The Complementary Role of Information and Contraceptive Access in Teen Pregnancy*

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Abstract

We investigate how information frictions affect the efficacy of contraception provision programs. We study a Costa-Rican initiative that combined two pillars: free access to long-acting-reversible contraceptives; and a tailored information campaign to raise awareness and correct for baseline misperceptions. Using administrative data and geographic variation in the initiative, we find a 16% decrease in the teen birth rate. We show information complements access: districts exposed to both pillars experience substantially larger reductions than those with contraception access alone. Using surveys on sexual behavior, we show the initiative shifted the information source from personal networks to healthcare professionals, amending misperceptions on sexual health.

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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 through trained healthcare providers who delivered comprehensive consultations, thus alleviating friction in access to contraception. The second pillar consisted of school-based information campaigns designed to: (1) correct baseline misperceptions about sexual and reproductive health, contraceptive efficacy, and safety; and

[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).

(2) promote awareness among students that free LARCs and sexual health services were available.[2]

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. Crucially, low-SDI districts are also found in other regions of the country so our control regions contains districts that are comparable in terms of need and socioeconomic status to those that received the intervention. 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, complemented by implementation data from the Costa Rican Ministry of Health and Ministry of Education. 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 2000 and 2021, 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. To disentangle the effects of free contraceptive access from those of information campaigns, we further incorporate administrative data from the Ministry of Health on which districts were covered by treated Health Areas, and data from the Ministry of Education on which districts received information campaign visits. 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 six years after its implementation. The impact is stronger in districts with higher baseline information frictions and grows over time, consistent with both cumulative exposure to the program and improvements in delivery quality as the initiative matured. However, it is unclear whether this is driven by free contraception access, or its complementarity with the information campaigns. To disentangle the contributions of the two pillars, we exploit the fact that the access and information components were implemented through

[2]While healthcare consultations also included information provision by trained providers, school-based campaigns were crucial for raising awareness about the existence of these services. Without understanding the need for or availability of LARCs, adolescents might not seek care at health centers. The school-based campaigns addressed this by systematically reaching adolescents in schools, promoting service utilization in addition to correcting misconceptions.

different administrative channels, generating variation in treatment across locations. In the data, we observe three types of districts: (i) districts not exposed to any component of the program; (ii) districts that only received free access to contraceptive methods; and (iii) districts exposed to both pillars of the initiative. Our results show that the impact of the initiative was significantly stronger in districts that were subject to both access and information treatments, compared to those that only had access.

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 that identified key frictions among teenagers — including limited contraceptive knowledge, poor awareness of available services, and low trust in health services among others — and designed the campaign content accordingly (IDB, 2013; Ilse Cerda, 2018). 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 frictions directly with: (1) posters and discussions that address the misperceptions detected; (2) talks by healthcare professionals promoting free LARC availability and dedicated adolescent-only consultations; and (3) providing specific resources to seek help.

In conservative communities, 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, both teenagers and adults, had limited knowledge about sexual health, and specifically, LARCs. 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 reported a lower likelihood of getting pregnant, were better informed about how to use contraceptives correctly and 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 et al., 2025) and how a change in the source of information has higher effects in conservative contexts (Chong et al., 2020; Angrist, 2020). In our context, 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 altogether. 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.

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 that goes beyond take-up and explicitly connects these frictions to reductions in *teen births*: evidence on successful family planning interventions targeting adolescents in low-income countries remains scarce.[3] 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; in contemporaneous work, Bernal et al. (2024) also studies the SMI initiative and documents a similar decline. While Bernal et al. (2024) highlights changes in contraceptive use based on program administrative data, our study differs in its focus on mechanisms: we disentangle the roles of information and access, leveraging variation in exposure to the information campaign, and show they are complementary. We also examine different heterogeneity patterns — focusing on baseline misperceptions and conservatism — whereas Bernal et al. (2024) emphasizes age-based heterogeneity.

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

[3] 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.

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.

Finally, our study relates to the growing literature on the role of information sources and social norms in shaping reproductive choices and 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 et al. (2025) 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.

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 and survey data 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[4] and authorized the emergency "day after" pill in 2019. However, access to family planning services remains limited; for example, abortion is illegal except when the mother's life is at risk.

Long-acting reversible contraceptive methods (LARCs) are expensive and largely unaffordable for adolescents when not subsidized, and even free contraceptives face significant access barriers. Before the SM initiative, Costa Rica's public health system provided free male condoms, oral contraceptives, and copper IUDs through primary care centers (EBAIS), but access was limited by requirements for adult accompaniment during consultations and quality concerns about freely provided contraceptives (Valverde Cerros and Sánchez Calvo, 2015; Banco Interamericano de Desarrolo, 2015). Modern contraceptive methods such as dermal implants and levonorgestrel IUDs were not available through the public system. Obtaining these methods privately was prohibitively expensive for adolescents: a pack of birth control pills cost $27 on average — 121% of the 2024 daily minimum wage ($22.3) — while IUDs ranged from $100 to $136, or 440%–610% of the daily minimum wage. These access barriers were compounded by the conservative culture prevalent in some communities within the country. According to the 2010 Na-

[4]Sex education classes were implemented nationally, and aimed to cover general sexual health topics such as reproductive physiology and STDs. While they were supposed to be delivered by science teachers, several students reported that some teachers refused to deliver the content, as it did not align with their personal views on premarital sexuality.

tional Sexual and Reproductive Health (NSRH) survey, 65% of Costa Rica's population is catholic and 48% believe that the church is against family planning.

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

The Salud Mesoamérica Initiative's (SM Initiative henceforth) primary objective was tackling health disparities in Mesoamerican countries. In the case of Costa Rica, the 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). It's important to note that several pillars of the preparation phase were delayed, some up until the implementation phase.[5]

The preparation phase focused on preparing the healthcare and education systems to deliver adolescent sexual and reproductive health services. Authorities undertook several efforts to identify baseline frictions and inefficiencies, including collecting surveys from schools and healthcare centers and reviewing public health studies in Costa Rica, to pinpoint areas where information gaps might undermine program efficacy. Furthermore, the preparation phase included investments in infrastructure (e.g., youth-friendly clinics), inter-institutional coordination, evaluation systems, and initial steps toward integrating sex education in schools. Specifically, the baseline surveys identified four critical information frictions that shaped the intervention design: limited contraceptive knowledge among adolescents, poor awareness of service access points, inadequately trained personnel with adult-centric perspectives, and low trust in health services due to confidentiality concerns. The program responded with school-based education, referral systems, provider training, and adolescent-only service hours with enhanced privacy (IDB, 2013; Ilse Cerda, 2018).

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.

[5] According to the 2015 operational 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 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).

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 its resources primarily toward procuring LARCs, given the evidence on its effectiveness.

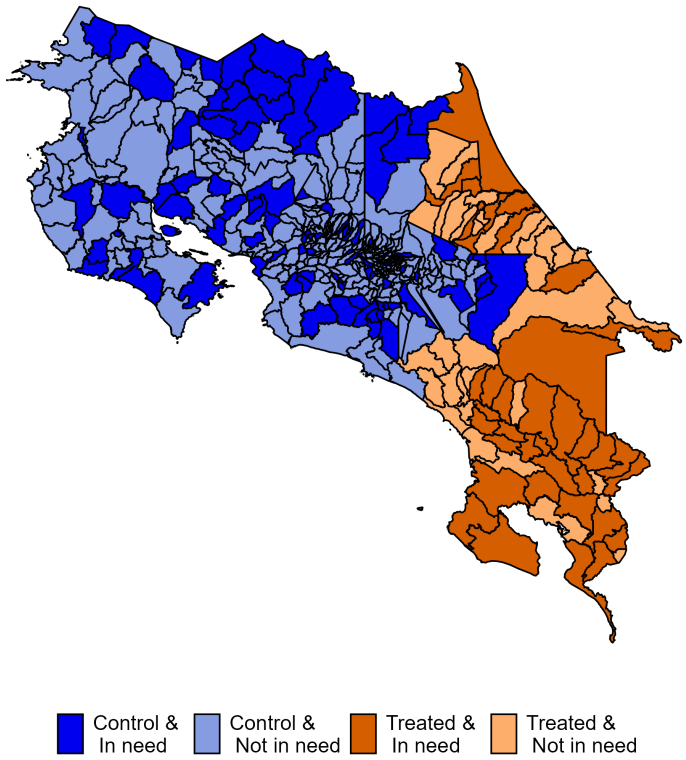
The resulting SM initiative centered on a two-pillar program: (1) Providing free access to LARCs; and (2) school-based information campaigns delivered by healthcare professionals. Under the first pillar, providers received specialized training to deliver adolescent-centered care, offering consultations that covered LARCs' functionality, efficacy, and safety and addressed individual concerns. Before the intervention, students were hesitant to visit health centers, fearing that their visit would be disclosed to their parents by staff (Valverde Cerros and Sánchez Calvo, 2015); the program specifically aimed to improve the sensitivity of healthcare professionals towards adolescents and provide adolescent-only service hours with enhanced privacy. Under the second, campaigns delivered in schools included audiovisual materials, guided debates, self-care activities, and periodic visits from healthcare professionals. Prior to the initiative, delivery of sex education in schools had been sporadic: Valverde Cerros and Sánchez Calvo (2015) report that several students noted their teachers disagreed with the content and abstained from delivering it, which motivated the choice of healthcare practitioners as campaign deliverers. These campaigns addressed two key barriers: promoting awareness of available services and correcting misperceptions about LARCs' functionality, safety, and benefits — both prerequisites for adolescents to seek and benefit from provider consultations. The 2013 baseline survey allowed campaign content to be tailored to mapped misperceptions about sexual health and students' needs.

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 (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).[6] Crucially, low-SDI districts are also found in other regions of the country (dark blue districts in Figure 1), meaning our estimation sample includes all districts but the control group contains districts that are comparable in terms of need and socioeconomic status to those that received the intervention. Summary statistics in Table A1 confirm this: treated districts have substantially lower SDI scores and higher

[6]To understand the external validity of these targeted regions, they are comparable to a similar measure—the Human Development Index—and teen birth rate in Brazil and Peru (Smits and Permanyer, 2019; United Nations Development Programme, 2024).

baseline teen birth rates than control districts — both expected, since the southern regions selected for treatment have the highest concentration of low-SDI districts, and the teen birth rate enters the SDI score as a component. Treated districts are also somewhat more conservative on average, by 3 percentage points. While modest, this gap is substantively relevant: conservative norms may shape how teenagers access information about contraception and sexual health in the first place — the very mechanism the SM Initiative was designed to address. We therefore examine heterogeneity by district-level conservatism directly in Section 4.2. On the remaining dimensions, school attendance and population size, the two groups are comparable.

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

Birth records: To estimate the SM initiative's impact on teen birth rates, we use administrative data on births by year, age, and district from 2000 to 2021. The underlying source is Costa Rica's National Institute of Statistics and Censuses (INEC), which compiles birth records from the Civil Registry. For our main teen birth rate series, we

use publicly available tabulations produced by the Centro Centroamericano de Población (CCP), which aggregates the INEC registry to the district–year–mother's-age level. We focus on births to mothers aged 12–19 to align with the SM initiative's target age group.[7] We verify these tabulations against INEC's publicly released individual-level microdata for 2014–2020, which records every registered birth together with mother's age in single years, district of residence, and a rich set of covariates. We also use the INEC microdata directly for our placebo tests on older women, where we need age cells outside the CCP tabulation's teen-focused range. 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.

Geographic coverage of the intervention: To disentangle the effects of free contraceptive access from those of information campaigns, we draw on administrative data from the Ministry of Health and Ministry of Education on which districts were covered by each pillar of the initiative. The health access pillar was administered by the Ministry of Health through the CCSS Health Areas (*Áreas de Salud*). The information pillar, on the other hand, was administered by the Ministry of Education on selected high-schools. We use official Health Area assignment records from the CCSS and school-level treatment lists from the Ministry of Education to classify districts into three groups: (i) districts not exposed to any component of the program; (ii) districts that received free access to LARCs only; and (iii) districts exposed to both pillars of the initiative.[8] Further details about the implementation can be found in Appendix C.

Sex education: To analyze the effect of the initiative on sexual behavior, information, and attitudes, 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 as a repeated cross-section, with different students sampled in each wave.[9] 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). We use the 2010 NSRH wave to characterize baseline information frictions, drawing on the full sample of respondents to capture both teenagers and adults. To assess whether districts with stronger baseline misperceptions

[7] 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.

[8] Since there are only 2 districts that received the information campaigns without free access to LARCs, we cannot study the impact of information on its own.

[9] Response rates for the SM initiative surveys were low but stable across waves (28.5% in 2013 and approximately 27% in 2018), consistent with the survey designers' expectations given the sensitive nature of questions on adolescent sexual and reproductive health (Institute for Health Metrics and Evaluation (IHME), University of Costa Rica, 2019; Institute For Health Metrics And Evaluation, 2024).

experienced larger reductions in teen births, we merge the 2010 wave to our district-level birth panel using the numeric district code (*distrito*) reported in the survey, retaining the 162 of Costa Rica's 489 districts covered by the survey (34%).[10] We then use both NSRH waves alongside the SM initiative survey to study changes in the source and quality of sexual-health information, restricting the NSRH sample to respondents aged 12–19 — the population directly targeted by the program.

Educational attainment and school attendance: We use administrative records from the Ministry of Education on public high-school enrollment by district in 2015 to verify whether the information campaigns delivered in schools complement free access to contraception — specifically, we examine whether the initiative's impact on teen birth rates is larger in districts with higher school attendance rates. We also draw on the educational attainment of the mother recorded in birth registry data to control for education in exercises that exploit variation in district-level conservatism.

Conservatism: 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. To validate this measure, we draw on administrative marriage registry data and compute the share of Catholic marriages in each district by 2015. The two measures are positively and significantly correlated (correlation =0.25), lending support to our survey-based proxy for local conservative social norms.

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

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.

[10] For heterogeneity exercises that use NSRH-based district measures, we further restrict to respondents in control and fully-treated districts to ensure a clean comparison unaffected by the composition of health-only districts across groups.

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:

$$\text{TBR}_{dt} = \phi_d + \gamma_t + \sum_{\substack{k=2000 \\ k \neq 2015}}^{2021} \beta_k \mathbb{1}(t = k) \cdot \text{Treat}_d + \epsilon_{dt}, \tag{1}$$

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. 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.

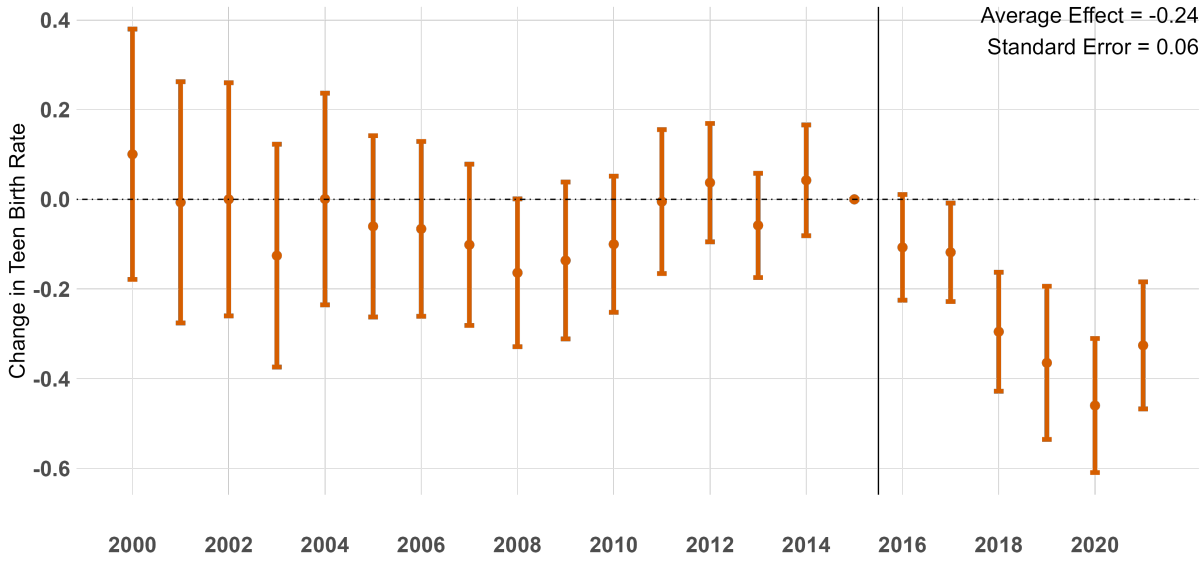
Our empirical strategy relies on the standard parallel trends assumption: Non-treated districts were on the same trajectory as treated districts in the absence of the SM initiative. We can assess the plausibility of this assumption with Figure 2, which illustrates the coefficient estimates from Equation 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

We find that the SM initiative reduced the teen birth rate by 0.24 percentage points (16%) on average.[11] Successful interventions reducing teenage fertility in low-income countries are rare in the literature, and this constitutes one of the few documented cases of a large-scale program achieving meaningful reductions in adolescent birth rates. This average effect, however, masks considerable variation: the SM initiative was explicitly designed to reach the most disadvantaged communities, and its impact may be concentrated among districts with the greatest information frictions and strongest barriers for contraceptive acces. We examine this heterogeneity next.

[11] See Figure A1 for the change in the teen birth rate in percentages, normalizing point estimates by the mean teen birth rate in 2015.

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



Notes: This figure plots the difference-in-differences estimates in teen birth rates between treatment and control districts between 2000-2021 (see Equation 1). 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.

Heterogeneity: Who benefits and why?

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 those with lower socioeconomic conditions (the SM Initiative's approach using the SDI score). To test these hypotheses, we collapse the year-by-year specification in Equation 1 into a static difference-in-differences that yields an average post-treatment effect, and estimate it separately on subsamples defined by each criterion:

$$\text{TBR}_{dt} = \phi_d + \gamma_t + \tau \, \text{Treat}_d \cdot \text{Post}_t + \epsilon_{dt}, \tag{2}$$

where TBR_{dt} is the teen birth rate in district d at time t, ϕ_d and γ_t are district and year fixed effects, Treat_d is the treatment indicator, and Post_t equals 1 for years from 2016 onwards. The coefficient τ recovers the average treatment effect across all post-initiative years.

Table 1: Heterogenous impact by subsample analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SDI Score		Baseline teen birth		Aware of 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*	-0.3734***	-0.0942	-0.2083*	-0.3239*
	(0.0852)	(0.1651)	(0.0678)	(0.0712)	(0.0917)	(0.0797)	(0.0900)	(0.1231)
p-value: Above = Below		0.864		0.605		0.022		0.447
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	1,782	1,782	1,782	1,782
R2	0.67878	0.72187	0.57407	0.67287	0.77033	0.78810	0.78483	0.78009
Within R2	0.01570	0.00370	0.00134	0.00403	0.03306	0.00169	0.01004	0.02056
Mean TBR	1.584	1.343	0.793	2.076	1.587	1.561	1.564	1.584

Notes: This table presents the impact of the SM Initiative. We represent the coefficients of a simplified differences-in-differences design, employing Equation 2. 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 below the median baseline teen birth rate (column 3) and above 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 LARCs awareness of individuals. 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 '.'.

Table 1 shows that the initiative's impact is stronger in districts with stronger information frictions, districts with low socioeconomic score, and districts with high teenage birth rates at baseline. We proxy information frictions using LARCs awareness, measured as the share of respondents in the 2010 NSRH Survey who can name LARCs when asked about contraceptive methods without prompting. Notably, the information frictions dimension is the only one that survives the p-value test, reinforcing the importance of information campaigns in conjunction with free access to LARCs. Section 4 builds on this by showing how and why the information campaigns work: they shifted the source and quality of teenagers' sex education and corrected baseline misperceptions about contraception, with intermediate effects on awareness of available services and contraceptive use that ultimately translated into reduced teen births.[12] Because correcting misperceptions takes time, this information channel also helps explain why the initiative's impact grows more pronounced over time in Figure 2. The last two columns split districts by conservatism; we return to this dimension in Section 4.2 when discussing when and where the source of information matters.

The growing impact of the SM initiative over time is mirrored in the cross-cohort pattern: later cohorts, who were younger at the time the initiative launched, benefit considerably more than those who were already in their late teens in 2015 (Figure B1). This cohort gradient is consistent with cumulative dosage rather than with younger adolescents being inherently more responsive to the program. The proportional impact stabilizes from age 15 onwards (Figure B2) — consistent with SM Initiative survey data indicating that over 80% of girls report initiating sexual activity at age 14 or later, implying that the program reaches most adolescents before or precisely as they enter the at-risk population. Younger cohorts instead accumulate more years of exposure to both free contraception and the school-based information campaigns (Table B1, Column 1), and later cohorts may additionally benefit from a more established program as providers became better trained and campaigns more embedded, though this latter difference is not statistically distinguishable at conventional levels (Table B1, Columns 2 and 3). We discuss these exercises in further detail in Appendix B. A natural concern is whether these cohort patterns reflect pre-existing trends rather than program exposure; the robustness checks we present next address this directly.

Robustness

Our estimates are not driven by pre-existing socioeconomic differences across districts or by secular trends in teen birth rates. Including the interaction between year

[12] Bernal et al. (2024) corroborate these patterns using administrative data, documenting increased rates of comprehensive health visits and contraceptive provision — particularly of LARCs — in treated health areas.

and the districts' SDI (Figure A2) leaves the estimates virtually unchanged.[13] Figure A3 shows our placebo test – we find no discernible effect of the initiative on birth rates for untreated women (aged 25–28), confirming that the effects we document are not driven by broader contemporaneous trends.

Having established the overall impact of the SM initiative, we now turn to disentangling the contributions of its two pillars — free access to LARCs and school-based information campaigns — to understand which components drive the observed reductions in teen birth rates.

3.2 Disentangling exposure to access from exposure to information

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 LARCs through comprehensive consultations at health centers but also included school-based information campaigns that: (1) corrected baseline misperceptions about sexual and reproductive health, contraceptive efficacy, and safety; and (2) promoted awareness that free LARCs and sexual health services were available. We refer to these school-based campaigns as the "information treatment" throughout our analysis. To disentangle the impact of information treatment from the impact of free access to contraception, we leverage the fact that the access and information pillars of the program were implemented through different administrative channels, generating variation in treatment across locations.

We compare districts that received only the health-access component with those exposed to both pillars of the initiative to identify the complementary effect of the information campaign. While the two components were designed to operate in tandem, free access to LARCs was administered by the health sector through *Áreas de Salud*, whereas the information campaign was delivered through high schools under the purview of the Ministry of Education. This administrative separation implies that not all districts receiving the health component also received the information component, generating cross-district variation in exposure that is not perfectly correlated across the two pillars.[14] In the data, we observe three types of districts: (i) districts not exposed to any component of the program; (ii) districts that only received free access to contraceptive methods; and (iii) districts exposed to both pillars of the initiative.[15] We pool all three types of districts in a single regression and estimate the average post-treatment effect separately for each

[13] The p-value for the difference between the model with SDI and the one without is 0.4990, which reinstates the robustness of our results to the specification choice.

[14] Further details on the implementation of the policy are provided in Appendix C.

[15] Since only two districts were exposed only to the information campaign, we do not have enough power to explore the role of information alone.

treated category, using untreated districts as the reference. Specifically, we estimate:

$$\text{TBR}_{dt} = \phi_d + \gamma_t + \beta_H \, \text{Health}_d \cdot \text{Post}_t + \beta_B \, \text{Both}_d \cdot \text{Post}_t + \epsilon_{dt}, \tag{3}$$

where Health_d equals one for districts that received only free access to LARCs and Both_d equals one for districts exposed to both pillars; ϕ_d and γ_t are district and year fixed effects; and Post_t equals one for years from 2016 onwards. The coefficients β_H and β_B recover the average post-treatment effect of each treatment arm relative to untreated districts, and the linear contrast $\beta_B - \beta_H$ identifies the incremental effect of layering the information campaign on top of free access. The results are reported in Table 2.

Table 2: Impact of exposure to information campaigns

	Baseline	Controlling for SDI
Health x Post	-0.0727	-0.1877
	(0.1359)	(0.1621)
Both x Post	-0.3219***	-0.3903***
	(0.0743)	(0.0921)
p-value (Both < Health)	0.049	0.088
Controls		
District	Yes	Yes
Year	Yes	Yes
SDI x Year	No	Yes
S.E.: Clustered	by: District	by: District
Observations	10,252	10,252
R2	0.72123	0.72665

Notes: This table presents the impact of free access to LARCs and information campaigns. We report estimates of β_H and β_B from Equation 3, a single pooled regression that includes untreated districts, districts that received only free access to LARCs, and districts exposed to both pillars. *Health x Post* (β_H) is the coefficient on the interaction of the health-only indicator with the post-2015 dummy; *Both x Post* (β_B) is the coefficient on the interaction of the both-pillars indicator with the post-2015 dummy. The second column additionally controls for differential time trends by district SDI. Observations are weighted by teen female population. The row "p-value (H1: Both < Health)" reports a one-sided test of $\beta_B < \beta_H$, computed as a linear contrast within the same regression. Standard errors (in parentheses) are clustered at the district level. Significance levels according to p values are as follows: 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.'.

Our results in Table 2 suggest that the combination of access to LARCs with targeted information campaigns in schools has generated success in reducing the teen birth rate.[16]

[16]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 policymaker aiming to reduce teen pregnancy.

As a robustness check, we examine whether the initiative's impact varies with school attendance rates across districts. Figure A4 confirms that the reduction in teen birth rates is indeed larger in districts with higher school attendance, consistent with the notion that greater exposure to the information campaigns drives the effect.

In the following section, we ask how prolonged exposure to information campaigns 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

What exactly makes these high-school information campaigns successful? As described in Section 3.2, these school-based campaigns served a dual purpose: correcting misperceptions about sexual health and promoting awareness of available services. This two-stage approach is crucial because teenagers who are unaware of their need for sexual health services are unlikely to seek care at health centers—even when free LARCs and comprehensive consultations are offered. A possible mechanism explaining the campaigns' success is that teenagers switch the source of their sex education from informal networks to healthcare professionals. The campaigns may also improve the quality of information received, both in schools (through trained healthcare practitioners delivering the campaigns) and at health centers (through comprehensive consultations). In this section, we study baseline information frictions and analyze how this two-stage information provision changed the source and quality of teenagers' sex education.

Eliciting information sources and misperceptions at baseline

When designing interventions to target information frictions, it is difficult to assess ex-ante which barriers and frictions to target in a given context, as 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 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 (Figure 3). 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 3 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.[17]

Having detected the sources of information frictions at baseline, the interventions delivered in schools were designed to correct these specific misperceptions. Figure A5 shows examples of the visual material used in high schools, each directly addressing a misconception identified in the baseline survey. For instance, the baseline survey revealed that a non-trivial share of students believe condoms can be reused after washing; the poster "¿Bien Lavadito?" ("Have you washed it well?") directly targets this misconception. Similarly, given that a significant share of students reported that a condom should only be put on just before ejaculation, the poster "Todo o Nada" ("All or Nothing") reinforces that a condom must be worn from the beginning of intercourse.[18] In the

[17]According to the 2010 NSRH Survey responses of teenagers, the primary source of information for sexual health is parents 46%, 74% of teenagers havent heard about LARCs before, and 28% engage in risky sexual activity.

[18]While we focus here on items relating to pregnancy prevention, a similar pattern holds for misperceptions about STI protection. At baseline, 36% of students thought that birth control pills protect against STIs, which directly motivated the campaign poster *"¿Las Pastillas Te Protegen de Una I.T.S.?"* ("Do Pills Protect You from an STI?") (Figure A5). By the 2018 follow-up, this share had fallen by 18% ($p<0.01$),

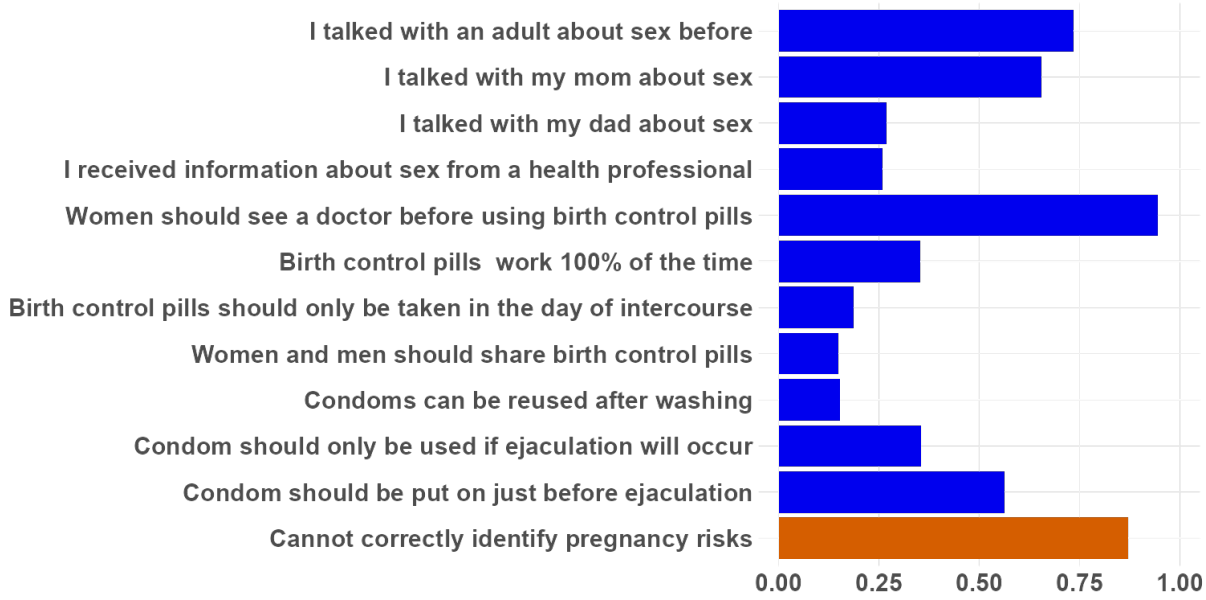


Figure 3: Baseline share of "Yes" replies (SM Initiative Survey)

Notes: This figure summarizes key questions regarding baseline information frictions from 2013 SM Initiative survey, highlighting the baseline share of "Yes" replies to a series of questions. 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.

next section, we show that this tailored design was successful at effectively correcting misperceptions about sexual health.

Changing sex information source and quality

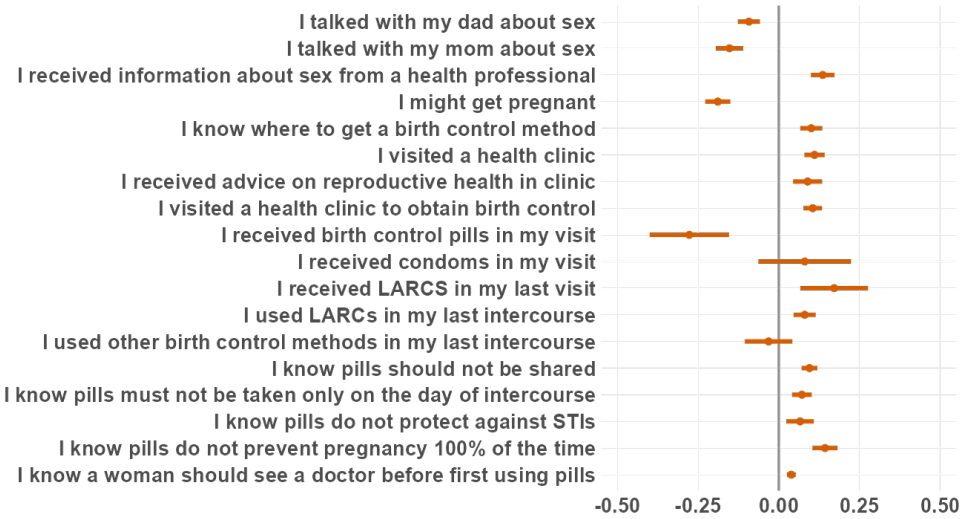
In contexts in which sex education largely comes from personal networks (e.g., parents or peers), the quality of information depends heavily on cultural norms. Conversations may not be feasible if sexual topics are taboo, limited to abstinence if premarital sex is discouraged, or incomplete if personal networks are uninformed or fear promoting premarital sex. In cases of widespread misconceptions, personal networks may inadvertently pass on misconceptions, thus increasing risks. In this section, we analyze the role of the SM initiative in changing sex information source and quality, and discuss whether the reduction in teenage pregnancy is mediated through this switch in information source and quality.

To understand whether the SM initiative affected the source and quality of sexual information, we employ two exercises. First, we use the SM Initiative's baseline (2013) and follow-up (2018) surveys to perform a before-after analysis among teenagers in treated regions. Since these surveys sample different cohorts of students in treated regions only, we cannot construct a control group, but they are informative of changes in

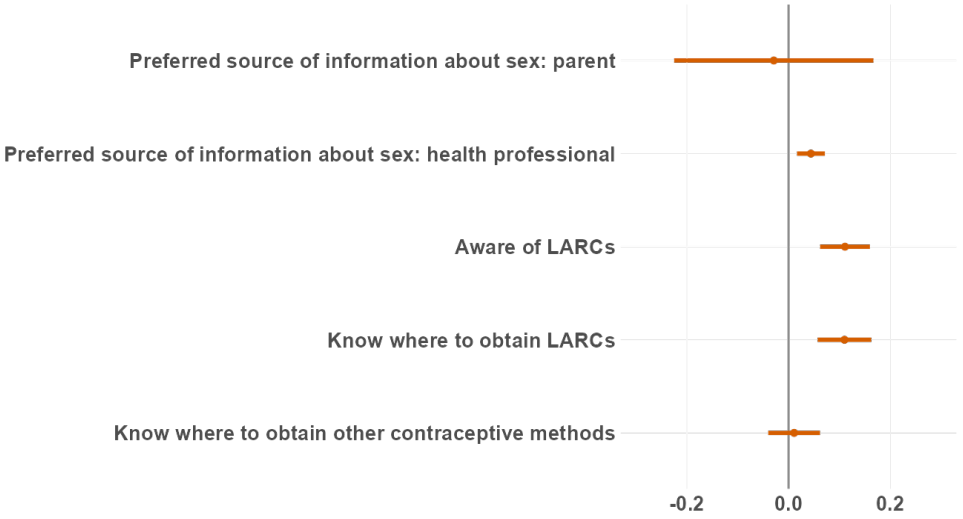
consistent with the targeted correction of this specific friction.

reproductive health practices after the initiative. Second, we employ a differences-in-differences design on the 2010 and 2015 NSRH surveys to validate our findings from the SM Initiative surveys.

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



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



(b) 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 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 4b presents diff-in-diff coefficient estimates τ from Equation 4, estimated using the responses from 12-19-year-olds on NSRH surveys, clustered at the region level. 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.

SM Initiative survey: The before-and-after analysis using the SM initiative's surveys suggests that targeted in-school information campaigns successfully increased stu-

dents' knowledge about pregnancy risks and protection. Figure 4a reports the 2013 to 2018 changes in knowledge, information sources, and sexual health practices among teenagers. Students became more likely to visit health centers to obtain contraception — consistent with the program's aim of alleviating confidentiality concerns that had previously deterred adolescents from seeking care (Valverde Cerros and Sánchez Calvo, 2015). Students became more likely to receive information from health professionals, grew more aware of how to access and use birth control methods, and reported a lower likelihood of getting pregnant. While questions on condom use are not repeated across survey waves, the five pill-knowledge items are, and we observe significant improvements across all of them. Consecutively, conditional on having visited a health center, self-reported take-up of LARCs increased, while take-up of birth control pills declined, suggesting a shift in preferred contraceptive method.[19] These findings show that the information campaigns improved students' sexual education by successfully correcting the baseline misperceptions they were designed to target. Notably, Figure A6 shows that there is no statistically significant change in sexual activity, indicating that the campaigns affected knowledge and contraceptive choices rather than the decision to be sexually active. These survey responses can be interpreted as intermediate outcomes tracing the pathway from school-based information campaigns to the observed reduction in teen births.

NSRH survey: To validate 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*.[20] We focus our attention on questions that are similar to those asked on the SM initiative survey and employ the following model:

$$Y_{it} = \alpha_{r(i)} + \beta\,\text{Post}_t + \tau\,\text{Treat}_{r(i)} \cdot \text{Post}_t + \epsilon_{it} \tag{4}$$

where Y_{it} records the response of individual i in survey wave t; $\alpha_{r(i)}$ are region fixed effects, and Post_t equals one for responses from the follow-up wave. The coefficient τ on the interaction recovers the differences-in-differences estimate. Observations are

[19] We repeat this exercise by gender; results are qualitatively the same but quantitatively stronger for females. We report the coefficients in Figure A6.

[20] 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.

weighted by the NSRH sampling weights, and standard errors are clustered at the region level. We plot estimated coefficients $\widehat{\tau}$ in Figure 4b.

The results in Figure 4b confirm that teenagers are shifting their source of sex information toward health professionals, are more aware of LARCs as a contraceptive option, and are better informed about where to obtain them. The shift away from parents as an information source is not statistically significant, perhaps because moving away from parents as a go-to source may take longer to materialize. As a placebo test, we re-estimate Equation 4, restricting the sample to women aged 20–25, who were not directly targeted by the initiative; all coefficients are small in magnitude and statistically insignificant (see Figure A7).

Discussion: Overall, these difference-in-differences results are consistent with the before-and-after exercise from the SM Initiative's survey: after the SM initiative, students are better prepared to make choices regarding pregnancy prevention, and better informed about where to find contraception if they choose to do so. Our findings are consistent with administrative evidence from Bernal et al. (2024), who document increased rates of comprehensive health visits, and contraceptive provision (particularly LARCs) in treated areas using de-identified medical and pharmacy records.

To assess whether the magnitude of these intermediate changes are consistent with our main estimate of a 16% reduction in teen births, we conduct a simple accounting exercise. The observed pattern points to method switching rather than an increase in contraceptive take-up as the dominant channel: LARCs use rose from zero, while reliance on less effective methods declined, consistent with findings of Bernal et al. (2024). A back-of-the-envelope calculation applying baseline contraceptive shares and method-specific failure rates imply that a complete switch toward LARCs would reduce the teen birth rate by approximately 16.8%, virtually identical to our estimated effect.[21] Two caveats pull in opposite directions: actual switching was likely partial, which would push the implied reduction below 16%; but adherence with short-acting methods was poor (Figure 3 shows widespread misinformation on how to use pills and condoms). This means that effective failure rates before 2015 were substantially higher than suggested by NHS (2024), so even partial switching would suffice to generate large reductions. Together, these complementary findings document the pathway from school-based information campaigns to broader service uptake and ultimately to reduced teen births.

[21] We take the share of sexually active teenagers at baseline (26%, 2013 SM Initiative survey) and apply the difference in failure rates between LARCs and each method. At baseline, teenagers relied predominantly on condoms (53%), withdrawal (12%), and pills (9%), implying reductions of $0.26 \times (0.09 \times (0.09 - 0.01) + 0.12 \times (0.22 - 0.01) + 0.53 \times (0.18 - 0.01)) \approx 0.032$ pp, corresponding to $0.032/1.91 \approx 16.8\%$ of the pre-intervention mean.

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 poor before the SM initiative, and the information campaigns in schools improved the quality of sex education among teenagers 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.[22] In cases in which information frictions and misperceptions about birth control methods are common among adults, teenagers inevitably receive inadequate sex education.

To test whether conservative attitudes toward family planning are associated with information frictions, we use the 2010 NSRH survey (i.e., before the SM Initiative) to identify respondents with conservative sexual beliefs. Specifically, we classify a respondent as *against family planning* based on 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 code a respondent as "against family planning" if they answered "against" to the first question and "maintain its position" to the second.[23]

Using this classification, we first compare baseline information sources and quality between individuals who are against family planning and those who are not. While measuring differences in the source of information, we restrict to respondents aged 12–19; for the three quality-of-information outcomes, we use the full sample of teenagers and adults, since teenagers predominantly learned from personal networks before the initiative. Figure 5a shows that respondents against family planning are significantly less aware of LARCs as a contraceptive method, are less aware of contraceptive methods more generally, and answer fewer HIV-related questions correctly.[24] Among teenagers, having parents as a primary source of information is more common among conservative

[22] If parental consent was an issue for teenagers' access to contraception before the initiative (as reported by Valverde Cerros and Sánchez Calvo (2015)), this barrier would also be stronger for conservative districts compared with others, as shown by Brooks et al. (2025).

[23] As a validation exercise, this measure is positively and significantly correlated with an alternative conservatism proxy — the district-level share of Catholic marriages (correlation = 0.25).

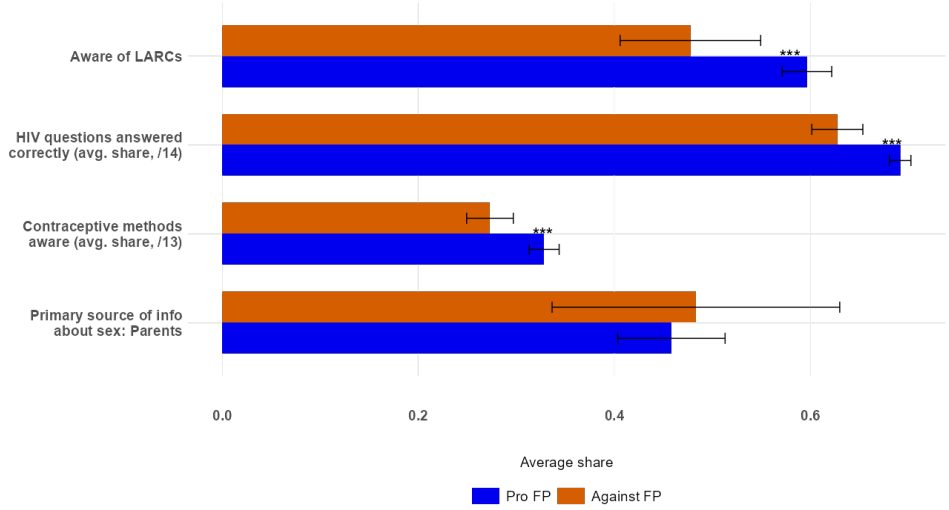
[24] We measure awareness of contraceptives strictly, as the share of respondents who *spontaneously* can name a method (without prompting) when asked which contraceptive methods they had heard of.

individuals, though the difference is not statistically significant — potentially reflecting limited power, as this comparison is restricted to the teenager subsample.

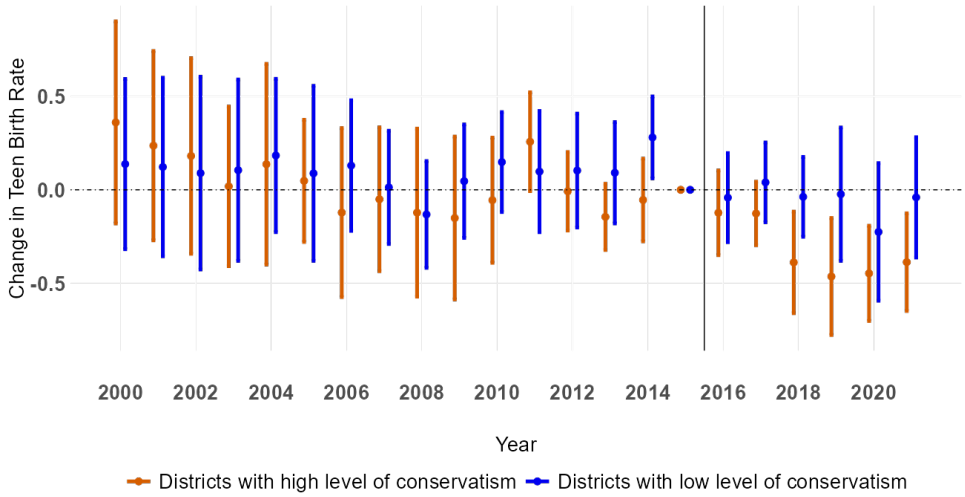
Having documented that conservative attitudes are associated with larger information frictions at the individual level, we next ask whether the SM Initiative had a larger impact in districts where such attitudes are more prevalent. To do so, we aggregate the individual-level measure to the district level: for each district d, we compute the share of respondents against family planning. The same pattern documented at the individual level also holds across districts: Figure A8 in Appendix Appendix A shows that districts with a higher share of respondents against family planning know fewer contraceptive sources, score lower on HIV/STI knowledge, and have higher realized fertility, with all three relationships statistically significant. We then classify districts below the median as *low conservatism* and those above as *high conservatism*, and re-estimate our main specification in Equation 1 on subsamples stratified by conservatism level, additionally controlling for the district-level share of college graduates to account for potential correlations between conservatism and education.

Figure 5b shows that the impact of the SM Initiative is indeed larger in conservative districts. This pattern is consistent with the average treatment effects reported in the last two columns of Table 1, where the impact on teen birth rates is also larger in the high-conservatism subsample. Together, these findings reinstate the importance of context-specific policies in constrained settings: access to free LARCs and exposure to the information campaigns offered by the SM Initiative matter more for teenagers from conservative families.

Figure 5: Impact is larger in conservative districts



(a) Baseline information frictions by conservatism



(b) Impact of initiative by conservatism

Notes: This figure plots how baseline information frictions and the impact of the SM Initiative vary with conservatism, with low-conservatism units in blue and high-conservatism units in orange. We classify individuals as conservative if they self-identify as against family planning, and split districts at the median share of conservative respondents. Panel 5a compares baseline information sources and quality between groups using the 2010 NSRH survey, restricting to teenagers for information-source outcomes and using the full sample otherwise; asterisks denote the significance of mean differences (* p<0.10, ** p<0.05, *** p<0.01). Panel 5b plots event-study coefficients from Equation 1 on district-level teen birth rates, separately for low- and high-conservatism districts. The dashed line marks 0, the solid line marks 2015; standard errors are clustered at the district level.

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 con-

traceptive 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 misperceptions 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.

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.

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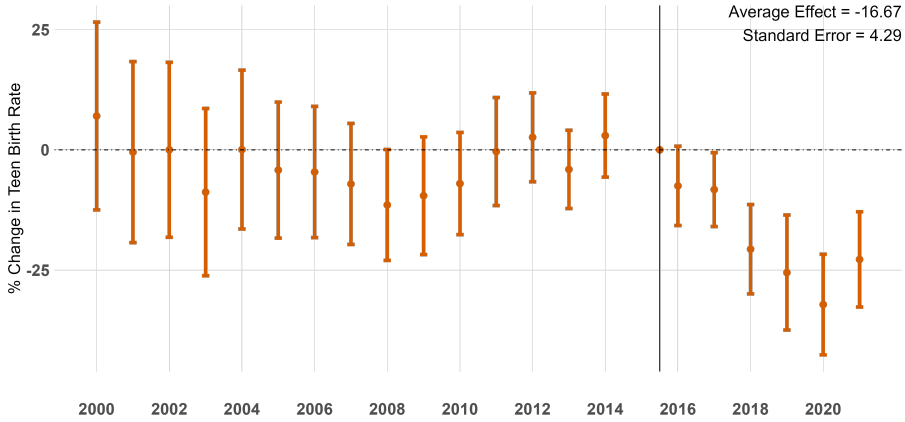
Appendix A Additional Figures and Tables

Table A1: Baseline characteristics of treated and untreated districts

	Treated	Untreated	Differences
Mean SDI	45.89	62.32	-16.43***
	(1.17)	(0.66)	(1.71)
Teen birth rate	1.91	1.35	0.56***
	(0.10)	(0.05)	(0.12)
School attendance rate	0.89	1.03	-0.14
	(0.05)	(0.03)	(0.09)
Conservatism	0.12	0.09	0.03*
	(0.01)	(0.00)	(0.02)
Average teen female population per district	2,084	1,468	
Average population per district	11,652	9,878	
Number of districts	71	416	
Number of regions	2	4	

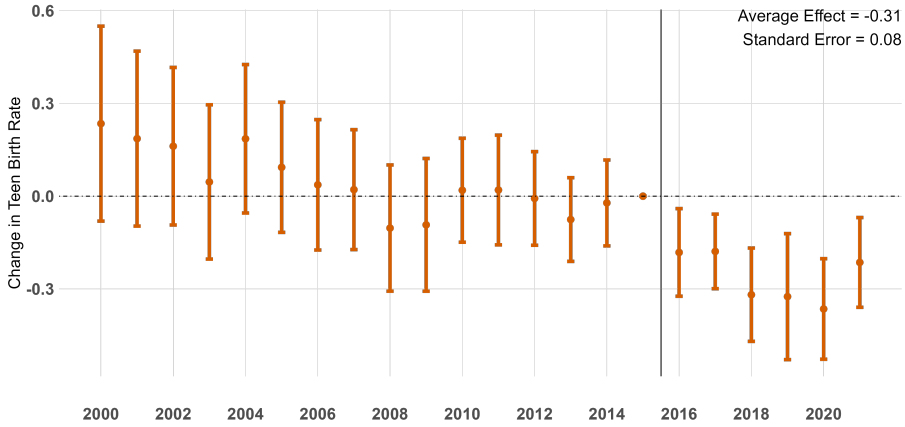
Notes: This table reports district-level baseline summary statistics for treated and untreated districts. Entries are means; standard errors are in parentheses. "Differences" reports the treated minus untreated difference. SDI is the Social Development Index. The teen birth rate is measured as births per 100 teen girls. The school attendance rate is defined as the ratio of students enrolled in district schools to the resident school-age population in the district; values above one can arise if schools in a district attract students residing in neighboring districts, which we hypothesize is more common among untreated districts. Conservatism is our district-level measure constructed from the survey responses described in the text. The bottom panel reports average teen female population and total population per district, and the number of districts and regions in each group. Stars denote statistical significance ($^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$)

Figure A1: Change in Teen Birth Rate in percentages



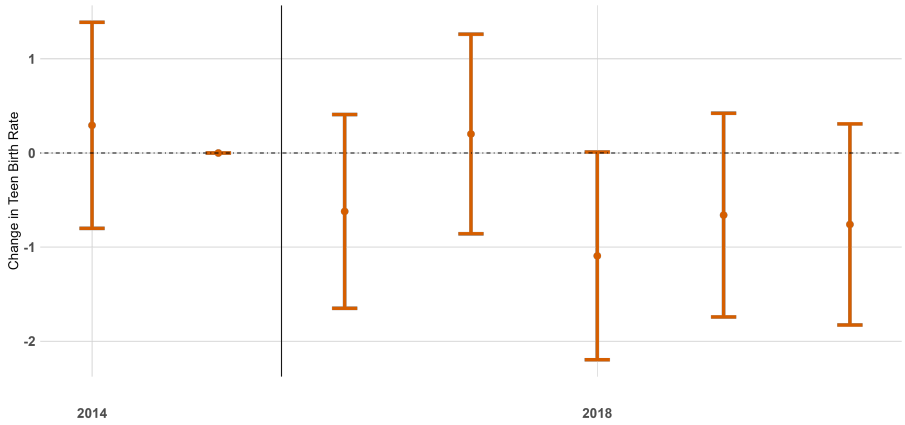
Notes: This figure plots the difference in teen birth rates between treatment and control districts over 2000-2021 (see Equation 1), expressed in percentages by dividing the estimated coefficient by the mean teen birth rate in 2015, the baseline year. Standard errors are clustered at district level. 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 controlling for SDI



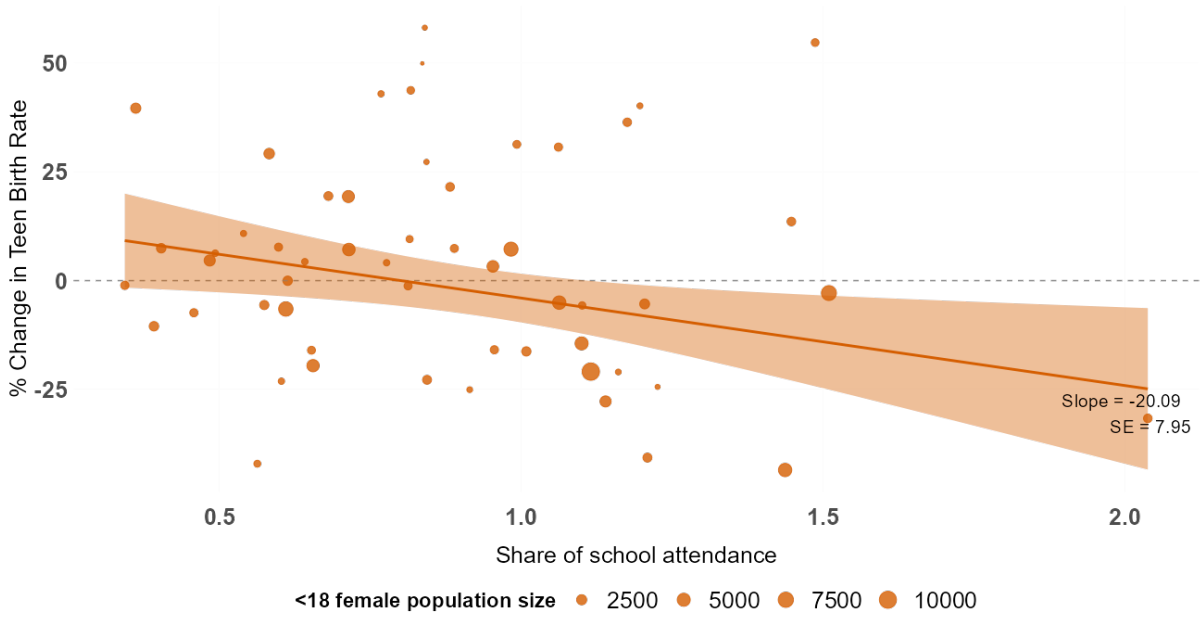
Notes: This figure plots the difference in teen birth rates between treatment and control districts over 2000-2021 (see Equation 1), controlling for differential time trends in districts' Social Development Index (SDI). Standard errors are clustered at district level. The lines are 95% confidence intervals. The vertical line denotes the year in which the policy was implemented, 2015, and the horizontal line denotes 0.

Figure A3: Placebo Test: Impact of the initiative for women aged 25–28



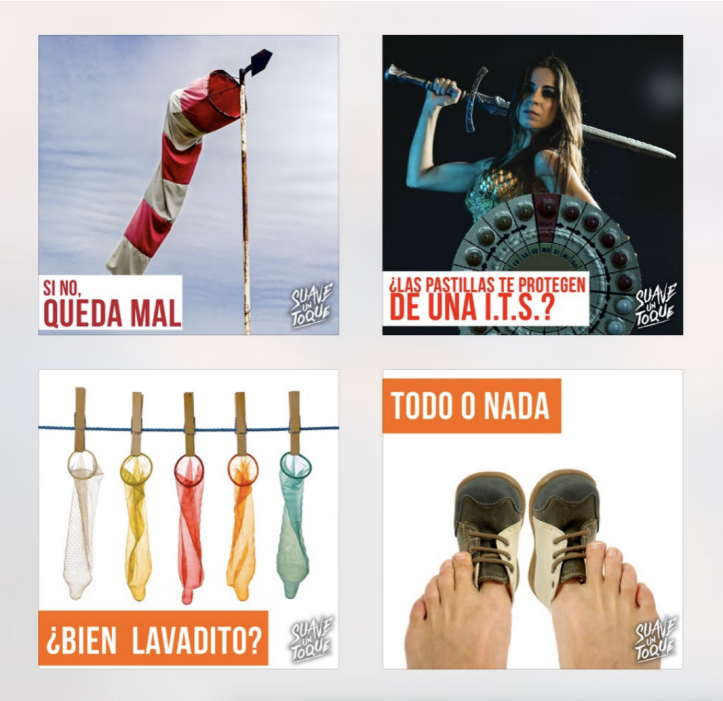
Notes: This figure tests whether the initiative affected women aged 25–28 over 2014–2020 — a placebo group, since teenagers in our treatment group would be aged 18–24 by then and thus never directly treated. The estimates are limited to 2014–2020 as data for older women are missing beforehand. Coefficients are estimated using Equation 1, and 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 A4: Impact of the initiative by school attendance rates across districts



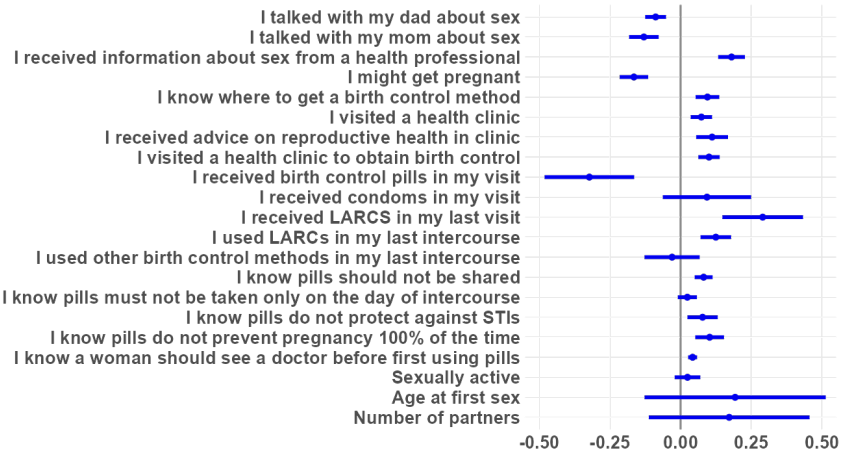
Notes: This figure correlates district-level treatment effects with high school attendance rate in each district at 2016. The y-axis plots the percent change in the teen birth rate with respect to 2015 levels due to the SM Initiative, estimated using a two-step Minimum Distance estimator from Arkhangelsky et al. (2026). 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.

Figure A5: Visual material provided in information campaigns

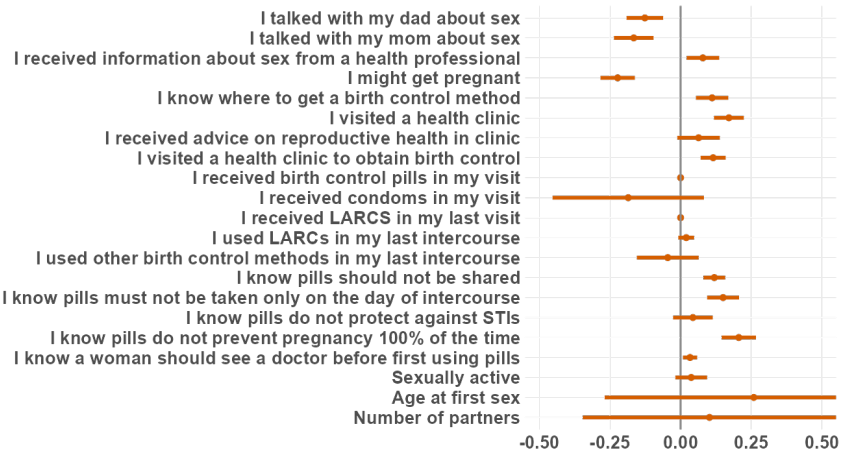


Notes: This figure shows an exemplary exhibit that was provided to teenagers in the information campaigns in high schools (in Spanish). Statements in the panels map to the true-false statements on the baseline survey of the SM initiative in 2013, which can be seen in Figure 3.

Figure A6: Change source and quality of information about sexual health by genders



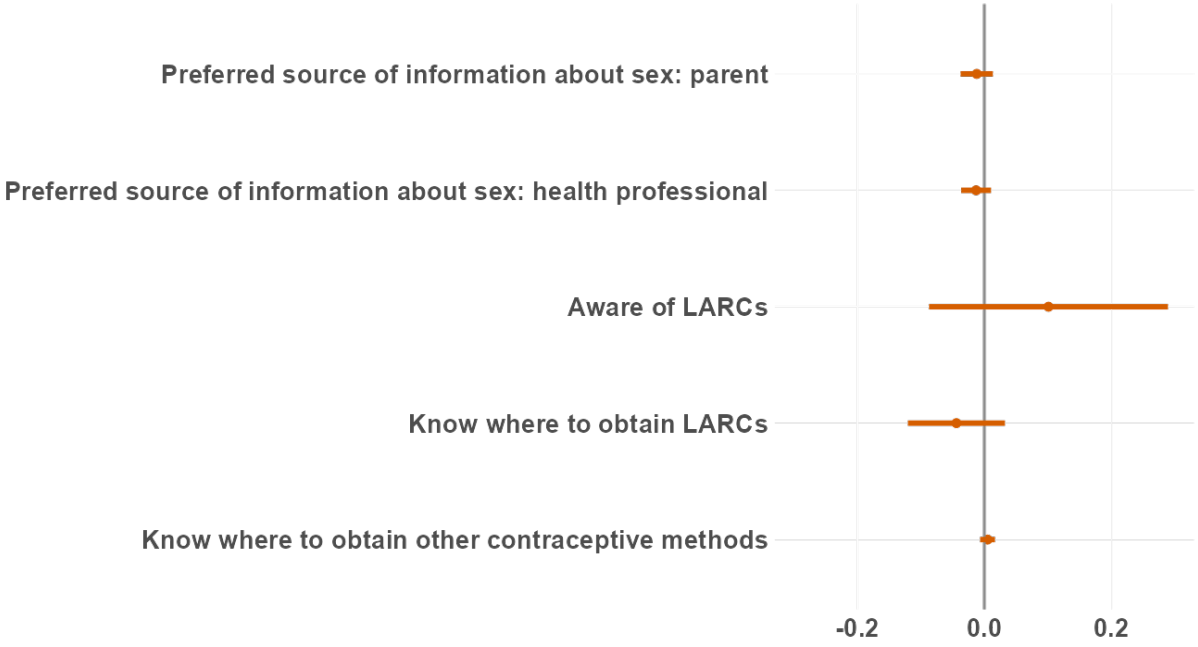
(a) Change in "Yes" replies post-initiative for girls



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

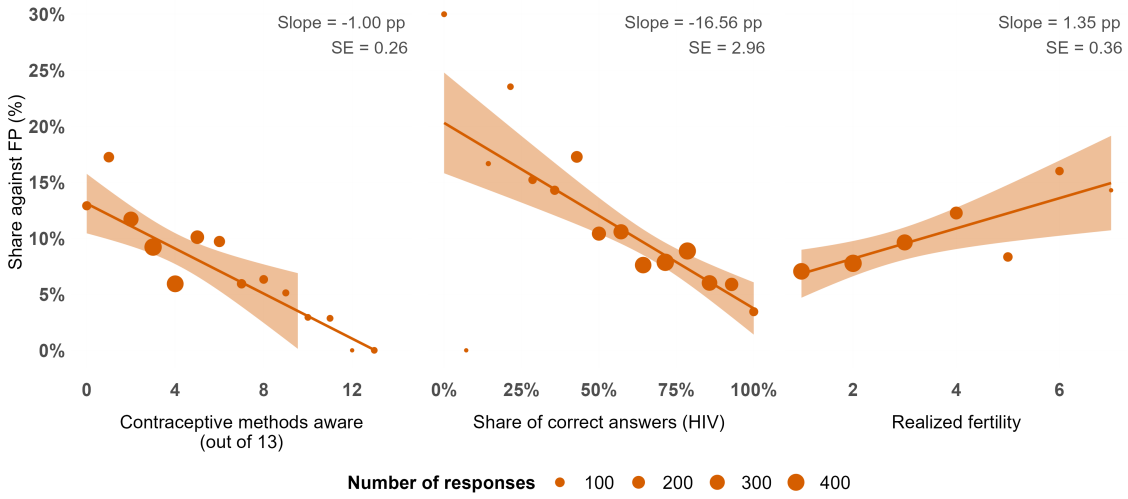
Notes: This figure summarizes key questions regarding the source of sex information and knowledge from the SM Initiative's surveys and NSRH surveys. Figure A6a highlights the change in the share of female students who responded "yes" to the given question from pre- to post-initiative. Figure A6b shows 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.

Figure A7: DiD coefficients from NSRH with women aged 20-25 (Placebo)



Notes: This figure summarizes key questions regarding sexual information sources and knowledge from the NSRH surveys for women aged 20-25 (i.e. a placebo test). It presents diff-in-diff coefficient estimates from Equation 4. 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.

Figure A8: Conservatism, information frictions, and fertility



Notes: This figure provides descriptive evidence on the relationship between conservative attitudes towards family planning (FP) and district-level outcomes in Costa Rica (2010). Each panel plots the share of respondents against FP in a district against the average outcome: number of contraceptive sources known (out of 13), share of correct answers on a set of questions on HIV/STI, and realized fertility of adult women. Circle size is proportional to the number of survey respondents in the district. The orange line shows the weighted linear regression fit with its 95% confidence interval. Slopes and standard errors are reported in each panel.

Appendix B Heterogeneity in age and dosage

The pattern in Figure 2 reveals an important feature of the SM initiative's impact: effects grow more pronounced over time, rising from approximately 10% in 2016 to 30% by 2020. A natural question is what drives this secular increase. We investigate this by decomposing the aggregate effect along three dimensions: birth cohort, age at treatment, and cumulative years of exposure.

Impact by cohorts: As a first step, we re-estimate the baseline model by cohorts rather than calendar years, illustrating treatment effect estimates separately for each birth cohort observed between ages 12–19. To do so, we measure births occurring between ages 12–19 to generate total births by age 19, divided by each cohort's population in each district, noting that birth rates for cohorts born after 2002 remain incompletely realized as these cohorts have not yet reached age 19 over our sample period. We estimate an equation analogous to Equation 1 but defined in cohort rather than calendar-year terms:

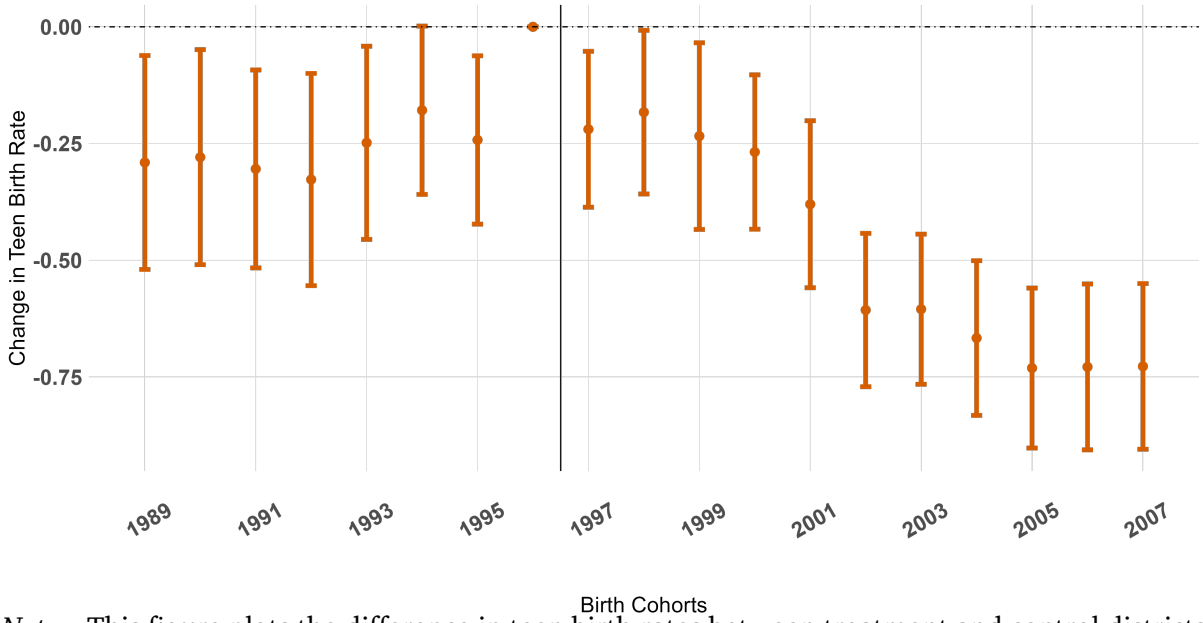
$$\text{TBR}_{dc} = \phi_d + \gamma_c + \sum_{\substack{k=1989 \\ k \neq 1996}}^{2007} \beta_k \mathbb{1}(c = k) \cdot \text{Treat}_d + \epsilon_{dc} \tag{B1}$$

Figure B1 shows that the estimated effects are systematically larger for younger birth cohorts. Cohorts born in the late 1990s, who were already in their late teens when the SM initiative launched in 2015, exhibit relatively modest declines in teen birth rates. By contrast, cohorts born around 2000 and later — who entered their teenage years after the initiative was already in place — show considerably larger reductions, indicating that younger cohorts benefit more from the initiative.

The larger impact for younger cohorts may be explained by three distinct mechanisms: greater susceptibility, longer exposure, or higher treatment quality over time. First, younger cohorts may simply be more malleable at the time the initiative was launched: starting from a younger age under a new policy environment may allow behavioral norms and contraceptive practices to be shaped more fundamentally. Second, younger cohorts are mechanically exposed to the SM initiative for a longer period, so what looks like a cohort effect may in fact be a dosage effect. Third, the initiative itself may have improved in effectiveness over time as implementation matured and awareness spread – in which case, younger cohorts benefit simply by virtue of being treated later. Unfortunately, variation across cohorts alone cannot distinguish between these explanations. We therefore examine variation by age and by years of exposure next.

Impact by age: To assess whether younger age at the time of the SM initiative leads to larger reductions in teen pregnancy, we estimate age-specific treatment effects. For each age $a \in \{12, \ldots, 19\}$, we run the following model on the subsample of births to

Figure B1: The impact of SM Initiative by cohorts



Notes: This figure plots the difference in teen birth rates between treatment and control districts (see Equation B1) over cohorts. 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 marks 0.

mothers of age a, i.e. restricting to observations where $t - c = a$:

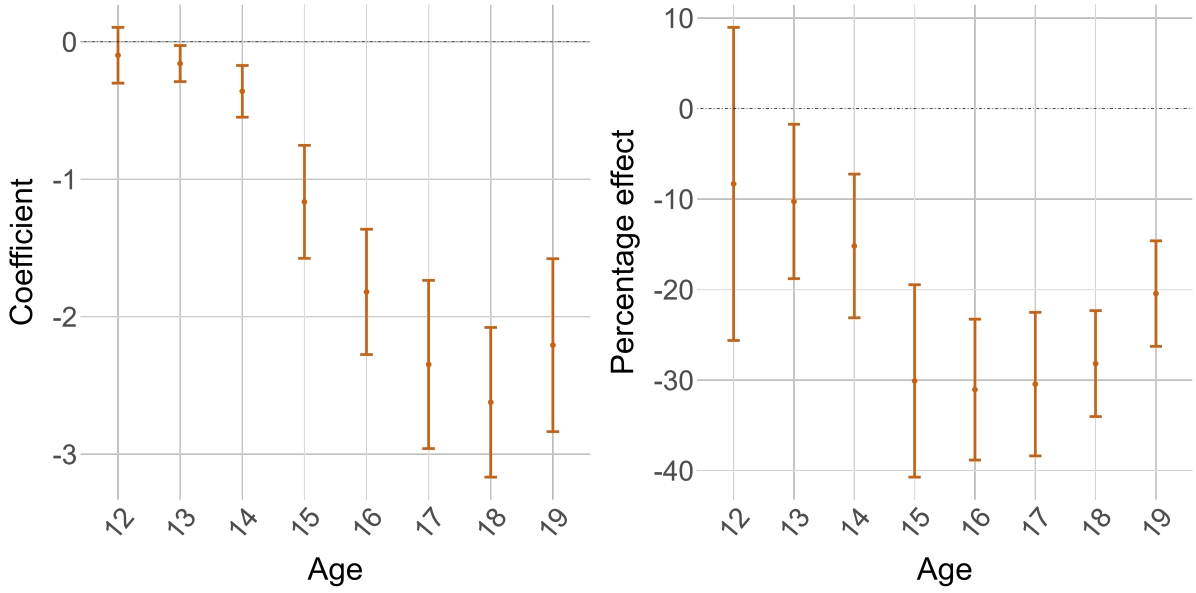
$$\text{TBR}_{dtc}\big|_{t-c=a} = \phi_d + \gamma_c + \beta_a \left(\text{Treat}_d \cdot \text{Post}_t\right) + \epsilon_{dtc} \tag{B2}$$

where TBR_{dtc} is the teen birth rate in district d at time t for cohort c, ϕ_d and γ_c are district and cohort fixed effects, and β_a is the age-specific treatment effect.

Figure B2a plots the resulting coefficient estimates, which grow larger as age increases – reflecting the mechanical fact that older teens have higher baseline fertility rates. However, once we normalize by baseline fertility rates, Figure B2b tells a different story: the proportional impact stabilizes from age 15 onwards, with no systematic pattern of younger adolescents benefiting more than older ones. This may not be a coincidence: SM Initiative survey data indicate that over 80% of girls report initiating sexual activity at age 14 or later, implying that the program reaches most adolescents before or precisely as they enter the at-risk population. Once adolescents cross this threshold, the benefits of subsidized contraception and sexual health information appear broadly similar regardless of exact age. The cohort gradient in Figure B1 is therefore unlikely to reflect differences in susceptibility by age at first exposure.

Dosage and program quality: Having ruled out differential susceptibility, we turn to the remaining two explanations: cumulative dosage and improvements in program quality over time. To assess the dosage effect, we restrict our sample to 19-year-olds,

Figure B2: The impact of SM initiative by ages



(a) Coefficient change in teenage fertility (b) Percentage change in teenage fertility

Notes: This figure plots the difference in teen birth rates between treatment and control districts over ages 12-19 (2005-2002) estimated by Equation B2. Panel B2a shows point estimates, while Panel B2b shows proportional impact estimated from point estimates and baseline birth rates by age. Standard errors are clustered at district level. The lines are 95% confidence intervals. The horizontal line marks 0.

as births observed at age 19 were conceived at 18 — the last year of high school and therefore the end of exposure to information campaigns. — This age group provides the greatest variation in the exposure variable across cohorts.[25] Specifically, we estimate the effect of each additional year of exposure to the SM initiative on the teen birth rate, holding access to LARCs fixed via the Treat $\times$ Post indicator (Column 1 of Table B1):

$$\text{TBR}_{dtc}\big|_{t-c=19} = \phi_d + \gamma_c + \tau\,\text{Treat}_d \cdot \text{Post}_t + \alpha\,\text{Exp}_{dtc} + \epsilon_{dtc} \tag{B3}$$

where $\text{TBR}_{dtc}\big|_{t-c=19}$ is the teen birth rate in district d at time t for cohort c, restricted to 19-year-olds, ϕ_d are district fixed effects, and γ_c are cohort fixed effects.[26] Treat_d is the treatment indicator for district d, Post_t is a post-initiative indicator (after 2015), and Exp_{dtc} captures the cumulative number of years cohort c in district d has been exposed to the SM initiative up to and including the year of conception. Formally:

$$\text{Exp}_{dtc} = \text{Treat}_d \cdot \max(0,\, t - 2015) \tag{B4}$$

[25] We do not compare the exposure effect across ages, as the distribution of the exposure variable changes at each age, making such comparisons uninformative.

[26] 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 $\gamma_t = \gamma_c$.

The key insight is that a birth recorded at age a in year t was conceived in year $t-1$. The program launched in 2015, so the number of years it had been running up to and including the conception year is $\max(0,\,(t-1)-2015+1) = \max(0,\,t-2015)$. For cohort 1997, observed giving birth at age 19 in 2016: conception occurred in 2015, the program's first year, yielding one year of exposure. In this setup, the exposure variable constitutes a continuous treatment, and identifying a causal dose-response relationship requires a stronger assumption than standard parallel trends. Following Callaway et al. (2024), we require that in the absence of the SM initiative, the evolution of teen birth rates would have been the same across cohorts of 19-year-olds, irrespective of the number of years they would have been exposed to the program. Since we limit this exercise to 19-year-olds, variation in exposure is driven mechanically by birth year relative to the program launch rather than by individual selection into higher doses, and we therefore consider this assumption plausible.

To assess whether the program became more effective over time, we hold both age and years of exposure constant and instead vary the calendar window. Specifically, we focus on 15-year-olds — the age at which we have seen the effect begin to stabilize in Figure B2 — and compare two cohorts with the same number of years of exposure: one treated in the early phase of the program (observed in 2018) and one treated in the late phase (observed in 2020). Each cohort is compared against control cohorts in untreated districts, and the difference between the two DiD estimates captures any improvement in program quality over time (Columns 2 and 3 of Table B1).

The results in Table B1 reveal two patterns. First, Column 1 shows a clear dosage effect: each additional year of exposure to the SM initiative reduces the teen birth rate among 19-year-olds, above and beyond the baseline effect of free LARC access. Second, comparing Columns 2 and 3, the point estimate among 15-year-olds with identical years of exposure is larger in the late window than in the early window, consistent with the program becoming more effective over time as delivery matured — though the difference between the two estimates is not statistically distinguishable at conventional levels ($p = 0.201$). Taken together, the evidence points most clearly to longer cumulative exposure as the driver of the growing impact documented in Figure 2, with a suggestive but not statistically conclusive role for improvements in program quality.

Table B1: Dosage and program quality effects

	Age 19	Age 15	
	Dosage Effect	Early Impact (2018)	Late Impact (2020)
Treat × Post	-0.6222	-1.2664***	-1.7339***
	(0.4822)	(0.2784)	(0.2370)
Exposure	-0.5137***		
	(0.1191)		
District FE	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes
S.E. Clustered by	District	District	District
Observations	9,897	7,801	7,801
Adj. R^2	0.4698	0.4187	0.4267
Mean teen birth rate	8.1140	2.3721	2.3721
p-value (Late = Early)			0.201

Notes: Column 1 reports estimates from a model that includes both a Treat × Post indicator and a continuous years-of-exposure variable, restricted to 19-year-olds. Columns 2 and 3 estimate the treatment effect among 15-year-olds with identical years of exposure (3 years), observed in an early (2018) and late (2020) calendar window respectively. The p-value at the bottom tests whether the early and late effects are statistically different from one another. Standard errors are clustered at district level. Significance levels: 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.'.

Appendix C Further Details about the Implementation of the SM Initiative

This appendix provides additional details on the implementation of the intervention and the construction of treatment exposure, and builds on the analysis discussed in Section 3.2.

The intervention was implemented through the primary health care system and targeted specific Health Areas rather than administrative districts directly (Banco Interamericano de Desarrolo, 2015). In Costa Rica, health service delivery at the first level of care is organized by the Costa Rican Social Security Fund (CCSS) into Health Areas (Áreas de Salud, AS), each comprising several primary care units (Equipos Básicos de Atención Integral en Salud, EBAIS). Because Health Area boundaries do not coincide with district boundaries, some districts are only partially covered by treated Health Areas. We do not exploit this within-district variation, for two reasons. First, there is very little of it: among districts with any treated coverage, 76% of the districts have 100% coverage, so coverage is essentially binary in practice. Second, since most districts have the majority of their assigned population directly exposed, within-district spillovers — teenagers in nominally untreated areas accessing services at a nearby treated unit — would make these districts effectively fully treated regardless of the exact coverage share. We therefore classify a district as treated by the health pillar if treated Health Areas cover at least 50% of its assigned population; only about 10% of districts with any treated coverage fall below this threshold.

Treatment exposure in the information dimension is constructed using an administrative list of schools that participated in the program, obtained from the Ministry of Education, which allows us to identify treated schools and assign educational exposure at the district level. As noted in Section 3.2, only two districts received the information pillar without also receiving free LARC access — too few to identify the effect of information on its own — so we drop them and retain three groups in our classification: untreated, health-only, and both pillars. Among districts with any treated school, the interquartile range of student coverage runs from 71% to 100%, with the median district having 93% of its students in treated schools. Given this concentration, within-district spillovers in exposure are likely, especially considering that the program included components encouraging peer counseling and word-of-mouth diffusion among teenagers, and that Costa Rican high schools comprise several distinct tracks (academic, technical, night schools, among others), so siblings or cousins within the same district may attend different schools. Therefore, we classify a district as exposed to the information campaign if at least 50% of its high-school students attend treated schools, and only about 13% of districts with information treatment fall below this threshold.