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ABSTRACT

Big Sisters and Child Marriage in Sub-Saharan Africa*

We study the effect of having an older sister on the likelihood that girls in sub-Saharan Africa marry before reaching adulthood. Relying on the randomness of the firstborn sibling's sex, we show that having an older sister (as opposed to an older brother) reduces the likelihood of marrying before the age of 18 by 1.5 percent. In addition, we find that older sisters reduce the likelihood that their younger sisters become sexually active as a teenager, reduce the likelihood that their younger sisters give birth as a teenager, and increase their younger sisters' awareness of HIV/AIDS. The estimated effects on childhood marriage are largest in more conservative societies (as measured by the Social Institutions and Gender Index), suggesting that the protective role played by firstborn sisters can be especially important when access to accurate information about sex and reproductive rights is limited.

JEL Classification: I12, J12

Keywords: older sisters, child marriage, reproductive health, teenage sexual activity

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1. INTRODUCTION

Approximately one-third of girls in sub-Saharan Africa marry (or cohabitate) before reaching the age of 18 (Koski et al. 2017; UNICEF 2022). There is quasi-experimental evidence that child marriage prevents girls in Africa from completing their secondary education (Nguyen and Wodon 2014; Delprato et al. 2015; Sunder 2019). There is also evidence, albeit correlational, that child marriage reduces the age of sexual debut, increases fertility, and increases the likelihood of experiencing intimate partner violence (Walker 2012; Olamijuwon et al. 2017; Efevbera et al. 2019; Yaya et al. 2019; Fan and Koski 2022). In recognition of its potential harms, United Nations member states have committed to eradicating the practice of child marriage by the year 2030.[1]

In this study, we explore whether having an older sister affects the likelihood that girls in sub-Saharan Africa marry before reaching the age of 18. Older sisters could influence this likelihood through several potential channels or routes. For instance, younger sisters could mimic their older sisters' behaviors or learn from their mistakes (Dunn 1983, 1985; Rodgers and Rowe 1988; Buhrmester 1992), channels that could, in theory, be more important in socially conservative countries where openly talking about sex is socially costly or even forbidden (Ege et al. 2014). Older sisters could also exert influence through their role as caregivers, especially when one of the parents is working or missing from the household altogether (Zukow-Goldring 2002; Argys et al. 2006; Averett et al. 2011). Finally, older sisters could apply direct pressure on their younger sibling to become sexually active (Zimba 2011) or could (either inadvertently or purposely) introduce their younger sisters to potential partners earlier than would otherwise be the case (Rodgers and Rowe 1988; Argys et al. 2006).

[1] United Nations General Assembly Resolution 70/1, "Transforming Our World: The 2030 Agenda for Sustainable Development", A/RES/70/1. New York, NY: United Nations, 2015.

Our analysis uses Demographic and Health Surveys (DHS) data from 23 sub-Saharan African countries for the period 2015-2023.[2] The DHS program has been conducting nationally representative household surveys in developing countries across the globe since the mid-1980s (Boerma and Sommerfelt 1993). The standard DHS questionnaires include items on fertility as well as items on marital history, current marital status, and the age when marriage/cohabitation first began; since 1988, DHS questionnaires have included a series of items that measure respondents' knowledge, beliefs and behaviors regarding HIV/AIDS. Our initial focus is on 237,132 female DHS respondents ages 18-49, all of whom had at least one older sibling.

Leveraging the randomness of the firstborn sibling's sex, we find that, on net, having a big sister (as compared to having a firstborn brother) serves to protect girls in sub-Saharan Africa against child marriage. The estimated effect of having a firstborn sister is, however, modest in terms of magnitude. Specifically, having a firstborn sister is associated with a 0.51 percentage-point reduction in the likelihood of marrying before the age of 18, or 1.5 percent relative to the untreated mean (i.e., the mean among respondents who had a firstborn brother).

When we expand our analysis to include female DHS respondents between the ages of 15 and 17, we find additional evidence that, on net, big sisters protect their younger sisters from child marriage. Specifically, having a firstborn sister is associated with a 0.20 percentage-point reduction in the likelihood of marrying before the age of 15, or 2.3 percent relative to the untreated mean. The estimated effect of having a firstborn sister is roughly 6 percent of the estimated effect of an

[2] See Appendix Table 1 for a list of countries from which our sample is drawn and the year in which each DHS survey was conducted.

additional year of schooling on the likelihood that girls in Uganda marry before reaching the age of 15 (Keats 2018).[3]

Having shown that firstborn sisters reduce the likelihood that their younger sisters marry before reaching adulthood, we turn our attention to exploring other ways in which big sisters could protect their younger sisters from risky (i.e., potentially unhealthy) sexual and/or reproductive behaviors. Relying on the randomness of the firstborn sibling's sex, we find that having a big sister leads to a reduction in the likelihood of having sex before the age of 18, and leads to a reduction in the likelihood of giving birth before the age of 18. Restricting our attention to female DHS respondents between the ages of 15 and 17, we find that having a big sister leads to increased awareness of HIV/AIDS and an increase in the likelihood of having been tested for HIV. These estimates, although statistically distinguishable from zero at conventional levels, cannot be characterized as economically significant. For instance, having a firstborn sister is associated with a 0.65 percentage-point increase in the likelihood of having heard about HIV/AIDS, which is only one fourth the size of the estimated effect of having an additional year of schooling (Agüero and Bharadwaj 2014).[4]

The DHS data are rich enough to allow for an exploratory analysis of mechanisms. The protective effects of having a firstborn sister on child marriage appear to be stronger when the respondent's birth order position is 4th or higher, which is consistent with the observation that, in sub-Saharan Africa, older siblings are often expected to provide childcare and actively teach the younger children in their family (Weisner and Gallimo 1977; Mweru 2011; Nsamenang 2011;

[3] Keats (2018) leveraged a nation-wide reform in Uganda that eliminated primary school fees to estimate the effect of schooling on the likelihood of marrying before the age of 15. More details regarding Keats (2018) are provided below, in Section 4.1.

[4] Agüero and Bharadwaj (2014) leveraged a nation-wide education reform in Zimbabwe that dramatically increased secondary school enrollment. More details regarding Agüero and Bharadwaj (2014) are provided below, in Section 5.2.

Tchombe 2011). Similarly, we find that the protective effects of having a firstborn sister are stronger when there is an age difference between the sisters of 7+ years. Finally, we find that the estimated effects of having a firstborn sister on child marriage are largest in the most socially conservative countries, as measured by the Social Institutions and Gender Index (SIGI). This last result suggests that the protective role of big sisters can be especially important when access to accurate information about sex and reproductive health is limited by discriminatory norms and economic institutions.

The remainder of the paper is organized as follows. In the next section, we provide background information, including a brief introduction to the practice of child marriage in sub-Saharan Africa and its potential harms. In Section 3, we describe the DHS data, our methodology, and provide definitions of key variables. Our primary results are reported in Section 4. Then, in Section 5, we extend our analysis by examining the effect of firstborn's sex on risky sexual and/or reproductive behaviors. Section 6 concludes.

2. BACKGROUND

2.1. Child marriage and its potential harms

Child marriage is typically defined as marriage (or cohabitation) before the age of 18 (Walker 2012; de Groot et al. 2018; Efevbera and Bhabha 2020). Although substantial progress has been made over the past several decades (Nguyen and Wodon 2015; Koski et al. 2017), millions of girls in sub-Saharan Africa are still at risk of marrying before reaching adulthood (UNICEF 2022).[5]

[5] According to UNICEF (2022), Eastern and Southern Africa is home to more than 50 million women ages 20-24 who were married (or entered into an informal union) before reaching their 18th birthday. Although girls are disproportionately affected by the practice, child marriage among boys is common in several sub-Saharan African countries. Based on DHS data, UNICEF (2022) estimates that more than 10 percent of boys in Comoros, Madagascar, and Mozambique marry before reaching the age of 18.

Eliminating the practice of child marriage will require a sustained commitment on the part of national governments, international development agencies, and local communities (Walker 2013; Cappa et al. 2023).[6]

Quasi-experimental studies provide evidence of substantial education-related benefits from delaying marriage (Field and Ambrus 2008; Nguyen and Wodon 2014; Delprato et al. 2015; Chari et al. 2017; Sunder 2019; Dhamija and Roychowdhury 2020). For instance, Field and Ambrus (2008) analyze data from Matlab (a rural region of Bangladesh) on ever-married women ages 25-44; using age of menarche as an instrument, these authors find that a one-year delay in marriage increases literacy and educational attainment. Adopting the Field and Ambrus (2008) identification strategy, Sunder (2019) finds that, among women in Uganda ages 15-49, delaying marriage by one year leads to non-trivial increases in educational attainment, literacy, and labor force participation.[7]

Correlational studies in the public health literature document strong and consistent associations between child marriage and a wide range of health- and fertility-related outcomes (Fan and Koski 2022). For instance, using data on women from northern Ghana, de Groot et al. (2018) find that child marriage is associated with a two-year reduction in age of first birth; using DHS data

[6] Although girls are disproportionately affected by the practice, child marriage among boys is common in several sub-Saharan African countries. Based on DHS data, UNICEF (2022) estimates that more than 10 percent of boys in Comoros, Madagascar, and Mozambique marry before reaching the age of 18. See Greene et al. (2023) for descriptions of various interventions aimed at reducing child marriage in Africa. Behrman (2015), Duflo et al. (2015), and Keats (2018) provide evidence that encouraging girls to stay in school protects them from marrying before reaching adulthood. See McGavock (2021) and Rokicki (2021) for evidence that raising the minimum legal marriage age in Ethiopia from 15 to 18 was effective. Using DHS data from 12 sub-Saharan African countries, Maswikwa et al. (2015) analyze the cross-sectional associations between child marriage, adolescent fertility, and the minimum legal marriage age.

[7] Several studies use age of menarche as an instrument to estimate the effect of delaying marriage on educational attainment and other outcomes (Field and Ambrus 2008; Chari et al. 2017; Sunder 2019; Dhamija and Roychowdhury 2020), but there is descriptive evidence from Kenya, Tanzania, and India that menstruation is an important barrier to attending school (Sommer 2010; Mason et al. 2013; Sivakami et al. 2019), casting doubt on whether age of menarche is a valid instrument. Using data from India and a difference-in-differences design, Khanna (2020) shows that starting menses before age 12 reduces school enrollment by approximately 13 percent.

on women from 34 sub-Saharan countries, Yaya et al. (2019) find that child marriage is associated with a 17-fold increase in the odds of having three or more children; and using data on women from Ethiopia, Erulkar (2013) finds that marriage before the age of 15 is associated with a substantial increase in the risk of experiencing intimate partner violence.

It should be noted, however, that these and similar associations in the public health literature—despite being of obvious concern—are not intended for causal interpretation (Fan and Koski 2022). Fan and Koski (2022) review 58 studies in the public health literature that examine child marriage and its associations with outcomes related to health and/or reproduction. These authors argue that child marriage could, "plausibly affect many aspects of maternal and reproductive health through complex causal pathways" (Fan and Koski 2022, p. 13), and caution that all 58 of the studies included in their review were "at serious to critical risk of bias" (Fan and Koski 2022, p. 14).

2.2. Older siblings

Much of what we know about how older siblings influence the sexual and reproductive behavior of their younger brothers and sisters comes from U.S. and European studies. Compared to firstborns, younger siblings in the United States and Europe are more likely to be sexually active as teenagers (Rodgers and Rowe 1988; Black et al. 2005; Argys et al. 2006; Averett et al. 2011) and are more likely to have learned about sex from their brothers and sisters as opposed to their parents (Elton et al. 2019).

Elton et al. (2019) use data on British men and women ages 17-29 to the explore the effect of birth order on sex education. These authors find that, compared to firstborns, middle- and last-born children were more likely to reported having learned about sex from their siblings (as opposed to their parents). Using data on American 7th through 12th graders, Averett et al. (2011) explore the effects of older brothers and sisters on the sexual behavior of their younger siblings. These authors

find that having an older sister increases the likelihood that younger brothers become sexually active as teenagers. By contrast, having an older brother is not associated with statistically significant differences in the sexual behavior of their younger siblings (Averett et al. 2011, Table 6, p. 972).

Qualitative studies provide evidence that older sisters actively mentor their younger sisters, serving as confidants and giving experience-based advice about sex and contraception (Buhrmester 1992; Killoren and Roach 2014; Grossman et al. 2018). In sub-Saharan Africa, older siblings are widely expected to help rear their younger brothers and sisters (Weisner and Gallimo 1977; Mweru 2011; Nsamenang 2011; Tchombe 2011). In fact, they often care for, supervise, and teach them "free from parental supervision and adult control" (Nsamenang 2011, p. 238). Big sisters teach their younger sisters to perform household chores, cook, and care for infants (Rabain-Jamin et al. 2003; Tudge 2006; Mweru 2011). Across the developing world, big sisters take on more childcare responsibilities and perform more household chores as compared to their male counterparts (Lancy 2015).

To our knowledge, no previous study has explored whether having a firstborn sister affects age at first marriage. Jakiela et al. (2023) do, however, estimate the effect of older sisters on human capital accumulation. Using data on 699 young children from 73 rural communities in western Kenya, these authors find that having an older sister (as opposed to an older brother) increases the vocabulary and fine motor skills of younger siblings. Jakiela et al. (2023, p. 25) conclude that big sisters, through their role as caregivers, profoundly shape the "developmental trajectories" of their younger siblings.[8] Adopting the Jakiela et al.'s (2023) identification strategy, we explore whether having a big sister affects younger sisters' risk of marrying before adulthood.

[8] See also Garg and Morduch (1998). Using data from the 1988-1989 Ghana Living Standards Survey, these authors find that children with sisters (as opposed to brothers) have better health as measured by height for age and weight for age.

3. Data, Outcomes, and Empirical Strategy

3.1. Data and outcomes

We draw on DHS data from 23 sub-Saharan countries for the period 2015-2023. Appendix Table 1 lists these countries and the year in which each DHS survey was conducted. We restrict our attention to female DHS respondents who completed the Adult and Maternal Mortality module and who had at least one older sibling (i.e., firstborns and only children were excluded from the analysis). The Adult and Maternal Mortality module asks respondents for a complete list of their siblings, the year in which each sibling was born, the sex of each sibling, and the survival status of each sibling. [9]

We have two primary outcomes: *Marriage < 18*, equal to 1 if respondent *i* was married or cohabitating before the age of 18 (and equal to zero otherwise); and *Marriage < 15*, equal to 1 if respondent *i* was married or cohabitating before the age of 15 (and equal to zero otherwise). When estimating the effect of having a firstborn sister on marrying before the age of 18, our sample is composed of 237,132 female respondents ages 18-49. We expand our sample to include 15- through 17-year-olds when estimating the effect of having a firstborn sister on marrying before the age of 15. In supplementary regressions, we explore the effects of having a big sister on marrying before the age of 16, marrying before the age of 17, having sex before adulthood, giving birth before adulthood, HIV/AIDS awareness, and knowledge of modern contraceptives.

3.2. Empirical strategy

The outcomes described above are modeled as a function of the firstborn sibling's sex, country-by-survey year fixed effects (δ_{ct}), a vector of controls ($\boldsymbol{X}_{ict}$), and an error term (ε_{ict}):

[9] The DHS data can be download free of charge (after registration) from https://dhsprogram.com. All of the respondents in our analysis completed the standard DHS Women's Questionnaire, which includes items about fertility and items intended to measure respondents' marital status, marriage/cohabitation history, and the age when marriage/cohabitation first began.

(1) $$y_{ict} = \beta_0 + \beta_1 Female\ Firstborn_{ict} + \delta_{ct} + \boldsymbol{X}_{ict}\boldsymbol{\beta}_2 + \varepsilon_{ict},$$

where *i* indexes respondents, *c* indexes country, and *t* indexes the year in which the DHS survey was conducted. $Female\ Firstborn_{ict}$ is equal to 1 if *i*'s firstborn older sibling was female and equal to 0 otherwise.[10] The coefficient β_1 represents the reduced-form (i.e., the net) effect of having a firstborn sister as opposed to having a firstborn brother. *A prior*, we cannot sign this effect. A positive estimate of β_1 would suggest that younger sisters are at an elevated risk of marrying before adulthood if there is a big sister in their household, while a negative estimate would suggest that, on net, big sisters have a protective effect.

Following Jakiela et al. (2023), we treat the sex of *i*'s firstborn sibling as exogenously determined. Sex-selective abortion is not widely practiced in sub-Saharan Africa (Rossi and Rouanet 2015). Most countries in the region have adopted restrictive abortion laws (Rossi and Rouanet 2015; Hinson et al. 2022) and there is no evidence that the male-to-female sex ratio at birth (SRB) is elevated or trending upwards over time (Anderson and Ray 2010; Chao et al. 2019).[11] According to Garenne (2009), the male-to-female SRB among firstborn children in sub-Saharan Africa 1.046; absent sex-selective abortion, biological SRBs range from 1.02 to 1.06 (WHO 2011).[12]

[10] *Female Firstborn* is based on the sex of *i's* firstborn older sibling regardless of whether this sibling survived past infancy. Below, we explore the effects of having an older sister who survived into adolescence.

[11] Moreover, very few pregnant women in the region have access to ultrasound technology. Carrera (2011) estimates that roughly 30 percent of women in cities and only 6 percent of women in rural areas have access to ultrasound during their pregnancies.

[12] Using DHS data from the 23 sub-Saharan African countries listed in Appendix Table 1, we calculate a firstborn male-to-female SRB at birth of 1.046, which exactly matches the firstborn SRB for sub-Saharan Africa reported by Garenne (2009). Estimates of the overall male-to-female SRB for sub-Saharan Africa produced by Chao et al. (2019) range from 1.037 (1990) to 1.032 (2017).

The country-by-survey year fixed effects, δ_{ct}, capture shared (i.e., common) determinants of child marriage such as cultural norms and economic conditions. The vector $\boldsymbol{X}_{ict}$ includes indicators for *i*'s age at the time of the DHS interview and her religion (*Muslim*, *Traditional*, *Christian*). In Appendix Table 2, we report descriptive statistics for these controls and provide definitions. We do not control for *i*'s educational attainment, urban status, or fertility history because these variables could, in theory, be influenced by the sex of *i*'s firstborn sibling. Likewise, aside from the *Female Firstborn*, we do not include any sibling characteristics on the right-hand side of equation (1), although we do show that our results are not sensitive to controlling for *i*'s birth order.

In theory, having a firstborn sister (as opposed to a firstborn brother) could affect the size and structure of the household in which *i* was raised, which in turn could affect the likelihood that she marries before reaching adulthood. Although our estimate of β_1 could reflect these (and other) indirect effects of the firstborn sibling's sex on child marriage, we find no evidence that the indicator *Female Firstborn* predicts the number of siblings reported by *i* (Appendix Table 3).[13] Likewise, there is no evidence that the sex of *i's* firstborn sibling predicts *i's* age at the time of her DHS interview or her religion (Appendix Table 3).

[13] In Appendix Table 3, we report the results of regressing the number of *i*'s younger siblings on *Female Firstborn*, country-by-survey year indicators, and birth order indicators. Because we include birth order indicators on the right-hand side of this regression, there is no variation in the number of older siblings that can be explained by *Female Firstborn*. (In other words, within a particular position in the birth order, every respondent has exactly the same number of older siblings.) See Dahl and Moretti (2008) for evidence that the firstborn's sex affects family structure in the United States. For instance, these authors show that, among mothers who have taken an ultrasound test during pregnancy, having a girl (as opposed to a boy) is associated with an increase in the likelihood of being married at the time of delivery.

4. RESULTS

4.1. Marrying before adulthood

Ordinary least squares (OLS) estimates of equation (1) are reported in Table 1. Regressions are unweighted, standard errors are clustered at the level of the DHS sampling unit, and the dependent variable is *Married < 18*. Without controlling for *i*'s age and religion, our estimate of β_1 is -.0.0050 and is statistically significant at the 0.01 percent level. Adding controls for *i*'s age and religion slightly increases its (absolute) magnitude: having a firstborn sister is associated with a 0.52 percentage-point reduction in the likelihood of marrying before the age of 18. Compared to the mean for untreated respondents (i.e., respondents with a firstborn male sibling), this represents a 1.5 percent reduction in the likelihood of marrying before the age of 18 (0.0052/0.3376 = 1.54).

In the third and last column of Table 1, we include controls for *i*'s birth order. Specifically, we include a series of birth order indicators (e.g., an indicator for whether *i* was the second-born child in her family, an indicator for whether *i* was the third-born child, an indicator for whether *i* was the fourth-born child, and so forth). Adding birth order indicators to the vector $\boldsymbol{X}$ does not appreciably change the estimate of β_1. Having a firstborn sister is associated with a 0.51 percentage-point reduction in the likelihood of marrying before the age of 18, or 1.5 percent compared to the untreated mean.[14]

In Table 2, we explore the effects of having a big sister on child marriage using alternative age cutoffs for adulthood. In columns (1) and (2) of Table 2, we expand the sample to include 15- through 17-year-olds and use *Married < 15* as the outcome. Having a firstborn sister is associated

[14] Four-hundred and fifty-eight of the 237,132 respondents reported having a male firstborn sibling and a female second-born sibling who were twins (i.e., they had the same birth date). Three-hundred and seventy-five of the 237,132 respondents reporting having a female firstborn sibling and a male second-born sibling who were twins. Dropping these 833 (458+ 375 =833) respondents produces almost identical results to those we report below. In general, excluding respondents from the analysis who reported having first- and second-born opposite-sex twin siblings had very little impact on our results.

with a 0.20 percentage-point reduction in the likelihood of marrying before the age of 15, or 2.3 percent compared to the untreated mean.[15]

Keats (2018) examines the effects of a nation-wide reform in Uganda that eliminated primary school fees. He finds that, among girls, this reform increased educational attainment by approximately one year and reduced the likelihood of marrying before the age of 15 by 3.4 percentage points. Our estimate of the effect of having an older sister on the likelihood of marrying before the age of 15 is roughly 6 percent of Keats' estimate the effect of staying in school for an additional year (0.20/3.4 = 0.059).[16]

In the remaining columns of Table 2, we experiment with two alternative outcomes: *Married < 16*, equal to 1 if respondent *i* was married or cohabitating before the age of 16 (and equal to zero otherwise); and *Married<17*, equal to 1 if respondent *i* was married or cohabitating before the age of 17 (and equal to zero otherwise). The estimates of β_1 using these alternative outcomes provide further evidence that having a firstborn sister protects against marrying before reaching adulthood. They are consistently negative and statistically significant at conventional levels. The estimated effect of having a firstborn sister on marrying before the age of 16 is approximately twice as large as the estimated effect on marrying before the age of 15 (-0.4 versus -0.2); the estimated effect on marrying before the age of 17 is slightly smaller than the estimated effect on marrying before the age of 16.

[15] It should be noted, however, that this estimate is only significant at the 10 percent level (p-value = 0.062).

[16] Keats also examines the effects of educational attainment on the likelihood of being sexually active and marrying before the age of 20. He finds no evidence that the reform affected the likelihood of being sexually active as a teenager, but an additional year of education is associated with a reduction of 3.5 percentage points in the likelihood of marrying before the age of 20.

4.2. Exploratory analysis of mechanisms

The estimates of β_1 reported thus far suggest that, on net, big sisters offer some protection against marrying before becoming an adult (Tables 1 and 2). Although modest in terms of magnitude, they are clearly distinguishable from zero in a statistical sense. In Table 3, we explore potential mechanisms. Specifically, we report estimates of the following equation:

$$(2) \qquad y_{ict} = a_0 + a_1 Female\ Firstborn_{ict} + a_2 Female\ Firstborn_{ict} \times Survived_{ict} + a_3 Survived_{ict} + \delta_{ct} + \boldsymbol{X}_{ict}\boldsymbol{\alpha_4} + \varepsilon_{ict},$$

where $Survived_{ict}$ is equal to 1 if *i*'s firstborn sister survived past *i*'s 14th birthday (and is equal to 0 otherwise). In addition, we report estimates of:

$$(3) \qquad y_{ict} = a_0 + a_1 Female\ Firstborn_{ict} + a_2 Female\ Firstborn_{ict} \times Fourth\text{-}Born_{ict} + \delta_{ct} + \boldsymbol{X}_{ict}\boldsymbol{\alpha_3} + \varepsilon_{ict},$$

where $Fourth\text{-}Born_{ict}$ is equal to 1 if *i*'s birth order position was 4th or higher (and is equal to 0 otherwise).[17] Because *Survived* and *Fourth-Born* could both, in theory, be influenced by the sex of *i*'s firstborn sibling, we are careful not to interpret the estimates of a_1 and a_2 in a causal fashion.

There is little evidence that the effect of having a big sister depends upon her survival status as of *i*'s 14th birthday (Table 3, columns 1 and 3). By contrast, our estimates of a_1 and a_2 provide evidence, albeit suggestive, that the protective influence of firstborn sisters is strongest if *i*'s birth order position was 4th or higher. For instance, our estimate of a_1 is 0.0006 (standard error = 0.0027) and our estimate of a_2 is -0.0108 (standard error = 0.0037) using *Married < 18* as the outcome, a pattern of results that is consistent with anthropological studies showing that older siblings in sub-

[17] Please note that the vector $\boldsymbol{X}$ in equation (3) includes a series of birth order dummies.

Saharan Africa care for and actively teach the youngest children in their family (Weisner and Gallimo 1977; Mweru 2011; Nsamenang 2011; Tchombe 2011). This pattern of results is confirmed when we interact *Female Firstborn* with an indicator for birth spacing of 7+ years (instead of the indicator *Fourth-Born*). If *i* was born 7+ years after her firstborn sibling, having a big sister is associated with a 0.89 percentage-point reduction in the likelihood of marrying before the age of 18 and a 0.55 percentage-point reduction in the likelihood of marrying before the age of 17 (Appendix Table 4).[18]

Next, we interact *Female Firstborn* with two indicators based on the Social Institutions and Gender Index (SIGI), created by the OECD Development Centre. The SIGI is intended to measure social norms, practices, and institutions that discriminate against women.[19] In Table 4, we show estimates of the following equation:

$$(4)\quad y_{ict} = a_0 + a_1 Female\ Firstborn_{ict} + a_2 Female\ Firstborn_{ict} \times High\ SIGI_c + a_3 High\ SIGI_c + a_4 Female\ Firstborn_{ict} \times Medium\ SIGI_c + a_5 Medium\ SIGI_c + \delta_{ct} + \boldsymbol{X}_{ict}\boldsymbol{\alpha}_6 + \varepsilon_{ict},$$

where $High\ SIGI_c$ is equal to 1 if *c*, ***i***'s country of residence, received a score of 22 or higher on the SIGI (and is equal to 0 otherwise); $Medium\ SIGI_c$ is equal to 1 if *c* received a score between 12 and 22 (and is equal to 0 otherwise). A SIGI score of 22 or higher indicates that women in country *c* face significant levels of discrimination, while a SIGI score below 12 indicates that country *c*

[18] If *i* was born 0-6 years after her firstborn sibling, the estimated effects of having a big sister are small and statistically insignificant (Appendix Table 4). In our sample, the median age difference between respondents and their firstborn sibling was 7 years. Because having a firstborn sister (as opposed to a firstborn brother) could, in theory, affect birth spacing, we are careful not to put a causal interpretation on the estimates of a_1 and a_2 reported in Appendix Table 4.

[19] The SIGI is intended to measure discrimination against women and girls in 5 broad areas: the family legal code, physical safety, bias against daughters (e.g., the degree to which selective abortion is practiced), access to land and assets, and civil liberties (Ferrant and Nowacka 2015).

is "characterised by strong laws providing equal rights for women and men in the family code, in access to resources and assets, and in civil liberties" (OECD 2014, p. 10).[20]

The estimates of equation (4) reported in Table 4 provide evidence that the protective effect of having a firstborn sister is strongest in countries with higher levels of discrimination against women (i.e., countries with a SIGI score of 22 and above), where access to accurate information about sex and reproductive health is likely curtailed (Ege et al. 2014). In low-SIGI countries, the estimated effects of having a firstborn sister are consistently positive but statistically insignificant at conventional levels. By contrast, in high- and medium-SIGI countries, having a firstborn sister is associated with reductions in the likelihood of marrying before the ages of 17 and 18. For instance, in high-SIGI countries, having a firstborn sister is associated with a 0.55 percentage-point reduction in the likelihood of marrying before the age of 18; in medium-SIGI countries, having a firstborn sister is associated with a 0.60 percentage-point reduction in the likelihood of marrying before the age of 18.[21]

5. DO BIG SISTERS HAVE OTHER PROTECTIVE EFFECTS?

5.1. Teenage sexual activity and births

As part of the standard Women's Questionnaire, DHS respondents are asked if they are sexually active and, if they are sexually active, the age at which they first had intercourse. Using the answers to these questions, we examine whether having a firstborn sister influences the likelihood of

[20] In Appendix Table 5, we report the SIGI score and SIGI category of each of the 23 countries that contributed data to our analysis. These SIGI scores and categories are from OECD (2014). Fourteen out of the 23 countries have a SIGI score of 22 or above, 7 are in the medium range, and two are in the low range. Of the 14 countries with a SIGI score of 22 or above, 5 are Muslim-majority; of the 7 countries in medium range, one is Muslim-majority. According to the OECD (2014, p. 10), a SIGI score of greater than 22 indicates that there is "discrimination embedded in customary laws, social norms and practices and by inappropriate legal protections against gender discrimination in all dimensions of social institutions".

[21] Both of these estimates are statistically significant at the 5 percent level.

becoming sexually active before adulthood. Economists have long been interested in gauging the effects of sex education programs on teen pregnancy and the sexual behavior of U.S. teenagers (Oettinger 1999; Sabia 2006; Kearney and Levine 2012; Carr and Packham 2017; Paton et al. 2020). There is also extensive research on the determinants of teenage sexual behavior in sub-Saharan Africa (Uchudi et al. 2012; Kangmennaang et al. 2019; Puplampu et al. 2021; Budu et al. 2023) but whether older sisters discourage (or encourage) their younger siblings from having sex is an open question.[22]

In the first two columns of Table 5, we report estimates of the effect of the firstborn sibling's sex on the likelihood that *i* had sex before reaching adulthood.[23] These estimates provide additional evidence that big sisters serve in a protective role. Having a firstborn sister (as opposed to a firstborn brother) is associated with a 0.23 percentage-point reduction in the likelihood of having sex before the age of 15 (p-value = 0.081) and a 0.46 percentage-point reduction in the likelihood of having sex before the age of 18. Compared to the untreated means, these estimates represent 1.6 percent and 0.8 percent reductions, respectively.[24]

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[22] Adeokun et al. (2009) surveyed 989 high school students in northern Nigeria about their sexual behaviors. About half (48 percent) of these students reported having talked to someone about their sexual experiences in the past year. Among female students who knew how to prevent unwanted pregnancies, 70 percent reported learning about contraception from their siblings; among male students who knew how to prevent unwanted pregnancies, only 30 percent reported learning about contraception from their siblings. Onyeonoro et al. (2011) surveyed 360 female high school students in southeastern Nigeria. Eighteen percent reported that elder siblings were their primary source of information about sex, but only 12.5 percent reported that parents were their primary source of information about sex. Mostert et al. (2020) surveyed 79 students from a rural South African high school about their sexual experiences and preference. Among these 79 students, 42 percent reported that television was their primary source of knowledge about sex, 29 percent reported that magazines/books were their primary source of knowledge, and 14 percent reported that siblings were their primary source of knowledge.

[23] Specifically, we use two new outcomes: (1) $Sex < 15$, equal to 1 if *i* was sexually active before the age of 15 (and equal to 0 otherwise), and (2) $Sex < 18$, equal to 1 if *i* was sexually active before the age of 18 (and equal to 0 otherwise).

[24] In Appendix Table 6, we report estimates of the effect of having a firstborn sister on the likelihood of having sex before the age of 16 and the likelihood of having sex before the age of 17. The results are qualitatively similar to those reported in Table 5.

In the remaining columns of Table 5, we explore the reduced-form effect of big sisters on giving birth before reaching adulthood.[25] There is no evidence that the sex of the firstborn sibling affects the likelihood of giving birth before the age of 15. Having a firstborn sister is, however, associated with a 0.46 percentage-point reduction in the likelihood of giving birth before the age of 18 (p-value = 0.015). Compared to the untreated mean, this estimate represents a 1.6 percent reduction.[26]

5.2. HIV/AIDS awareness, HIV testing, and knowledge of modern contraceptive methods

Sexually transmitted diseases are a critically important health problem in sub-Saharan Africa. It is estimated that almost 26 million people in the region are infected with HIV; girls and young women account for approximately 25 percent of all new HIV infections (WHO 2022).

Building on studies that have identified siblings as a key source of information about HIV/AIDS among African youth (Dimbuene and Defo 2011; Harling et al. 2018), we estimate the effect of having a big sister on awareness of HIV/AIDS. The dependent variable, *HIV/AIDS Awareness* is equal to 1 if respondent *i* answered the question, "Have you ever heard of HIV or AIDS?" in the affirmative (and is equal to 0 otherwise). For this sub-analysis, our focus is on female DHS respondents ages 15-17 with at least one older sibling.

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[25] Specifically, we use two new outcomes: (1) *Birth < 15,* equal to 1 if *i* gave birth before the age of 15 (and equal to 0 otherwise); and (2) *Birth < 18*, equal to 1 if *i* gave birth before the age of 18 (and equal to 0 otherwise).

[26] In Appendix Table 6, we report estimates of the effect of having a firstborn sister on the likelihood of giving birth before the age of 16 and the likelihood of giving birth before the age of 17. Having a firstborn sister is associated with a 0.21 to 0.22 percentage-point reduction in the likelihood of giving birth before the age of 16 and a 0.52 to 0.53 percentage-point reduction in the likelihood of giving birth before the age of 17.

The results, reported in the first column of Table 6, provide evidence that the protective role of big sisters extends to HIV/AIDS awareness and HIV testing. Having a firstborn sister is associated with a 0.65 percentage-point increase in HIV/AIDS awareness (p-value = 0.055), or 0.73 percent relative to the untreated mean. Agüero and Bharadwaj (2014) leveraged a nation-wide education reform in Zimbabwe that increased secondary school enrollment by approximately 25 percent. Their instrumental variables (IV) estimates suggest that, among 9- through 20-year-olds, an additional year of schooling leads to an increase of 2.7 percentage points in the likelihood of having heard about HIV/AIDS, an estimate that these authors describe as "small" (Agüero and Bharadwaj 2014, p. 508). Our estimate of the effect of having a firstborn sister is only a fourth the size of Agüero and Bharadwaj estimate (0.0065/0.027 = 0.24).[27]

In the second column of Table 6, we report the estimated effect of having a firstborn sister on the likelihood of ever having been tested for HIV; in the last column, we report the estimated effect of having a firstborn sister on the likelihood of having knowledge of at least one modern contraceptive method.[28] Having a firstborn sister is associated with a 0.92 percentage-point increase in the likelihood of having been tested for HIV, or 4.6 percent relative to the untreated mean. The estimated effect on contraceptive knowledge is not statistically significant at conventional levels.[29]

[27] Agüero and Bharadwaj (2014) find larger effects on other, related outcomes. For instance, they find that an additional year of schooling leads to an increase of 6.5 percentage points in the likelihood of having "comprehensive knowledge" of HIV and an increase of 5.6 percentage points in the likelihood of knowing that using a condom reduces the chances of being infected with HIV.

[28] Specifically, this outcome is equal to 1 if the respondent answered the question, "Do you have knowledge of any contraceptive method that is classified as modern?" in the affirmative (and is equal to 0 otherwise).

[29] In Appendix Table 7, we restrict our attention to female DHS respondents ages 15-17 who were sexually active. With this restriction in place, having a firstborn sister is associated with a 1.04 percentage-point increase in the likelihood of having knowledge of at least one modern contraceptive method (p-value = 0.069).

5.3. Where and when are these protective effects strongest?

In Appendix Tables 8-10, we explore where and when the protective effects documented in Tables 5 and 6 are strongest by interacting *Female Firstborn* with the indicators *Survived*, *Fourth-Born*, *High-SIGI*, and *Medium-SIGI*, all of which were introduced in Section 4. The resulting estimates are imprecise but provide suggestive evidence that the protective effects of having a firstborn sister are strongest when the respondent's birth order position was 4th or higher. Specifically, if *i*'s birth order position was 4th or higher, having a firstborn sister is associated with a (statistically insignificant) 0.76 percentage-point reduction in the likelihood of becoming sexually before the age of 18 (p-value = 0.107). Similarly, if *i*'s order birth position was 4th or higher, having a firstborn sister is associated with a (statistifcally insignificant) 0.75 percentage-point reduction in the likelihood of giving birth before the age of 18 (p-value = 0.112).[30]

6. CONCLUSION

Child marriage, defined as marrying or cohabitating before the age of 18, is common in sub-Saharan Africa. According to UNICEF, there are currently 50 million child brides in Eastern and Southern Africa (UNICEF 2022); approximately one-third of girls in this region marry or cohabitate before reaching adulthood (Koski et al. 2017; UNICEF 2022). Member states of the United Nations have pledged to eradicate child marriage by 2030, but reaching this ambitious goal will take

[30] These estimates are reported in Appendix Table 8. If *i* was the second- or third-born, the estimated effects of having a big sister are small and statistically insignificant. The estimates reported in Appendix Table 10, although imprecise, offer tentative evidence that the protective effect of having a big sister is respondents is largest in high-SIGI countries. In high-SIGI countries, having a firstborn sister is associated with a 0.66 percentage-point reduction in the likelihood of becoming sexually active before the age of 18 and a 0.67 percentage-point reduction in the likelihood of giving birth before the age of 18. These associations, however, are not statistically significant at the 10 percent level. In high-SIGI countries, having a firstborn sister is associated with a 0.83 percentage-point increase in the likelihood of having knowledge about at least one modern contraceptive method (p-value = 0.082). This latter estimate is one percent of the untreated mean (0.0083/0.8231 = 0.010).

considerable resources and a sustained effort on the part of national governments and local communities (Cappa et al. 2023).

In this study, we examine the effect of having a firstborn sister on the likelihood of marrying before reaching adulthood. We build upon previous research that explores the effects of having a girl (as opposed to a boy) on parental attitudes and behaviors (Dahl and Moretti 2008; Washington 2008; Glynn and Sen 2015) and on the outcomes of other children in the family (Parish and Willis 1993; Garg and Morduch 1998; Jakiela et al. 2023). Drawing on DHS data from 23 sub-Saharan African countries and relying on the randomness of the firstborn sibling's sex, we find evidence that, on net, big sisters have modest—but precisely estimated—protective effects. Having a firstborn sister leads to a 0.5 percentage-point reduction in the likelihood of marrying before the age of 18, or 1.5 percent relative to baseline; having a firstborn sister leads to a 0.2 percentage-point reduction in the likelihood of marrying before the age of 15, or approximately 2 percent relative to baseline. This latter estimate is only 6 percent of the estimated effect of an additional year of schooling on the likelihood that girls in Uganda marry before reaching the age of 15 (Keats 2018).

The protective effects of big sisters appear to extend beyond child marriage to other risky health and reproductive behaviors. We find that having a firstborn sister is associated with reductions of:

- 1.6 percent in the likelihood of having sex before the age of 15;
- almost 1 percent in the likelihood of having sex before the age of 18; and
- 1.6 percent in the likelihood of giving birth before the age of 18.

Having a firstborn sister is also associated with an increase of 0.7 percent in the likelihood of having heard of HIV/AIDS and an increase of 4.6 percent in the likelihood of having been tested for HIV. These estimated protective effects of having a firstborn sister are distinguishable from zero in a

statistical sense but are, without exception, modest in terms of magnitude. For instance, the estimated effect of having a firstborn sister on having heard of HIV/AIDS is only a fourth the size of the estimated effect of having an additional year of schooling (Agüero and Bharadwaj 2014).

Exploratory analyses provide evidence that the effects of having a firstborn sister are often stronger for respondents whose birth order position was 4th or higher, which is consistent with the observation that, in sub-Saharan Africa, older siblings are expected to provide childcare and actively teach the younger children in their family (Weisner and Gallimo 1977; Mweru 2011; Nsamenang 2011; Tchombe 2011). In addition, we find that the estimated effects of having a firstborn sister on child marriage are largest in high-SIGI countries, which suggests that big sisters can play an important role when access to accurate information about sex and reproductive health is limited by discriminatory norms and economic institutions. Communication campaigns designed to promote positive role modeling by older siblings could be especially effective in high-SIGI countries.

Finally, it should be emphasized that all of our reported estimates are reduced form. They represent the net effect of having a firstborn sister, which could, in theory, reflect myriad direct and indirect effects. Although we show that the firstborn sibling's sex is not predictive of the number of siblings reported by the respondents who compose our sample, we cannot not rule out other indirect channels. Because selective abortion is not generally practiced in sub-Saharan Africa (Anderson and Ray 2010; Chao et al. 2019), we are confident that firstborn sibling's sex is as good as random, but documenting the precise causal chain through which big sisters protect their younger sisters from marrying before reaching adulthood and engaging in other risky behaviors is beyond the scope of our study.

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Table 1. The Effect of Having a Firstborn Sister on the Likelihood of Marrying Before the Age of 18

	Married < 18	*Married < 18*	*Married < 18*
Female Firstborn	-0.0050***	-0.0052***	-0.0051***
	(0.0019)	(0.0019)	(0.0019)
Age and religion indicators	no	yes	yes
Birth order indicators	no	no	yes
Country-by-survey year fixed effects	yes	yes	yes
N	237,132	237,132	237,132
Mean of DV (*Female Firstborn* = 0)	0.3376	0.3376	0.3376
Mean of DV (*Female Firstborn* = 1)	0.3282	0.3282	0.3282

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. The sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome *Married < 18* is equal to 1 if *i* married before the age of 18 (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Table 2. Firstborn Sisters and Marrying Before Adulthood

	(1)	(2)	(3)	(4)	(5)	(6)
	Married < 15	*Married < 15*	*Married < 16*	*Married < 16*	*Married < 17*	*Married < 17*
Female Firstborn	-0.0020*	-0.0020*	-0.0041***	-0.0040***	-0.0036**	-0.0035**
	(0.0011)	(0.0011)	(0.0014)	(0.0014)	(0.0017)	(0.0017)
Age and religion indicators	yes	yes	yes	yes	yes	yes
Birth order indicators	no	yes	no	yes	no	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes	yes
N	275,485	275,485	261,509	261,509	248,863	248,863
Mean of DV (*Female Firstborn* = 0)	0.0867	0.0867	0.1610	0.1610	0.2443	0.2443
Mean of DV (*Female Firstborn* = 1)	0.0826	0.0826	0.1537	0.1537	0.2368	0.2368

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In columns (1) and (2), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in columns (3) and (4), the sample is composed of female DHS respondents ages 16-49 with at least one older sibling; and in columns (5) and (6), the sample is composed of female DHS respondents ages 17-49 with at least one older sibling. The outcome *Married < 15* is equal to 1 if *i* married before the age of 15 (and is equal to 0 otherwise). The outcome *Married < 16* is equal to 1 if *i* married before the age of 16 (and is equal to 0 otherwise). The outcome *Married < 17* is equal to 1 if *i* married before the age of 17 (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Table 3. Exploratory Analysis: Firstborn's Survival Status and the Respondent's Birth Order

	(1)	(2)	(3)	(4)
	Married < 15	*Married < 15*	*Married < 18*	*Married < 18*
Female Firstborn x Survived	0.0003		0.0041	
	(0.0035)		(0.0062)	
Female Firstborn x Fourth-Born		-0.0052**		-0.0108***
		(0.0020)		(0.0037)
Female Firstborn	-0.0018	0.0008	-0.0079	0.0006
	(0.0034)	(0.0015)	(0.0059)	(0.0027)
Age and religion indicators	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes
N	274,104	275,485	235,895	237,132
Mean of DV (*Female Firstborn* = 0)	0.0867	0.0867	0.3376	0.3376
Mean of DV (*Female Firstborn* = 1)	0.0826	0.0826	0.3282	0.3282

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In columns (1) and (2), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in columns (3) and (4), the sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome *Married < 15* is equal to 1 if *i* married before the age of 15 (and is equal to 0 otherwise). The outcome *Married < 18* is equal to 1 if *i* married before the age of 18 (and is equal to 0 otherwise). *Survived* is an indicator for whether *i's* firstborn older sister survived until *i* reached the age of 14. The indicator *Fourth-Born* is equal to 1 if *i's* birth order position was 4th or higher (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Table 4. Exploratory Analysis: The SIGI

	(1)	(2)	(3)	(4)
	Married < 15	*Married < 16*	*Married < 17*	*Married < 18*
Female Firstborn x *High SIGI*	-0.0033	-0.0056	-0.0113**	-0.0156**
	(0.0025)	(0.0040)	(0.0055)	(0.0074)
Female Firstborn x *Medium SIGI*	-0.0014	-0.0019	-0.0096*	-0.0161**
	(0.0025)	(0.0040)	(0.0056)	(0.0076)
Female Firstborn	0.0005	0.0001	0.0068	0.0101
	(0.0020)	(0.0035)	(0.0050)	(0.0070)
Age and religion indicators	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes
N	275,485	261,509	248,863	237,132
Mean of DV (*Female Firstborn* = 0)	0.0867	0.1610	0.2443	0.3376
Mean of DV (*Female Firstborn* = 1)	0.0826	0.1537	0.2368	0.3282

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In column (1), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in column (2), sample is composed of female DHS respondents ages 16-49 with at least one older sibling; in column (3) the sample is composed of DHS respondents ages 17-49 with at least one older sibling; and in column (4), the sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome *Married < 15* is equal to 1 if *i* married before the age of 15 (and is equal to 0 otherwise). The outcome *Married < 16* is equal to 1 if *i* married before the age of 16 (and is equal to 0 otherwise). The outcome *Married < 17* is equal to 1 if *i* married before the age of 17 (and is equal to 0 otherwise). The outcome *Married < 18* is equal to 1 if *i* married before the age of 18 (and is equal to 0 otherwise). The indicator *High SIGI* is equal to 1 if *c*, *i's* country of residence received a score of 22 or higher on the SIGI, indicating significant levels of discrimination against women (and is equal to 0 otherwise). The indicator *Medium SIGI* is equal to 1 if *c* received a score between 12-22 on the SIGI (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Table 5. The Effects of Firstborn Sisters on Teenage Sex and Births

	(1)	(2)	(3)	(4)
	Sex < 15	*Sex < 18*	*Birth < 15*	*Birth < 18*
Female Firstborn	-0.0023*	-0.0046**	-0.0003	-0.0046**
	(0.0013)	(0.0019)	(0.0008)	(0.0019)
Age and religion indicators	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes
N	279,391	240,998	243,094	212,014
Mean of DV (*Female Firstborn* = 0)	0.1457	0.5620	0.0403	0.2850
Mean of DV (*Female Firstborn* = 1)	0.1429	0.5563	0.0395	0.2786

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In columns (1) and (3), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in columns (2) and (4), the sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome *Sex < 15* is equal to 1 if *i* was sexually active before the age of 15 (and is equal to 0 otherwise). The outcome *Sex < 18* is equal to 1 if *i* was sexually active before the age of 18 (and is equal to 0 otherwise). The outcome *Birth < 15* is equal to 1 if *i* gave birth before the age of 15 (and is equal to 0 otherwise). The outcome *Birth < 18* is equal to 1 if *i* gave birth before the age of 18 (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Table 6. The Effects of Firstborn Sisters on HIV/AIDS Awareness and Knowledge of Modern Contraceptive Methods.

(Sample Restricted to Adolescents)

	(1) *Heard of HIV/AIDS*	(2) *Tested for HIV*	(3) *Knowledge of Modern Contraceptive*
Female Firstborn	0.0065*	0.0092**	0.0046
	(0.0034)	(0.0041)	(0.0036)
Age and religion indicators	yes	yes	yes
Birth order indicators	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes
N	29,879	33,158	38,481
Mean of DV (*Female Firstborn* = 0)	0.8942	0.1992	0.8231
Mean of DV (*Female Firstborn* = 1)	0.9035	0.2159	0.8332

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. The sample is composed of female DHS respondents ages 15-17 with at least one older sibling. The outcome *Heard of HIV/AIDS* is equal to 1 if *i* answered yes to the question, "Have you ever heard of HIV or AIDS?" (and is equal to 0 otherwise). The outcome *Tested for HIV* is equal to 1 if *i* was ever tested for HIV (and is equal to 0 otherwise). The outcome *Knowledge of Modern Contraceptive* is equal to 1 if *i* had knowledge of at least one modern contraceptive method (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Appendix for online publication.

Appendix Table 1. DHS Surveys and Observations

		Observations	Year of Survey
1.	Angola	7,422	2015
2.	Benin	9,474	2017
3.	Burkina Faso	10,526	2021
4.	Burundi	11,386	2016
5.	Cameroon	8,321	2018
6.	Chad	10,409	2015
7.	Ivory Coast	8,801	2021
8.	Ethiopia	9,901	2016
9.	Gambia	7,909	2019
10.	Gabon	5,606	2021
11.	Lesotho	3,831	2023
12.	Liberia	5,189	2019
13.	Mali	6,234	2018
14.	Mozambique	7,319	2023
15.	Nigeria	25,907	2018
16.	Rwanda	9,235	2015
16.	Rwanda	9,644	2020
17.	Senegal	10,961	2017
17.	Senegal	9,836	2023
18.	Sierra Leone	9,099	2019
19.	South Africa	4,531	2016
20.	Tanzania	8,944	2015
20.	Tanzania	9,989	2022
21.	Uganda	11,953	2016
22.	Zambia	8,637	2018
23.	Zimbabwe	6,068	2015
	Total observations:	237,132	

Appendix Table 2. Means and Definitions of Independent Variables

Variable	Mean	Definition
Christian	0.5865	*Christian* is equal to 1 if *i* was Christian (and is equal to 0 otherwise).
Traditional	0.0172	*Traditional* is equal to 1 if *i*'s religion was traditional (and is equal to 0 otherwise).
No Religion	0.0145	*No Religion* is equal to 1 if *i* reported no religion (and is equal to 0 otherwise).
Muslim (omitted)	0.3818	*Muslim* is equal to 1 if *i* was Muslim (and is equal to 0 otherwise).
Age 46-49	0.0610	*Age 46-49* is equal to 1 if *i* was 46- through 49-years old (and is equal to 0 otherwise).
Age 42-45	0.0774	*Age 42-45* is equal to 1 if *i* was 42- through 45-years old (and is equal to 0 otherwise).
Age 38-41	0.0988	*Age 38-41* is equal to 1 if *i* was 38- through 41-years old (and is equal to 0 otherwise).
Age 34-37	0.1159	*Age 34-37* is equal to 1 if *i* was 34- through 37-years old (and is equal to 0 otherwise).
Age 30-33	0.1353	*Age 30-33* is equal to 1 if *i* was 30- through 33-years old (and is equal to 0 otherwise).
Age 26-29	0.1437	*Age 26-29 1* is equal to 1 if *i* was 26- through 29-years old (and is equal to 0 otherwise).
Age 22-25	0.1724	*Age 22-25* is equal to 1 if *i* was 22- through 25-years old (and is equal to 0 otherwise).
Age 18-21 (omitted)	0.1956	*Age 18-21* is equal to 1 if *i* was 18- through 21-years old (and is equal to 0 otherwise).

Observations = 237,132

Appendix Table 3. Does Having a Firstborn Sister Predict *i*'s Religion or the Number of Her Younger Siblings?

	(1)	(2)	(3)	(4)	(5)
	Christian	*Muslim*	*Traditional*	*No Religion*	*Younger Siblings*
Female Firstborn	-0.0002	0.0009	-0.0003	-0.0004	-0.0020
	(0.0016)	(0.0015)	(0.0005)	(0.0005)	(0.0086)
Age and religion indicators	yes	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes
N	237,132	237,132	237,132	237,132	237,132
Mean of DV (*Female Firstborn* = 0)	0.5833	0.3847	0.0174	0.0146	2.5849
Mean of DV (*Female Firstborn* = 1)	0.5901	0.3787	0.0169	0.0142	2.5982

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. The sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome *Christian* is equal to 1 if *i* was Christian (and is equal to 0 otherwise). The outcome *Muslim* is equal to 1 if *i* was Muslim (and is equal to 0 otherwise). The outcome *Traditional* is equal to 1 if *i*'s religion was traditional (and is equal to 0 otherwise). The outcome *No Religion* is equal to 1 if *i* reported no religion (and is equal to 0 otherwise). *Younger Siblings* is equal to *i*'s number of younger siblings. Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Appendix Table 3 (continued). Does Having a Firstborn Sister Predict *i*'s Age?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Age 18-21	*Age 22-25*	*Age 26-29*	*Age 30-33*	*Age 34-37*	*Age 38- 41*	*Age 42-45*	*Age 46-49*
Female Firstborn	-0.0030*	-0.0002	0.0007	0.0022	0.0022*	-0.0011	0.00003	-0.0009
	(0.0017)	(0.0015)	(0.0014)	(0.0014)	(0.0013)	(0.0012)	(0.0011)	(0.0010)
Age and religion indicators	yes	yes	yes	yes	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	237,132	237,132	237,132	237,132	237,132	237,132	237,132	237,132
Mean of DV (*Female Firstborn* = 0)	0.1972	0.1727	0.1434	0.1344	0.1148	0.0992	0.0772	0.0612
Mean of DV (*Female Firstborn* = 1)	0.1938	0.1720	0.1440	0.1364	0.1172	0.0983	0.0776	0.0608

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. The sample is composed of female DHS respondents ages 18-49 with at least one older sibling. Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Appendix Table 4. Interacting *Female Firstborn* with an Indicator for Birth Spacing

	(1)	(2)	(3)	(4)
	Married < 15	*Married < 16*	*Married < 17*	*Married < 18*
Female Firstborn **x** *Age Difference 7+*	-0.0027	-0.0012	-0.0071*	-0.0119***
	(0.0023)	(0.0030)	(0.0037)	(0.0041)
Female Firstborn	-0.0002	-0.0026	0.0016	0.0030
	(0.0017)	(0.0023)	(0.0027)	(0.0031)
Age and religion indicators	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes
N	225,311	213,114	202,041	191,762
Mean of DV (*Female Firstborn* = 0)	0.0867	0.1610	0.2443	0.3376
Mean of DV (*Female Firstborn* = 1)	0.0826	0.1537	0.2368	0.3282

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In column (1), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in column (2), sample is composed of female DHS respondents ages 16-49 with at least one older sibling; in column (3) the sample is composed of DHS respondents ages 17-49 with at least one older sibling; and in column (4), the sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome *Married < 15* is equal to 1 if *i* married before the age of 15 (and is equal to 0 otherwise). The outcome *Married < 16* is equal to 1 if *i* married before the age of 16 (and is equal to 0 otherwise). The outcome *Married < 17* is equal to 1 if *i* married before the age of 17 (and is equal to 0 otherwise). The outcome *Married < 18* is equal to 1 if *i* married before the age of 18 (and is equal to 0 otherwise). The indicator *Age Difference 7+* is equal to 1 if *i* was born 7 or more years after her firstborn sister (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Appendix Table 5. SIGI Scores and Categories

		Score	Low	Medium	High and Very High
1.	Angola	17.19		✔	
2.	Benin	27.80			✔
3.	Burkina Faso	28.19			✔
4.	Burundi	16.62		✔	
5.	Cameroon	28.03			✔
6.	Chad	46.65			✔
7.	Ivory Coast	25.37			✔
8.	Ethiopia	24.50			✔
9.	Gambia	52.40			✔
10.	Gabon	40.22			✔
11.	Lesotho	8.76	✔		
12.	Liberia	38.28			✔
13.	Mali	51.64			✔
14.	Mozambique	13.75		✔	
15.	Nigeria	39.11			✔
16.	Rwanda	13.39		✔	
17.	Senegal	19.85		✔	
18.	Sierra Leone	37.20			✔
19.	South Africa	5.99	✔		
20.	Tanzania	25.04			✔
21.	Uganda	21.63		✔	
22.	Zambia	44.89			✔
23.	Zimbabwe	13.92		✔	

Notes: The Social Institutions and Gender Index (SIGI) measures discrimination against women in social institutions. See OECD (2014) for details on its construction and interpretation.

Appendix Table 6. The Effects of Firstborn Sisters on Teenage Sexual Activity and Births

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Sex < 16	*Sex < 16*	*Sex < 17*	*Sex < 17*	*Birth < 16*	*Birth < 16*	*Birth < 17*	*Birth < 17*
Female Firstborn	-0.0041**	-0.0041**	-0.0063***	-0.0063***	-0.0022*	-0.0021*	-0.0053***	-0.0052***
	(0.0017)	(0.0017)	(0.0019)	(0.0019)	(0.0012)	(0.0012)	(0.0016)	(0.0016)
Age and religion indicators	yes	yes	yes	yes	yes	yes	yes	yes
Birth order indicators	no	yes	no	yes	no	yes	no	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	265,408	265,408	252,756	252,756	230,754	230,754	220,671	220,671
Mean of DV (*Female Firstborn* = 0)	0.2985	0.2985	0.4371	0.4371	0.0949	0.0949	0.1788	0.1788
Mean of DV (*Female Firstborn* = 1)	0.2935	0.2935	0.4298	0.4298	0.0918	0.0918	0.1721	0.1722

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In columns (1), (2), (5), and (6) the sample is composed of female DHS respondents ages 16-49 with at least one older sibling; in columns (3), (4), (7), and (8) the sample is composed of female DHS respondents ages 17-49 with at least one older sibling. The outcome *Sex < 16* is equal to 1 if *i* was sexually active before the age of 16 (and is equal to 0 otherwise). The outcome *Sex < 17* is equal to 1 if *i* was sexually active before the age of 17 (and is equal to 0 otherwise). The outcome *Birth < 16* is equal to 1 if *i* gave birth before the age of 16 (and is equal to 0 otherwise). The outcome *Birth < 17* is equal to 1 if *i* gave birth before the age of 17 (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Appendix Table 7. The Effects of Firstborn Sisters on HIV/AIDS Awareness and Knowledge of Modern Contraceptive Methods: Sample Restricted to Sexually Active Adolescents

	(1) *Heard of AIDS/HIV*	(2) *Tested for HIV*	(3) *Knowledge of Modern Contraceptive*
Female Firstborn	0.0133**	0.0161*	0.0104*
	(0.0068)	(0.0090)	(0.0057)
Age and religion indicators	yes	yes	yes
Birth order indicators	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes
N	7,461	8,775	10,072
Mean of DV (*Female Firstborn* = 0)	0.8907	0.3418	0.8834
Mean of DV (*Female Firstborn* = 1)	0.9059	0.3671	0.8971

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. The sample is composed of sexually active female DHS respondents ages 15-17 with at least one older sibling. The outcome *Heard of HIV/AIDS* is equal to 1 if *i* answered yes to the question, "Have you ever heard of HIV or AIDS?" (and is equal to 0 otherwise). The outcome *Tested for HIV* is equal to 1 if *i* was ever tested for HIV (and is equal to 0 otherwise). The outcome *Knowledge of Modern Contraceptive* is equal to 1 if *i* had knowledge of at least one modern contraceptive method (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. See Appendix Tables 1 and 2 for more information on the sample and controls.

Appendix Table 8. Interacting the *Female Firstborn* indicator with Firstborn's Survival Status and the Respondent's Birth Order: Teenage Sexual Activity and Fertility as Outcomes

	(1) *Sex < 15*	(2) *Sex < 15*	(3) *Birth < 15*	(4) *Birth < 15*	(5) *Sex < 18*	(6) *Sex < 18*	(7) *Birth < 18*	(8) *Birth < 18*
Female Firstborn x *Survived*	-0.0051		-0.0021		0.0041		-0.0026	
	(0.0043)		(0.0026)		(0.0063)		(0.0063)	
Female Firstborn x *Fourth-Born*		-0.0018		0.0006		-0.0062		-0.0061
		(0.0026)		(0.0016)		(0.0038)		(0.0038)
Female Firstborn	0.0024	-0.0014	0.0016	-0.0006	-0.0074	-0.0014	-0.0016	-0.0014
	(0.0041)	(0.0019)	(0.0024)	(0.0012)	(0.0060)	(0.0028)	(0.0060)	(0.0028)
Age and religion indicators	yes	yes	yes	yes	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	277,981	279,391	241,844	243,094	239,733	240,998	210,879	212,014
Mean of DV (*Female Firstborn* = 0)	0.1453	0.1457	0.0402	0.0403	0.5613	0.5620	0.2845	0.2850
Mean of DV (*Female Firstborn* = 1)	0.1425	0.1429	0.0393	0.0395	0.5557	0.5563	0.2781	0.2786

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In columns (1)-(4), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in columns (5)-(8), the sample is composed of female DHS respondents ages 18-49 with at least one older sibling. The outcome Sex *< 15* is equal to 1 if *i* was sexually active before the age of 15 (and is equal to 0 otherwise). The outcome *Sex < 18* is equal to 1 if *i* was sexually active before the age of 18 (and is equal to 0 otherwise). The outcome *Birth < 15* is equal to 1 if *i* gave birth before the age of 15 (and is equal to 0 otherwise). The outcome *Birth < 18* is equal to 1 if *i* gave births before the age of 18 (and is equal to 0 otherwise). *Survived* is an indicator for whether *i's* firstborn older sister survived until *i* reached the age of 14. The indicator *Fourth-Born* is equal to 1 if *i's* birth order position was 4th or greater (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses.

Appendix Table 9. Interacting the *Female Firstborn* indicator with Firstborn's Survival Status and the Respondent's Birth Order: HIV/AIDS Awareness and Knowledge of Modern Contraceptive Methods

	(1) *Heard of HIV/AIDS*	(2) *Heard of HIV/AIDS*	(3) *Tested for HIV*	(4) *Tested for HIV*	(5) *Knowledge of Modern Contraceptive*	(6) *Knowledge of Modern Contraceptive*
Female Firstborn x *Survived*	-0.0104		0.0135		-0.0051	
	(0.0105)		(0.0135)		(0.0111)	
Female Firstborn x *Fourth-Born*		-0.0019		0.0026		0.0050
		(0.0069)		(0.0081)		(0.0072)
Female Firstborn	0.0157	0.0075	-0.0025	0.0079	0.0093	0.0020
	(0.0099)	(0.0050)	(0.0128)	(0.0059)	(0.0105)	(0.0052)
Age and religion indicators	yes	yes	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes	yes
N	29,745	29,879	33,018	33,158	38,334	38,480
Mean of DV (*Female Firstborn* = 0)	0.8942	0.8942	0.1989	0.1992	0.8229	0.8231
Mean of DV (*Female Firstborn* = 1)	0.9034	0.9035	0.2160	0.2159	0.8330	0.8332

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. The sample is composed of female DHS respondents ages 15-17 with at least one older sibling. The outcome *Heard of HIV/AIDS* is equal to 1 if *i* answered yes to the question, "Have you ever heard of HIV or AIDS?" (and is equal to 0 otherwise). The outcome *Tested for HIV* is equal to 1 if *i* was ever tested for HIV (and is equal to 0 otherwise). The outcome *Knowledge of Modern Contraceptive* is equal to 1 if *i* had knowledge of at least one modern contraceptive method (and is equal to 0 otherwise). *Survived* is an indicator for whether *i's* firstborn older sister survived until *i* reached the age of 14. The indicator *Fourth-Born* is equal to 1 if *i's* birth order position was 4th or greater (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses.

Appendix Table 10. Interacting the *Female Firstborn* indicator with SIGI

	(1) *Sex < 15*	(2) *Sex < 18*	(3) *Birth < 15*	(4) *Birth < 18*	(5) *Heard of HIV/AIDS*	(6) *Tested for HIV*	(7) *Knowledge of Modern Contraception*
Female Firstborn x High SIGI	0.0010	-0.0089	-0.0015	-0.0138	-0.0189	0.0083	0.0212*
	(0.0053)	(0.0112)	(0.0024)	(0.0091)	(0.0212)	(0.0297)	(0.0122)
Female Firstborn x Medium SIGI	0.0038	-0.0042	0.0003	-0.0092	-0.0198	0.0088	0.0128
	(0.0054)	(0.0114)	(0.0025)	(0.0092)	(0.0212)	(0.0301)	(0.0127)
Female Firstborn	-0.0043	0.0023	0.0005	0.0071	0.0255	0.0009	-0.0129
	(0.0050)	(0.0109)	(0.0022)	(0.0087)	(0.0207)	(0.0293)	(0.0112)
Age and religion indicators	yes	yes	yes	yes	yes	yes	yes
Birth order indicators	yes	yes	yes	yes	yes	yes	yes
Country-by-survey year fixed effects	yes	yes	yes	yes	yes	yes	yes
N	279,391	240,998	243,094	212,014	29,879	33,158	38,480
Mean of DV (*Female Firstborn* = 0)	0.1457	0.5620	0.0403	0.2850	0.8942	0.1992	0.8231
Mean of DV (*Female Firstborn* = 1)	0.1429	0.5563	0.0395	0.2786	0.9035	0.2159	0.8332

*Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Each cell represents the results from a separate OLS regression based on DHS data from 23 sub-Saharan African countries. In columns (1) and (3), the sample is composed of female DHS respondents ages 15-49 with at least one older sibling; in columns (2) and (4), the sample is composed of female DHS respondents ages 18-49 with at least one older sibling; and in columns (5)-(7), the sample is composed of female DHS respondents ages 15-17 with at least one older sibling. The outcome Sex < *15* is equal to 1 if *i* was sexually active before the age of 15 (and is equal to 0 otherwise). The outcome *Sex < 18* is equal to 1 if *i* was sexually active before the age of 18 (and is equal to 0 otherwise). The outcome *Birth < 15* is equal to 1 if *i* gave birth before the age of 15 (and is equal to 0 otherwise). The outcome *Birth < 18* is equal to 1 if *i* gave births before the age of 18 (and is equal to 0 otherwise). The indicator *High SIGI* is equal to 1 if *c*, *i's* country of residence received a score of 22 or higher on the SIGI, indicating significant levels of discrimination against women (and is equal to 0 otherwise). The indicator *Medium SIGI* is equal to 1 if *c* received a score between 12 and 22 on the SIGI (and is equal to 0 otherwise). Standard errors clustered at the DHS primary sampling unit level are reported in parentheses. The outcome *Heard of HIV/AIDS* is equal to 1 if *i* answered yes to the question, "Have you ever heard of HIV or AIDS?" (and is equal to 0 otherwise). The outcome *Tested for HIV* is equal to 1 if *i* was ever tested for HIV (and is equal to 0 otherwise). The outcome *Knowledge of Modern Contraceptive* is equal to 1 if *i* had knowledge of at least one modern contraceptive method (and is equal to 0 otherwise).