working paper
2507

The Complementary Role of Information and Contraceptive Access in Teen Pregnancy

Sevin Kaytan
Stwarth Piedra-Bonilla
Tom Zohar

February 2025

CENTRO DE ESTUDIOS
MONETARIOS Y FINANCIEROS
Casado del Alisal 5, 28014 Madrid, Spain
www.cemfi.es

CEMFI Working Paper No. 2507
February 2025

The Complementary Role of Information and Contraceptive Access in Teen Pregnancy

Abstract

We investigate how information frictions affect the efficacy of contraception provision programs. We study a Costa-Rican initiative that combined free access to long-acting-reversible contraceptives and a tailored information campaign to correct for baseline misinformation. Using administrative data and geographic variation in the initiative, we find a 16% decrease in the teen birth rate. We show information complements access – an extra year of exposure to the information campaign is equivalent to the effect of contraception access alone. Using surveys on sexual behavior, we show the policy changed the information source from personal networks to healthcare professionals, amending misinformation on sexual health.

JEL Codes: I15, I18, J13, J16, D83.

Keywords: Teen pregnancy, LARCs, information frictions, fertility, sexual health, Costa Rica.

Sevin Kaytan
CEMFI
sevin.kaytan@cemfi.edu.es

Stwarth Piedra-Bonilla
Compass Lexecon
stw.piedrab@gmail.com

Tom Zohar
CEMFI
tom.zohar@cemfi.es

Acknowledgement

We thank Pello Aspuru, Nina Brooks, Nina Buchmann, Cauê Dobbin, Pascaline Dupas, Grant Miller, Nezih Guner, Warn Lekfuangfu, Costas Meghir, and Ana Costa-Ramón; as well as seminar participants at BSE Gender and Work, Carlos III, CEMFI, EWMES2024, Istanbul Applied Economics Workshop, MESS and SAEe2024 for their helpful comments. We gratefully acknowledge financial support from: Juan de la Cierva 2022, Grant FJC2022-049259-I funded by MICIU/AEI/10.13039/501100011033 and by "European Union NextGenerationEU/PRTR", the Proyectos de Generación de Conocimiento 2021, PRE2022-101675 grant, funded by MICIU/AEI/10.13039/501100011033 and by "ESF +"; the Maria de Maeztu Unit of Excellence grant CEMFI MDM-2016-0684 and CEMFI CEX2020-001104-M, funded by MICIU/AEI/10.13039/501100011033; and the graduate scholarship funded by CEMFI. All views and errors are our own.

1 Introduction

Modern contraceptives play a critical role in preventing unintended teen pregnancies, which are a leading driver of teenage mortality and reduced educational attainment (Fund, 2017; Lang and Weinstein, 2015). Teen pregnancy is especially prevalent in low-income countries where contraception use is limited (WHO, 2024). These high teen pregnancy rates might be sustained even when contraceptives are available since most contraceptive methods suffer from poor adherence. In addressing this issue, long-acting reversible contraceptives (*LARCs* - such as subdermal implants or intrauterine devices) do not suffer from the adherence problem by design, and therefore are more effective in preventing pregnancy compared with methods such as birth control pills or condoms.[1] However, they are expensive. Although subsidizing modern contraceptives such as LARCs relieves cost considerations, misperceptions about the efficacy or safety of these devices might inhibit their adoption, and these misperceptions vary widely by the context at hand.

Understanding context-specific frictions is the key to a successful teen pregnancy reduction policy (Dupas and Miguel, 2017). However, there is limited evidence comparing the effectiveness of targeted campaigns (that address context-specific barriers) with improved access to contraception. The unique frictions in each context suggest that general strategies derived from the fertility literature may not apply universally. For instance, evidence from regions with high fertility rates, such as Sub-Saharan Africa, may not be relevant for regions that have completed the fertility transition, such as Latin America. Moreover, policies that have been effective in reducing fertility rates may not prove useful for teen pregnancies, given the fundamental difference in the population at hand and the reasons behind the pregnancy.

In this paper, we study what makes contraception provision programs effective under ex-ante uncertain information frictions. We find that providing teenagers with context-relevant information about the efficacy and risks of subsidized contraceptives complements — and thus enhances — the efficacy of contraception provision programs.

We evaluate the Salud Mesoamerica Initiative (SM Initiative), a 2015 program that aimed to reduce teenage pregnancies in Costa Rica using a two-pillar campaign. The first pillar of the initiative provided teenagers (aged 12 to 19) with free access to LARCs in health centers, thus alleviating friction in access to contraception. The second pillar aimed to reduce misperceptions about sexual health following a two-step approach: Elicit baseline misperceptions among teenagers and design an information campaign that addressed the misperceptions detected.

[1] LARCs last for a long time once implanted and do not suffer from poor adherence, which results in a 99% success rate. In contrast, the efficacy of short-term birth control methods, such as pills and condoms, depends on correct use. These result in significantly lower effective success rates of 91% and 82%, respectively (NHS, 2024).

We exploit geographic variation in the implementation of the SM initiative and employ a differences-in-differences design. Due to limited resources, the program was implemented in two southern Costa Rican regions, selected based on need and feasibility. The government defined districts with the highest need as those in the bottom quintile of the Social Development Index (SDI). However, lacking the infrastructure to reach all low-SDI districts, the program made use of regional distribution channels, and two southern Costa Rican regions which had a higher share of districts in need were chosen to receive the intervention. This feasibility criterion allows us to compare districts that are similar in terms of need but are in different regions of the country. Our identification assumption is that non-treated districts were on the same trajectory of teen pregnancy as treated districts, which we test and confirm.

We combine administrative data on births with rich survey data on sexual behavior and beliefs. First, to estimate the impact of the SM initiative on teen births, we use comprehensive administrative data from the Costa Rican National Bureau of Statistics on births that took place between the years 2005 and 2020, restricting our sample to births in which the mother is aged 12 to 19. Merging this data with population records and the 2011 Census enables us to calculate the adolescent birth rate by district, cohort, and year. We also examine reproductive health practices, sexual behavior, and knowledge among teenagers using survey data from the SM initiative and the National Sexual and Reproductive Health (NSRH) survey by the Costa Rican government.

We find that the SM initiative reduces the teen birth rate by 16% in the subsequent five years after its implementation. This effect grows in the first few years of the initiative, perhaps due to cumulative prolonged exposure to the SM initiative: Younger cohorts benefit longer from free contraception and information campaigns, which amplifies the impact over time. However, it is unclear whether this is driven by free contraception access, information campaigns, or their complementarity. To disentangle the importance of these two pillars, we exploit the fact that information campaigns are delivered in high schools. This leaves the 19-year-olds unexposed to information campaigns, but still eligible for free LARCs — thus, restricting our analysis to 19-year-olds allows us to disentangle the two pillars. We exploit the variation in the number of years each cohort spent in school since the launch of the SM initiative (in 2015) to the age of 19. Our results suggest that every extra year of exposure to information campaigns is equivalent to the effect of free access to LARCs, and thus serves as a strong and effective complement.

A possible explanation for the success of the information campaigns was their targeted design: When designing interventions to target information frictions, it's hard to assess which information frictions are present in the first place. To address this issue, the SM initiative ran a baseline survey in 2013 and collected insights on the information frictions among teenagers. Baseline responses showed that the initial level of knowledge regarding sexual health was quite limited: More than 80% of teenagers couldn't

correctly identify how to use birth control methods, contact with reproductive health services was low, and self-reported likelihood of teenage pregnancy was high. As a result of the baseline survey, the SM initiative targeted those three frictions directly with: (1) posters and discussions that address the misperceptions detected; (2) talks by healthcare professionals; and (3) providing specific resources to seek help.

[Sevin: edited version. olf version commented below]

In conservative cultures like Costa Rica, personal networks are often the main source of sexual health information, which can lead to misinformation due to stigma around premarital sex and unintentional misperceptions. Both the SM Initiative and the NSRH surveys reveal that, before the SM Initiative, teenagers primarily relied on their parents for guidance. However, limited knowledge about sexual health, and specifically, LARCs was prevalent among both parents and teenagers. The information campaigns were designed to address these gaps and promote awareness of LARCs' availability, efficacy, and safety. We find the SM initiative's information campaigns switched the source of — and improved the quality of — sex education: teenagers were more likely to receive information about sexual matters from healthcare professionals rather than their parents. In turn, they were better at identifying pregnancy risk, reported a lower likelihood of getting pregnant, were more aware of where to obtain LARCs, and were more likely to visit a health center to do so.

Finally, we ask – when (and where) would changing the source of information matter? We focus on the role of social norms, given the empirical evidence on the role of social norms in fertility and sexual health decisions (Munshi and Myaux, 2006; Godlonton and Thornton, 2012; Yang et al., 2023; Brooks and Zohar, 2024) and how a change in the source of information has higher effects in conservative contexts (Chong et al., 2020; Angrist, 2020). The change in source and quality of information might be particularly important for teenagers from conservative families; for example, if they advocate against sexual activity outside of marriage and therefore might be less open to discussion of sexual health. Therefore, we analyze the impact across conservative districts, which we define based on the share of the population in the district who oppose family planning. We find that before the SM initiative, teenagers in more conservative districts were more likely to receive their information from parents — however, residents in conservative districts themselves were less likely to know about LARCs. In turn, the decline in the teen birth rate due to the SM initiative is larger in these conservative districts. These results suggest that a change in information sources is particularly important in a conservative context, in which information frictions and misperceptions about birth control methods are more prevalent.

Our study contributes to three strands of the literature. First, we add to the literature on contraceptive access and fertility. There is substantial evidence that subsidizing contraception access can increase *take-up* in the US (Bailey et al., 2023; Luca et al., 2021;

Kelly et al., 2020; Lindo and Packham, 2017; Kearney and Levine, 2009). However, there is surprisingly little evidence, in a developing context, that goes beyond take-up and explicitly connects these frictions to reductions in *teen births*.[2] Furthermore, Dupas et al. (2024) show that in the presence of other frictions, removing financial barriers alone may have no impact on contraception use. We contribute to this literature by providing novel empirical evidence from a developing context, in which we observe an especially large decline (16%) in teen births. Our findings provide insight for policy-makers on the potential effectiveness and complementarity of targeted information and contraceptive interventions that could support adolescent reproductive autonomy and effectively lower teen birth rates.

[Tom: Sevin here is the place-holder to plug thenphrasing we converged to in R1.1]

A different strand of the literature discusses how information frictions hinder the take-up of reproductive technologies; however, the evidence is mixed. On the one hand, several studies show that women underestimate pregnancy risk and contraception efficacy (Miller et al., 2020) and overestimate fear of infertility due to contraception use (Bau et al., 2024), and informing them increases contraception use (Andalón et al., 2014; Chong et al., 2020). On the other hand, Yang et al. (2023) and Jamison et al. (2013) demonstrate that information campaigns can inadvertently increase stigma and misinformation in reproductive health. These findings show that the role of information is not trivial: Some information programs that combat misperceptions can complement programs that improve reproductive health access, while others might have negligible effects or even backfire.

The success of information programs that aim to change sexual behavior depends on their design, because they need to effectively update baseline beliefs in order to achieve the desired outcomes (Dupas, 2011). Therefore, providing specific information rather than general education is more effective in changing sexual behavior (Dupas and Miguel, 2017). Most closely related to our work, Kelly et al. (2020) show that media coverage boosts LARC take-up among teens, and Athey et al. (2023) and Luca et al. (2021) show that personalized counseling increases the take-up of contraception, although the latter focuses on repeated pregnancies. We contribute to this literature by studying a unique setting in which improved contraception access is supported by *targeted context-specific* information campaigns, which highlights the role of accurate information diffusion as a complement to contraceptive provision in order to reduce teenage fertility and not simply take-up.

[Tom: Can cut for a short paper:]Finally, our study relates to the growing literature on the role of information sources and social norms in shaping reproductive choices and

[2] Miller and Babiarz (2016) review the empirical literature and conclude that family planning programs have historically explained a limited portion of fertility declines in low- and middle-income countries.

influencing teen birth rates. Angrist (2020) finds that the source of information can "make or break the intervention" and has large implications for teen pregnancy. Relatedly, Ashraf et al. (2014) shows that the husband's involvement enhances contraception take-up and fertility decisions in Zambia. Furthermore, social norms might be perpetuated through conservative families: Brooks and Zohar (2024) find that conservative parental attitudes can constrain young women's agency in abortion decisions. Another channel in which social norms might affect outcomes in sexual health is through stigma and biases in personal networks: Godlonton and Thornton (2012) show that personal networks affect decisions on HIV testing, whereas Yang et al. (2023) demonstrate that HIV/AIDS programs designed to reduce stigma through information provision can inadvertently worsen misinformation and reinforce stigmatizing attitudes. Similarly, Wagner et al. (2023) discusses how age-based bias in family planning in low-to middle-income countries might impact the quality of care received by young women, and educating healthcare providers about this bias helps young women receive better care in sexual health. Most closely related to our work, Chong et al. (2020) discuss how teachers might fail to educate teenagers properly due to their conservative beliefs in a predominantly catholic, middle-income country; and that internet-based information treatments might prove useful for sexual education in these contexts. We contribute to this body of work by highlighting the importance of targeting information frictions in conservative regions – where the information source might play a large role in the information frictions – and the implications for teen births rather than merely contraception use.

[Tom: For a short paper this isn't necessary:]The remainder of the paper is organized as follows. Section 2 provides an overview of the SM initiative and describes the data used in the analysis. Section 3 introduces our empirical strategy, examines the overall effect of the SM initiative, and disentangles the effects of free contraception access versus the information campaigns. Section 4 studies the impact of information campaigns on its source and quality, and investigates why changing the information source is important to change sexual behavior. Section 5 concludes with policy recommendations.

2 Data and context

This section describes the Salud Mesoamérica Initiative, which aimed to reduce teen pregnancy in Costa Rica by providing free access to LARCs and conducting information campaigns in targeted regions. It then describes the comprehensive administrative data and survey results we will use in our analysis to evaluate the effectiveness of this initiative.

2.1 Context: High rates of teen pregnancy in Costa Rica

Costa Rica offers a unique setting with high teen pregnancy rates and limited access to family planning. In 2011, 9.1% of adolescents between the ages of 12 and 19 had already become parents in Costa Rica (Unicef and PANI, 2017). Taking steps to tackle this issue, the government integrated sex education into the national high school curriculum in 2012[3] and authorized the emergency "day after" pill in 2019. However, access to family planning services remains limited: Abortion is illegal except when the mother's life is at risk. Furthermore, when not subsidized, modern contraceptive methods are expensive and largely unaffordable for adolescents.[4]

On top of the high costs of modern contraceptive devices, the limited access to family planning services is further propagated by the conservative culture that prevails in the country. According to the 2010 NSRH survey, 65% of Costa Rica's population is catholic and 48% believe that the church is against family planning. Furthermore, 14% of the responders who stated that the church is against family planning agree with the church's stance, which highlights the potential importance of social norms in sexual health.

2.2 The Salud Mesoamérica Initiative: Providing access to LARCs and information campaigns

The Salud Mesoamérica Initiative's (SM initiative henceforth) primary objective is tackling health disparities in Mesoamerican countries. In the case of Costa Rica, its aim was to reduce pregnancies and births among teenagers. For that purpose, it was planned to be executed in two distinct phases: a preparation phase (2012-2014) and an implementation phase (2015-2020) (Bernal et al., 2024). The preparation phase focused on preparing the healthcare and education systems to deliver adolescent sexual and reproductive health services. It included investments in infrastructure (e.g., youth-friendly clinics), inter-institutional coordination, evaluation systems, and initial steps toward integrating sex education in schools (IDB, 2013). However, several pillars of the preparation phase were delayed, some up until the implementation phase.[5]

[3]The content of sex education classes covered general sexual health topics such as reproductive physiology and STDs delivered by science teachers. They were implemented nationally (in both treatment and control regions of the SM initiative). However, several students reporded that some teachers refused to deliver the content, as it did not align with their personal views on premarital sexuality. In contrast, the SM initiative's information campaigns were designed to deliver specific information on LARCs' accessibility, functionality, safety, and benefits, provided by healthcare professionals to high schools in treated regions.

[4]A pack of birth control pills costs $27 on average, which is 121% of the daily minimum wage in 2024 ($22.3). IUDs can cost $100-$136 depending on the type, which is 440%-610% of the daily minimum wage.

[5]According to the 2015 systematization report, delays in the first phase stemmed from poor coordination between consultancies, lack of operational funding, weak institutional governance, and poor communication channels. Although schools were expected to begin extracurricular and curricular sexual

The second phase, beginning in 2015, marked the full rollout of the program and focused on enrolling adolescents, assessing their risk levels, and delivering services accordingly. This comprehensive approach included several components, ranging from specialized interventions for at-risk groups—such as teenagers who already had children and pregnant adolescents—to broader preventive measures across the general adolescent population. Given that the preventive measures formed the core of the program's strategy to reduce teen pregnancy rates, we focus our analysis on this component.

To implement these preventive measures, the investment was allocated to local authorities to support the establishment of a program operated through local networks, and disbursed in two installments: 2015 to 2018 and 2018 to 2020. The Costa Rican government chose to allocate it's resources primarily toward procuring LARCs, given the evidence on its effectiveness. The resulting SM initiative centered on a two-pillar program: providing free access to LARCs and educating teens on the safety and efficacy of these devices through information campaigns.

Given the limited availability of resources and the feasibility of distribution channels, the program focused on two regions. The government defined districts with the highest need as those in the bottom quintile of the Social Development Index (SDI), which contains scores for education, economic conditions, political participation, and health (99 low-SDI districts in dark colors in Figure 1). However, lacking the infrastructure to reach all low-SDI districts, the program used regional distribution channels. Two regions in southern Costa Rica, with a high concentration of low-SDI districts, received the intervention starting in 2015 (orange area in Figure 1). Given that low-SDI districts are also found in other regions of the country (dark blue districts in Figure 1), we can compare districts that are similar in terms of need and socioeconomic status but are in different regions of the country.

The SM initiative operation manual (Banco Interamericano de Desarrolo, 2015) describes a two-part approach in selected regions that combines free access to LARCs with targeted information campaigns. The healthcare authorities provided LARCs[6] and the schools conducted campaigns that included audiovisual materials, guided debates, self-care activities, and periodic visits from healthcare professionals.[7] These campaigns

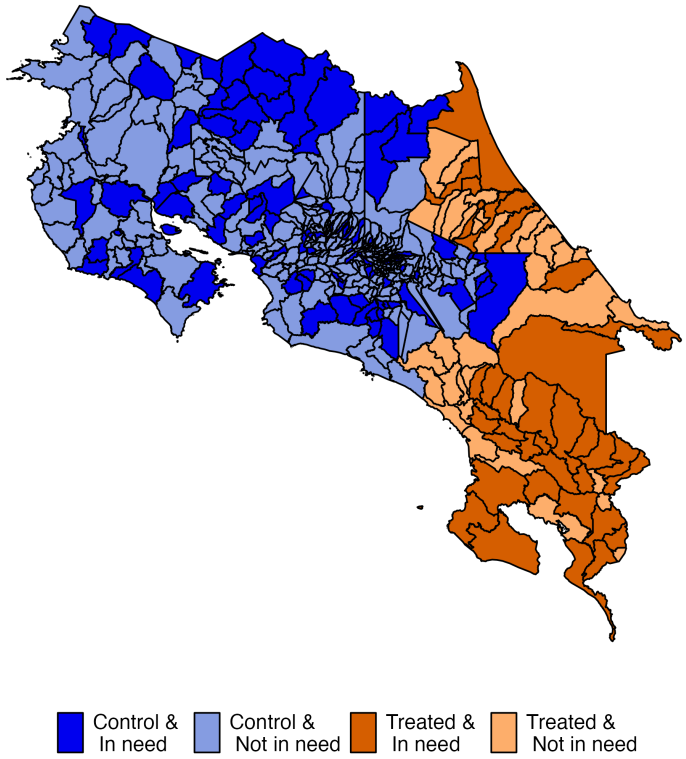
education activities before 2015, in practice, many communities had not yet begun implementation by March 2015. Similarly, although LARCs had been distributed to health areas by early 2015, they were not yet being administered due to pending staff training (Damaris González et al., 2015).

[6] **?** report that before the intervention students were hesitant to visit health centers, in fear that their visit would be disclosed to their parents by staff. While this might also have improved with the initiative, we find no mention of such an improvement in the operations manual of the program (Banco Interamericano de Desarrolo (2015)), apart from an aim of "improving the sensitivity of healthcare professionals towards adolescents".

[7] **?** report that delivery of sex education classes before the initiative has been sporadic: Several students reported that their teachers disagreed with the content provided, and abstained from delivering it to students. To remedy this issue and ensure that campaigns were delivered by an objective and trusted source, healthcare practitioners were chosen.

aimed to address misinformation and educate students on LARCs' functionality, safety, and benefits, emphasizing their accessibility to all students. Recognizing the uncertainty about specific information frictions, the initiative conducted a 2013 baseline survey to identify misperceptions about sexual health among teens, which allowed the campaign content to be tailored to students' needs.

Figure 1: Regions selected for treatment



Notes: This figure highlights districts in Costa Rica based on treatment and need status. Treatment status refers to regions that were chosen to receive free access to contraceptives and information campaigns. Need status here reflects districts that scored in the bottom quantile of the country's Social Development Index (SDI).

2.3 Data

To estimate the SM initiative's impact on teen birth rates, we use administrative data from the Costa Rican National Bureau of Statistics and Centro Centroamericano de Población on births by year, age, and district from 2005 to 2020. We focus on births to mothers aged 12-19 to align with the SM initiative's target age group.[8] Population projections by district and year for individuals aged 12-19, along with 2011 census data, enable us to calculate accurate teen birth rates relative to the at-risk population.

[8]The World Health Organization defines adolescent pregnancy as involving mothers aged 10-19. However, since the SM initiative targets high school students, we limit our sample to ages 12-19 since ages 10 and 11 are below the high school attendance age in Costa Rica.

To analyze the effect of the initiative on sexual behavior, we use two survey sources: SM initiative surveys and the National Sexual and Reproductive Health (NSRH) survey. The SM initiative surveyed 3,049 students aged 12-20 in a random sample of 39 *treated* schools in 2013 and 2018, collecting data on sexual knowledge, attitudes, and health behaviors. Since this survey only includes treated schools, we complement our analysis with the NSRH survey, which collected data on sexual beliefs and practices from over 3,000 individuals in 2010 (pre-SM initiative) and 2015 (the first year of the SM initiative).

Using two 2010 NSRH survey questions, we calculate district-level conservatism by identifying the share of respondents who "support the church's stand against family planning programs." Respondents who answered that the church is *"against"* family planning and should *"maintain its position"* were recorded as opposing family planning. We aggregated these responses by district, and classified districts above the median share as highly conservative and those below as less conservative.

3 Assessing the impact of contraception access and information campaigns on teen births

[Tom: Can cut this in a short paper format:]

In this section, we employ two exercises to evaluate the effects of the SM initiative. First, we adopt a difference-in-differences design to evaluate the effects of the overall initiative and find a noteworthy reduction of 16% in the teen birth rate due to the SM initiative. Then, we disentangle the importance of the access and information pillars and find strong complementarity between the two: Every extra year of exposure to information campaigns is equivalent to the effect of free access to LARCs.

3.1 The total effect of LARCs access and information campaigns

Empirical strategy

We estimate a difference-in-differences design to evaluate the effects of free access to LARCs and information campaigns. Our design compares districts in treated regions with districts that were not impacted by treatment, allowing the effects to vary across years using the following model:

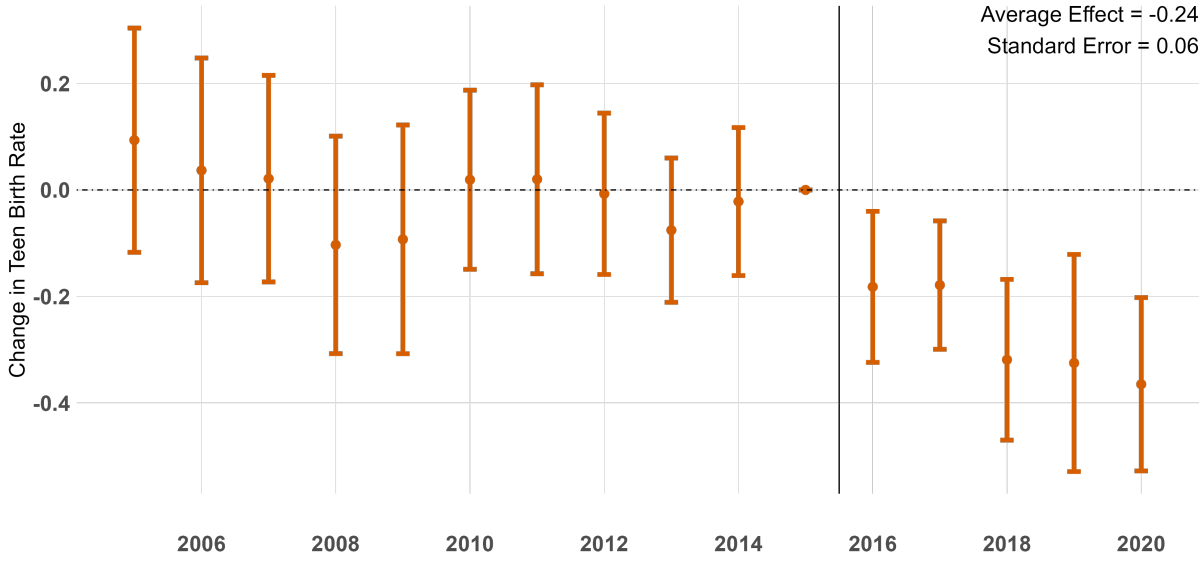
$$\text{TBR}_{dt} = \phi_d + \gamma_t + \sum_{\substack{k=2000 \\ k \neq 2015}}^{2020} \beta_k \mathbb{1}(t = k) \cdot \text{Treat}_d + \sum_{k=2000}^{2020} \alpha_k \mathbb{1}(t = k) \cdot \text{SDI}_d + \epsilon_{dt}, \quad (1)$$

where TBR_{dt} is the teen birth rate in district d at time t, $Treat_d$ is the treatment indicator (orange districts in Figure 1), ϕ_d and γ_t indicate district and time fixed effects. To control for the different evolution of teen birth rates in targeted districts, we control for differential time effects by SDI levels SDI_d, measured in 2015. Our reference year is 2015 since most births in 2015 were conceived in 2014, one year before the policy took place. Consecutively, we consider 2016 as the initial year while evaluating the impact of access and information campaigns on teen births. Finally, we cluster standard errors at district level.

Our empirical strategy relies on the standard parallel trends assumption: Non-treated districts were on the same trajectory as treated districts, in the absence of the SM initiative. We can assess the plausibility of this assumption with Figure 2, which illustrates the coefficient estimates from Equation 1. We don't observe any pre-trends in teen birth rates, point estimates for the years before the SM initiative's implementation remain insignificant and stable, and thus confirm our identification assumption.

Results

Figure 2: The total effect of LARCs access and information campaigns on teen birth rates



Notes: This figure plots the difference in teen birth rates between treatment and control regions (estimates of Equation 1) over time (2005-2020). Standard errors are clustered at district level. The lines are 95% confidence intervals. The vertical line marks the year in which the SM initiative was implemented, 2015, and the horizontal line marks 0.

We find that the SM initiative reduced the teen birth rate by 0.24 percentage points (16%) on average.[9] Figure 2 offers an important insight: The impact becomes more

[9]See Figure A1a for the change in the teen birth rate in percentages, normalizing point estimates

pronounced over time, from 12% to 25%. Perhaps this is not a coincidence: The longer the SM initiative was in place, the more students were included in the SM initiative, and they were exposed to subsidized LARCs and information campaigns for a longer period.

Given the high cost of LARCs and delivering information campaigns, a policymaker might want to find ways to target districts in which such interventions will be of greater efficacy. One natural approach is to focus on areas in which information frictions are stronger. Another is to target areas with the greatest baseline rates of teenage pregnancy or target those with lower socioeconomic conditions (the SM Initiative's approach using the SDI score). We test these hypotheses and assess the heterogeneity in the impact across these criteria. Table A1 shows that the initiative's impact is stronger in districts with stronger information frictions (proxied by statement *"I heard about LARCs before"* in 2010 NSRH Survey), districts with low socioeconomic score, and districts with high teenage birth rates at baseline. These results speak to the importance of information campaigns in conjunction with free access to LARCs. However, we cannot differentiate between the impact of free access and information campaigns with the differences-in-differences design. Therefore, we exploit the differential exposure to information campaigns in the following subsection.

3.2 Disentangling exposure to access from exposure to information

One natural explanation for the secular increase in the effects in Figure 2 is the cumulative prolonged exposure to the SM initiative: Younger cohorts are exposed to free access to contraception and information campaigns for a longer period compared with those who were already in their late teens by 2015, which amplifies the impact over time (e.g., a 15-year-old using LARCs in 2016 will still mechanically affect her fertility in 2020, when she is 19). However, it is unclear whether the effect of this prolonged exposure is driven merely by free contraception access, information campaigns, or the complementarity between the two, since they address different constraints.

Subsidizing LARCs relieves economic constraints, yet information frictions might still impede the efficacy of these subsidizing policies: Women who don't know where to get these devices (or don't trust their efficacy or safety) will not use them. To remedy this issue, the SM initiative not only provided free access to contraceptives but also included information campaigns that were delivered in high schools. To disentangle the impact of information campaigns from the impact of free access to contraception, we exploit differential rates of exposure to information campaigns by age: Information campaigns are delivered in high schools, and teens typically attend high school until the age of 18. This leaves 19-year-olds in 2015 unexposed to information campaigns, but still eligible

by the mean teen birth rate in 2015. We show the robustness of the estimates when we exclude the interaction between year and the district's SDI in Figure A1b.

for free LARCs.

To test this mechanism, we restrict our sample to 19-year-olds and exploit the number of years each cohort spent in school since the SM initiative's initiation: Depending on how old they were in 2015, each cohort was exposed to the information campaign for a different number of years. As can be seen in Figure 3, the SM initiative affected the 1996 cohort in treatment districts when they were 19 years old and already out of school. Therefore, they had free access to LARCs but not to the high school information campaigns (denoted by lighter orange color). The 1997 cohort, on the other hand, had been exposed to the high school information campaigns for one year by the time they turned 19 (similarly, the 1998 cohort was exposed for two years, and so on). Therefore, comparing the treatment effects on individuals from the same district when they were 19 years old allows us to disentangle the role of an extra year of exposure to the high school information campaigns. Formally, we employ the following model to study the impact of exposure:

$$\text{TBR}_{dc}^{19} = \phi_d + \gamma_c + \tau \text{Treat}_d \cdot \text{Post}_{t(c)} + \alpha \text{Exp}_{dc}^{19} + \epsilon_{dc} \tag{2}$$

where TBR_{dc}^{19} is the teen birth rate in district d for cohort c when participants are 19 years old, ϕ_d are district fixed effects, and γ_c are cohort fixed effects.[10] Treat_d is the treatment indicator for district d, $\text{Post}_{t(c)}$ is an indicator for cohorts treated after the initiative had started (after 2015), and Exp_{dc}^{19} is a variable that captures how many years cohort c in district d has been exposed to the information campaign by the time they are 19 years old. Formally, it is defined as

$$\text{Exp}_{dc}^{19} = \text{Treat}_d \cdot \text{Post}_{c(t)} \cdot (t - 2015 - \mathbb{1}) \tag{3}$$

By definition, students were only exposed to the information campaign in high schools in treated districts from the year of implementation, 2015. Since the 19-year-olds are no longer in high school, we subtract a year of exposure to account for the years they were exposed before.

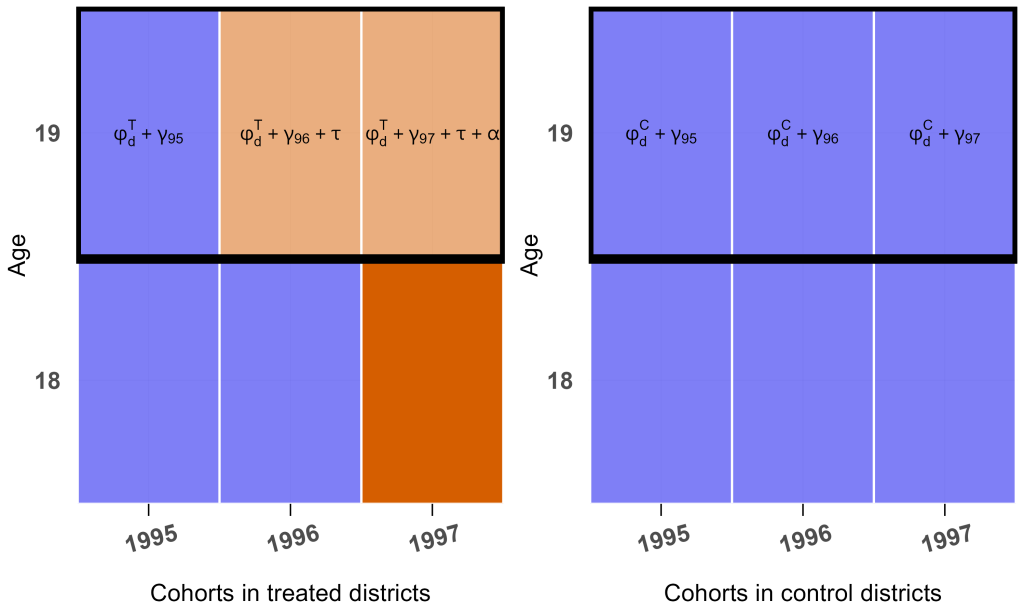
Figure 3 illustrates how the coefficients in Equation 2 are identified: Across-district comparison of the 1995 cohort allows us to estimate ϕ_d, whereas τ, the free contraception access effect, is identified thanks to the 1996 cohort and the difference between district fixed effects $\Delta\phi_d$, recovered from the 1995 cohort. Having identified $\Delta\phi_d$ and τ, a comparison of treatment and control districts among the 1997 cohort is sufficient to identify the impact of information exposure, α.[11]

[10] In this setup, we cannot distinguish between time fixed effects and cohort fixed effects: Since we limit our sample to 19-year-olds, we observe each cohort only for a year. Hence, in this model, we implicitly assume that $\gamma_t = \gamma_c$.

[11] We test the implicit linearity assumption here by repeating this exercise without imposing linearity and using dummies for each year of exposure. Figure B2 plots the estimated coefficients, which validates

[Tom: Sevin, why does the greek letter used for the district FE in the figure doesn't correspond to the one in Equation 2?]

Figure 3: Variation in exposure by cohort to LARCs access versus information campaigns (19-year-olds)



Notes: This figure explains the variation in exposure to free LARCs access versus information campaigns, corresponding to the empirical strategy in Equation 2. Specifically, it illustrates the cohort structure in our sample, by birth year and age. Blue blocks represent the control group: years before implementation of the SM initiative (before 2015) in treatment districts and all cohorts in control districts. Orange blocks represent years in which the affected cohorts were treated in treatment districts. Darker orange blocks represent exposure to information campaigns in schools (which cover ages 12-18). Blocks that represent 19-year-olds are marked to indicate our choice of subsample. We indicate the relevant coefficients for each block, which illustrates how coefficient α is identified.

Our results in Table 1 suggest that every extra year of exposure to information campaigns is equivalent to the effect of free access to LARCs alone on 19-year-olds' teen birth rate, and serves as an important complement. The first column of Table 1 shows the coefficient estimates of Equation 2, where we see that each extra year of exposure decreases the teenage birth rate by 0.38 percentage points among 19-year-olds. Furthermore, the role of exposure is even stronger when we control for differential time trends according to district SDI (second column of Table 1). This result is in line with our priors: the more time spent under the coverage of the SM initiative while being exposed to information campaigns, the further the teenage birth rate declines.[12]

our choice of linearity in Equation 2.

[12]We cannot disentangle whether the information campaigns operate directly on students or indirectly via their peers. Nevertheless, the difference between the two does not matter to a policy maker aiming to reduce teen pregnancy.

Table 1: Impact of Exposure to the SM initiative for 19-year-olds

	(1)	(2)
	Baseline Model	Controlling for SDI
Treated x Post	-1.386**	-0.4728
	(0.4655)	(0.5614)
Exposure	-0.3830**	-0.5584**
	(0.1428)	(0.2013)
Controls		
SDI	No	Yes
District fixed effects	Yes	Yes
Cohort fixed effects	Yes	Yes
S.E.: Clustered	by: District	by: District
Observations	9,884	9,884
R2	0.33319	0.33719
Within R2	0.00281	0.00880
Mean teen birth rate	8.131	8.131

Notes: This table presents the impact of exposure to the SM initiative. We represent the coefficients estimated from Equation 2, limiting the sample to only 19-year-olds. The second column also controls for the differential time trends according to the SDI scores of districts. The mean is calculated using teenage birth rates in 2015, just before the SM initiative took place for the respective sample. Exposure levels are calculated using Equation 3, which tracks how many years each cohort has been exposed to the SM initiative since the SM initiative's start. Standard errors in parentheses are clustered at district level. Significance levels according to p values are as follows: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

It should be noted that by limiting our sample to 19-year-olds, we lose observations from younger ages. To generalize this result, we repeat the same exercise including all age groups in Appendix B. Figure B1 represents the cohort structure in this exercise, and we report the results in Table B1, which confirms our findings in Table 1.[13]

As an alternative test for the role of the information campaigns, we estimate district-level treatment effects (Arkhangelsky et al., 2024) and show that the decline in teenage pregnancy is larger in districts with higher school attendance, where the SM initiative's LARCs-specific information campaigns were delivered (see Appendix B.2 for more details).[14] In the following section we ask how prolonged exposure to information cam-

[13]It's important to note that when we include other age groups, the interpretation of variable "exposure" changes: As ages from 12-18 are exposed to information campaigns and free access to LARCs at the same time, the interpretation of α should be regarded as the impact of an additional year under the SM initiative and not solely the information campaigns.

[14]We test whether the initiative had any impact on high school or university graduation using self-reported responses from the SM initiative surveys. While we find an increase in university graduation, we don't see a change in high school graduation. This might be because 95% of the students already expected to graduate from high school before the SM initiative.

paigns amplifies the initiative's impact: what makes these information campaigns effective in the first place?

4 The role of information frictions in teen pregnancy

The information campaigns of the SM initiative were targeted to raise awareness about LARCS among teenagers and instill confidence regarding the safety, efficacy, and ease of use of LARCS. Miller, De Paula, and Valente (2020) argue that a successful contraception program must provide information that is trusted, relevant, and challenges *existing beliefs*. Since LARCs require an invasive procedure to be implanted, the relevance, quality, and source of information are particularly important for overcoming lack of knowledge and misconceptions. Therefore, we study the role of information source and quality in reducing information frictions regarding sexual beliefs and behavior in Subsection 4.1. We then further investigate why the source of information matters in Section 4.2, emphasizing the role social norms play in these frictions.

4.1 Quality and source of information matter in reproductive health

[Tom: I am commenting this out for a short version:]What exactly makes these high-school information campaigns successful? A possible mechanism is that teenagers might be switching the source of their sex education, and hence receiving a higher quality of information on contraception than before the SM initiative. In this section, we study information frictions at baseline level and analyze the impact of information campaigns on the source and quality of teenagers' sex education.

Eliciting information sources and misperceptions at baseline

When designing interventions that aim to target existing information frictions, it's hard to assess what those information frictions are. In contexts in which sex education largely comes from personal networks (e.g., parents or peers), the quality of information depends heavily on cultural norms. Conversations may not be feasible if sexual topics are taboo, limited to abstinence if premarital sex is discouraged, or incomplete if personal networks are uninformed or fear promoting premarital sex. In cases of widespread misinformation, personal networks may inadvertently pass on misconceptions, thus increasing risks.

[Tom: The following paragraph was written in the intro so if we need to cut we can cut this out (maybe leave a short version here.]

From the perspective of a policy maker, it's hard ex-ante to assess which barriers and frictions to target in a given context; general strategies derived from the fertility liter-

ature may not apply universally. For instance, evidence from regions with high fertility rates, such as Sub-Saharan Africa, may not be relevant for countries that have already completed their fertility transition. Moreover, policies that have been effective in reducing fertility rates may not prove useful for teen pregnancies, given the fundamental difference in the given population and the reasons for the pregnancy. Hence, eliciting existing frictions using baseline surveys seems useful for addressing the issue at hand.

The SM initiative understood the importance of targeting context-specific information frictions, and therefore administrated a baseline survey in 2013 to assess information frictions among teenagers and design an information intervention based on those frictions. We use responses from this baseline survey to study the initial sources of sex education and baseline knowledge and attitudes regarding sexual health. Responses from the baseline survey suggest that the majority of students are receiving sex education from their parents and are misinformed regarding potential pregnancy risks. Figure 4a shows that while a large share of students talk to adults about sexual health, before the intervention only 25% resort to talking to healthcare professionals. When asked if they could correctly identify how to use different birth control methods (condoms and birth control pills), 85% incorrectly responded to at least one measure. We validate these patterns with the responses of teenagers from the 2010 NSRH Survey: Both sources show that teenagers learn from their parents, and they are misinformed about sexual health.

Having detected the sources of information frictions at baseline, the interventions delivered in schools were designed to correct these misperceptions. An example of the visual material that was used in high schools can be seen in Figure A3, and responses from the baseline survey can be seen in Figure 4a. It should be noted that the content delivered matched the questions asked in the baseline survey closely to provide context-specific information. In the next section, we show that this tailored design was successful at effectively correcting misinformation about sexual health.

Changing sex information source and quality

[Tom: can remove this in a short version:]We begin by showing evidence from the SM initiative's survey that teenagers changed their source of information and updated their baseline beliefs about sexual health after the SM initiative. At the same time, they did not change their sexual activity, which suggests that the source of sex education does not promote sexual activity.

To understand whether the SM initiative affected the source and quality of sexual information, we employ two exercises. First, we use the baseline (2013) and follow-up surveys (2018) collected by the Salud Mesoamerica Initiative to perform a before-after analysis. Unfortunately, the surveys are only collected from a random sample of students in *treated* regions, and hence it's not feasible to construct a control group to ad-

dress time trends and establish a causal relationship. Nevertheless, they are informative of the change in reproductive health practices among teenagers after the SM initiative. Second, we employ a differences-in-differences design using responses from NSRH surveys (2010 and 2015) to validate the causality of our findings from the SM initiative surveys. However, since 2015 is too early to assess changes in *behavioral* outcomes after the initiative, we use the NSRH survey to study changes in sex education.[15]

Using the SM initiative's follow-up survey, we perform a simple before-and-after analysis. Our results suggest that receiving targeted in-school information campaigns successfully increased students' knowledge about pregnancy risks and protection. Figure 4b reports the 2013 to 2018 changes in the source of information, knowledge about sex, and sexual health practices among teenagers after the information campaigns. First, students are more likely to receive information about sex from a health professional rather than a parent. Second, students are more aware of where to receive and how to use birth control methods and, possibly as a result, report a lower likelihood of getting pregnant. Third, responses indicate that they are more likely to visit a health center and use LARCs after the information campaigns: Conditional on having visited a health center to obtain a birth control method, self-reported take-up of LARCs increases. In contrast, there's not a sizable change in take-up of condoms. Simultaneously, we observe a decline in the take-up of birth control pills, conditional on requesting a birth control method during clinic visits, which suggests a shift in the preferred birth control method.[16]

To assess these results, we cross-check responses on SM Initiative surveys with responses on NSRH surveys, which were administered independently of the SM Initiative. Unlike the SM initiative surveys, NSRH surveys are collected from a nationally representative sample, and include responses from both the control and treated districts. However, the period of the NSRH surveys is not ideal for studying the change in *behavioral* outcomes after the initiative, with a baseline in 2010 and a follow-up in 2015. Therefore, we use responses on NSRH surveys to study the immediate impact of the SM initiative on sex *information*. We focus our attention on questions that are similar to those asked on the SM initiative survey[17] and employ the following model:

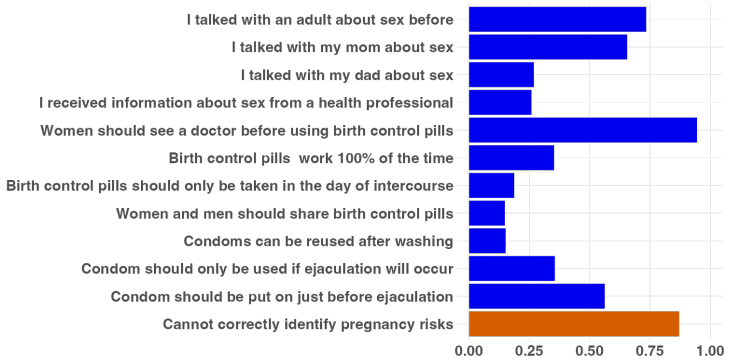
$$Y_{it} = \beta_0 + \beta_1 \text{Treat}_{d(i)} + \beta_2 \text{Post}_t + \tau \text{Treat}_{d(i)} \cdot \text{Post}_t + \epsilon_{it} \tag{4}$$

[15] Since the NSRH survey of 2015 was collected at the end of the year (in months November and December), we have a sufficient time frame to observe changes in information, but not in behavioral outcomes.

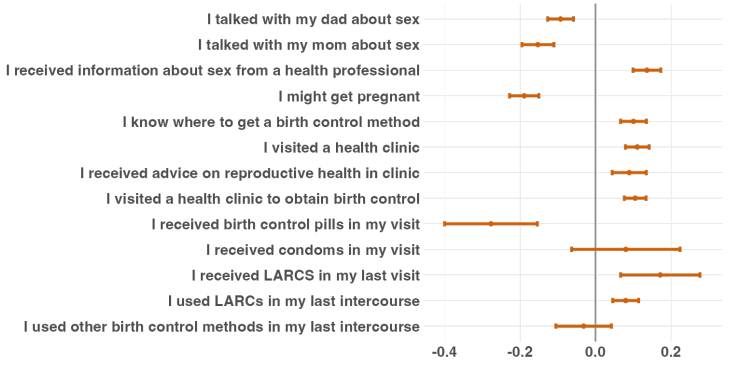
[16] We repeat this exercise by gender to assess the validity of the patterns observed. The results are qualitatively the same by gender, but quantitatively stronger for females. We report the coefficients of this exercise in Figure A5.

[17] Even though the wording of these questions is different in both surveys, we chose questions that focus on similar themes.

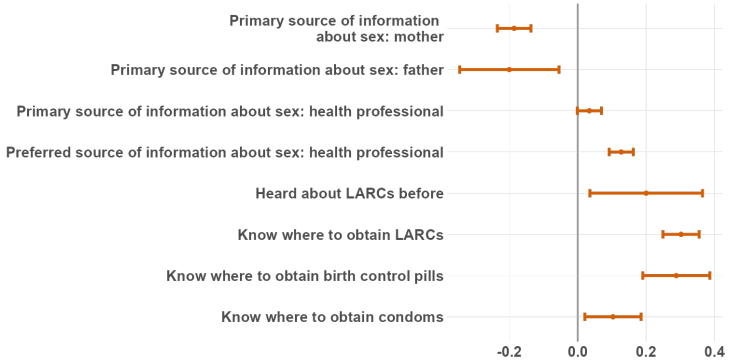
Figure 4: The change in source and quality of information on sexual health



(a) Baseline share of "Yes" replies (SM Initiative Survey)



(b) Change in "Yes" replies post-initiative (SM Initiative Survey)



(c) Differences-in-differences estimates (NSRH Surveys)

Notes: This figure summarizes key questions regarding sexual information sources and knowledge from SM Initiative surveys and the NSRH surveys. Figure 4a highlights the baseline share of "Yes" replies to a series of questions in the 2013 survey. The last question, "Cannot correctly identify pregnancy risk", reports students who responded incorrectly to one of the seven questions above, regarding the correct usage of birth control methods. Figure 4b reports the change in the share of students who responded "Yes" to the given question from pre- to post-initiative (2013 to 2018) in treated districts. Figure 4c presents diff-in-diff coefficient estimates τ from Equation 4, estimated using the responses from 12-19-year-olds on NSRH surveys. All reported questions are phrased using "you or your partner" to ensure that the respondent's gender does not limit the target audience. Vertical lines denote 0. Orange lines denote the 95% confidence intervals.

where Y_{it} records the response of individual i in time t, $\text{Treat}_{d(i)}$ is the treatment indicator for respondents from treatment districts, and Post_t is equal to 1 for responses from the follow-up survey. We plot estimated coefficients $\widehat{\tau}$ in Figure 4c.

The results in Figure 4c confirm that teenagers are changing their source of sex information from personal networks to health professionals, and are better informed about where to obtain birth control methods. Overall, these difference-in-differences results are consistent with the before-and-after exercise from the SM Initiative's survey: They confirm that after the SM initiative, students are better informed about the risks of unprotected sexual activity and better prepared to make choices regarding pregnancy prevention.

4.2 When (and where) would change in the source of information matter?

In Section 3.1, we demonstrated that the SM initiative's impact is stronger in districts that suffer from stronger information frictions at baseline. Section 4.1 provides an explanation why: The level of sex education among teenagers was quite poor before the SM initiative, and the information campaigns in schools improved the quality of sex education information by shifting its source toward healthcare professionals.

A natural question that follows is when (and where) can we reduce information frictions by shifting their source? Chong et al. (2020) discuss how conservative cultures might constrain the sex education of teenagers — and how a change in the source of information might prove useful in these contexts. In a similar fashion, the information campaigns of the SM initiative might be particularly important for teenagers from conservative families who advocate against sexual activity outside of marriage and therefore might be less open to discussion of sexual health.[18] In cases in which information frictions and misperceptions about birth control methods are common among adults, teenagers inevitably receive inadequate sex education.[19]

To test whether a more conservative social network plays an important role in baseline sex information, we split our analysis by districts that featured a more conservative culture in the first place. To construct a measure of conservative sexual beliefs, we use responses to questions about opinions regarding family planning sources in the 2010

[18] If parental consent was an issue for teenagers' access to contraception before the initiative (as reported by **?**), this barrier would also be stronger for conservative districts compared with others, as shown by Brooks and Zohar (2024).

[19] One might wonder whether the change in the source of information in a conservative population (from personal networks and family to healthcare professionals) is necessarily desired, since it might promote sexual behavior. We abstain from such normative discussions. Instead, we opt into a nonpartisan question: Whether the change in the source of information in the conservative population promotes unprotected sexual behavior, which propagates to teen births. Nevertheless, it should be noted that we find no change in the self-reported sexual activity, age at first sex, or the number of sexual partners.

NSRH survey (i.e., before the SM Initiative). Specifically, we impute for each respondent a score of *being against family planning* using the interaction of two questions: (1) *What do you think is the position of the Catholic church on family planning? Is the church in favor, against, or neutral?* and (2) *Do you think the church should maintain its position or change it?* We record the response "I don't support family planning programs" for those who responded "against" and "maintain their position" to the corresponding questions. Then, we aggregate the responses within each district d and generate a score for 'conservatism' for each district based on the share of responses against family planning. Finally, we measure the median score of conservatism, and classify districts that fall below this threshold as *low level of conservatism* and districts that are above as *high level of conservatism*.

To study the impact of the SM Initiative according to the level of conservatism, we employ two exercises. First, we split responses on the 2010 NSRH survey into two groups according to our threshold conservatism value, and analyze responses to questions about information sources and quality. We restrict our sample to teenagers for statements *"Preferred source of information about sex: Healthcare professional"* and *"Primary source of information about sex: Parents"* to assess differences in the source of information by conservatism. To study the information quality, we use the entire sample: In Section 4.1, we argued that teenagers learned from personal networks before the initiative, hence, the quality of sex information of adults is as relevant as teenagers. Second, we reestimate our main analysis in Equation 1 using subsamples of districts based on conservatism level.[20] We report the results of these two exercises in Figure 5.[21]

Figure 5 illustrates two interesting takeaways. First, Figure 5a shows that having parents as a primary source of information is much more common in conservative districts, whereas less teenagers indicate a healthcare professional as their preferred source of information about sex. Furthermore, respondents in conservative districts are less informed about LARCs as an available contraceptive method.[22] Second, in Figure 5b we see that the impact of the SM Initiative is much larger over the years in conservative districts.

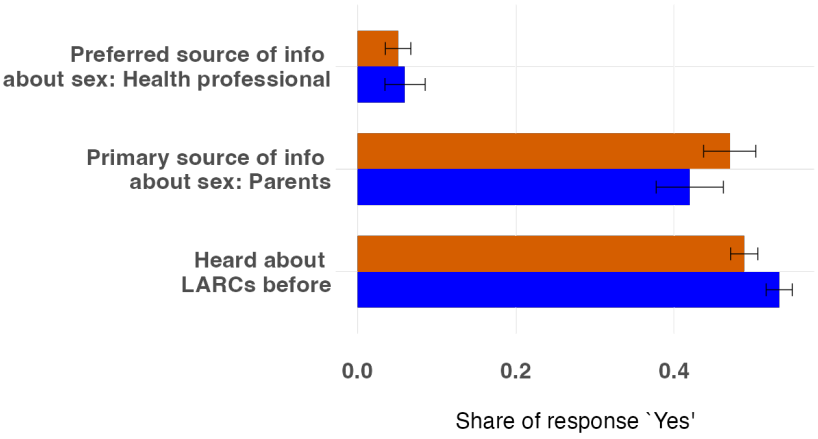
[Tom: Can cut to a short paragraph in a short paper version:]This result reinstates

[20] 2010 NSRH survey only has responses recorded from 162 districts, missing close to 66% of districts in Costa Rica. Consequently, by merging the responses from NSRH surveys with administrative data, we reduce our sample size from 10,494 to 3,404 and introduce sample selection.

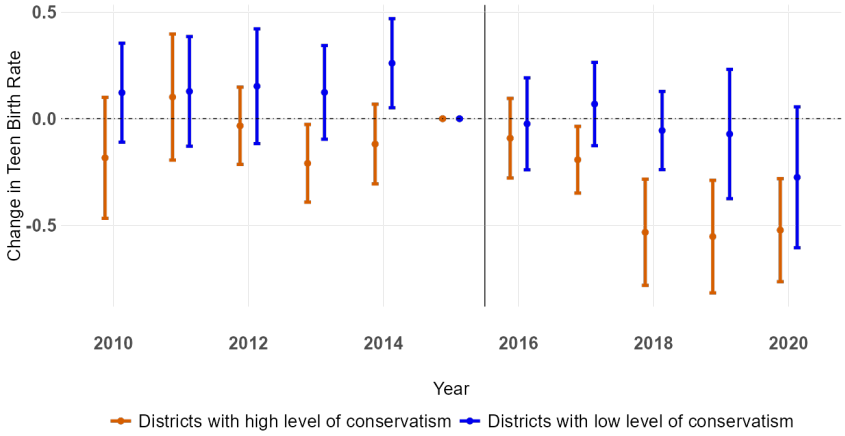
[21] We also repeat the exercise in Equation 2 on subsamples of districts with low and high levels of conservatism. We find results that are consistent with larger effects of both pillars of the SM initiative in more conservative regions. However, these results are very noisy, given the smaller sample (19-year-old women, only in districts that responded to the survey), and the higher data-demanding exercise.

[22] We formally test the difference of means using linear regression models. Estimates are in line with the patterns reported in Figure 5a, however, they are noisy for the statements about information source (which is expected, since we focus on responses from teenagers in the baseline survey, significantly restricting our sample). The p-values for differences in means are as follows: *"Preferred source of information about sex: Healthcare professional"*=0.09,*"Primary source of information about sex: Parents"*=0.18,*"Heard about LARCs before"*=0.001

Figure 5: Impact is larger in conservative districts



(a) Baseline information frictions by conservatism



(b) Impact of initiative by conservatism

Notes: This figure plots the differences across responses and impacts for districts with low levels of conservatism in blue and districts with high levels of conservatism in orange. We develop a score of conservatism by computing the share of respondents against family planning in each district and measuring the median level of conservatism across districts. Districts below the median score are classified as *'low level of conservatism'*, and districts above the median score are classified as *'high level of conservatism'*. In Figure 5a, we plot the number share of responses 'Yes' among several questions. We use all sample for "Heard about LARCs before" and respondents aged 12-to-19 in the rest. In Figure 5b, replicate Equation 1, where subsamples are classified according to the level of conservatism. The dashed line marks 0, whereas the solid line marks 2015.

the importance of context-specific policies in constrained settings: Access to free LARCs and exposure to the information campaigns offered by the SM Initiative matters more for teenagers from conservative families. We show a more continuous version of this result by correlating the share of respondents against family planning with respect to the size of the treatment effect in each district, following Arkhangelsky et al. (2024), in Figure A4. Figure A4 presents an interesting pattern: In the first year of the program, we don't see any correlation between the level of conservatism and treatment effects. With

time, this pattern changes: We see that the decline in teenage pregnancy is larger in districts that featured a more conservative culture initially. This results in a downward-sloping line in 2018, 3 years after implementation of the SM initiative. This result is consistent with our priors: Changing the source of information can enhance the SM initiative's impact, particularly in contexts with stronger information frictions. However, this change takes time.

5 Conclusion

Our study provides robust evidence of the complementarity of economic and information frictions in reducing teenage birth rates. We contribute to the literature on contraceptive access and teenage pregnancy in a developing context, by providing evidence that an approach that combines economic access to LARCs with targeted context-specific information campaigns can substantially reduce teen birth rates, rather than merely using contraception. Our findings also underscore the value of shifting sexual health information sources from personal networks to healthcare providers — particularly in conservative settings, in which traditional sources may impede effective knowledge transfer. This approach highlights how tailored, high-quality information campaigns can support adolescent reproductive autonomy and inform policymakers seeking effective, resource-efficient interventions.

Our findings underscore several policy-relevant takeaways. First, this study highlights the importance of eliciting baseline misinformation before intervention. In contexts in which misconceptions about contraceptive safety and efficacy vary widely, baseline elicitation enables the design of targeted campaigns that address the most prevalent misunderstandings and ensures that information efforts are both contextually relevant and resource-efficient. Second, our findings emphasize the value of shifting the primary source of sexual health information from parents, social networks, and even teachers to healthcare providers. By doing so, programs can improve the quality and reliability of reproductive health information, thus leading to better-informed contraception decisions. Finally, when resources are scarce, policymakers can have a greater impact by targeting areas with higher rates of teen births, or conservative areas in which misinformation and restrictive social norms are more embedded. Our results suggest that conservative regions benefit disproportionately from comprehensive contraception programs that include both access to LARCs and customized information, as these interventions can substantially bridge knowledge gaps and mitigate the influence of restrictive norms.

[Tom: cut for a short paper:]

Future research could explore the broader implications of our findings in several important domains. First, investigating how similar interventions influence sexually

transmitted diseases could shed light on the potential for combined economic and informational approaches to improve broader sexual health outcomes beyond teenage pregnancy. Second, the interplay between reproductive autonomy and female empowerment warrants further study, particularly regarding how improved access to contraception and information affects young women's education, labor market outcomes, and agency in household decision-making. By addressing these complementary questions, researchers can deepen our understanding of how reproductive health policies contribute to broader socioeconomic development.

References

Mabel Andalón, Jenny Williams, and Michael Grossman. Empowering Women: The Effect of Schooling on Young Women's Knowledge and Use of Contraception. Technical Report w19961, National Bureau of Economic Research, Cambridge, MA, March 2014.

N. Angrist. *Essays in Development Economics, Human Capital and External Validity*. http://purl.org/dc/dcmitype/Text, University of Oxford, 2020.

Dmitry Arkhangelsky, Kazuharu Yanagimoto, and Tom Zohar. Flexible Analysis of Individual Heterogeneity in Event Studies: Application to the Child Penalty, 2024.

Nava Ashraf, Erica Field, and Jean Lee. Household Bargaining and Excess Fertility: An Experimental Study in Zambia. *American Economic Review*, 104(7):2210–2237, July 2014. ISSN 0002-8282. 10.1257/aer.104.7.2210.

Susan Athey, Katy Bergstrom, Vitor Hadad, Julian C. Jamison, Berk Özler, Luca Parisotto, and Julius Dohbit Sama. Can personalized digital counseling improve consumer search for modern contraceptive methods? *Science Advances*, 9(40):eadg4420, October 2023. ISSN 2375-2548. 10.1126/sciadv.adg4420.

Martha Bailey, Vanessa Wanner Lang, Alexa Prettyman, Iris Vrioni, Lea Bart, Daniel Eisenberg, Paula Fomby, Jennifer Barber, and Vanessa Dalton. How Costs Limit Contraceptive Use among Low-Income Women in the U.S.: A Randomized Control Trial. Technical Report w31397, National Bureau of Economic Research, Cambridge, MA, June 2023.

Banco Interamericano de Desarrolo. SALUD MESOAMÉRICA 2015:MANUAL OPERATIVO DEL PROYECTO (COSTA RICA), 2015.

Natalie Bau, David Henning, Corinne Low, and Bryce Millett Steinberg. Family Planning, Now and Later: Infertility Fears and Contraceptive Take-Up. 2024.

Pedro Bernal, Antonella Bancalari, Matías Muñoz, Paola Zúñiga Brenes, and Patricia Jara Maleš. Impact Evaluation of Salud Mesoamerica Initiative on Adolescent Fertility in Costa Rica. *IDB Publications*, November 2024. 10.18235/0013228.

Nina Brooks and Tom Zohar. Women's Autonomy and Abortion Decision-Making. 2024.

Alberto Chong, Marco Gonzalez-Navarro, Dean Karlan, and Martín Valdivia. Do Information Technologies Improve Teenagers' Sexual Education? Evidence from a Randomized Evaluation in Colombia. *The World Bank Economic Review*, 34(2):371–392, June 2020. ISSN 0258-6770. 10.1093/wber/lhy031.

Damaris González, Diana Acuña, Rita Villanueva, Wilburg Jiménez, Luis Diego Calderón, María Fernanda Mora, Carol Rodríguez, and Montserrat Solano. Sistematización del Proyecto SM2015 Costa Rica. Technical report, Ministerio de Salud de Costa Rica, Costa Rica, June 2015.

P. Dupas and E. Miguel. Impacts and Determinants of Health Levels in Low-Income Countries. In *Handbook of Economic Field Experiments*, volume 2, pages 3–93. Elsevier, 2017. ISBN 978-0-444-64011-6. 10.1016/bs.hefe.2016.09.003.

Pascaline Dupas. Do Teenagers Respond to HIV Risk Information? Evidence from a Field Experiment in Kenya. *American Economic Journal: Applied Economics*, 2011.

Pascaline Dupas, Seema Jayachandran, Adriana Lleras-Muney, and Pauline Rossi. The Negligible Effect of Free Contraception on Fertility: Experimental Evidence from Burkina Faso. Technical Report w32427, National Bureau of Economic Research, Cambridge, MA, May 2024.

United Nations Population Fund. Adolescent Pregnancy, May 2017.

Susan Godlonton and Rebecca Thornton. Peer effects in learning HIV results. *Journal of Development Economics*, 97(1):118–129, January 2012. ISSN 03043878. 10.1016/j.jdeveco.2010.12.003.

IDB. Manual operativo del proyecto: Iniciativa Salud Mesoamérica 2015, Costa Rica (CR-G1001, GRT/HE-13629-CR, GRT/HE-13630-CR). Technical Report CR-G1001, GRT/HE-13629-CR, GRT/HE-13630-CR, Ministerio de Salud de Costa Rica, March 2013.

Julian Jamison, Dean Karlan, and Pia Raffler. Mixed Method Evaluation of a Passive mHealth Sexual Information Texting Service in Uganda. Technical Report w19107, National Bureau of Economic Research, Cambridge, MA, June 2013.

Melissa S Kearney and Phillip B Levine. Subsidized Contraception, Fertility, and Sexual Behavior. *Review of Economics and Statistics*, 91(1):137–151, February 2009. ISSN 0034-6535, 1530-9142. 10.1162/rest.91.1.137.

Andrea Kelly, Jason M. Lindo, and Analisa Packham. The power of the IUD: Effects of expanding access to contraception through Title X clinics. *Journal of Public Economics*, 192:104288, December 2020. ISSN 00472727. 10.1016/j.jpubeco.2020.104288.

Kevin Lang and Russell Weinstein. The Consequences of Teenage Childbearing before Roe v. Wade. *American Economic Journal: Applied Economics*, 7(4):169–197, October 2015. ISSN 1945-7782, 1945-7790. 10.1257/app.20130482.

Jason M. Lindo and Analisa Packham. How Much Can Expanding Access to Long-Acting Reversible Contraceptives Reduce Teen Birth Rates? *American Economic Journal: Economic Policy*, 9(3):348–376, August 2017. ISSN 1945-7731, 1945-774X. 10.1257/pol.20160039.

Dara Lee Luca, Jack Stevens, Dana Rotz, Brian Goesling, and Robyn Lutz. Evaluating teen options for preventing pregnancy: Impacts and mechanisms. *Journal of Health Economics*, 77:102459, May 2021. ISSN 01676296. 10.1016/j.jhealeco.2021.102459.

Grant Miller and Kimberly Singer Babiarz. Family Planning Program Effects: Evidence from Microdata. *Population and Development Review*, 42(1):7–26, 2016. ISSN 0098-7921.

Grant Miller, Áureo De Paula, and Christine Valente. Subjective Expectations and Demand for Contraception. Technical Report w27271, National Bureau of Economic Research, Cambridge, MA, May 2020.

Kaivan Munshi and Jacques Myaux. Social norms and the fertility transition. *Journal of Development Economics*, 80(1):1–38, June 2006. ISSN 0304-3878. 10.1016/j.jdeveco.2005.01.002.

NHS. How well contraception works at preventing pregnancy, January 2024.

Unicef and PANI. A systematic review of the determinants of the violence that children and adolescents: Costa Rica, 2017.

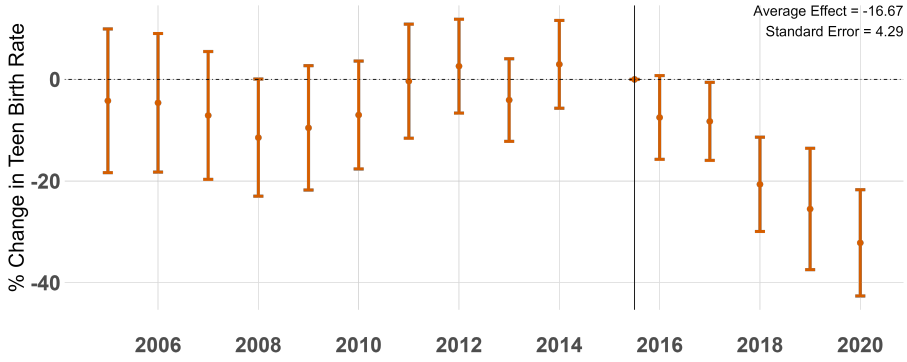
Zachary Wagner, Corrina Moucheraud, Manisha Shah, Alexandra Wollum, Willa Friedman, and William Dow. Reducing Bias Among Health Care Providers: Experimental Evidence From Tanzania, Burkina Faso, and Pakistan. Technical Report w31269, National Bureau of Economic Research, Cambridge, MA, May 2023.

WHO. Adolescent pregnancy, April 2024.

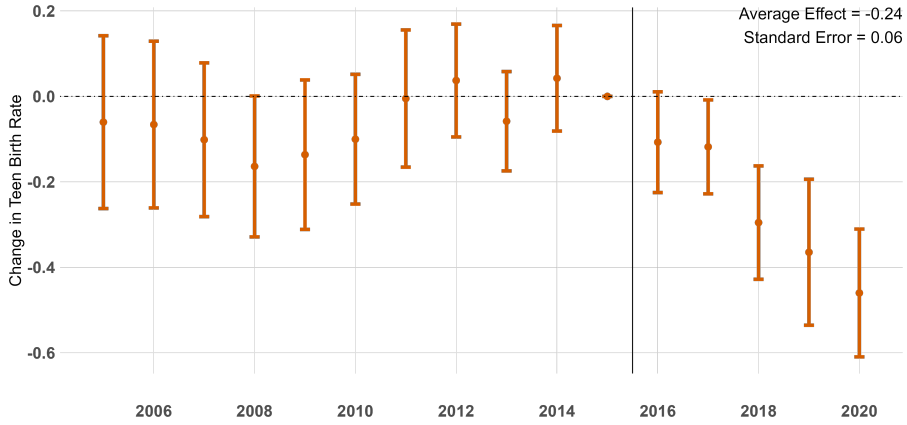
Dean Yang, James Allen, Arlete Mahumane, James Riddell, and Hang Yu. Knowledge, stigma, and HIV testing: An analysis of a widespread HIV/AIDS program. *Journal of Development Economics*, 160:102958, January 2023. ISSN 03043878. 10.1016/j.jdeveco.2022.102958.

A Appendix A: Further results

Figure A1: Change in Teen Birth Rate



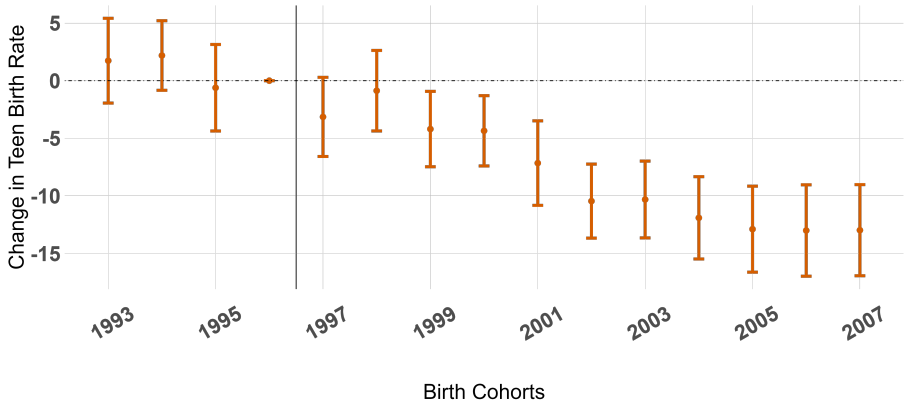
(a) Change in percentages



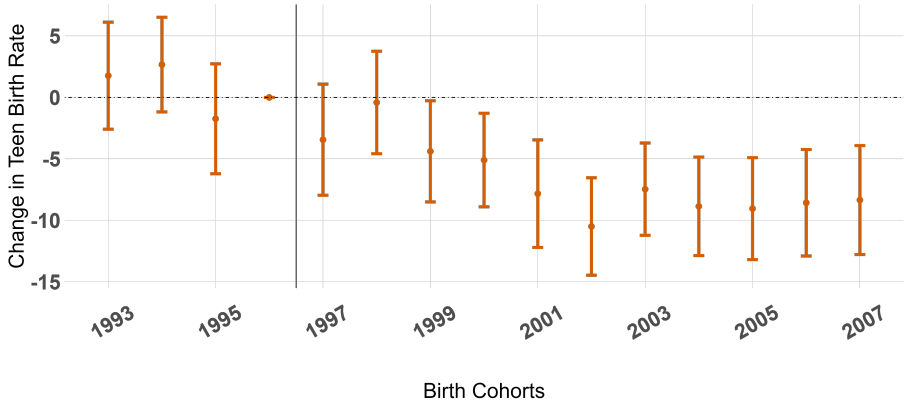
(b) Baseline model (not controlling for SDI)

Notes: This figure plots the difference in teen birth rates between treatment and control districts over 2005-2020. Figure A1a represents the difference in percentages, computed by dividing the estimated coefficient by the mean teen birth rate in 2015, the baseline year. Figure A1b shows the estimates from the baseline model without controlling for time trends in districts' Social Development Index (SDI). Standard errors are clustered at district level. The lines are 95% confidence intervals. The vertical line denotes the year in which the policy was implemented, 2015, and the horizontal line denotes 0.

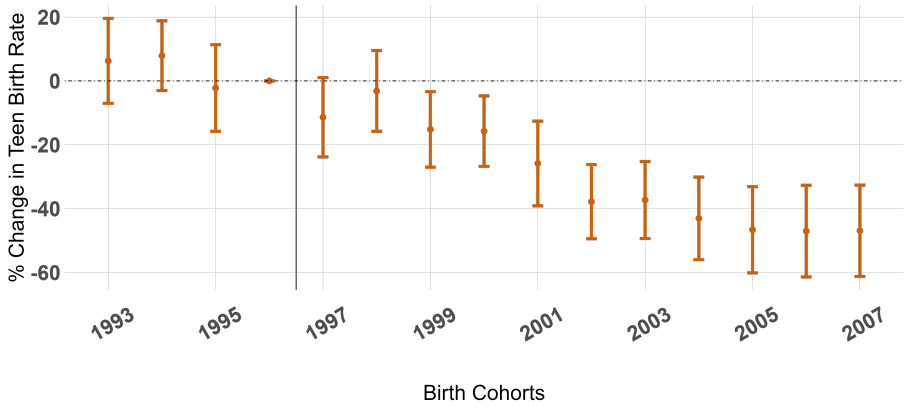
Figure A2: Change in Teen Birth Rate by Cohorts



(a) Baseline model (without controlling for SDI)



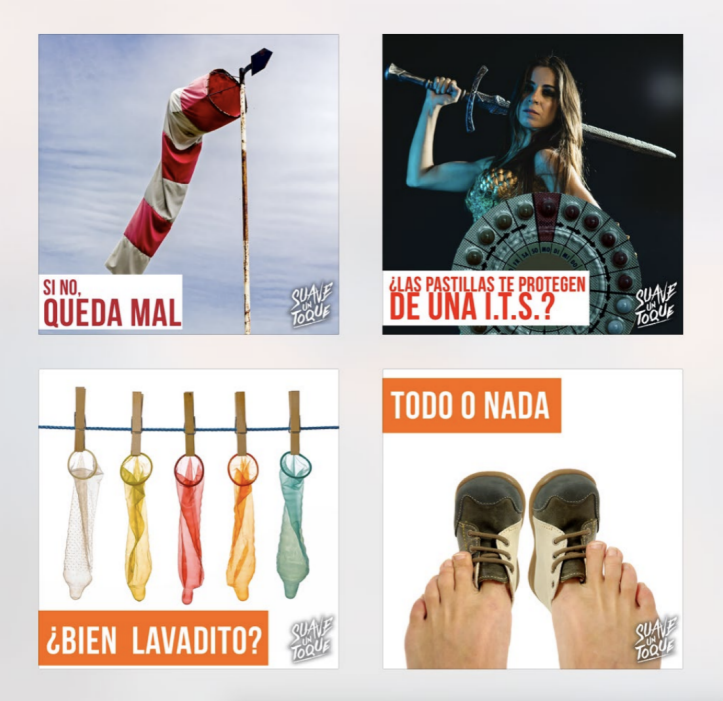
(b) Baseline model (controlling for SDI)



(c) The impact in percentages

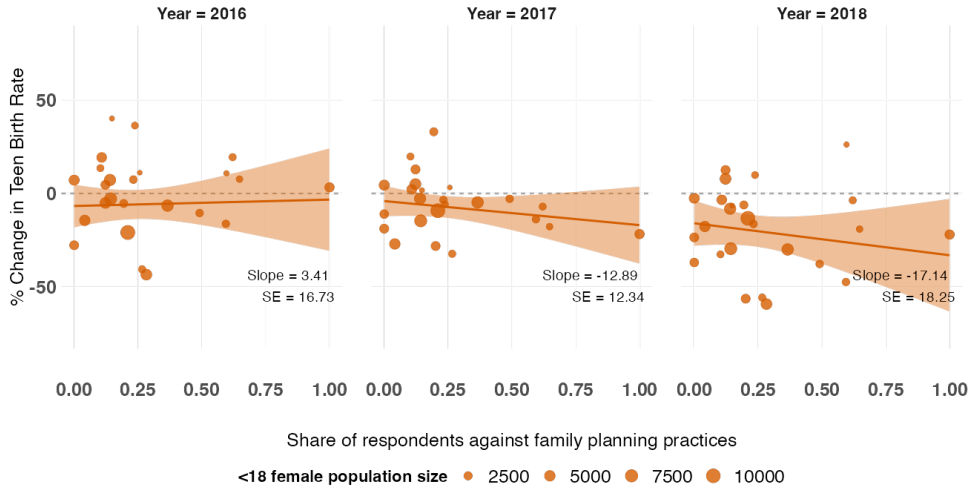
Notes: [Tom: Change this figure to be only with SDI and starting from 1993 cohort]This figure plots the difference in adolescent birth rates between treatment and control regions over cohorts. Figure A2a represents the estimations without controlling for SDI. Figure A2b depicts estimates while controlling for SDI (our baseline model), but in cohorts structure. Figure A2c plots the difference in percentages, where percentages were computed by dividing the estimated coefficient by the mean birth rate of cohort 1996, which is our reference cohort (since they were not covered by the policy, as can be seen in Figure 3). Standard errors are clustered at district level. The lines are 95% confidence intervals. The vertical line denotes the youngest cohort that was not covered by the policy, 1996, and the horizontal line denotes 0.

Figure A3: Visual material provided in information campaigns



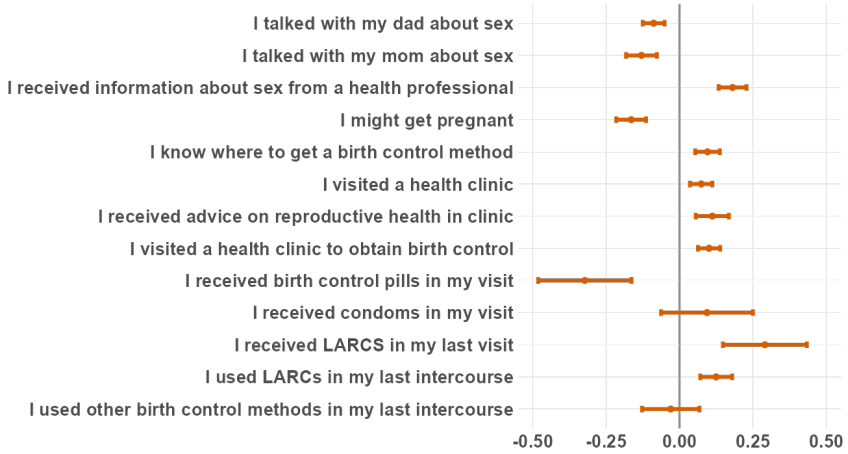
Notes: This figure shows an exemplary exhibit that was provided to teenagers in the information campaigns in high schools (in Spanish). Statements in the panels map to the true-false statements on the baseline survey of the SM initiative in 2013, which can be seen in Figure 4a.

Figure A4: District—level treatment effects vs share against family-planing

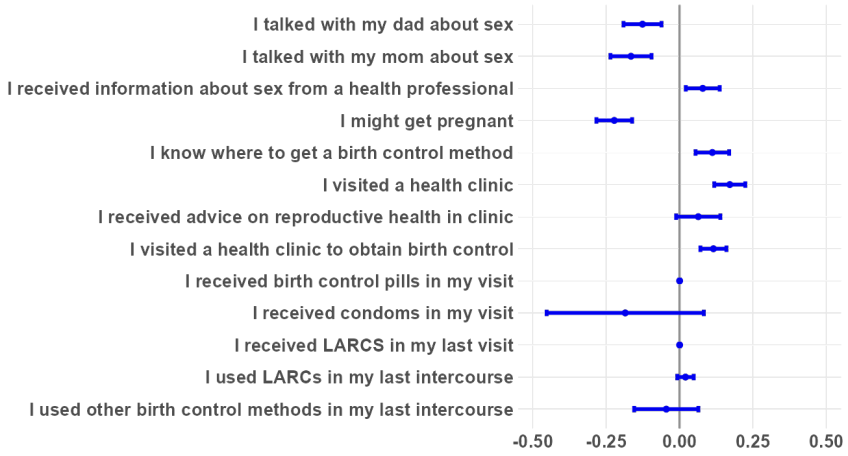


Notes: This figure correlates district-level treatment effects with the share of respondents against family planning programs in 2010 in each district. The y-axis plots the percent change in the teen birth rate due to the SM Initiative, normalized to the baseline levels of teen pregnancy in 2015, following Equation 7. The x-axis plots the share of respondents in districts who are against family planning programs, measured by the NSRH survey in 2010, before the SM Initiative. Observations were weighted by the size of the female teenage population in 2014 when estimating the regression slope, and the size of each observation signifies these weights.

Figure A5: Change source and quality of information about sexual health by genders



(a) Change in "Yes" replies post-initiative for girls



(b) Change in "Yes" replies post-initiative for boys

Notes: This figure summarizes key questions regarding the source of sex information and knowledge from the SM Initiative's surveys and NSRH surveys. Figure A5a highlights the change in the share of female students who responded "yes" to the given question from pre- to post-initiative. The last measure records students who responded incorrectly to one of the seven birth control method questions above. Figure A5b shows the change in the share of male students who responded "yes" to the given question from pre- to post-initiative. All reported questions regarding sexual activity or use of contraceptives are phrased as "you or your partner" to ensure that the respondent's gender does not limit the target audience. Questions that do not concern male students ('I received birth control pills' and 'I received LARCs') are recorded as null for male respondents. Vertical line denotes 0.

Table A1: Heterogenous impact by subsample analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SDI Score		Baseline teen birth		% knows about Larcs		Conservatism	
	Below median	Above median	Low	High	Below median	Above median	Low	High
Treat x Post	-0.2911***	-0.2593	-0.1096	-0.1604*	-0.4185***	-0.1291	-0.1970*	-0.3334**
	(0.0852)	(0.1651)	(0.0678)	(0.0712)	(0.0990)	(0.0802)	(0.0949)	(0.1169)
Fixed effects								
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustered	by: District	by: District	by: District	by: District	by: District	by: District	by: District	by: District
N. Obs	5,192	5,236	5,126	5,346	1,562	1,760	1,782	1,782
R2	0.67878	0.72187	0.57407	0.67287	0.75449	0.80376	0.78422	0.77816
Within R2	0.01570	0.00370	0.00134	0.00403	0.03613	0.00352	0.00931	0.02115
Mean TBR	1.584	1.343	0.793	2.076	1.591	1.518	1.506	1.642

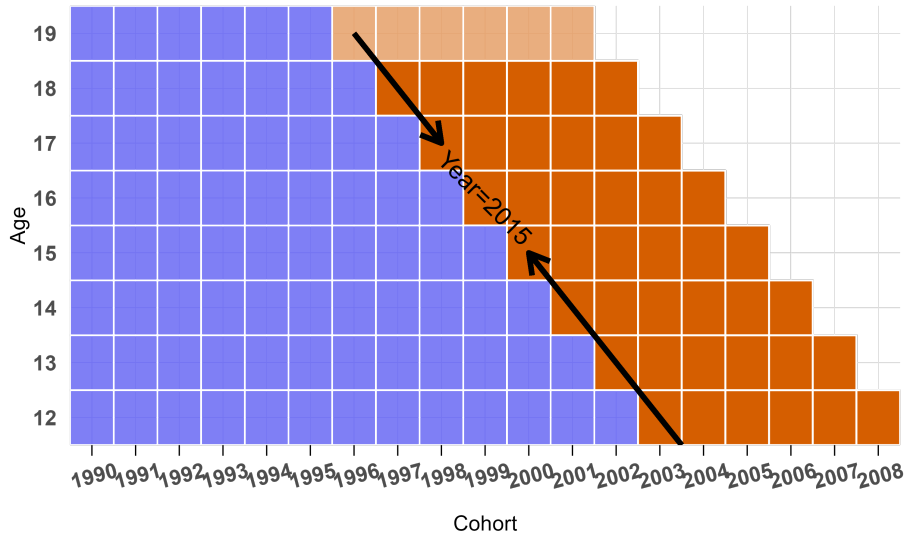
Notes: This table presents the impact of the SM Initiative. We represent the coefficients of a simplified differences-in-differences design, in a similar fashion to Equation 4, but with year and district fixed effects. The first two columns represent results according to districts' SDI score — the criteria used to determine which districts to target — those below the median SDI score (in column 1), and those above (in column 2). In the third and fourth columns, we split the sample into districts that fall above the median baseline teen birth rate (column 3) and below the median baseline teen birth rate (column 4), where our baseline year is 2015. Columns 5 and 6 show subsample analysis by baseline information frictions, which we proxy using the statement *"I have heard about LARCs before"*. We classify districts into two groups: those below the median rate of recognition in column 5, and those above in column 6. In the last two columns, we employ subsample analysis based on conservatism: We develop a score of conservatism by computing the share of respondents against family planning in each district and measuring the median level of conservatism across districts. Districts below the median score are classified as *'low level of conservatism'* (in column 7) and districts above the median score are classified as *'high level of conservatism'* (in column 8). The mean is calculated using teenage birth rates in 2015, just before the SM initiative took effect for the respective sample. Standard errors in parentheses are clustered at district level. Significance levels according to p values are as follows: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

B Impact of exposure to the SM Initiative

B.1 Variation in exposure to information campaigns by cohorts

In this section, we explain the general identification of an extra year of exposure on the teen birth rate, extending beyond the cleaner exercise on 19-years-olds (Equation 2 and Figure 3). We repeat this exercise including all age groups in Equation 5, and the cohort structure in this exercise can be seen in Figure B1.

Figure B1: Variation in exposure to LARCs access versus information campaigns (all age groups)



Notes: This figure represents the cohort structure in our sample by birth year and age. Blue blocks represent our control group: years before implementation of the SM Initiative (before 2015). Orange blocks represent our treatment group: years in which the affected cohorts were treated by the SM Initiative. Darker orange blocks represent exposure to information campaigns in schools (which cover ages 12-18). The blocks represent the cohort structure of the entire sample, which was used in the analysis of Equation 5, allowing for different levels of exposure across ages. The diagonal line denotes blocks that belong to the year 2015.

$$\begin{aligned} \text{TBR}_{dtc} =& \phi_d + \gamma_t + \lambda_c + \tau_1 \text{Treat}_d \cdot \text{Post}_t + \tau_2 \text{Treat}_d \cdot \text{Age}_{ct} \\ &+ \tau_3 \text{Post}_t \cdot \text{Age}_{ct} + \tau_4 \text{Treat}_d \cdot \text{Post}_t \cdot \text{Age}_{ct} + \alpha \text{Exp}_{dtc} + \epsilon_{dt}, \end{aligned} \tag{5}$$

where TBR_{dtc} is the teen birth rate in district d at time t for cohort c, Treat_d is the treatment indicator for district d, Post_t is a post-initiative indicator (after 2015), Age_{ct} denotes the age of cohort c at time t (normalized to start at 0 instead of 12), and Exp_{dtc} is a variable that captures how many years a cohort in district d at time t has been exposed to the information campaign: We formalize the definition of Exp_{dtc} in Equation 6.

$$\text{Exp}_{dtc} = \text{Treat}_d \cdot \text{Post}_t \cdot \begin{cases} (t-2014) - \mathbb{1}(t-c=19) & \text{if } 1997 \leq c \leq 2003 \\ t-(c+12) & \text{if } c > 2003 \\ 0 & \text{otherwise} \end{cases} \tag{6}$$

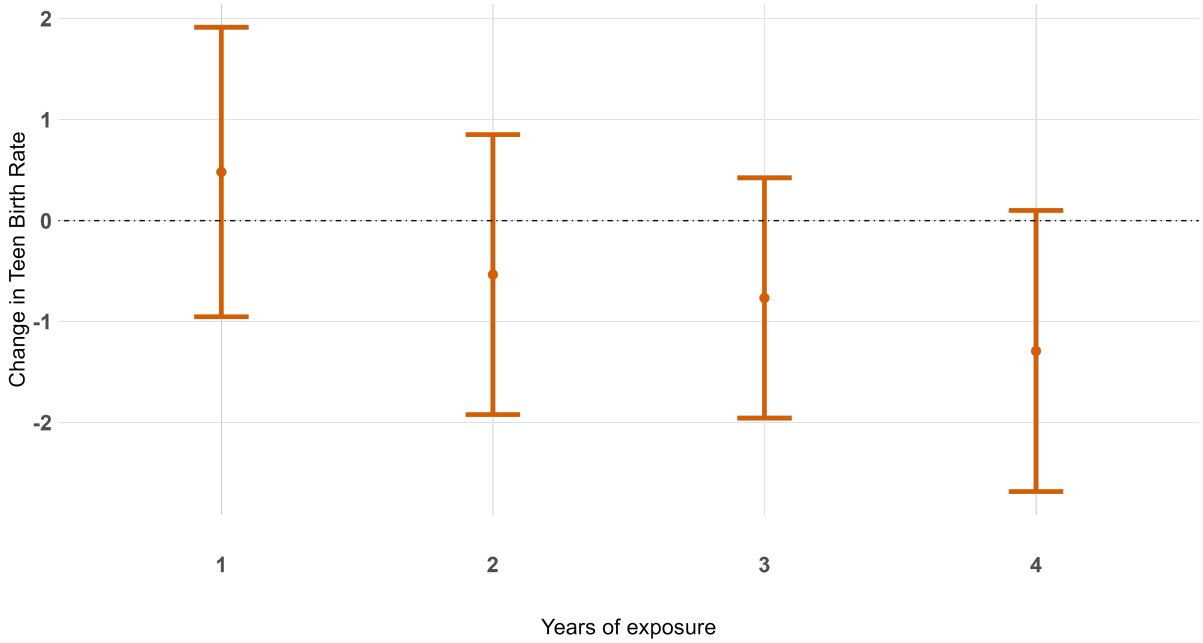
This unique setup enables us to explore variations across different ages and exposure levels, and allows us to disentangle the effects arising from teens being older and potentially more mature and responsible from the specific impact exposure to the information campaigns may have had in terms of changing sexual norms and normalizing contraception takeup. We report the results of this exercise in Table B1.

Table B1: Impact of exposure to the SM Initiative

	(1)	(2)
	Baseline	Controlling for Age
Treated x Post	-1.164***	0.3724*
	(0.1928)	(0.1547)
Exposure	-0.2219***	-0.3154***
	(0.0543)	(0.0684)
Treated x Age		0.4589***
		(0.0741)
Post x Age		0.0558
		(0.0476)
Treated x Post x Age		-0.3056***
		(0.0571)
Controls		
SDI	No	No
District	Yes	Yes
Year	Yes	Yes
Cohort	Yes	Yes
S.E.: Clustered	by: District	by: District
Observations	67,553	67,553
R2	0.44496	0.44873
Mean dependent variable	4.291	4.291

Notes: This table presents the impact of exposure to the SM Initiative. The first and second columns represent the coefficients estimated from Equation 5, including all age groups. The mean is calculated using teenage birth rates in 2015, just before the SM Initiative took effect for the respective sample. Exposure levels are calculated using Equation 5, which tracks how many years each cohort has been exposed to the SM Initiative since the SM Initiative's start. Standard errors in parentheses are clustered at district level. Significance levels according to p values are as follows: 0 '***' 0.001 '**' 0.01 '*'.

Figure B2: Impact of exposure to information campaigns by year



Notes: This figure presents estimates based on data on births per age per district per year between 2005 and 2020. Estimates are from a variation of Equation 2, where exposure is not used linearly but as a collection of dummies for each level. Standard errors are clustered at the district level. The horizontal line denotes 0.

B.2 Variation in exposure to information campaigns by districts

In this section we study whether being exposed to information campaigns amplified the decline in teen birth rates. Therefore, we explore whether districts with higher baseline high school attendance rates, where the information campaigns were delivered, also had larger declines in teen birth rates.

To evaluate the success of the SM Initiative's LARCs-specific information campaigns delivered in schools, we rely on administrative data on high school attendance rates in each district per year. We divide the aggregate number of students registered in public high schools by the number of high school-age teenagers in each district to calculate the high school attendance rate. We opt for students registered in public high schools, since regulations require students to attend the public institution in the district they are registered in, and hence mobility is more limited compared with private schools. We limit our analysis to baseline attendance rates in 2015 — the year that the SM Initiative started — and abstain from using attendance rates in following years, since high school attendance might be responsive to the program in conservative regions.

Following Arkhangelsky, Yanagimoto, and Zohar (2024), we estimate district-level treatment effects as follows:

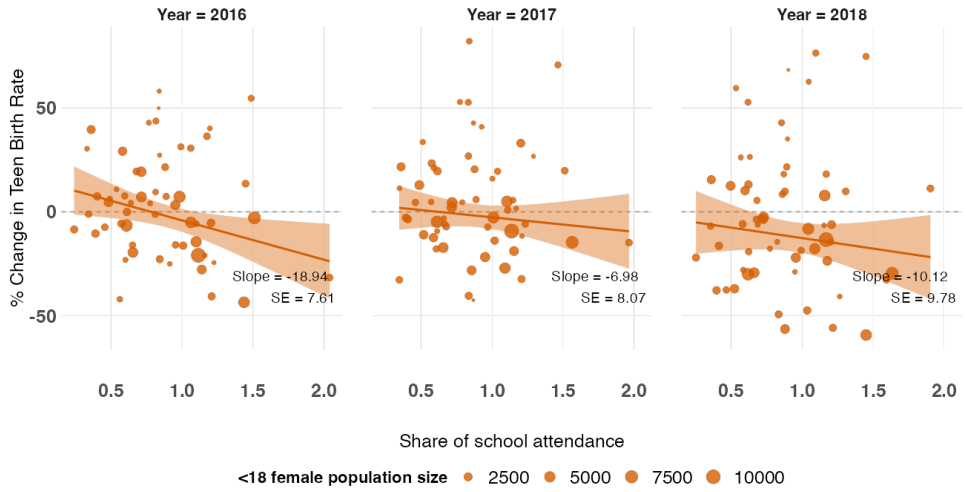
$$TBR_{dt} = \alpha_d + \delta_t + \sum_{k \neq 2015, \infty} \tau_{dk} + \epsilon_{dt} \tag{7}$$

where TBR_{dt} stands for teen birth rates per district d and year t, α_d are district fixed effects and δ_t are year fixed effects. As in Section 3.1, we define the reference year as 2015, since births that took place in 2015 are likely the result of conceptions in 2014 — a year before the policy took effect. Consequently, we consider 2016 as the initial year we expect to see a change in teen birth rates as a result of the SM Initiative. Importantly, we now estimate a matrix of coefficients τ_{dk} of district d in year k relative to those in 2015. The control group features an event time of infinity, which allows the model to consistently estimate year fixed effects δ_t from districts that are never treated (i.e., control districts).

We perform a heterogeneous treatment effect analysis by high school attendance rates by using the estimated district-level treatment effects τ_{dk} against the high school baseline attendance rate for each district (Figure B3).[23] Figure B3 shows that the decline in teenage pregnancy is larger in districts with higher school attendance. These results suggest that higher exposure to related sexual educational content results in a stronger decline in teen birth rates, highlighting the importance of information campaigns. In Section 4.1 we explore whether these results can be explained by a shift in the source — and hence the quality — of teenagers' sex education. Furthermore, a level shift downward in the change in teen pregnancy is observed over the years, which indicates that the decline becomes more pronounced over time. This might suggest that receiving information persistently for a long period might normalize the use of LARCs, and change norms about sexual health and contraception among teenagers; which we explore in Section 3.2.

[23] We opt to illustrate the results up to the year 2018 to be comparable to results from the SM Initiative's follow-up survey, which we use in Section 4.1.

Figure B3: District–level treatment effects versus high school attendance



Notes: This figure correlates district-level treatment effects with high school attendance rate in each district for 3 years post–SM Initiative. The y-axis plots the percent change in the teen birth rate with respect to 2015 levels due to the SM Initiative, following Equation 7. The x-axis plots the share of high school attendance, measured by the aggregate number of students registered in public high schools in 2015 divided by the number of high school age population in each district. The observations were weighted by the size of the female teenage population in 2014 when estimating the regression slope, and the size of each observation signifies these weights. The share of school attendance exceeds 1 for districts that receive students from surrounding areas that do not have public schools. The horizontal line marks 0.