Effects of tuition-free primary education on women's access to family planning and on health decision-making: A cross-national study

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ABSTRACT

At least one in ten married or in-union women of reproductive ages had an unmet need for family planning in 2017. Gender inequalities in multiple social settings, including education, work and household decision-making, influence access to family planning. In this paper, we examine whether laws and policies that increase gender equality in education can lead to improved family planning outcomes. In particular, we focus on tuition-free primary education policies as a means of change. We estimate the impact of girls being exposed to tuition-free primary education policies on their health decision-making and on their family planning needs as women. Using a difference-in-difference methodology on 17 low- and middle-income countries, we find that women who were exposed as children to tuition-free education policy throughout primary school have a greater likelihood of meeting their family planning needs and of shifting from traditional to modern contraceptives, relative to women without similar exposures. These women also have a greater likelihood of having some say in health-related decisions of the couple. More gender-equal decision-making is shown to mediate a portion of the positive impact of the education policy on reproductive health. The results of this study indicate the need for increased investments in education and for health policy makers to prioritize cross-sectoral engagements.

1. Introduction

In September of 2000, all member-states of the United Nations agreed to work towards universal access to reproductive health-care services, including family planning, as a part of the Millennium Development Goals. After nearly two decades, we are far from achieving this ambitious goal. Globally, in 2017, at least one in ten married or in-union women of reproductive ages had an unmet need for family planning, that is, they wanted to delay or stop the birth of a child but were not using any contraception (United Nations, Department of Economic and Social Affairs, 2017). The world is also lagging in the use of modern contraceptives over traditional and folkloric methods of preventing childbearing. The percentage of women with unmet need for modern contraception is the highest in Sub-Saharan Africa, while Southern Asia has the largest numbers of such women (Guttmacher Institute, 2017).

The numerous benefits of family planning in terms of health and economic outcomes are widely recognized (see Starbird et al., 2016 for review). This is perhaps why countries have repeatedly reaffirmed their promises of ensuring that women have access to life-saving contraceptives though commitments such as the Family Planning 2020 and

the Sustainable Development Goals. In all these multinational agreements, governments have prioritized investments to reduce the supply-side constraints of family planning methods. However, the existence of high rates of unwanted births in areas where contraception is readily and cheaply available underscores the importance of other obstacles to household use of contraception (Prichett, 1994). It is, therefore, equally important to pay attention to what affects households seeking contraception. Women's decision to use contraception to restrict fertility is influenced by the social settings in which they are born, grow and live. Consequently, it has been argued that policies that improve women's social conditions, are 'the most important voluntary and sustainable way to achieve' improvements in contraceptive prevalence (Prichett, 1994). Our focus in this paper is on understanding the impacts of girls' education on the likelihood of women making decisions over their own health and using family planning in low- and middle-income countries.

Estimating the causal effect of education on health decision-making and family planning is problematic because factors like belief systems and gender norms that affect education may also directly affect reproductive health practices. One way to deal with the endogeneity of years of schooling completed is to utilize an exogenous variation in policy that is unrelated to reproductive health practices as an

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instrumental variable. In this paper, we use tuition-free primary education policies to examine whether increased access to primary schools improves health decision-making and family planning practices of women. Since tuition-fees can deter parents from sending their children, particularly girls, to schools, educational reforms that eliminate tuition-fees are important policy tools and, therefore, are at the center of our study.

Existing studies show that the elimination of tuition fees delays initial and reduces total fertility in Sub-Saharan Africa (Keats, 2018; Osili and Long, 2008), including through keeping adolescents in school for longer durations. There are fewer rigorous studies which have explored the relationship between tuition-free primary education and family planning. There is only one study to our knowledge, focusing on a single low-income country (Uganda), that found women with more schooling being more likely to have used contraceptives before a first pregnancy (Keats, 2018).

There is reason to believe that lowering tuition barriers could improve both educational and reproductive outcomes simultaneously. Educational attainment has a positive impact on the extent of an individual's health-related information (Glewwe, 1999; Thomas et al., 1991; Willis, 1973). Those who go to school gain some information from teachers, they acquire some information through reading, and they also better process the information they receive (Cutler and Lleras-Muney, 2010). Studies have shown that more educated couples have more knowledge of contraceptive methods in high-income countries such as the United States and Israel (Lavy and Zablotsky, 2015; Rosenzweig and Schultz, 1989).

Knowledge of family planning is important but translating it into action is equally important. Given men's preference for larger number of children in many countries (Westoff, 2010) and lack of unity among couples in household decisions (Lundberg et al., 1997; Thomas, 1990), using family planning might be problematic for women in some settings. The difficulty is highlighted in a field experiment in Zambia which showed that women who were given access to contraceptives with their husbands were less likely to seek family planning services (Ashraf et al., 2014). We hypothesize that female schooling can improve the health decision-making autonomy of women in the household which may contribute to family planning needs being met.

In this study, we examine the relationship between tuition-free primary education laws and policies and the adoption of family planning. Specifically, we estimate the effects of tuition-free education policies on (1) the met need for family planning for women who want to control their pregnancy and (2) the use of modern contraceptives among women using family planning. We also test whether the policies can improve autonomy of women by estimating the effects of the policies on the ability of women to decide matters related to their and their partners' health. Finally, we conduct a mediation analysis to calculate the extent to which policy-induced changes in health decision-making facilitate the use of contraception. This is the first cross-country study to evaluate the causal impact of tuition-free primary education laws and policies on reproductive health and on health decision-making using a quasi-experimental approach.

2. Methods

The identification strategy of this paper relies on the variance in women's exposure to the tuition-free primary education policy by country of residence and by year of birth. Following the 1990 World Conference on Education for All in Jomtien, Thailand, many countries gradually abolished tuition fees in public primary schools. The subsequent decade saw an increase in primary school enrolments in low-income countries, with the greatest gains occurring in Sub-Saharan Africa (UNESCO, 2000). Research has shown that making education tuition-free ensured that more children, especially girls, could attend school. For example, in 1997, Uganda introduced a universal primary education program that was associated with an increase in enrollment

and a decrease in the probability of delayed school entry, with a larger effect for girls (Deininger, 2003; Grogan, 2008; Nishimura et al., 2008).

2.1. Data

The individual-level data used in this paper comes from the Demographic Health Surveys (DHS). The DHS are nationally representative cross-sectional household surveys of women aged 15–49 years conducted in low- and middle-income countries. Some surveys also include questionnaires for men aged 15–49 years or 59 years, depending on the country. Our sample includes countries with at least three years of DHS data since 2000. DHS consistently included information on women's participation in household decision-making, a key variable in this analysis, from 2000 onwards. We excluded countries with no data or missing data on important variables for men in all of the survey years, ending up with a sample of 19 countries.

The policy data comes from a novel dataset on education policies and legislation from the WORLD Policy Analysis Center (WORLD). WORLD's database contains details related to education policies and laws as of 2016 in each country along with the year of adoption. The database was primarily constructed from national legislation and official country documents accessible via the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Observatory on the Right to Education. Countries with and without tuition-free primary education policies since 1990 are included in our analysis. Sources are conflicting on when tuition-free education policy was introduced in Bangladesh and Ethiopia, and may reflect the differential timing of policy adoption in different parts of the country. In the absence of a firm date of education policy reform, we excluded these two countries from our analysis, ending up with a sample of 17 countries.

We pooled the multiple rounds of DHS in our final sample of countries to create a repeated cross-sectional dataset. We included women aged 15–49 years who were born between 1960 and 2000. We further restricted the sample to married or in-union women residing with their husbands or partners, resulting in a base sample size of 323,047 women and 105,954 men.

Country-level data was obtained from the World Development Indicators. These included gross domestic product (GDP) per capita adjusted for purchasing power parity, share of population living in urban areas of the country, domestic health expenditure as a percentage of GDP, and unemployment rates. All relevant variables used constant 2011 dollars.

2.2. Empirical strategy

To identify the effect of women's exposure to tuition-free primary education on their family planning outcomes, we used a difference-in-difference estimation method. In this approach, we compare the outcomes in countries with tuition-free primary education policies (treatment countries) to the outcomes in countries with no similar policies (control countries), for women with and without exposure to the policy in primary school. Only examining the experiences of women who went to school before and after the policy change in a single country does not estimate the causal impact of the policy because it does not account for other factors that have changed over time. At the same time, only comparing the experiences of women in a country with the policy to women in a country without the policy is insufficient because of other potential differences between the countries. The difference-in-difference method combines comparing both across time and across countries to 'produce a better estimate of the counterfactual' (Gertler et al., 2016). We estimated the following equation:

$$y_{ict} = \beta_0 + \beta_1 exposure_{cb} + \beta_2 X_{ict} + \beta_3 Z_{ct} + \delta_c + \delta_t + \delta_b + \varepsilon_{ict}$$

where y_{ict} are the family planning outcomes of woman i living in country c in year t. The primary outcomes in the analysis are (i) a dummy variable indicating whether married or in-union women, who

were sexually active, fecund, and did not want to become pregnant, were using any contraception to space or limit births (met need for family planning); and (ii) a dummy variable for whether women using birth control relied on modern contraceptive methods, including injectable and oral hormones, implants, intrauterine devices, spermicides, condoms, diaphragms, or sterilization. A secondary outcome is women's report of who in the household makes decisions regarding their health. We created a dummy variable to indicate if a woman had some say, joint say with her partner or independent say in the matter. We also have data on women's ability to take decisions about their partners' health, as reported by the men.

The *exposure_cb* variable, the key independent variable, equals 1 if a woman was exposed to the tuition-free education policy all through primary school (full exposure), and 0 if she had no exposure to the policy. We also ran the same regression comparing women with partial exposure to the tuition-free education policy to women with no exposure to the policy.

A woman's exposure to tuition-free education policy is defined as a function of her country of residence and birth year. In each country, primary school starts at a pre-specified age for children and lasts for a fixed duration. Women who reached the expected age of entry to primary school in the year following the policy or later in a treatment country, that is, with birth year ≥ (policy year – minimum age of entry into primary school + 1), were exposed to the policy throughout primary school (full exposure). Older women, who were born early enough relative to year of the education policy and required school duration, were never exposed to the policy in their primary school (no exposure). Women born in years that made them eligible for tuition-free primary schooling for at least a year but less than the complete duration of primary school under the policy (partial exposure), are also considered in the analysis.

It is important to note two things about the exposure definition. First, we allow for a one-year lag between the announcement of the education policy and its coming into effect to allow for girl's families to know about the policy and for implementation. Second, we do not account for grade repetition or late entrance into the schooling system which could cause older girls to be in primary school beyond the expected graduation ages. Thus, our estimates have an intention-to-treat interpretation, with potential underestimation for certain subpopulations.

Using the policy information on the 17 countries in the sample, we divided the countries into treatment and control groups. Treatment countries were those that had adopted a tuition-free education policy early enough for some women with full exposure to the tuition-free education policies to have been included in the DHS. Control countries were those that did not adopt tuition-free primary education policies early on, relative to their most recent DHS. Zimbabwe is the only control country that has not introduced tuition-free primary education by 2016. Table 1 lists the treatment and control countries along with the parameters used for the classification. Sample sizes are provided in Appendix Table A1.

The model also included country fixed effects (δ_c) and birth year fixed effects (δ_b). The first set of fixed effects controlled for time-invariant country characteristics and the second set controlled for time-specific factors affecting both groups of countries. We also included a set of survey year dummies. One consideration is that there may be time-varying country characteristics that are correlated with contraceptive use and distribution of household decision-making. Therefore, we directly controlled for several observed time-varying economic characteristics including GDP per capita, unemployment rate, and share of urban population (Z_{ct}). Another consideration is that the impact of

the policies may not be homogeneous across countries, but rather may vary as a function of individual and household characteristics. We, thus, controlled for several observed time-varying individual and household characteristics including indicators for rural residence, married couples (versus in-union couples) and ages of the woman and her partner (X_{ict}). To account for the non-linear relationship between women's ages and the outcomes, we used logarithm transformation of the ages in the regressions. The use of five-year age grouping also resulted in the same estimated coefficients. The details on how these variables were generated from the DHS are presented in Appendix Table A2.

We estimated the above equation using logistic regression. β_1 gives us the reduced-form estimate of the average effect of exposure to tuition-free primary education, full or partial, on the likelihood of better outcomes. We computed the standard errors clustered at country level (Bertrand et al., 2004). With fewer than 30 clusters, we also used the recommended wild cluster bootstrapped-t methods to estimate the standard errors (Cameron et al., 2008). Our key results remain unchanged (results available on request).

3. Results

3.1. Summary statistics

Individual and country level summary statistics are presented in Table 2. Our final sample included mostly married women living in rural areas with an average age of 31 years. Their husbands or partners were older by 6 years on average. A greater share of men in the sample completed primary education than women. 35% of the women in the sample reported not using any birth control. Of those using family planning, most tended to use modern methods of contraception but the share of women using traditional or folkloric methods was 16%. While 60% of the women reported having some say in decisions about their health, fewer women were involved in decisions about their husbands or partners' health, as reported by the men.

3.2. Pre-policy trends

The key identifying assumption underlying the difference-in-difference estimation is that the secular trends in the outcomes are similar across the treatment and control countries in the absence of the policy intervention. First, we plotted the key outcomes for women born before 1984 in treatment and control countries. This is the earliest year a woman could be born in any treatment country to ensure that she was affected by the tuition-free primary education policy for at least one year. The Fig. 1A and Fig. 1B provided in the Appendix shows similar trends in the two key outcomes, prevalence of met need for family planning and the use of modern methods among contraception users, among treatment and control countries.

We also formally tested that the similarity of trends in all the outcomes of interest for women with no policy exposure in the treatment and control countries by running additional regressions. We estimated a model for each outcome where the outcome variable was regressed on interactions between the treatment status and a constant linear trend, along with treatment status and the country and survey year fixed effects. We included only women with no exposure to the education policy; that is, women born before 1984 in all the control countries and women born before the birth year cutoffs in each treatment country. The results are reported in Appendix Table A3. We do not find evidence of consistent pre-policy differential time trends between treatment and control countries in the outcomes.

Table 1
Identifying treatment and control countries.

1	2	3	4	5	6
Country	Policy year	Minimum age for primary school	Earliest birth cohort fully exposed to policy	Earliest survey year with fully exposed birth cohort	Survey years
Treatment countries (N = 8)					
Armenia	1999	7	1993	2008	2000, 2005, 2010, 2015-16
Ghana	1996	6	1991	2006	2003, 2008, 2014
Malawi	1994	6	1989	2004	2000, 2004–2005, 2010, 2015–2016
Mali	1999	7	1993	2008	2001, 2006, 2012–2013
Nepal	2001	5	1997	2012	2000–2001, 2005–2006, 2010–2011, 2016
Tanzania	2001	7	1995	2010	2004–2005, 2009–2010, 2015–2016
Uganda	1997	6	1992	2007	2000–2001, 2006, 2011, 2016
Control countries (N = 9)					
Benin	2003	6	1998	2013	2001, 2006, 2011–2012
Cambodia	2001	6	1996	2011	2000, 2005–2006, 2010–2011, [2014]
Indonesia	2003	7	1997	2012	2002–2003, 2007, [2012]
Kenya	2003	6	1998	2013	2003, 2008–2009, [2014]
Lesotho	2000	6	1995	2010	2004–2005, 2009–2010, [2014]
Namibia	2001	6	1996	2011	2000, 2006–2007, [2013]
Rwanda	2003	7	1997	2012	2000, 2005, 2010–2011, [2014–15]
Senegal	2004	7	1998	2013	2005, 2010–2011, 2012–2013, 2014, [2015, 2016]
Zambia	2002	7	1996	2011	2001–2002, 2007, [2013–2014]
Zimbabwe	–	6	–	–	2005–2006, 2010–2011, 2015

Women born in the year indicated in Column 4 or later would have been exposed to the tuition-free education policy for every year they were in primary school—that is, they were fully exposed to the policy. This is opposed to women who were older by a few years and would have been partially influenced by the policy for some years of their primary schooling. Column 5 indicates the year in which the women fully exposed to the tuition-free primary education in their countries would have turned 15 and therefore become eligible to be interviewed in the DHS. Column 6 indicates the actual years in which the DHS were conducted; the years in brackets indicate DHS surveys that were excluded from the analysis due to small sample sizes of women with full exposure & non-missing data for outcomes. The 2014 survey in Lesotho was excluded from the analysis of men's outcomes. Zimbabwe is the only control country that did not introduce tuition-free primary education by 2016

Table 2
Summary statistics.

	Mean	SD	Min	Max
Met need for family planning	0.65	0.48	0	1
Use of modern methods among contraception users	0.84	0.37	0	1
Women: They have some say in their health decisions	0.60	0.49	0	1
Women's completion of primary schooling	0.68	0.47	0	1
Age of woman	30.85	7.95	15	49
Men: Partners' have some say in their health decisions	0.48	0.50	0	1
Men's completion of primary schooling	0.78	0.41	0	1
Age of spouse	37.41	10.23	15	59
Rural	0.70	0.46	0	1
In-union	0.09	0.28	0	1
Per capita GDP	2808.34	2136.35	785.48	8195.93
Unemployment rate	6.24	5.48	0.2	38.04
Share of urban population	30.88	13.76	12.082	64.67

3.3. Effect on family planning outcomes

Implementation of policies is a problematic issue in low-and middle-income countries and raises the question of whether the education policies in fact raised educational attainment. To correctly interpret the estimates on the outcomes as the effect of increased education, we first examined whether exposure to the tuition-free education policy affected the years of education. We used an indicator variable for completion of at least 5 years of education as a dependent variable in the difference-in-difference estimation. Column 1 in Table 3 illustrates the efficacy of the policies in improving educational attainment of girls. We

Table 3
Effects on family planning outcomes & educational outcomes (odds ratios).

	1	2	3
	Completion of at least 5 years of schooling	Met need for family planning	Use of modern methods among contraception users
Full exposure to policy	1.315***	1.467**	2.517***
	(0.12)	(0.24)	(0.53)
N	303685	191090	124420
Partial exposure to policy	1.118	1.052	1.283
	(0.10)	(0.09)	(0.23)
N	308782	191090	124420

Standard errors are in parentheses and are clustered at the country level. All regressions include country fixed effects, birth year fixed effects, survey year fixed effects, and all control variables. Country-level controls include log of GDP per capita, unemployment rate, and share of urban population. Individual-level controls include indicator for rural-urban residence, indicator for married or cohabiting, and logs of respondents' and partners' ages. A woman who was fully exposed to the policy had access to the tuition-free primary education policy throughout primary school, while a woman with partial exposure had access to the policy for at least one year, but not all years, of primary school. *p < 0.1 **p < 0.05 ***p < 0.01.

find that full-exposure to tuition-free primary policies increased the likelihood of completing at least five years of schooling by 32% while partial-exposure did not have a significant effect on years of schooling. We get similar results with indicator variables for varying thresholds of years of education less than seven years.

Columns 2 and 3 in Table 3 present the estimated odds ratio for the two key outcomes. Exposure to tuition-free education throughout

Table 4
Effects on decision-making authority (odds ratio).

	1	2	3	4
	Women reported having some say in her health decisions	Women reported having joint say in her health decisions	Women reported having independent say in her health decisions	Women reported having some say in her health decisions for new contraceptive users
Full exposure to policy	1.432***	1.528***	1.156	1.496***
	(0.12)	(0.14)	(0.22)	(0.15)
N	287726	216550	186474	52589
Partial exposure to policy	1.006	1.084	0.882	1.077
	(0.09)	(0.07)	(0.14)	(0.12)
N	292801	220837	190185	53189
	Men reported women having some say in his health decisions	**Men reported women having joint say in his health decisions**	**Men reported women having independent say in his health decisions**	**Men's years of education**
Full exposure to policy	1.203**	1.337***	1.179	1.084
	(0.09)	(0.12)	(0.15)	(0.09)
N	56440	43895	34203	78159
Partial exposure to policy	1.028	1.067	1.121	1.047
	(0.08)	(0.09)	(0.11)	(0.06)
N	57187	44516	34720	79181

Standard errors are in parentheses and are clustered at the country level. All regressions include country fixed effects, birth year fixed effects, survey year fixed effects, and all control variables. Country-level controls include log of GDP per capita, unemployment rate, and share of urban population. Individual-level controls include indicator for rural-urban residence, indicator for married or cohabiting, and logs of respondents' and partners' ages. Column 4 in panel 2 is not an odds ratio. A woman who was fully exposed to the policy had access to the tuition-free primary education policy throughout primary school, while a woman with partial exposure had access to the policy for at least one year, but not all years, of primary school. *p < 0.1 **p < 0.05 ***p < 0.01.

primary school is associated with a 47% increased likelihood of women having met their family planning needs, relative to women who had no access to tuition-free education. We also find a 152% increase in likelihood of modern contraceptive use for women who relied on family planning. When extending the analysis to women who were partially exposed to the policies, we find no significant effect on either family planning outcomes.

3.4. Effect on health decision-making

Table 4 presents the estimated effects of policy exposure on women's reports of decision-making about their health. Women with full exposure to tuition-free primary education were 43% more likely to report having some say in decisions about their own health, relative to women with no exposure to the policy. When looking separately at the reports of women who made joint decisions and of women who decided independently, we find that exposure to the policies made women 53% more likely to report having a joint say in her health decisions but did not significantly increase the chances of reporting independent say. There are no significant effects on decision-making reports of women who were partially exposed to the policies.

We examined women who started using contraception within one year of the survey to ensure we had measures of decision-making near the time of new contraception use. Column 4 shows the results of this analysis and continues to show similar results.

We also estimated the effects of policy exposure on men's reports of their wives' involvement in decision-making about their health. Women with full exposure to tuition-free primary education were 20% more likely to have some say in decisions about their husband or partner's health, as reported by the men. These women are more likely to be jointly involved in deciding about their partners' health, than taking the decisions independently.

It is likely that more educated women tend to choose a mate with

higher levels of education, both of which could have been facilitated by the tuition-free primary education policies that were adopted at the national level. To test whether the above estimated coefficients could be capturing the effect of men's education, we used men's years of education as a dependent variable in our estimation. We find no evidence of assortative matching in Column 4 of Table 4. This indicates that women's increased education is driving the positive effect of tuition-free education policies on decision-making related to men's health.

3.5. Robustness tests

Table 5 provides the estimated coefficients from several specification checks conducted to test the validity of our identification strategy. In Panel A, we repeat our baseline findings to facilitate comparison. Given the possibility of countries having differential pre-policy trends in the outcomes, we included country-specific linear time trends for all but one country in the regression. Panel B in Table 5 shows that the coefficients on all the outcomes remain positive and significant. Given our interest in reproductive health outcomes, we also controlled for health expenditures of the countries by including domestic health expenditure as a percentage of GDP in the regressions. The results remain qualitatively unchanged (Panel C in Table 5).

For some women in the sample, the duration between when they went to primary school and when they were surveyed was long. To test whether this affected our results, we limited the sample to women of ages 15 years–27 years, where 27 years the maximum age of the women fully exposed to the education policy. The results are robust to the restriction of the sample (Panel D in Table 5). Another potential threat to our identification strategy is the existence of migration among the countries. Our assignment of treatment status assumed that women were born and educated in the same country as they were surveyed in. If this is not true, our results will be biased. As an additional check we limited the sample to those respondents who remain in the same village

Table 5
Robustness checks (odds ratios).

	1	2	3	4	5	6
	Met need for family planning	Use of modern methods among contraception users	Women having joint say in her health decisions	Women having independent say in her health decisions	Women's completion of at least 5 years of schooling	Women having some say in men's health decisions
			Panel A: Baseline estimates			
Full exposure	1.467**	2.517***	1.528***	1.156	1.315***	1.203**
	(0.24)	(0.53)	(0.14)	(0.22)	(0.12)	(0.09)
			Panel B: Including country-specific linear time trends			
Full exposure	1.437*	1.508***	1.202**	1.216	1.370**	1.147*
	(0.26)	(0.18)	(0.09)	(0.19)	(0.15)	(0.07)
			Panel C: Including domestic health expenditure as percentage of GDP			
Full exposure	1.454**	1.951**	1.328***	1.196	1.323**	1.277**
	(0.24)	(0.46)	(0.09)	(0.22)	(0.15)	(0.14)
			Panel D: Restricting sample to women of ages 15–27			
Full exposure	1.318***	2.931***	1.501*	0.99	1.286**	1.34
	(0.12)	(0.73)	(0.32)	(0.20)	(0.13)	(0.25)
			Panel E: Restricting sample to women living in the same city/village			
Full exposure	1.593**	3.321***	1.881***	1.05	1.17	0.969
	(0.30)	(0.73)	(0.38)	(0.24)	(0.16)	(0.08)
			Panel F: Restricting sample to individuals exposed to tuition-free primary education laws only			
Full exposure	0.996	34.591*	1.054	0.905	4.778*	1.094
	(0.04)	(40.92)	(0.03)	(0.26)	(2.16)	(0.05)

Standard errors are in parentheses and are clustered at the country level. All regressions include country fixed effects, birth year fixed effects, survey year fixed effects, and all control variables. Country-level controls include log of GDP per capita, unemployment rate, and share of urban population. Individual-level controls include indicator for rural-urban residence, indicator for married or cohabiting, and logs of respondents' and partners' ages. A woman who was fully exposed to the policy had access to the tuition-free primary education policy throughout primary school, while a woman with partial exposure had access to the policy for at least one year, but not all years, of primary school. *p < 0.1 **p < 0.05 ***p < 0.01.

or city since birth. The coefficients are positive and significant and larger in magnitude as reported in Panel E in Table 5. The results for men's health decision-making are not significant for these two smaller samples.

Finally, we recognize the fact that some of the treatment countries in our sample passed laws making public education free simultaneously at the primary and secondary levels. It was possible that we are capturing the effect of these laws taken together in our estimations. To isolate the effect of tuition-free primary education laws, we reran our main specification with two treatment countries: Uganda and Tanzania. There were lags in the introduction of tuition-free primary education policies and tuition-free secondary education policies in these two countries, allowing us to restrict the analysis to only those women were fully exposed to free primary schooling alone, not tuition-free secondary education. We included Zimbabwe as the control country. Panel F shows that the results on women's years of education and use of modern contraception by those practicing family planning were robust to the restriction of the sample. The absence of significant effects on the other variables hints at a contributing effect of tuition-free secondary education that needs further investigation.

A final problem with our identification strategy is that of selection of the men's sample. The analysis of men's report on decision-making is possible only when we can match a wife and her husband or partner. To test whether this results in biased estimates, we ran all the regressions with a sample of all women and imputed data on the missing husbands. Husband's reports on decision-making and education variables are imputed as the mean of the respective variables of the surveyed husbands for year and country of birth of the woman. The results using this complete sample are similar to those using our original sample (results available on request).

4. Effects on contraceptive use mediated by health decision-making

So far our results indicate the positive effects of the education policy on reproductive health and on decision-making abilities of women. We conducted a mediation analysis to estimate the amount of the total

Table 6
Mediation analysis.

	Met need for family planning	Use of modern methods among contraception users
Direct effect	0.070***	0.057***
	(0.009)	(0.007)
Indirect effect	0.003***	0.001***
	(0.000)	(0.000)
Total effect	0.074	0.057

Standard errors are in parentheses and are clustered at the country level. All regressions include country fixed effects, birth year fixed effects, survey year fixed effects, and all control variables. Country-level controls include log of GDP per capita, unemployment rate, and share of urban population. Individual-level controls include indicator for rural-urban residence, indicator for married or cohabiting, and logs of respondents and partners ages. *p < 0.1 **p < 0.05 ***p < 0.01.

effect of tuition-free primary education policies on family planning that is mediated by women's health decision-making autonomy. Mediation analysis is useful in decomposing the effect of a policy into two components – the direct effect on the outcome and the indirect effect on the outcome operating through an intermediate variable. It typically involves estimation of the effect of the policy on the outcome variable and on the mediating variables along with estimation of the effects of the mediating variable on the outcome variable adjusted for the policy effect.

Using the empirical specification outlined in Section 2, we estimated two sets of equations. First, we regressed women's decision-making power on their exposure status. Second, we regressed each family planning outcome on women's exposure status, with their decision-making power as an explanatory variable. The regression coefficient on the exposure status in the second regression is an estimation of the direct effect of the education policies on each of the family planning outcomes. We relied on the product of coefficients method to estimate the indirect effect where the regression coefficients on the exposure status in the first regression and the decision-making variables in the second regression are multiplied (MacKinnon, 2008). We used the

bootstrapping method to assess the statistical significance of the estimators. Since the variance of the residual in the logistic regressions is fixed, unlike the constant variance in linear regression models, we used a linear probability model for estimation.

In Table 6 we present the direct, indirect, and total effects for the two family planning outcomes, where the total effect is the sum of direct and indirect effects. We find that 5% and 1% of the total effects of full policy exposure on met need for family planning and use of modern methods among contraception users is mediated by increased reported health decision-making of women, respectively.

5. Discussion

In this paper, we have shown that making primary education tuition-free has positive impacts on women's use of family planning, particularly on the use of modern methods by contraception users. We find that married or in-union women who were exposed to tuition-free education policy throughout primary school have a 47% greater likelihood of meeting their family planning needs, relative to women without similar exposures. We also find that married or in-union women with similar policy exposure have a 152% greater likelihood of relying on modern methods when using contraception when compared to women without access to tuition-free primary education. Our results further show that women with full exposure to tuition-free primary education policy have a 43% and 20% greater likelihood of reporting having some say in their own and their partners' health-related decisions, respectively. A part of the improvements in reproductive health outcomes is mediated by improved decision-making by women. With the exception of the estimated coefficients on the women's decision-making in matters of their partners' health, our results are robust to various sensitivity tests.

Given the large estimated effects of these policies, investments in education for the adoption and implementation of tuition-free education policies might be helpful in achieving better reproductive health of women. Such investments, therefore, should be a priority for the health sector with the explicit goal of boosting the education sector. Health policy makers need to play an important role in ensuring that all children can enroll and complete school. This is especially important in the light of our finding that exposure to tuition-free education for only a few years of primary school do not have any significant impacts on reproductive health outcomes. The inclusion of education as a core health concept and cross-sectoral investments can help to reduce the costs of education that can then reduce the incidence of health problems.

This study also demonstrated a significant impact on health decision-making. This in turn contributed to met family planning need. While the impact on family planning of increased health decision-making was modest, this is only one of many likely positive outcomes. Research has shown that increased autonomy of women leads to better health outcomes for the household, including greater nutrient intake by children (Duflo, 2003). At a community level too, empowerment of women leads huge gains since women leaders have been shown to prioritize the women-oriented infrastructural projects (Bhalotra and Clots-Figueras, 2014; Chattopadhyay and Duflo, 2004).

It is important to note that, beyond tuition fees, there are additional potential barriers to schooling, including distances between households and schools, lack of hygienic facilities at school, and other costs of schooling. Kattan and Burnett report that 90% of the low- and middle-income countries they surveyedhad several different types of fees such as parent teacher association dues, textbook charges, compulsory uniform costs (Kattan and Burnett, 2004). While there exists evidence on the benefits of eliminating some of these barriers in individual countries (Abdul Latif Jameel Poverty Action Lab (J-PAL), 2019), further research is needed to understand the relative impact of each.

This study has a few limitations arising from nature of the data available. Without individual level panel data, particularly data from women's childhood, we cannot control for several factors correlated to contraception and health outcomes that could bias our results. This also prevents us from accounting for grade repetitions and late entries into the schooling system in our methodology, as mentioned in Section 2.2. We also estimate impact based on women attending school in the same country in which they are currently residing because of the lack of information on migration in the DHS. Though the evidence indicates small indirect effects of the education policies on the reproductive outcomes through improved decision-making of women, the data and methods do not allow us to estimate the full extent of the mediated effects because we have data on health decision-making only at a single point in time. Another problem with the validity of the difference-in-difference model is the possibility that other policies and programs affecting the outcomes were introduced during the study period. There is evidence on the positive influence of paid maternity leave policies on health and decision-making outcomes. While the timing of paid maternity leave policies in our sample countries does not invalidate our methodology, there could be other sub-national or national interventions in the countries that could have biased the results.

Despite these limitations, this study adds to the evidence on the numerous positive consequences of tuition-free primary education laws and policies that operate at scale. However, several important questions around the impact of schooling of girls remain open to future research. A more thorough understanding of the diverse ways in which tuition-free education policies influence health outcomes is required. Our findings, in particular, highlight the importance of examining secondary education policies and the interaction of men with such policies.

Appendix

Table A1

Sample sizes of women with different levels of exposure to tuition-free education policies.

|	Full	Partial	None
Treatment countries (N = 8)			
Armenia	228	278	12185
Ghana	472	1097	7365
Lesotho	134	710	5343
Malawi	6904	5390	28651
Mali	648	1943	22974
Nepal	346	903	22583
Tanzania	842	2226	16218
Uganda	3079	4032	14699
Control countries (N = 9)			
Benin	0	242	24519
Cambodia	0	361	26369
Indonesia	0	23	49691
Kenya	0	1	7322
Namibia	0	20	4356
Rwanda	0	30	14019
Senegal	0	468	16499
Zambia	0	53	7569
Zimbabwe	0	0	12255

Table A2

Description of individual and country level control variables.

Variable	Measurement
Woman's age	Logarithm of woman's age.
	We also used five years age-grouping where we divided the women in the sample into age groups of 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 44–49.
Partner's age	Logarithm of husband or partner's age, as reported by the married or cohabiting women.
	We also used five years age-grouping where we divided the men in the sample into age groups of 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 44–49, 50–54, 55–59, 60–64.
Woman's marital status	Indicator of whether woman is currently married or cohabiting.
Area of residence	Indicator of whether de facto type of place of residence is rural.
GDP per capita	Logarithm of GDP per capita based on purchasing power parity (PPP). Data are in constant 2011 international dollars.
	Source World Bank, International Comparison Program database.
Unemployment rate	Percentage of the labor force that is without work but available for and seeking employment (modelled ILO estimate).
Urban population	Number of people living in urban areas as a percentage of the total population.
Domestic health expenditure as percentage of GDP	Public expenditure on health from domestic sources as a share of the economy as measured by GDP

Table A3

Comparing pre-policy trends in the outcome variables in treatment & control countries (odds ratios).

Met need for family planning	Use of modern methods among contraception users	Women's report of household decision making	Women's years of education	Men's report of household decision making	Men's years of education
0.988	0.999	1.013	1.028	0.996	1.022
(0.04)	(0.05)	(0.03)	(0.02)	(0.05)	(0.02)

In this regression, we interact a linear time trend with an indicator of whether the woman lived in a treatment or control country. The regressions include women who were not exposed to the tuition-free education policy—that is, those born before 1984 in all the control countries and women born before the birth year cutoffs in each treatment country. All regressions include country fixed effects. No statistical differences were found between the trends in outcomes between the treatment and control countries. Standard errors are in parentheses and are clustered at the country level. *p < 0.1 **p < 0.05 ***p < 0.01.
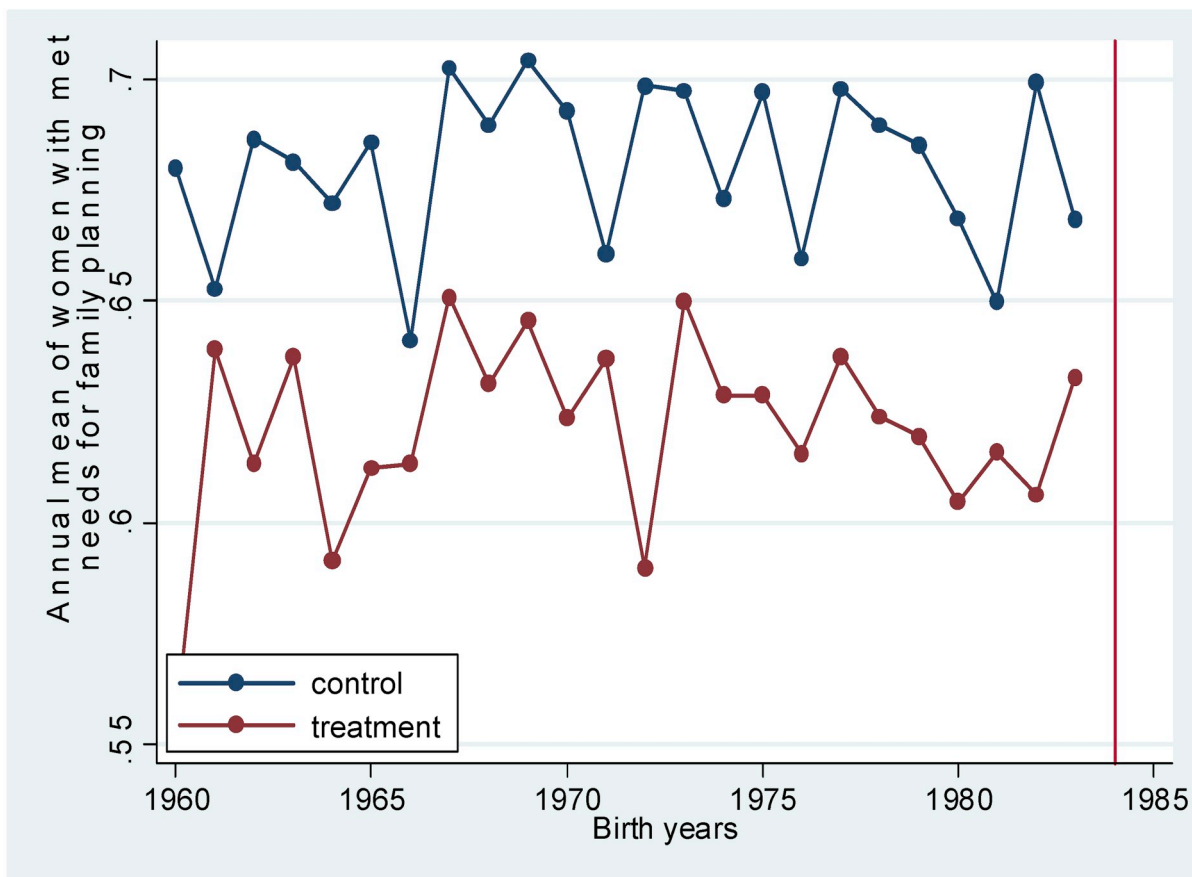
Notes: Figure compares the yearly trend in the met need for family planning of women not exposed to the tuition-free primary education policies in the treatment and the control countries. For each year, the blue line provides the average met need for family planning in the control countries, calculated by pooling together all women born before 1984 across all the control countries. Similarly, the red line provides the average in the treatment countries for each year, calculated by pooling together all women born in years such that they were not of primary school age when the policy was implemented in their countries. No statistical difference was found between the trends in the treatment and control countries; see Table A3.

Fig. 1A. Met need for family planning.
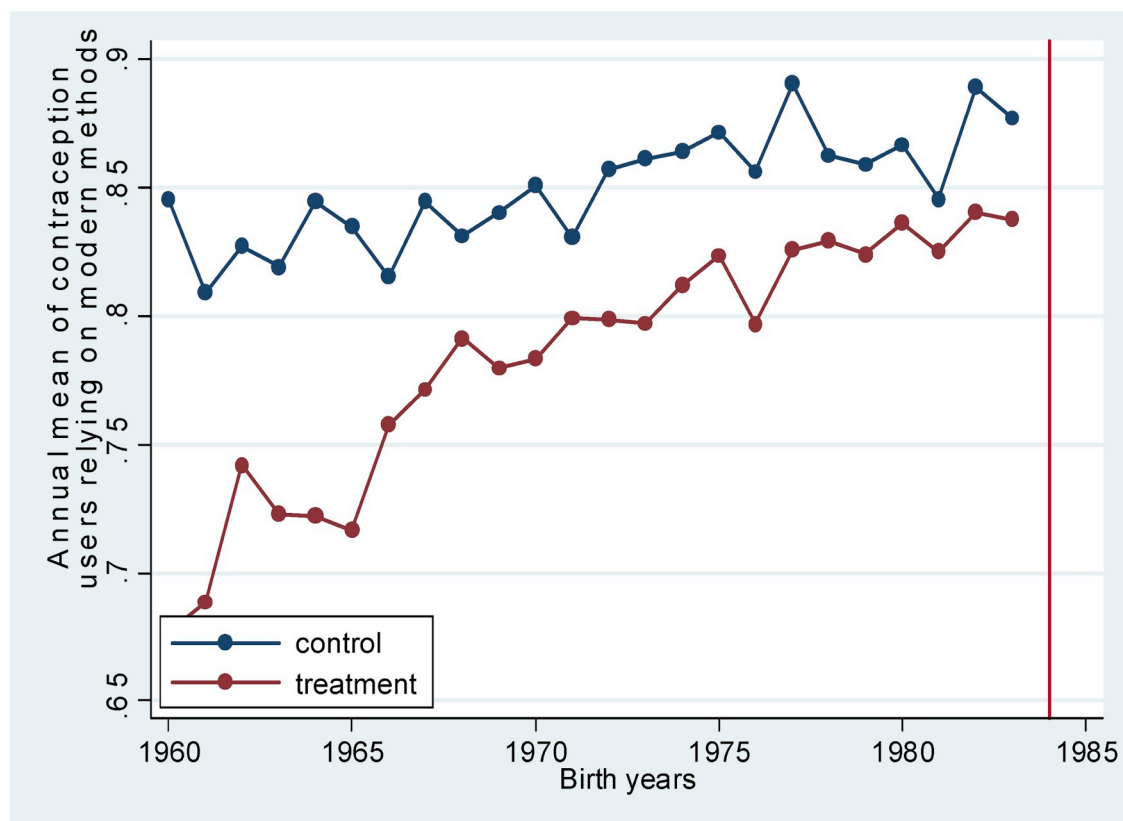
Notes: Figure compares the yearly trend in the use of modern methods by women using contraception who were not exposed to the tuition-free primary education policies in the treatment and the control countries. For each year, the blue line provides the average use of modern methods by contraception users in the control countries, calculated by pooling together all women born before 1984 across all the control countries. Similarly, the red line provides the average in the treatment countries for each year, calculated by pooling together all women born in years such that they were not of primary school age when the policy was implemented in their countries. No statistical difference was found between the trends in the treatment and control countries; see Table A3.

Fig. 1B. Use of modern methods by contraception users.

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