/midwife in Mali; and doctor and nurse/midwife in Niger.

3. **Institutional delivery** indicates if a woman delivered her last child in any health care facility and not at home.

Two sets of control variables have been included in the models to test the two hypotheses. The first set is a group of variables that serve as proxies for women's empowerment. 'Decision making power' has been considered to point at "evidence" of the process of empowerment as noted by Kishor and Subaiya [31] or "agency" as described by Kabeer [32]. Further, we argue that intra-familial power relationships have an important role to play in child marriage and as such variables that point at the "setting of empowerment" [31] in other contexts have also been included in this set and include- support for woman's right to negotiate safer sex or condom use, mobility, relative education of spouses, and spousal age gap. The reference category for each of these indicators reflects high female empowerment.

Decision making power reflects the number of decisions for which the husband alone has the final say. These decisions pertain to (a) the respondent's own health care, (b) making large household purchases, (c) making household purchases for daily needs, and (d) respondent's visits to family or relatives. The index obtained from summing the information on these variables has a Cronbach's alpha of 0.8307 in Niger, 0.8741 in Mali, 0.7004 in Ethiopia, and 0.8858 in Guinea. Three categories have been constructed as follows: category 1 indicates that the husband alone has no say (reference category), category 2 indicates that the husband alone has a say in 1-2 decisions, and category 3 indicates that the husband alone has a say in 3-4 decisions.

Support for women's rights to negotiate safer sex and condom use indicates that the respondent doesn't feel a wife is justified in refusing to have sex or in asking her husband to use condom if he has STD. Of the resulting three categories, category 1 signifies high support if she supports both reasons for refusing sex (reference category), category 2 signifies medium support if she supports any one of the two, and category 3 signifies low support if she supports neither.

Mobility indicates that the woman has a big problem in getting permission to go for medical care.

Relative education is based on the difference in educational attainment of the husband and wife and has three categories: "same level"(reference category); "wife educated higher"; and "husband educated higher".

Spousal age gap has been derived from the difference in the ages of the two partners resulting in three categories: "husband/spouse older by 1-5 years or same age or younger" (reference category); "husband/spouse older by 6-9 years"; and "husband/spouse older by ten years or more".

The second set of background characteristics includes age of respondent in years, household wealth terciles, urban/rural area of residence, woman's education, religion, and language of respondent. Household wealth terciles are based on relative wealth in urban and rural areas using wealth scores, the latter derived through principal component analysis of information on household assets like dwelling characteristics and possession of certain consumer items. Wealth terciles were generated by ranking and dividing the wealth scores into terciles for urban and rural areas separately followed by grouping the lowest tercile of both regions into category "low" (reference group), the middle tercile of both regions into category "medium", and the highest tercile of both regions into category "high". Woman's level of education is subdivided into three categories: no education (reference group), primary, and secondary or higher. Country specific categories have been derived from information on religion. Accordingly, religion has three categories in Ethiopia- Orthodox, Muslim and others, while Niger, Mali, and Guinea have two categories each of Muslim and non-Muslim. Information on language has been collapsed into country-specific categories based on sample size and has been used as a proxy for ethnicity. Thus, language has five categories in Niger- Djerma/Songhai, Haoussa, Kanouri, Touareg, and other; four categories in Mali- Bambara, Sonrai, Sénoufo/Minianka, and other; four categories in Ethiopia- Amarigna, Oromigna, Tigrigna, and other; and four categories in Guinea- Soussou, Peuhl, Malinke, and other. The models on maternal health care utilization also control for birth order.

Methods

Descriptive and multivariate analyses have been carried out separately for each country. Observations with missing values for all variables included in the analysis were dropped.

Furthermore design-based F- tests were generated to see if non-missing cases were significantly different from missing cases in background characteristics and health outcomes of interest.

Descriptive analyses include univariate distribution of background characteristics of the study population and bivariate tabulations of the prevalence of reproductive and maternal health outcomes of interest by child marriage.

For the multivariate analyses, three logistic regression models are estimated sequentially to explore the role of child marriage as a risk factor for poor reproductive health outcomes and low utilization of maternal health services after controlling for the set of empowerment variables and the set of background characteristics. Model 1 is the unadjusted model with age at first marriage alone. Model 2 adds measures of empowerment to test the hypotheses that age at first marriage effects are partly accounted for by poor empowerment among these women. Model 3 additionally adjusts for socio-demographic variables to test whether the effects of age at first marriage on reproductive and maternal health outcomes are mediated by women's background characteristics. Results are presented as odds ratios and their 95% confidence intervals. Furthermore, the coefficients for the two categories of child marriage are tested to see if they have a significant association with the outcome as a group. Adjusted Wald tests on the coefficients for the two categories of child marriage are carried out to investigate if they are significantly different from each other. Sampling weights are used to account for the complexity of the survey design and multi-collinearity is analyzed among control variables. All analyses are conducted using Stata, version 10.1.

The number of women excluded from the analysis of reproductive health outcomes was 66 in Ethiopia, 42 in Guinea, 203 in Mali, and 91 in Niger. For the analysis of maternal health outcomes, the number of women excluded from the analysis was 64 in Ethiopia, 67 in Guinea, 196 in Mali, and 85 in Niger. Women who are excluded from the analysis are quite similar to those who are included in terms of their background characteristics and reproductive health and maternal healthcare utilization outcomes, with a few exceptions. In Ethiopia, a higher proportion of excluded women feel they can negotiate neither sexual activity nor condom use if their husband has an STI (41% versus 12%) and gave birth within 12 months of marriage (32%

versus18%). For the maternal health outcomes, significantly more of the excluded Ethiopian women married at age 18 or older, live in rural areas and feel that they cannot negotiate sex or condom use compared to included women. In Guinea, there are no significant differences between included and excluded women in the analysis of reproductive health outcomes. For the analysis of maternal health outcomes, more excluded Guinean mothers were from urban areas compared to their included counterparts (38% versus 25%), lived in the wealthiest households (59% versus 32%), and spoke Soussou and Peuhl compared to included mothers. In Mali, a higher proportion of excluded women were Muslim and fewer had husbands who had comparatively more education. Compared to their included counterparts, fewer excluded Malian women gave birth within 12 months of marriage (22% versus 35 percent) and more have ever had an unintended pregnancy (28% versus 15%). In Niger, fewer women with missing information had comparatively higher educated husbands (6% versus 16%), gave birth within 12 months of marriage compared to those that were included in the analysis (15% versus 27%) and had four or more antenatal visits during their most recent pregnancy in the past five years (5% versus 15%).

Results

Background Characteristics

Characteristics of currently married women aged 20-24 are shown in Table 1. In each country, more than one of four women was first married below the age of 15, with the proportion reaching 40 percent in Niger. The proportion first marrying in adulthood ranges from approximately 17 percent in Niger to 30 percent in Ethiopia. More than two-thirds of the women live in rural areas. The mean age of women in the sample is approximately 22 and ranges from 21.61 in Guinea to 21.76 in Niger. More than 70 percent of women have never attended school with the proportion ranging from 72 percent in Ethiopia to 86 percent in Niger. The overwhelming majority of women are Muslim, with the exception of Ethiopia where 46 percent are Orthodox Christians.

Table 1. Percent distribution of currently married women aged 20-24 by background characteristics and country

Background Characteristics	Ethiopia	Guinea	Mali	Niger
Age at first marriage				
18 or older	29.5	21.0	23.8	16.6
15-17	36.0	53.9	49.5	43.4
14 or younger	34.5	25.1	26.7	40.0
Type of place of residence				
Urban	11.2	29.2	32.9	15.1
Rural	88.8	70.8	67.1	84.9
Household wealth				
Low	28.8	33.3	31.0	33.0
Medium	37.2	32.2	35.4	34.2
High	34.0	34.5	33.6	32.8
Educational Attainment				
None	71.8	82.7	79.8	85.7
Primary	19.1	9.2	9.7	11.1
Secondary	9.1	8.1	10.5	3.2
Age				
20	38.8	32.6	28.6	32.8
21	10.6	14.9	14.9	12.0
22	19.3	20.4	23.4	22.0
23	17.0	18.3	16.0	16.0
24	14.3	13.8	17.1	17.2
Religion				
Orthodox Christian	45.5	n.a.	n.a.	n.a.
Muslim	33.3	87.0	93.0	98.5
Other/no religion	21.1	13.0	7.0	1.5
Decision- making index				
0	41.4	38.3	21.6	10.4
1-2	40.6	18.2	18.4	13.4
3-4	18.0	43.5	60.0	76.2
Support for women's rights to negotiate safer sex and condom use				
High	38.5	56.0	39.4	57.4
Medium	49.5	29.7	34.0	28.3
Low	12.0	14.3	26.6	14.3
Mobility				
Small problem	63.2	87.1	80.4	90.0
Big problem	36.8	12.9	19.6	10.0
Relative education				
Same level	55.3	67.9	72.9	74.9
Wife higher	8.4	6.6	9.0	8.7
Husband higher	36.3	25.5	18.1	16.4
Spousal age gap				
Husband younger/same age	45.2	12.8	18.7	21.0
Husband 6-9 years older	28.5	19.9	27.1	29.1
Husband 10+ years older	26.3	67.3	54.2	49.9
Total	100.0	100.0	100.0	100.0
N	1430	837	2180	1234

Country-specific language groups are not shown.
Column totals may not add up to 100.0 percent due to rounding.
n.a. Not applicable.

The proportion of women, who report that their husbands alone made 3-4 of the specified household decisions, ranges from 18 percent in Ethiopia to 76 percent in Niger. Women's mobility is more problematic in Ethiopia than in the other countries. Most women support a woman's right to negotiate safer sex. However, in Mali, at least one out of four women did not

support a woman's right to negotiate safer sex by refusing sex or proposing condom use if she knows her husband has a sexually-transmitted infection. The proportion of women who said that getting permission to go for treatment was a big problem in medical care is three times as high in Ethiopia as in Niger (37 percent versus 10 percent). Most women have the same level of education as their husbands but in Ethiopia twice as many women have spouses who have attended higher levels of schooling as in Mali and Niger. Regarding the spousal age gap, in each country, more than half of women have husbands who are at least 6 years older. The proportion of women whose partners are 10 or more years older ranges from 26 percent in Ethiopia to 67 percent in Guinea. Roughly half of women in Mali and Niger have a spousal age gap of 10 or more years.

Bivariate Results

Table 2 shows bivariate associations between age at first marriage and reproductive and maternal health outcomes. In all countries, the proportion of women with 3 or more births in their lifetime (high fertility) and a history of rapid repeat child birth (low lifetime fertility control) is significantly higher and the proportion whose most recent birth in the five years preceding the survey was delivered by skilled medical personal is significantly lower among women who first married at age 14 or younger than among those who first married at age 18 or older. For example, in Ethiopia, 43 percent of women who married at age 14 or younger have given birth to 3 or more children by the time of the survey compared to 1 percent of those who married in adulthood. In Niger, five times as many women who married at age 14 or younger are classified as having low fertility control as their counterparts who married in adulthood.

Table 2. Percent prevalence of selected reproductive and maternal health outcomes among currently married women in 4 African countries by age at first marriage.

Age at First Marriage	Ethiopia	Guinea	Mali	Niger
EARLY FERTILITY (Given birth within the first year of marriage)				
Total	17.7	37.7	35.2	26.5
18 or older	21.8	34.3	41.3	33.5
15-17	20.2	41.2	36.8	28.5
14 or younger	11.5	33.0	26.9	21.5
	**		***	*
HIGH FERTILITY (Ever had three or more than three children)				
Total	22.9	24.1	31.1	34.2
18 or older	1.4	4.8	9.7	6.7
15-17	21.6	21.6	28.4	27.7
14 or younger	42.8	45.6	55.1	52.7

	***	***	***	***
LACK OF FERTILITY CONTROL (Living child or children prior to first use of contraception)				
Total	92.5	94.2	93.7	99.5
18 or older	87.1	86.7	86.7	98.9
15-17	94.6	95.6	94.7	99.4
14 or younger	94.8	97.3	98.0	99.8
	***	***	***	
LOW FERTILITY CONTROL (History of rapid repeat child birth)				
Total	22.5	13.5	26.7	28.7
18 or older	8.7	4.3	12.7	8.2
15-17	26.5	12.4	28.6	25.1
14 or younger	30.2	23.8	35.8	41.0
	***	***	***	***
TERMINATED PREGNANCY				
Total	6.9	10.1	11.2	11.2
18 or older	4.0	10.4	8.0	6.6
15-17	9.6	8.3	11.5	11.6
14 or younger	6.7	13.4	13.4	12.6
	*			
UNINTENDED PREGNANCY				
Total	32.2	10.2	15.1	11.0
18 or older	26.4	7.1	13.0	11.4
15-17	35.8	8.1	17.0	12.0
14 or younger	33.5	17.4	13.2	9.6
		**		
4+ ANTENATAL CARE VISITS [a]				
Total	15.5	54.3	37.1	14.6
18 or older	21.8	63.5	42.5	24.8
15-17	16.0	56.9	35.0	13.6
14 or younger	11.2	43.7	36.6	12.2
	**	**		**
SKILLED ATTENDANCE AT BIRTH [a]				
Total	9.6	36.5	28.3	19.5
18 or older	15.3	49.7	40.1	43.2
15-17	8.3	34.7	26.7	19.3
14 or younger	7.4	32.8	22.4	11.9
	*	*	***	***
INSTITUTIONAL DELIVERY [a]				
Total	8.7	31.7	48.4	19.2
18 or older	15.1	39.2	59.7	43.1
15-17	6.6	32.0	49.3	19.1
14 or younger	6.9	26.9	38.4	11.5
	**		***	***
N	1430	837	2180	1234

* p<.05 ** p<.01 *** p < .001

Tests of significance pertain to age at marriage differentials in health outcomes within countries.

[a] Pertains to the last birth in the past five years. Number of cases equals 1170, 668, 1799, and 1071 in Ethiopia, Guinea, Mali, and Niger, respectively.

In three countries – Ethiopia, Mali, and Niger – delayed marriage is associated with a higher prevalence of childbirth within the first year of marriage (early fertility). In Mali, for example, the proportion of women who had a child within the first year of marriage has increased from 27 percent among those who first married at age 14 or younger to 41 percent among those who married in adulthood. This pattern can reflect lower fecundity and delayed initiation of sexual intercourse among women who married before the age of 15 or a hint of a "catching-up" fertility

effect among those women whose first marriages occurred in adulthood. The prevalence of unintended pregnancy is twice as high among Guinean women who first married at age 14 or younger as among their counterparts who married in adulthood.

The World Health Organization recommends that in the absence of complications, women should have at least four antenatal care visits. The results in Table 2 indicate that in all countries except Guinea, less than half of women made 4 or more antenatal visits during their last pregnancy, with the proportion being as low as 15 percent in Niger and 16 percent in Ethiopia. In three countries (Ethiopia, Guinea and Niger), there is evidence of a positive association between the age at first marriage and the prevalence of four or more antenatal visits. Similarly, institutional delivery rates increases with the age at first marriage in Ethiopia, Mali and Niger. In the latter country, institutional delivery rates are at least three times as high among women who married in adulthood (43 percent) as among those who married at age 14 or younger (12 percent).

Multivariate Results

The results of associations between age at first marriage and reproductive and maternal health outcomes for the three serially adjusted models are displayed in Tables 3-7. As explained earlier, Model 1 is the unadjusted model with age at first marriage alone. Model 2 adds measures of empowerment to test the hypotheses that age at first marriage effects are partly accounted for by poor empowerment among these women. Model 3 additionally adjusts for socio-demographic variables to test whether the effects of age at first marriage on reproductive and maternal health outcomes are mediated by women's background characteristics. Changes in the age-at-first-marriage odds ratios can be observed by comparing the estimates in Model 1 with those in Models 2 and 3. As Table 3 shows, women who married at age 14 or younger are significantly less likely than those who first married in adulthood to give birth within the first year of marriage in all countries except Guinea. Adjustment for the empowerment variables in Model 2 and background characteristics in Model 3 does not eliminate this association. Age at first marriage is also positively associated with the odds of having three or more children by the time of the survey in all countries and this association is not partly explained by women's empowerment or

background characteristics. However, the latter results should be interpreted with caution due to the wide confidence intervals.

Table 3. Results of multiple logistic regression models examining the association of age at first marriage with early fertility and high fertility among currently married women aged 20-24 in 4 African countries

	MODEL 1		MODEL 2 [a]		MODEL 3 [b]	
	OR	95% CI	OR	95% CI	OR	95% CI
EARLY FERTILITY(Given birth within the first year of marriage)						
Ethiopia (n=1430)						
15-17	0.907	(0.605, 1.359)	0.894	(0.589, 1.357)	0.987	(0.631, 1.545)
14 or younger	0.464**	(0.284, 0.758)	0.448**	(0.269, 0.745)	0.504*	(0.287, 0.883)
	F(2, 484)=5.26		F(11, 475)=1.57		F(25, 461)=1.93	
Guinea (n=837)						
15-17	1.341	(0.901, 1.995)	1.307	(0.877, 1.950)	1.110	(0.730, 1.689)
14 or younger	0.944	(0.579, 1.538)	0.895	(0.545, 1.472)	0.812	(0.481, 1.371)
	F(2, 269)=1.85		F(11, 260)=0.99		F(24, 247)=1.60	
Mali (n=2180)						
15-17	0.826	(0.645, 1.058)	0.790	(0.612, 1.020)	0.798	(0.616, 1.034)
14 or younger	0.521***	(0.389, 0.700)	0.488***	(0.362, 0.658)	0.484***	(0.357, 0.656)
	F(2, 397)=10.01		F(11,388)=3.11		F(24, 375)=2.57	
Niger (n=1234)						
15-17	0.791	(0.525, 1.191)	0.809	(0.536, 1.219)	0.872	(0.564, 1.349)
14 or younger	0.543**	(0.353, 0.835)	0.542**	(0.353, 0.833)	0.578*	(0.363, 0.919)
	F(2, 325)=4.33		F(11, 316)=1.87		F(25, 302)=2.31	
HIGH FERTILITY(Ever had three or more than three children)						
Ethiopia (n=1430)						
15-17	19.410***	(7.675, 49.088)	18.303***	(7.234, 46.308)	41.053***	(14.725, 114.450
14 or younger	52.763***	(20.844, 133.560)	51.573***	(20.010, 132.921)	284.286***	(92.586, 872.904)
	F(2, 484)=39.64		F(11, 475)=9.73		F(25, 461)=8.00	
Guinea (n=837)						
15-17	5.404***	(2.343, 12.467)	5.290***	(2.289, 12.223)	5.258***	(2.383, 11.603)
14 or younger	16.461***	(7.214, 37.564)	15.829***	(7.050, 35.538)	30.205***	(13.054, 69.891)
	F(2, 269)=30.47		F(11, 260)=8.29		F(24, 247)=8.48	
Mali (n=2180)						
15-17	3.693***	(2.399, 5.685)	3.424***	(2.236, 5.241)	5.070***	(3.300, 7.789)
14 or younger	11.401***	(7.605, 17.091)	10.562***	(7.057, 15.809)	20.525***	(12.797, 32.921)
	F(2, 397)=80.34		F(11, 388)=18.22		F(24, 375)=14.20	
Niger (n=1234)						
15-17	5.329***	(2.851, 9.961)	5.131***	(2.757, 9.548)	6.872***	(3.514, 13.438)
14 or younger	15.358***	(8.057, 29.276)	15.048***	(7.909, 28.632)	28.377***	(13.578, 59.307)
	F(2, 325)=43.83		F(11, 316)=12.56		F(25, 302)=8.08	

* p<.05 ** p<.01 *** p < .001

Reference category is 18 years or older.
[a] Controls for decision making, mobility, self-efficacy in negotiating sex and condom use, education gap between spouses and spousal age gap
[b] Controls for all variables in Model 2 plus rural/urban residence, women's educational attainment, age, household wealth, and language spoken.

Tests of the group significance of the age at first marriage categories in Model 3 (not shown) reveals that, after controlling for the full set of explanatory variables, age at first marriage is significantly associated with early fertility only in Mali and with high fertility in all countries examined. The results of the adjusted Wald test of the differences in the coefficients for first marriage at ages 15-17 and first marriage at age 14 or younger reveals that in Ethiopia and Mali, women marrying in early adolescent and childhood are significantly less likely than those marrying in middle adolescence to give birth within the first year of marriage and that in all countries, women who first married at early adolescence or childhood are significantly more likely than those marrying in middle adolescence to have had three or more births at the time of the survey.

The associations between age at first marriage and (a) lack of fertility control prior to the first child birth and (b) history of rapid repeat childbirth are shown in Table 4. Model 1 shows that compared with women who married in adulthood, both women who first married at ages 15-17 and those who first married at age 14 or younger have higher odds of not using contraception prior to the birth of the first child in all countries except Niger. When all measures of women's empowerment are entered simultaneously in the model (Model 2), these associations are somewhat reduced but nonetheless statistically significant. In the fully-adjusted model (Model 3), the associations between age at first marriage and lack of fertility control remains statistically significant in Ethiopia and Mali, but not in Guinea, suggesting that in the latter country, differences in women's background characteristics account partly for the significant age at first marriage associations. The association between age at first marriage and the odds of having a history of rapid repeat child birth (low fertility control) is significant in all countries and in all models and shows that first marriage in middle adolescence or in early adolescence/childhood is associated with a higher risk of having a history of rapid repeat child birth than marriage in adulthood. In Mali for example, the odds ratios in the fully adjusted model are 2.630 (95%

CI=1.817, 3.808) for marriage in middle adolescence and 3.476 (95% CI=2.374, 5.090) for marriage in early adolescence or childhood.

Table 4. Results of multiple logistic regression models examining the association of age at first marriage with lack of fertility control and low fertility control among currently married women aged 20-24 in 4 African countries

	MODEL 1		MODEL 2 [a]		MODEL 3 [b]	
	OR	95% CI	OR	95% CI	OR	95% CI
LACK OF FERTILITY CONTROL(Living child or children prior to first use of contraception)						
Ethiopia (n=1430)						
15-17	2.619***	(1.494, 4.593)	2.341**	(1.317, 4.162)	3.481**	(1.597, 7.587)
14 or younger	2.729***	(1.538, 4.842)	2.596**	(1.388, 4.856)	3.353**	(1.466, 7.670)
	F(2, 484)=8.54		F(11, 475)=5.38		F(25, 461)=8.00	
Guinea (n=837)						
15-17	3.288**	(1.561, 6.925)	2.895*	(1.212, 6.916)	1.615	(0.656, 3.979)
14 or younger	5.576***	(2.345, 13.260)	3.991**	(1.488, 10.706)	3.053	(0.762, 12.242)
	F(2, 269)=10.63		F(11, 260)=5.13		F(24, 247)=4.77	
Mali (n=2180)						
15-17	2.694***	(1.718, 4.224)	2.084**	(1.318, 3.296)	1.913**	(1.224, 2.990)
14 or younger	7.471***	(3.795, 14.708)	5.282***	(2.650, 10.526)	3.791***	(1.878, 7.653)
	F(2, 397)=21.61		F(11,388)=13.57		F(24, 375)=12.51	
Niger (n=1234)						
15-17	1.703	(0.415, 6.981)	1.317	(0.301, 5.754)	0.210	(0.027, 1.629)
14 or younger	4.444	(0.749, 26.381)	2.872	(0.399, 20.663)	0.189	(0.011, 3.162)
	F(2, 325)=1.35		F(10, 307)=5.70 [c]		F(19, 228)=. [a]	
LOW FERTILITY CONTROL(History of rapid repeat child birth)						
Ethiopia (n=1430)						
15-17	3.781***	(2.300, 6.216)	3.768***	(2.253, 6.301)	6.495***	(3.710, 11.370)
14 or younger	4.536***	(2.528, 8.136)	4.494***	(2.434, 8.297)	10.074***	(5.002, 20.289)
	F(2, 484)=15.62		F(11, 475)=3.50		F(25, 461)=5.08	
Guinea (n=837)						
15-17	3.132*	(1.303, 7.523)	3.010*	(1.238, 7.322)	3.134**	(1.315, 7.470)
14 or younger	6.911***	(3.051, 15.659)	6.160**	(2.765, 13.727)	7.906***	(3.599, 17.370)
	F(2, 269)=14.68		F(11, 260)=5.12		F(24, 247)=5.29	
Mali (n=2180)						
15-17	2.754***	(1.937, 3.916)	2.529***	(1.754, 3.645)	2.630***	(1.817, 3.808)
14 or younger	3.846***	(2.634, 5.615)	3.403***	(2.313, 5.006)	3.476***	(2.374, 5.090)
	F(2, 397)=24.53		F(11,388)=7.25		F(24, 375)=8.07	
Niger (n=1234)						
15-17	3.764***	(2.166, 6.542)	3.650***	(2.096, 6.357)	3.978***	(2.292, 6.905)
14 or younger	7.776***	(4.518, 13.382)	7.815***	(4.457, 13.702)	9.203***	(5.153, 16.436)
	F(2, 325)=30.66		F(11, 316)=7.58		F(25, 302)=6.01	

* p<.05 ** p<.01 *** p < .001
Reference category is 18 years or older.
[a] Controls for decision making, mobility, self-efficacy in negotiating sex and condom use, education gap between spouses and spousal age gap
[b] Controls for all variables in Model 2 plus rural/urban residence, women's educational attainment, age, household wealth, and language spoken.
[c] n=1064 as low support for safe sex was dropped from the regression model.
[d] n=829 as support for safe sex, religion, and language were dropped from the regression model.

In additional analyses (not shown), we test for the group significance of the age at first marriage categories. The test shows that the age at first marriage coefficients in the regressions on lack of fertility control are jointly significant at the one percent level in all countries except Niger and for the regressions on low fertility control in all countries examined. The results of the Wald test indicate that in the fully-adjusted model (Model 3), women first marrying at age 14 or younger have significantly higher odds of not using contraception prior to the first birth in Ethiopia and Guinea and significantly higher odds of having a history of rapid repeat childbirth in all countries compared to their counterparts who first married at ages 15-17 (not shown)

As can be seen in Table 5, the association between age at first marriage and the odds of having a terminated pregnancy or an unintended pregnancy is not consistent across countries. There is no evidence that Guinean and Malian women who first married at age 14 or younger are more likely to have a terminated pregnancy than their counterparts who first married in adulthood or that differences in women's empowerment account for the age at marriage associations with pregnancy termination in Mali. After controlling for the full set of explanatory variables in Model 3, age at first marriage is statistically significant in Niger, where women who married at age 14 or younger and those who first married at aged 15-17 are 1.922 (95% CI=1.041, 3.549) and 2.049 (95% CI=1.047, 4.007) times as likely as those who married at ages 18 or older to have had a terminated pregnancy. However, age at first marriage is not associated with the odds of having an unintended pregnancy in Mali and Niger but in Ethiopia, there is a significant negative relationship between age at first marriage and the odds of having an unintended pregnancy, while in Guinea, women who age 14 or younger are 4.557 times as likely as those marrying in adulthood to report an unintended pregnancy. A comparison of the odds ratios in Models 1 and 2 suggests that women's empowerment does not account for the age at marriage associations with pregnancy termination or unintended pregnancy.

Table 5. Results of multivariate regression models examining the association of age at first marriage with ever having a terminated pregnancy and an unintended pregnancy among currently married women aged 20-24 in 4 African countries

	MODEL 1		MODEL 2 [a]		MODEL 3 [b]	
	OR	95% CI	OR	95% CI	OR	95% CI
EVER HAD A TERMINATED PREGNANCY						
Ethiopia (n=1430)						
15-17	2.562*	(1.238, 5.304)	2.564*	(1.223, 5.375)	2.854*	(1.279, 6.369)
14 or younger	1.746	(0.811, 3.757)	1.733	(0.793, 3.788)	1.750	(0.704, 4.352)
		F(2, 484)=3.28		F(11, 475)=1.39		F(25, 461)=1.76
Guinea (n=837)						
15-17	0.781	(0.406, 1.501)	0.788	(0.404, 1.536)	0.696	(0.351, 1.381)
14 or younger	1.333	(0.696, 2.553)	1.379	(0.705, 2.699)	1.421	(0.720, 2.807)
		F(2, 269)=1.64		F(11, 260)=0.72		F(24, 247)=1.19
Mali (n=2180)						
15-17	1.488	(0.993, 2.231)	1.457	(0.970, 2.189)	1.425	(0.959, 2.117)
14 or younger	1.766*	(1.109, 2.814)	1.707*	(1.059, 2.751)	1.583	(0.997, 2.513)
		F(2, 397)=3.08		F(11,388)=1.10		F(24, 375)=1.34
Niger (n=1234)						
15-17	1.856*	(1.010, 3.411)	1.826	(0.988, 3.373)	1.922*	(1.041, 3.549)
14 or younger	2.045*	(1.059, 3.952)	1.914	(0.976, 3.750)	2.049*	(1.047, 4.007)
		F(2, 325)=2.53		F(11, 316)=1.52		F(25,302)=1.30
UNINTENDED PREGNANCY						
Ethiopia (n=1430)						
15-17	1.557*	(1.088, 2.228)	1.489*	(1.029, 2.155)	1.595*	(1.078, 2.362)
14 or younger	1.407	(0.965, 2.051)	1.456	(0.996, 2.127)	1.663*	(1.080, 2.559)
		F(2, 484)=3.04		F(11, 475)=2.58		F(25, 461)=1.94
Guinea (n=837)						
15-17	1.151	(0.570, 2.324)	1.350	(0.676, 2.696)	1.458	(0.665, 3.196)
14 or younger	2.741*	(1.221, 6.153)	3.945***	(1.726, 9.018)	4.557***	(1.913, 10.852)
		F(2, 269)=5.56		F(11, 260)=3.60		F(24, 247)=2.19
Mali (n=2180)						
15-17	1.370	(0.941, 1.995)	1.387	(0.957, 2.011)	1.391	(0.964, 2.008)
14 or younger	1.020	(0.696, 1.495)	1.025	(0.684, 1.535)	1.043	(0.703, 1.548)
		F(2, 397)=1.89		F(11,388)=2.29		F(24, 375)=2.39
Niger (n=1234)						
15-17	1.063	(0.656, 1.721)	1.020	(0.623, 1.669)	1.512	(0.887, 2.576)
14 or younger	0.831	(0.473, 1.460)	0.722	(0.413, 1.263)	1.234	(0.669, 2.276)
		F(2, 325)=0.62		F(11, 316)=1.63		F(25, 302)=3.66

* p<.05 *** p < .001

Reference category is 18 years or older.

[a] Controls for decision making, mobility, self-efficacy in negotiating sex and condom use, education gap between spouses and spousal age gap

[b] Controls for all variables in Model 2 plus rural/urban residence, women's educational attainment, age, household wealth, and language spoken.

Tests of the linear combination of the age at first marriage categories in Model 3 are significant in Ethiopia, Mali and Niger for the pregnancy termination regression and in Ethiopia and Guinea for the unintended pregnancy regressions (not shown). The Wald test of the equality in the coefficients for first marriage at ages 15-17 and first marriage at ages 14 or younger reveals that in Model 3, there are significantly higher odds of pregnancy termination and of unintended pregnancy among Ethiopian women who married in middle adolescence than among their counterparts who married in early adolescence or childhood. In addition, the results of the Wald test (not shown) suggest that in Guinea, those who married in middle adolescence have significantly lower odds of having had an unintended pregnancy in their lifetime than those who married in early adolescence or childhood.

Tables 6 and 7 present the multivariate results for the maternal healthcare utilization outcomes. Age at first marriage is not significantly associated with having an adequate number of prenatal visits in Mali and with institutional delivery in Guinea. A comparison of Models 1 and 2 suggests that in three countries, the association between age at first marriage and having four or more antenatal visits during the most recent pregnancy in the past five years is not explained by differences in women's empowerment but by differences in women's background characteristics. Similarly in Ethiopia, Mali, and Niger, the significantly lower odds of delivery attendance by skilled medical personnel among women who married as children compared to those who married in adulthood can be attributed in part to differences in women's back ground characteristics (See Models 2 and 3 in the bottom panel of Table 6). It is only in Guinea that the odds of delivery attendance by skilled medical personnel lose statistical significance after controlling for measures of women's empowerment in Model 2, offering support for one of our hypotheses.

Table 6. Results of multivariate regression models examining the association of age at first marriage with four or more antenatal visits and skilled attendance at birth during the last pregnancy among currently married women aged 20-24 in 4 African countries

	MODEL 1		MODEL 2 [a]		MODEL 3 [b]	
	OR	95% CI	OR	95% CI	OR	95% CI
4+ ANTENTAL CARE VISITS [d]						
Ethiopia (n=1170)						

15-17	0.685	(0.437, 1.075)	0.710	(0.450, 1.120)	1.329	(0.745, 2.370)
14 or younger	0.450 **	(0.268, 0.756)	0.437**	(0.252, 0.759)	1.362	(0.588, 3.152)
	F(2, 448)=4.57		F(11, 439)=5.59		F(26, 424)=6.73	
Guinea (n=668)						
15-17	0.759	(0.474, 1.216)	0.849	(0.512, 1.409)	1.142	(0.656, 1.987)
14 or younger	0.447**	(0.267, 0.749)	0.562*	(0.333, 0.947)	0.872	(0.451, 1.689)
	F(2, 259)=5.40		F(11, 250)=4.09		F(25, 236)=3.19	
Mali (n=1799)						
15-17	0.727	(0.524, 1.009)	0.753	(0.544, 1.044)	0.918	(0.645, 1.306)
14 or younger	0.782	(0.569, 1.076)	0.789	(0.566, 1.101)	1.236	(0.835, 1.831)
	F(2, 389)=1.91		F(11,380)=7.97		F(25, 366)=7.04	
Niger (n=1071)						
15-17	0.477**	(0.292, 0.780)	0.483**	(0.291, 0.801)	0.693	(0.398, 1.208)
14 or younger	0.422**	(0.247, 0.720)	0.400**	(0.227, 0.703)	0.723	(0.375, 1.394)
			SKILLED ATTENDANCE AT BIRTH			
Ethiopia (n=1170)						
15-17	0.500*	(0.293, 0.853)	0.513*	(0.288, 0.914)	0.748	(0.308, 1.816)
14 or younger	0.455*	(0.245, 0.845)	0.463*	(0.233, 0.919)	1.704	(0.672, 4.318)
	F(2, 448)=4.38		F(11, 439)=5.35		F(26, 424)=8.05	
Guinea (n=668)						
15-17	0.538*	(0.329, 0.882)	0.639	(0.376, 1.087)	0.846	(0.419, 1.711)
14 or younger	0.496*	(0.284, 0.866)	0.660	(0.369, 1.178)	0.829	(0.336, 2.046)
	F(2, 259)=3.71		F(11, 250)=4.57		F(25, 236)=5.48	
Mali (n=1799)						
15-17	0.545***	(0.407, 0.729)	0.616**	(0.455, 0.834)	0.798	(0.549, 1.160)
14 or younger	0.433***	(0.312, 0.600)	0.476***	(0.338, 0.669)	0.952	(0.587, 1.543)
	F(2, 389)=13.51		F(11,380)=10.21		F(25, 366)=11.21	
Niger (n=1071)						
15-17	0.314***	(0.196, 0.503)	0.304***	(0.187, 0.495)	0.538	(0.274, 1.055)
14 or younger	0.178***	(0.104, 0.303)	0.169***	(0.099, 0.286)	0.498	(0.231, 1.076)
	F(2, 321)=20.54		F(11, 312)=9.90		F(26, 297)=9.79	

* p<.05 ** p<.01 ** p < .001
Reference category is 18 years or older.
[a] Controls for decision making, mobility, self-efficacy in negotiating sex and condom use, education gap between spouses and spousal age gap
[b] Controls for all variables in Model 2 plus rural/urban residence, women's educational attainment, age, household wealth, and language spoken.
[c] n=707 as low support for safe sex was dropped from the regression model and 130 observations not used.
[d] Data pertain to the last birth in the past five years.

As Model 1 of Table 7 shows, first marriage at ages 15-17 or ages 14 or younger is associated with lower odds of institutional delivery than first marriage in adulthood in all countries except Guinea. In Niger for example, women who first married at age 15 or younger are 0.171 times as likely as those marrying in adulthood to deliver their last child in a health facility (95%

CI=0.100, 0.292). A comparison of the odds ratios in Models 1 and 2 suggests that the age at marriage effects are not explained by differences in women's empowerment but as Model 3 shows, in Mali, socio-demographic differences accounted for the age at marriage associations. In the fully-adjusted models, age at first marriage is significantly associated with the odds of institutional delivery only in Niger. The results of the Wald test suggest that there are no significant differences in the odds of institutional delivery between Malian women who first married in middle adolescence and their counterparts who first married in early adolescence or childhood.

Table 7. Results of multivariate regression models examining the association of age at first marriage with s institutional delivery during the last pregnancy among currently married women aged 20-24 in 4 African countries

	MODEL 1		MODEL 2 [a]		MODEL 3 [b]	
	OR	95% CI	OR	95% CI	OR	95% CI
			INSTITUTIONAL DELIVERY			
Ethiopia (n=1170)						
15-17	0.394***	(0.227, 0.686)	0.399**	(0.221, 0.722)	0.458	(0.188, 1.117)
14 or younger	0.417**	(0.221, 0.786)	0.404**	(0.202, 807)	1.202	(0.466, 3.100)
	F(2, 448)=6.37		F(11, 439)=6.29		F(26, 424)=8.87	
Guinea (n=668)						
15-17	0.730	(0.459, 1.161)	0.832	(0.513, 1.350)	1.022	(0.568, 1.840)
14 or younger	0.572	(0.310, 1.053)	0.730	(0.395, 1.350)	0.689	(0.314, 1.509)
	F(2, 259)=1.64		F(11, 250)=2.07		F(25, 236)=4.04	
Mali (n=1799)						
15-17	0.658**	(0.482, 0.898)	0.727*	(0.531, 0.997)	0.902	(0.620, 1.313)
14 or younger	0.421***	(0.295, 0.600)	0.450***	(0.309, 0.655)	0.737	(0.460, 1.181)
	F(2, 389)=12.04		F(11,380)=9.37		F(25, 366)=8.53	
Niger (n=1071)						
15-17	0.311***	(0.195, 0.499)	0.305***	(0.187, 0.499)	0.483*	(0.246, 0.950)
14 or younger	0.171***	(0.100, 0.292)	0.165***	(0.097, 0.283)	0.405*	(0.187, 0.878)
	F(2, 321)=21.46		F(11, 312)=9.95		F(26, 297)=9.80	

* p<.05 ** p<.01 ** p < .001
Reference category is 18 years or older.
[a] Controls for decision making, mobility, self-efficacy in negotiating sex and condom use, education gap between spouses and spousal age gap
[b] Controls for all variables in Model 2 plus rural/urban residence, women's educational attainment, age, household wealth, and language spoken.

Discussion

In this study, multivariate logistic models are used to assess the association of child marriage with fertility and maternal health care utilization outcomes among women aged 20-24 who are currently married or living together in four African countries – Niger, Guinea, Mali, and Ethiopia. The results suggest that the strength of the association between child marriage and reproductive health outcomes varies from country to country. In all four countries, the practice of child marriage is significantly associated with high fertility and a history of rapid repeat childbirth. The associations remain statistically significant even after controlling for women's empowerment and a number of individual- and household-level characteristics thereby indicating other mechanisms at play.

The model results of the association of child marriage with pregnancy termination, unintended pregnancy, and not having used a contraceptive method prior to the first birth are mixed. Child marriage is found to be positively associated with pregnancy termination in three countries – Ethiopia, Mali, and Niger, positively with unintended pregnancy in two countries – Ethiopia and Guinea, and positively associated with lack of fertility control prior to the first birth in three countries – Ethiopia, Guinea, and Mali. For the most part, these associations remain statistically significant after controlling for measures of women's empowerment and individual- and household-level characteristics. However, in three of the four countries – Ethiopia, Mali, and Niger – marriage at 14 years and younger is negatively associated with fertility in the first year of marriage. These results may be due to low fecundity and low coital frequency at very young ages [33]. Our hypothesis that poor empowerment among women accounts for some effects of child marriage holds true for pregnancy terminations among child brides in Niger. On the other hand, our hypothesis that background characteristics account for some effects of child marriage holds true for lack of fertility control among child brides in Guinea and for pregnancy termination among Malian women married at age 14 or younger.

With respect to maternal health care utilization, child marriage is found to be negatively and significantly associated with the use of maternal health care services associated with the most recent birth in all four countries (having had at least four antenatal care visits and/or institution

delivery). However, once individual- and household-level factors are controlled, the statistical significance of child marriage on maternal health care use mostly disappears suggesting that child marriage per se is not associated with use of maternal health care services. This is especially true for effects of child marriage on skilled birth attendance among child brides in Ethiopia, Mali, and Niger; on antenatal visits among women married before age 18 in Ethiopia and Niger and women married at age 14 or younger in Guinea; and on institutional delivery among child brides in Ethiopia and Mali. An exception is among Guinean child brides where some effects of child marriage on skilled birth attendance are accounted for by poor empowerment among these women.

An important contribution of the study is that it distinguishes between women who married in middle adolescence (15 to 17 years) from those who married in early adolescence and childhood (14 years and younger). Our results suggest that, although both groups appear to be disadvantaged, women who first married at age 14 years and younger show a significantly higher propensity towards a number of negative outcomes than those who first married at ages 15 to 17 years. These outcomes include high fertility, a history of rapid repeat childbirth, unintended pregnancy, and having not using contraception prior to the first childbirth.

Overall, the study results provide important insights into the association of child marriage with various fertility-related outcomes in four sub-Saharan Africa countries that continue to have very high child marriage prevalence rates. As the results suggest that not many observed child marriage associations are explained by lower levels of empowerment among women who married early or by their background characteristics, more research is needed on the pathways through which child marriage influences fertility and fertility control outcomes. Among the possible pathways that may be at play are social norms and economic incentives for early marriage and high fertility.

However, these findings should be interpreted with caution due to a number of limitations of the study. First, the outcomes are self-reported and as a result, may be prone to bias due to social desirability and recall. This may be particularly true for unintended pregnancy, which may be under reported. Second, because the data come from cross-sectional surveys, the results cannot

be used to attribute to outcomes to the practice of child marriage. However, temporality can be assumed because the reported marriages usually occurred prior to the fertility-related events. Third, the set of variables which serve as proxies for empowerment does not capture the underlying process completely [34, 32]. Fourth, in models on high fertility in Ethiopia, high odds ratios and wide confidence intervals may be due to very small variation of the outcome among the sample. Fifth, low lifetime fertility control reflects right censoring for three reasons: a) at the time of survey some women might have been pregnant without knowing it, b) some women might not have given birth by the time of the survey, and c) most if not all have several fertile years ahead of them. Accordingly, a Cox regression model is a better modeling approach for this outcome. Finally, region was not used as a control variable in the multivariate models owing to a large number of categories in some of the selected countries and complete dissociation of outcome in some. To make-up for this deficit, language has been used as a proxy for ethnic differences.

In conclusion, the study results provide important insight into the many negative consequences of child marriage, and suggest that strict reinforcement of laws against child marriage is imperative. The increased vulnerability of young women due to child marriage makes them prone to poor fertility control and adverse fertility outcomes. This vulnerability is context specific and varies from country to country. Some part of this vulnerability is accounted by background characteristics and some part to poor empowerment among child brides in different contexts but other reasons like social norms and economic incentives may also be responsible and require further research. This vulnerability also makes them an invisible sub-group that is hard to reach through reproductive health programs. Innovative strategies are needed to target this population separately, above and beyond the general population of young adolescent girls.

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