The Role of Information and Contraceptive Use on Teen Pregnancy*

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November 9, 2024

Abstract

This paper investigates how information frictions affect the efficacy of contraception provision programs. We study a Costa-Rican initiative that aimed at reducing teenage pregnancies. The program combined free access to long-acting reversible contraceptives, eliciting baseline misperceptions about sexual health, and a tailored information campaign to correct for them. Exploiting the geographic variation in the initiative combined with administrative birth data, we find a 16% decrease in teen birth-rate. Using survey data on sexual behavior and beliefs, we show this effect can be attributed to a change in the source of information from personal networks to healthcare professionals, which amends misinformation on sexual health and contraception use. The reduction in teen-birth is stronger in conservative districts, where restrictive social norms can explain teenagers' lower knowledge about sexual health, contributing to risky behaviors.

*We thank Pello Aspuru, Nina Buchmann, Nina Brooks, Cauê Dobbin, Grant Miller, Pascaline Dupas, Nezih Guner, Warn Lekfuangfu, and Costas Meghir; as well as seminar participants at BSE Gender and Work, Carlos III, CEMFI, EWMES2024, Istanbul Applied Economics Workshop, MESS and SAEe2024 for their helpful comments . We gratefully acknowledge financial support from the Maria de Maeztu grant and Proyectos de Generación de Conocimiento 2021 for travel expenses to present the project. All views and errors are our own.

1 Introduction

Modern contraceptives play a critical role in preventing unintended teen pregnancies – a leading driver of teenage mortality and reduced educational attainment in low-income countries where contraception use is limited (WHO, 2024; Lang and Weinstein, 2015). Rates of teen pregnancy might be high even with continuous use of contraceptives, as most contraceptive methods suffer from poor adherence. Addressing this issue, long-acting reversible contraceptives (*LARCs* - such as subdermal implants or intrauterine devices) are more effective in preventing pregnancy compared to methods such as birth control pills or condoms.[1] However, they are expansive. While 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 context in hand.

With context-specific frictions, the key to a successful teen pregnancy reduction policy lies in understanding the specific source of frictions within each context (Dupas and Miguel, 2017) – 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, such as Latin America, that have completed the 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 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 argue for policy-makers to elicit baseline misperceptions, which allows for a tailored policy design that addresses context-specific frictions. For this purpose, we evaluate the Salud Mesoamerica Initiative (SM initiative), which aimed to reduce teenage pregnancies in Costa Rica in 2015, using a two-pillar campaign. The first pillar of the initiative provided teenagers with free access to LARCs in health centers, alleviating economic frictions in access to contraception. The second pillar aimed to reduce misperceptions about sexual health following a two-step approach: elicit baseline misperceptions among teenagers and deliver a tailored information campaign addressing the detected misperceptions. Combining administrative data on births with rich survey data on sexual behavior and beliefs, we show that providing teenagers with context-relevant information about the efficacy and risks of subsidized contraceptives significantly enhanced the efficacy of contraception provision programs. We argue that this effect can be attributed to a change in the source of information from personal networks to healthcare professionals, which amends misinformation on sexual

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

health and contraception use, for which we find strong empirical support. Finally, we show that the change in the source of information might be of greater importance among more conservative population, where social norms regarding sexual activity could limit teenagers' knowledge about sexual health and contribute to risky sexual behavior.[2]

The geographic variation in the implementation of the SM initiative allows us to employ a differences-in-differences design to study the importance of tailored information campaigns on programs that provide free contraception. Given the limited availability of resources, the program was implemented only in two regions in the southern part of the country. The selection of treated regions was based on need and feasibility: ideally, authorities would treat all districts in need, but without local distribution channels, reaching these areas required nationwide coverage. Lacking the necessary funds for national coverage, two southern regions in Costa Rica, containing a higher share of districts in need, were selected for treatment. This feasibility criterion allows us to compare districts that are similar in terms of need and socioeconomic status but are in different regions of the country. The identification of our difference in difference design relies on the assumption that non-treated districts were on the same trajectory of teen pregnancy as treated districts – which we test and confirm.

To evaluate the SM initiative, we rely on both administrative and survey data sources. First, to estimate the impact of the SM initiative on teen births, we use comprehensive administrative data from the Costa Rican National Bureau of Statistics on births that took place between the years 2005-2020, restricting our sample to births where the mother is a teenager. Merging this data with population records and the 2011 Census enables us to calculate the adolescent birth rate by district, cohort, and year. Additionally, we examine reproductive health practices, sexual behavior, and knowledge among teenagers using survey data from the SM initiative and the National Sexual and Reproductive Health (NSRH) survey by the Costa Rican government.

We find that the SM initiative reduces the teen birth rate by 16% in the subsequent five years after its implementation. However, it is unclear what is driving this large reduction. This reduction is a compound of both pillars of the SM initiative: providing access to contraception to alleviate costs, and providing information about the functionality, safety, and benefits of distributed contraceptives to remedy information frictions. To disentangle the importance of these two pillars, we exploit the fact that information campaigns are delivered in high schools, leaving the 19-year-olds unexposed to information campaigns, but still eligible for free LARCs. Therefore, restricting our analysis to 19

[2]When the limited family planning options in Costa Rica combine with misinformation, risky sexual activity prevails – leading to high rates of unprotected sexual activity: More than 50% of the respondents in the 2010 NSRH survey had reported having unprotected sex at least once. In the absence of affordable modern contraception and legalized abortion, risky sexual activity drives high rates of teen pregnancy. Adolescent fertility rate (defined as births where the mother is between ages 15 and 19) in Costa Rica was 5.5% by 2015, compared to 2.1% in United States (World Bank Group, 2024).

year-old allows us to exploit the number of years each cohort spent in school since the SM initiative's initiation at 2015. Our results suggest that every extra year of exposure to information campaigns is equivalent to a quarter of the effect of free access to LARCs, serving as an effective compliment.

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 there in the first place. To address this issue, the SM initiative ran a baseline survey in 2013 and collected insights on the information frictions among teenagers. The 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 were low, and self-reported likelihood of teenage pregnancy was high.[3] As a result of the baseline survey, the SM initiative targeted directly those three frictions: (1) tailored posters and discussion groups around the detected misperceptions;[4] (2) provided talks by healthcare professionals; (3) provided specific places to seek help.

It is natural to wonder – why would switching the source of sexual advice from personal networks to healthcare professionals matter? Personal networks might provide misguided knowledge about sexual health which can propagate in several ways. First, sexual topics may be considered taboo, resulting in a complete absence of open dialogue. In cases where sex is discussed, the conversation may focus exclusively on abstinence or the information provided can be incomplete, leaving young people without the tools to make informed decisions.[5] Lastly, misinformation might provide inadvertently, still leading to misperceptions about sexual health.

Indeed, we find that teenagers used to learn from their parents and their initial level of sexual health was limited, however, this changed significantly after the initiative. Both the SM initiative's and the NSRH baseline surveys show that the most common source of information on sexual health for teenagers in Costa Rica was personal networks, however, sexual topics were not considered taboo: 75% of teenagers talk with their parents about sex, and 90% report they would tell their mom if they had sex. Although sex seems to be discussed, a lack of information about sexual matters prevailed, and specifically, knowledge about LARCs was limited – 30% of the general population had never heard of LARCs as a birth control method. Therefore, the information campaigns were designed

[3] When asked *'What's the likelihood of you getting pregnant/impregnating a girl before age 18?'* only 33% of students responded *'almost no chance'*, whereas 55% of them responded *'it might happen'*, and 12% responded *'very likely'*.

[4]

[5] A natural question is whether the change in the source of information from parents to healthcare professional is necessarily desired since it might promote sexual behavior. We abstain from such normative discussion. Instead, our aim is answering a non-partisan question – whether the change in the source of information promotes unprotected sexual behavior, that propagates to teen-births. Nevertheless, it should be noted we find no change in the self-reported sexual activity, age at first sex, or the number of sexual partners.

to amend these misperceptions specifically and to increase awareness of LARCs availability, efficacy, and safety. Indeed, we find that these information campaigns switched the source of– and improved the quality of–sexual education: students were more likely to receive information about sexual matters from healthcare professionals. In turn, they were better in identifying pregnancy risk, reported lower likelihood of getting pregnant, were more aware of where to obtain LARCs, and more likely to visit a health center to do so.

Finally, given the high cost of LARCs and delivering information campaigns, a policymaker might want to find ways to target districts where such interventions will be of greater efficacy. One natural approach is to target teenagers from conservative areas, where their social network might be uninformed about modern contraception methods themselves, inevitably leading to inadequate sexual education. However, teenagers in conservative areas might be less sexually active to begin with, leading to very little margin of an intervention to effect teen birth. To test these competing forces, we examine the heterogeneous treatment effect of the SM initiative in districts that exhibit a more conservative culture in the baseline. To do so, we use the NSRH survey to calculate the share of the population '*supporting the church's stand against family planning programs*' by district. We find that misinformation among teenagers was stronger in more conservative districts. Furthermore, the decline in teen birth rate due to the SM initiative is larger in these conservative districts, both due to LARCs access and information campaigns. This suggests that high-quality targeted information is effective in updating baseline beliefs in contexts where information frictions and misperceptions about birth control methods are common.

Our study contributes to three strands of the literature. First, we add to the literature on modern contraceptive access and teen pregnancy. Miller and Babiarz (2016) reviews the empirical literature and concludes that family planning programs have historically explained a limited portion of fertility declines in low- and middle-income countries. Although there is substantial empirical evidence of information frictions that affect contraceptive uptake among adolescents (Bau et al., 2024; Athey et al., 2023; Miller, 2022; Chong et al., 2020), few studies in a developing context go beyond participation and explicitly connect these frictions to reductions in *teen births*. Furthermore, Dupas et al. (2024) argue that removing financial barriers alone has no impact on contraception use. These insights vary significantly by context. For example, in the U.S., Bailey et al. (2023) finds that voucher programs alone can address access constraints and improve contraception use up, yet they do not test for reductions in fertility, and particularly not among teens. Other US-based studies, such as Luca et al. (2021); Kelly et al. (2020); Lindo and Packham (2017); Kearney and Levine (2009), show that LARCs subsidies increase contraception use, although the effect on teen birth remains mild. We contribute to this literature by providing novel empirical evidence from a developing context, where we

observe an especially large decline (16%) in teen birth. Our findings provide insight for policy makers on the potential effectiveness and complimentarily of targeted information and contraceptive interventions that could support adolescent reproductive autonomy and effectively lower teen birth rates.

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

The success of information programs that aim to change sexual behavior depends on their design, as they need to effectively update baseline beliefs to achieve the desired outcomes (Duflo et al., 2016; Dupas, 2011). Dupas and Miguel (2017) argue that providing specific information is more effective than general exhortation to change sexual behavior. Most closely related to our work, Kelly et al. (2020) shows that the media coverage of LARCs' subsidies increased the number of insertions among teenagers; whereas Athey et al. (2023) and Luca et al. (2021) show that personalized counseling increases the take-up of contraception in the United States, although the latter focuses on repeated pregnancies. We contribute to this literature by studying a unique setting where improved contraception access is supported by *targeted context-specific* information campaigns. We show the importance of high-quality information diffusion as a complement to contraceptive provision, as a mean to amend misinformation on sexual health.

Finally, our study relates to the growing literature on the role of the information source and social norms in shaping reproductive choices and influencing teen birth rates, particularly in conservative contexts. Angrist (2020) finds the source of information can 'make-or-break the intervention' and has large implications to teen pregnancy. Furthermore, social norms might be perpetuated through conservative families: Brooks and Zohar (2024) finds that conservative parental attitudes can constrain young women's agency in abortion decisions. Another channel where social norms might affect outcomes in sexual health is through stigma and biases in personal networks: Godlonton and Thornton (2012) shows that personal networks affect decisions on HIV testing, whereas Yang et al. (2023b) demonstrates 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-middle-income countries might impact the quality

of care received by young women; and educating healthcare providers on this bias helps young women receive better care in sexual health. Most closely our work, Chong et al. (2020) discusses how parents and 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 bigger role in the information frictions, and it's implications on teen-birth rather than merely contraception use.

The remainder of this 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 disentangle the effects of contraception access versus the information campaigns. Section 4 studies the impact of information campaigns on it's 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 long-acting reversible contraceptives (LARCs) and conducting information campaigns in targeted regions. It then describes the comprehensive administrative data and survey results that 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 exhibits a unique setting with high teen pregnancy rates and a conservative culture that limits 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), highlighting significant public health concerns. Taking steps to tackle this issue, the government integrated sexual education into the national high school curriculum in 2012[6] and authorized the emergency "day after" pill in 2019. However, access to family planning services remains limited: abortion is illegal except when the mother's life is at risk. Furthermore, when not subsidized, modern contraceptive methods are expensive

[6]Sexual education classes covered general sexual health topics like reproductive physiology and STDs but lacked specific information on LARCs' functionality, safety, and benefits. Nationally implemented, their impact was similar across treatment and control regions before SMI.

and largely unaffordable for adolescents.[7]

On top of the high costs of modern contraceptive devices, the limited access to family planning services is further propagated by the conservative culture that prevails in the country. According to the NSRH Survey of 2010, 65% of Costa Rican population is catholic, and 48% believe that the church is against family planning. In fact, 14% of the responders who stated that the church is against family planning agree with the stance of the church: which documents the conservative culture in the country, and highlights there might be further barriers, such as information frictions on sexual health, than just economic costs on access to contraception.

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

The Salud Mesoamérica Initiative (SM initiative henceforth) is a collaborative project with the primary objective of addressing health disparities prevalent in Mesoamerican countries. In the case of Costa Rica, it's aim was to reduce pregnancies and births among teenagers. 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 these resources towards procuring long-acting birth control devices (LARCs) due to the efficacy of these devices. Specifically, the SM initiative supported a two-pillar program: provide free access to LARCs and educate teens on the safety and efficacy of these devices through information campaigns.

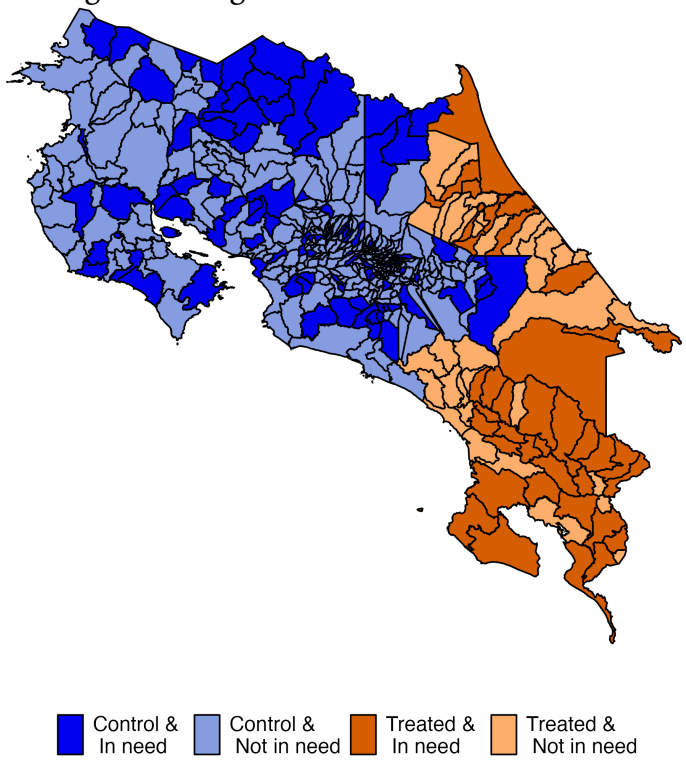
Given the limited availability of resources, the program focused on two regions. Ideally, the government would have prioritized contraceptive distribution to districts with the highest need, defined as those in the bottom quintiles of the Social Development Index (SDI), which includes scores of education, economic conditions, political participation, and health. However, lacking the infrastructure to reach all 99 districts in need (out of the 487 districts in the country (dark districts in Figure 1)), 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). that low SDI districts are also found in other regions of the country (dark blue districts in Figure 1), allowing us to compare districts that are similar in terms of need and socioeconomic status but are in different regions of the country.

The operative manual of the SM initiative (Banco Interamericano de Desarrolo, 2015) outlines a two-part approach in selected regions, combining free access to LARCs with targeted information campaigns. Healthcare authorities provided LARCs, while schools

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

led campaigns featuring audiovisual materials, guided debates, self-care activities, and periodic visits from healthcare professionals. These campaigns aimed to address misinformation and educate students on LARCs' functionality, safety, and benefits, emphasizing their accessibility to all students. Recognizing the uncertainty about specific information frictions, the initiative conducted a 2013 baseline survey to identify misperceptions in sexual health among teens, allowing the campaign content to be tailored to students' needs.

Figure 1: Regions selected into treatment



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

2.3 Data

To evaluate the SM initiative, we rely on several data sources: administrative data records on births, population records, and two survey data sources on sexual beliefs, and behavior.

To estimate the SM initiative's impact on teen birth rates, we use administrative data from the Costa Rican National Bureau of Statistics and Centro Centroamericano de Población on births by year, age, and district from 2005 to 2020. We focus on births to mothers aged 12-19, aligning with the SM initiative's target age group.[8] Population

[8]The World Health Organization defines adolescent pregnancy as involving mothers aged 10-19. How-

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.

To analyze the initiative's effect on sexual behavior, we use two survey sources: SM initiative surveys and the National Sexual and Reproductive Health (NSRH) survey. The SM initiative surveyed 3,049 students aged 12-20 in a random sample of 39 *treated* schools in 2013 and 2018, collecting data on sexual knowledge, attitudes, and health behaviors. As this survey only includes treated schools, we also use the NSRH survey, which collected data on sexual beliefs and practices from over 3,000 individuals in 2010 and 2015, capturing contraceptive use and sexual education rates across the country before and after the SM initiative

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

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

In this section, we employ two exercises to evaluate the effects of the SM initiative. First, we undertake a difference-in-differences design to evaluate the effects of the overall initiative and show a noteworthy reduction in the teen birth rate due to the SM initiative. Then, we disentangle the impact of contraception access from the impact of information campaigns and show that an extra year of exposure to information campaigns amplifies the impact further by 4%.

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 access to LARCs and information campaigns. Our design compares districts in the treated regions with districts that were not impacted by treatment, allowing the effects to vary across years using the following model:

ever, since the SM initiative targets high school students, we limit our sample to ages 12-19, the typical age range for high school attendance in Costa Rica.

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

where TBR_{dt} is the teen birth rate in district d at time t, Treat_d is the treatment indicator, SDI_d is the level of the Social Development Index measured in 2015, and finally ϕ_d and γ_t indicate district and time fixed effects. Our reference year is 2015, as births that took place in 2015 are likely the result of conceptions in 2014, a year before the policy took place. Consecutively, we consider 2016 as the initial year while evaluating the impact of access and information campaigns. Finally, we cluster our standard errors at the level of the treatment assignment – the district level. To control for different evolution of teen birth rates in targeted districts, we run an alternative specification where we control for differential time effects by SDI levels in the appendix.

Our empirical strategy relies on the standard parallel trends assumption. Specifically, in our context, we assume that non-treated districts were on the same trajectory as treated districts, had the treated districts were not subject to the SM intervention. 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 rate, where the point estimates for the years before the SM initiative's implementation remain insignificant and stable, confirming our identification assumption.

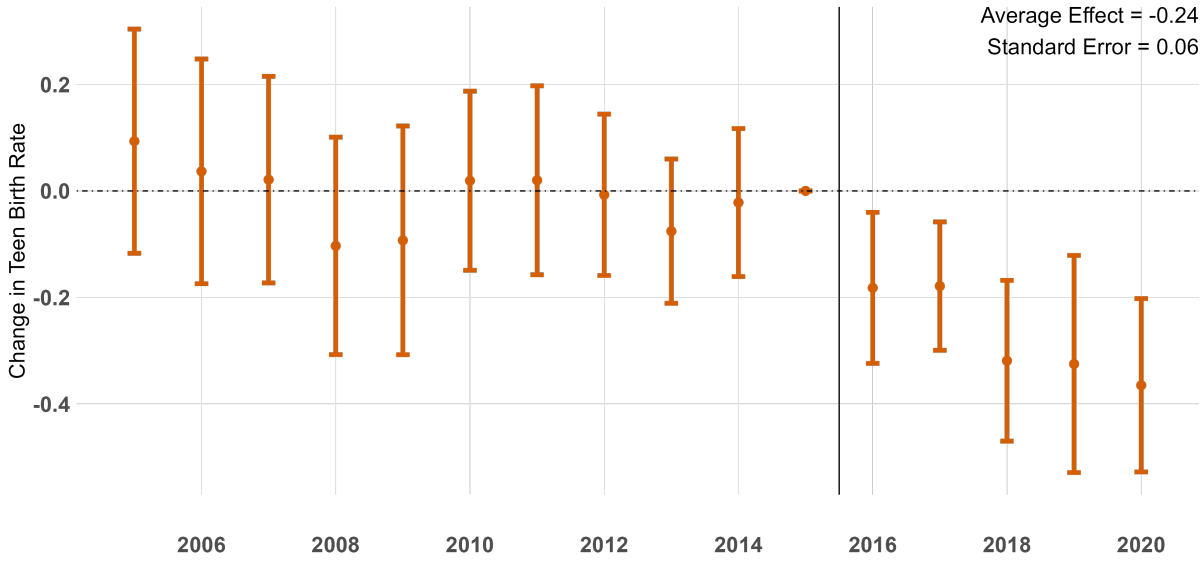
Results

Estimating Equation 1 we find the SM initiative had reduced the teen birth rate (Figure 2). The teen birth rate declined by 0.18 percentage points in the treated districts during the first year of the SM initiative, which amounts to a 12% decline.[9] In the medium term, this reduction becomes stronger: three years after the implementation, teen birth rates declined by 0.31 percentage points in the treated districts, which is equivalent to a 21% decline compared to the baseline level of teen birth rate in 2015. In the long-term, our results indicate a noteworthy reduction in teen births: by the end of the SM initiative in 2020, free from any confounding factors of the COVID-19 pandemic, the SM initiative reduced the teen birth rate by 25% in treated districts. On average, the SM initiative reduces the teen birth rate by 0.24 percentage points, which is equivalent to a 16% reduction.

Figure 2 offers an important insight: the impact becomes more pronounced over time. Perhaps this is not a coincidence: the longer the SM initiative took place, the

[9] See Figure A1a for the change in the teen birth rate in percentages, normalizing the point estimates by the mean teen birth rate in 2015. As a robustness exercise, we plot in Figure A1b the estimates from the model without controlling for the interaction between year and district SDI. While estimates differ slightly in magnitude, the observed pattern and significance of the estimated effect remain robust to the change.

Figure 2: The effect of the SM initiative on teen birth rate



Notes: This figure plots the difference in teen birth rates between treatment and control regions (estimates of Equation 1) over time (2005-2020). Standard errors are clustered at the 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.

more students were included in the SM initiative, and they were exposed to subsidized LARCs and information campaigns for a longer period. Yet it is unclear which channel of the SM initiative is driving this impact, as the SM initiative removes economic frictions (via free access to LARCs) as well as information frictions (via information campaigns). Since the SM initiative was implemented at the same time, in the same districts, we lack variation in the implementation of the programs to determine how these channels contributed to the observed decline. To remedy this issue, we exploit differential exposure to information campaigns in the following subsection.

3.2 Disentangling exposure to access from exposure to information

One salient pattern from Figure 2 is the secular increase in the impact of the SM initiative, with the decline in teen birth rates becoming more pronounced in the first three years following implementation. One natural explanation for this pattern is prolonged exposure to the SM initiative: younger cohorts are exposed to free access to contraception and information campaigns for a longer period compared to those who were already in their late teens by 2015, amplifying the impact over time. However, it is unclear whether this prolonged exposure is driven by the contraception access or the information campaigns, as they address different constraints in the use of contraception.

Subsidizing LARCs relieves economic constraints, yet information frictions might still

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

To test this mechanism, we restrict our sample to 19 year-old teenagers and exploit the number of years each cohort spent in school since the SM initiative's initiation: depending on how old they were in 2015, each cohort was exposed to the information campaign for a different number of years. As can be seen from Figure B3, the SM initiative affected the 1996 cohort in treatment districts when they were 19 years old, and already out of school. Therefore, they only had improved access to LARCs but none of the high-school information campaigns (marked by their lighter orange color). The 1997 cohort, on the other hand, was exposed to the high-school information campaigns for one year by the time they turned 19 (similarly, the 1998 cohort was exposed for two years, and so on). Therefore, comparing the treatment effects of individuals from the same district, when they were 19 years old, allows us to disentangle the role of an extra year of exposure to the high-school information campaigns. Formally, we employ the following model to study the impact of exposure:

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

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

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

By definition, students were only exposed to the information campaign in high schools of treated districts from the year of implementation, 2015. Since the 19-year-old teens are not in high school anymore, we subtract a year of exposure, to account for the years

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

they were exposed before.

Figure B3 illustrates how coefficients in Equation 2 are identified: across-district comparison of the 1995 cohort allows us to estimate ϕ_d, whereas τ is identified thanks to the 1996 cohort and the difference between district fixed effects $\Delta\phi_d$, recovered from 1995 cohort. Having identified $\Delta\phi_d$ and τ, a comparison of treatment and control districts among the 1997 cohort is sufficient to identify the impact of exposure, α.[11]

Table 1: Impact of Exposure to the SM initiative for 19 year old students

	(1)	(2)	(3)	(4)
	All	All	Low conservatism	High conservatism
Treated x Post	-1.386**	-0.4728	-1.002	-1.710.
	(0.4655)	(0.5614)	(0.7817)	(0.9857)
Exposure	-0.3830**	-0.5584**	-0.4008*	-0.4493
	(0.1428)	(0.2013)	(0.1979)	(0.3652)
Controls				
SDI	No	Yes	No	No
District fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
S.E.: Clustered	by: District	by: District	by: District	by: District
Observations	9,884	9,884	1,701	1,695
R2	0.33319	0.33719	0.49802	0.51314
Within R2	0.00281	0.00880	0.00513	0.00787
Mean teen birth rate	8.959	8.959	8.875	9.438

Notes: This table presents the impact of exposure to the SM initiative. The first and second columns represent the coefficients estimated from Equation 2, limiting the sample to only 19-year-olds. The the second column also controls for the differential time trends according to the SDI scores of districts.The third and fourth columns are estimated using Equation 2, however, the sample is restricted to districts with a low level of conservatism in column 3 and districts with a high level of conservatism in column 4. The mean is calculated using teenage birth rates in 2014, just before the SM initiative took place for the respective sample. Exposure levels are calculated using Equation 6, which tracks how many years each cohort has been exposed to the SM initiative since the SM initiative's start. Levels of conservatism are calculated using responses from NSRH surveys, as explained in subsection 4.2. Standard errors in parenthesis are clustered by district level. Significance levels according to p values are as follows: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Our results suggest that every extra year of exposure to information campaigns is equivalent to a quarter of the effect of free access to LARCs. The first column of Table 1 shows the coefficient estimates of Equation 2, where we see that each extra year of exposure declines the teenage birth rate by 0.38 percentage points among 19-year-old

[11]We test the implicit linearity assumption here by repeating this exercise without imposing linearity and using dummies for each year of exposure. Figure B4 plots the estimated coefficients, which validates our choice of linearity in Equation 2

teenagers. This result is in line with our priors: the more time spent under the coverage of the SM initiative while being exposed to information campaigns, the further the teenage birth rate declines. Furthermore, the role of exposure is even stronger when we control for differential time trends according to district SDI (second column of Table 1).

It should be noted that by limiting our sample to 19-year-olds, we lose observations from younger ages. To generalize this result, we repeat the same exercise including all age groups in the appendix: Figure B2 represents the cohort structure in this exercise, whereas 7 defines the level of exposure once we account for all age groups. We formalize the model in Equation 6 and report the results in Figure B1, which confirms our findings in 1.[12]

As an alternative test for the role of the information campaigns, we estimate district-level treatment effects (Arkhangelsky et al., 2024b), and show that the decline in teenage pregnancy is larger in districts with higher school attendance, where the SM initiative's LARCs-specific information campaigns were delivered (see Appendix B.1 for more details).[13] It is natural to ask how prolonged exposure to information campaigns amplifies the initiative's impact: what is it about these information campaigns that made them effective in the first place? We answer this question in the following section.

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 to instill confidence regarding the safety, efficacy, and ease of use of LARCS.[14] Miller, De Paula, and Valente (2020) argues that a successful contraception use program must provide information that is trusted, relevant, and challenging *existing beliefs*. Specifically, LARCs require an invasive procedure, hence information frictions might be even more prevalent in the case of LARCs among teenagers. Consequently, the relevance, quality, and source of information are particularly important in overcoming lack of knowledge and misconceptions. Therefore, we study the role of information source and quality in reducing information frictions regarding sexual beliefs and behaviour in subsection 4.1. We then further investigate why the source of information matters in Section 4.2, emphasizing the role of social norms.

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

[13] We test whether the initiative had any impact on likelihood to graduate from highschool or university using self-reported responses from the SM initiative surveys. We don't see an impact on likelihood to graduate from highschool (however, it should be noted that expected graduation rates are quite high - more than 95% of students report they expect to complete their highschool education) however we see an increase in the self-reported likelihood to graduate from university after the initiative.

[14] Dupas and Miguel (2017) discuss that providing specific information is more effective than general exhortation at changing sexual behavior.

4.1 Quality and source of information matter in reproductive health

What exactly makes these high-school information campaigns successful? A possible mechanism is that teenagers might be switching the source of their sexual advice, and hence receiving a higher quality of information on contraception compared to before the SM initiative.[15] In this section, we study the information frictions at the baseline level and analyze the impact of information campaigns on the source and quality of sexual education of teenagers.

Eliciting information sources and misperceptions in baseline

When designing interventions that aim to target the existing information frictions, it's hard to assess what those information frictions are. In contexts where sex education largely comes from parents and personal networks, the quality of information depends heavily on cultural norms. Conversations may be absent if sexual topics are taboo, limited to abstinence if premarital sex is discouraged, or incomplete if parents are uninformed or fear promoting premarital sex. In cases of widespread misinformation, parents may inadvertently pass on misconceptions, increasing risks.

From the perspective of a policy-maker, ex-ante it's hard to assess which barriers and frictions to target in a given context - 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 population at hand and the reasons behind the pregnancy. Hence, eliciting existing frictions using baseline surveys proves useful to address the issue at hand effectively.

The SM initiative collected a baseline survey (2013) to assess the information frictions among teenagers and design a tailored intervention. We use responses from this baseline survey to study the initial sources of sexual education and baseline knowledge and attitudes regarding sexual health. The responses from the baseline survey suggests that students are receiving sexual education from their family, and are misinformed regarding potential pregnancy risks. Figure 3a 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

[15] In the earlier reports of the SM initiative, it is reported that delivery of sexual education classes before the initiative has been sporadic: several students mentioned that their teachers disagreed with the content provided, and abstained from delivering it to students. To remedy this issue and ensure that campaigns were delivered by an objective, yet trusted source, healthcare practitioners were chosen.

the NSRH Survey of 2010: both sources show that teenagers learn from their parents, and they are misinformed on sexual health.

Having detected the sources of information frictions at baseline, the intervention delivered in schools are designed to correct these misperceptions. An example of the visual material that was disseminated in high schools can be seen in Figure A3, whereas the responses from the baseline survey can be seen in Figure 3a - it should be noted that the content delivered matched the questions asked in the baseline survey closely to provide context-specific information. In the next section, we show that this tailored design was successful at effectively correcting misinformation about sexual health.

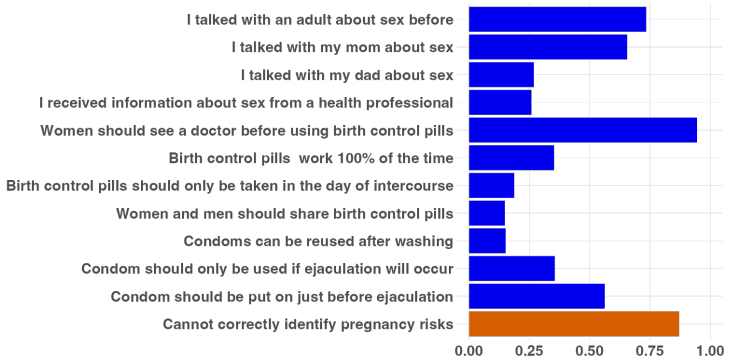
Changing sexual information source and quality

We begin by showing evidence from the SM initiative's survey that teenagers changed their source of information and updated their baseline beliefs about sexual health after the SM initiative. At the same time, they did not change their sexual activity, suggesting the source of sexual education does not promote sexual activity.

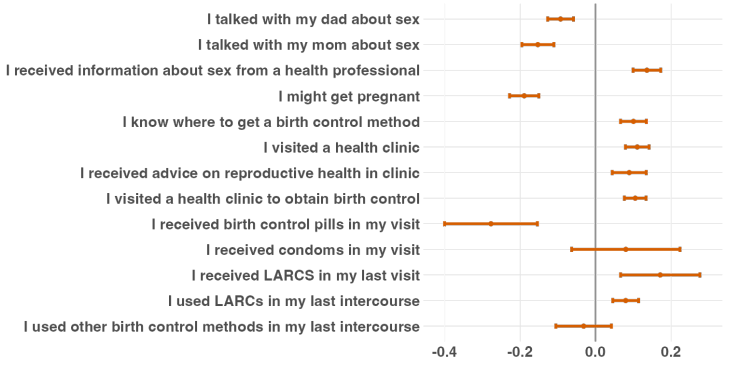
To understand whether the SM initiative affected the source and quality of sexual information, we employ two exercises. Firstly, we use the baseline (2013) and follow-up surveys (2018) collected by the Salud Mesoamerica Initiative to do a before-after analysis. Unfortunately, the surveys are only collected from a random sample of students in *treated* regions, hence it's not feasible to construct a control group to take care of time trends and establish a causal relationship. Nevertheless, they are informative of the change in reproductive health practices among teenagers after the SM initiative. Secondly, we employ a differences-in-differences design using the responses from NSRH surveys (2010 and 2015) to validate the causality of our findings from the SM initiative surveys.

Using the SM initiative's follow-up survey, we perform a simple before-and-after analysis, suggesting that receiving targeted in-school information campaigns successfully increased students' knowledge about pregnancy risks and protection. Figure 3b reports the 2013 to 2018 changes in source of information, sexual knowledge, and sexual health practices among teenagers after the information campaigns. First, students are more likely to receive information about sex from a health professional, rather than a parent. Second, students are more aware of where to receive and how to use birth control methods, and possibly as a result, report a lower likelihood of getting pregnant. Third, responses indicate that they are more likely to visit a health center and use LARCS after the information campaigns: Self-reported take-up of LARCs increases, whereas there's not a sizable change in take-up of condoms. Simultaneously, we observe a decline in take-up of birth control pills, conditional on requesting a birth control method during

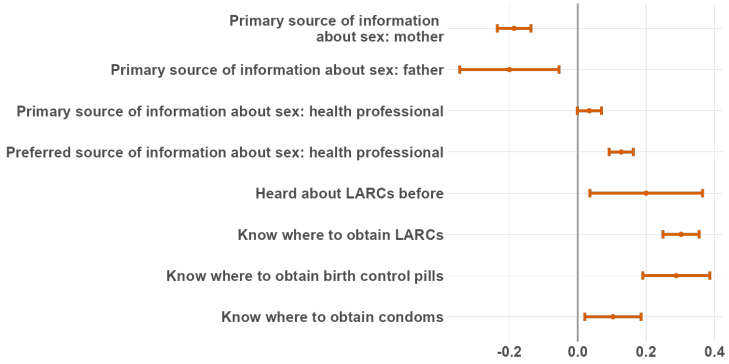
Figure 3: The change source and quality of information on sexual health



(a) Baseline share of reply 'Yes' (SM Initiative's Survey)



(b) Change in reply 'Yes' post-initiative (SM Initiative's Survey)



(c) Differences in Differences Estimates (NSRH Surveys)

Notes: This figure summarizes key questions regarding sexual information source and knowledge from the SM Initiative's surveys and the NSRH surveys. Figure 3a highlights the baseline share of replies 'Yes' to a series of questions in the 2013 survey. The last measure records students who responded incorrectly to one of the seven birth control methods questions above. Figure 3b 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 3c presents the diff-in-diff coefficient estimates τ from Equation 4, estimated using the responses from 12-19-year-old teenagers in NSRH surveys. All reported questions are phrased using "you or your partner" to ensure that the respondent's gender does not limit the target audience. The vertical lines mark 0. Orange lines mark the 95% confidence intervals.

clinic visits, suggesting a shift in preferred birth control method.[16]

To assess these results, we cross-examine the responses of the SM Initiative surveys with the responses from NSRH surveys, which were administered independently of the SM Initiative. Unlike the SM initiative surveys, NSRH surveys are collected from a nationally representative sample, including responses from both the control and treated districts. However, the time span 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 the responses from NSRH surveys to study the immediate impact of the SM initiative on sexual *information*. We focus our attention to questions that are similar to those asked in the SM initiative survey[17] and employ the following model:

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

Where Y_{it} records the response of individual i in time t, $\text{Treat}_{d(i)}$ is the treatment indicator for respondents from treatment districts, and Post_t is equal to one for the responses from follow-up survey. We plot the estimated coefficients $\widehat{\tau}$ in Figure 3c:

The results in Figure 3c confirm teenagers are changing their source of sexual information from their close networks to health professionals, and are better informed of where to obtain birth control methods. Overall, these difference-in-difference results are consistent with the before-and-after exercise from the SM Initiative's survey – they confirm that after the SM initiative, students are better informed about the risks of unprotected sexual activity and better prepared to make choices regarding pregnancy prevention.

4.2 Why does changing the source of information matter?

So far, we have shown evidence that the SM initiative's information campaigns in schools improved the quality of the sexual education information by shifting it's source towards healthcare professionals. This new information channel might be particularly important for teenagers from conservative families who advocate against sexual activity outside of marriage and therefore might be less open for discussion on sexual health. In cases where information frictions and misperceptions about birth control methods are common among adults, teenagers are inevitably left with inadequate sexual education.[18]

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

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

[18] A natural question is whether the change in the source of information in a conservative population (from personal networks and family to healthcare professionals) is necessarily desired since it might promote sexual behavior. We abstain from such normative discussions. Instead, we opt into a non-partisan

To test whether a more conservative social network plays an important role in baseline sexual information, we study the impact of the SM initiative on districts that exhibited a more conservative culture in the first place. To construct a measure of conservative sexual beliefs we use responses to questions about opinions regarding family planning sources, sexual information source, and sexual information quality in the 2010 NSRH survey (before the SM Initiative).[19] Specifically, we impute for each respondent a score of *being against family planning* using an interaction of two questions: (1) *What do you think is the position of the Catholic church about family planning? Is the church in favor, against, or neutral?* and; (2) *Do you think the church should maintain their position or change it?*. We record the response 'I don't support family planning programs' for those who responded 'against' and 'maintain their position' to the indicated questions. Then, we aggregate the responses within each district d and generate a score of 'conservatism' for each district based on the share of responses against family planning. Finally, we measure the median score of conservatism, and mark the districts that fall below this threshold as *low level of conservatism* and the districts that are above as *high level of conservatism*.

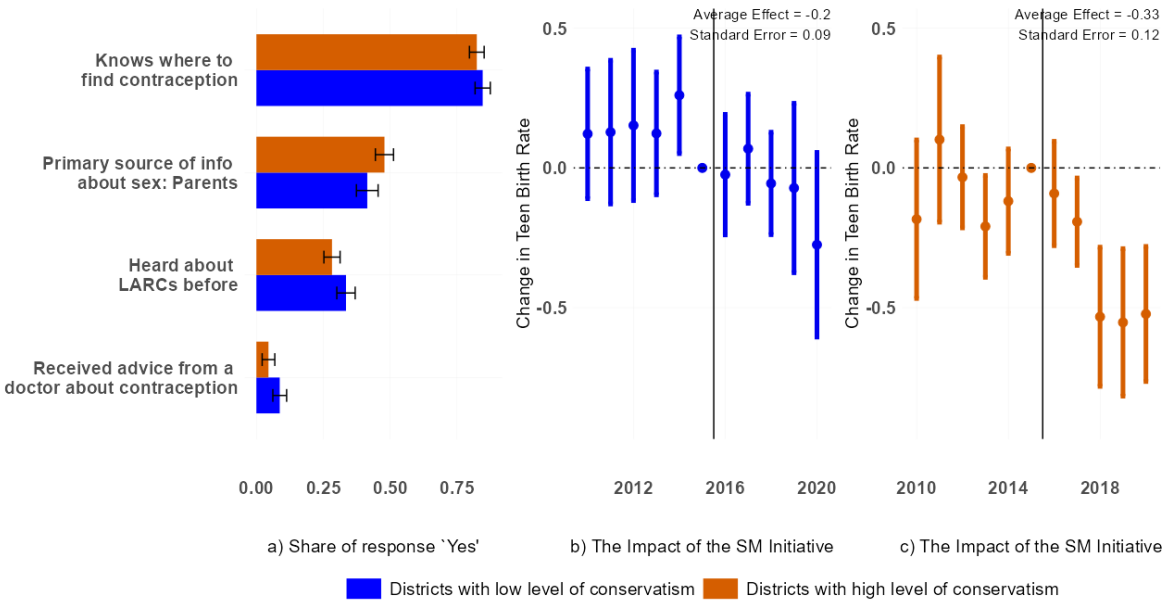
To study the impact of the SM Initiative according to the level of conservatism, we employ three exercises. First, we split the responses from the 2010 NSRH survey into two groups according to our threshold conservatism value, and analyze the responses to questions about information sources and quality from teenagers based on whether they are in a district with a low level of conservatism or not. Second, we repeat the Diff-in-diff exercise in Equation 1 (and in Figure 2) on subsamples of districts with low level of conservatism and districts with high level of conservatism. We report the results of these two exercises in Figure 4. Finally, we repeat the exercise in Equation 2 on subsamples of districts with low level of conservatism and districts with high level of conservatism. We report the results of this exercise on the third and fourth columns of Table 1.

Figure 4 illustrates a couple of interesting takeaways. To start with, Panel a shows that having parents as a primary source of information is much more common in conservative districts, whereas receiving advice from a doctor about contraception is relatively rare in conservative districts. Furthermore, teenagers in conservative districts are less informed about contraception types and where to achieve them compared to teenagers in less conservative districts. Secondly, comparing responses from panel b and panel c, we see that the impact of the SM Initiative is much larger per year (and also on average) in conservative districts.

question – whether the change in the source of information in conservative population promotes unprotected sexual behavior, that propagates to teen-births. Nevertheless, it should be noted we find no change in the self-reported sexual activity, age at first sex, or the number of sexual partners.

[19]We exclude questions about 'knowing where to obtain LARCs' and 'using LARCs', and 'healthcare professionals as a source of sexual information' as these were irrelevant before the program: LARCs were too expensive to obtain in the first place, and healthcare professionals were not commonly sought for as a source of information.

Figure 4: Impact is larger in conservative districts



Notes: This figure plots the differences across responses and impacts for districts with low levels of conservatism in blue and districts with high levels of conservatism in orange. We develop a score of conservatism by computing the share of respondents against family planning in each district and measuring the median level of conservatism across districts. Districts below the median score are classified as *'low level of conservatism'*, and districts above the median score are classified as *'high level of conservatism'*. In the first panel, we plot the number share of responses 'Yes' among several questions for respondents aged 12-to-19 by conservatism. In the second panel, we restrict our sample to districts that are below the median conservatism score and replicate our analysis in Equation 1. In the third panel, we restrict our sample to districts that are above the median conservatism score and replicate our analysis in Equation 1. The dashed line marks 0, whereas the solid line marks 2015.

Finally, Columns 3 and 4 of Table 1 show that the impact of the overall policy (estimated by the coefficient 'Treated x Post') and the impact of an additional year of information campaigns (estimated by 'Exposure') is greater in conservative districts. It should be noted that a score of conservatism is not available for each district, hence, by merging the responses from NSRH surveys to the admin data, we shrink our sample size from 9,884 to 3,404, and introduce a sample selection. As a result, we suffer from greater noise in our estimations. Nevertheless, these exercises are informative of why does it matter to change the source and quality of information - we see a greater impact of the overall policy in conservative districts, as well as a stronger impact of an additional year of information campaigns, which confirms our priors.

This result reinstates the importance of context-specific policies in constrained settings: access to free LARCs and exposure to the information campaigns offered by the SM Initiative matters more for teenagers from conservative families. We validate our results

from Figure 4 and Table 1 employing a heterogeneous treatment effect analysis. We estimate the treatment effect per district using Arkhangelsky et al. (2024a) and correlate the share of respondents against family planning with respect to the size of treatment effect in each district in Figure A4. Figure A4 plots an interesting pattern: in the first year of the program, we don't see any correlation between the level of conservatism and treatment effects. With time, this pattern changes: we see that the decline in teenage pregnancy is larger in the districts that exhibited a more conservative culture initially, resulting in a downward-sloping line in 2018, three years after the implementation of the SM initative. This result confirms our priors: changing the source of information can enhance the SM initiative's impact, particularly in contexts with stronger information frictions - however, this change takes time.

5 Conclusion

In conclusion, our study provides robust evidence on the complementarity of economic and informational frictions in reducing teenage birth rates. Our study contributes to the literature on contraceptive access and teenage pregnancy in a developing context, providing evidence that a combined approach, economic access to LARCs with targeted context-specific information campaigns, can substantially reduce teen birth rates, rather than merely taking contraception. Additionally, our findings underscore the value of shifting sexual health information sources from personal networks to healthcare providers, particularly in conservative settings, where 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 three policy-relevant takeaways. First, this study highlights the importance of eliciting baseline misinformation prior to intervention. In contexts where misconceptions about contraceptive safety and efficacy vary widely, baseline elicitation enables the design of targeted campaigns that address the most prevalent misunderstandings, ensuring 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. In doing so, programs can improve the quality and reliability of reproductive health information, leading to better informed contraceptive decisions. Finally, when resources are scarce, policymakers can have greater impact by targeting conservative areas where misinformation and restrictive social norms are more embedded. Our results suggest that conservative regions benefit disproportionately from comprehensive contraceptive 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.

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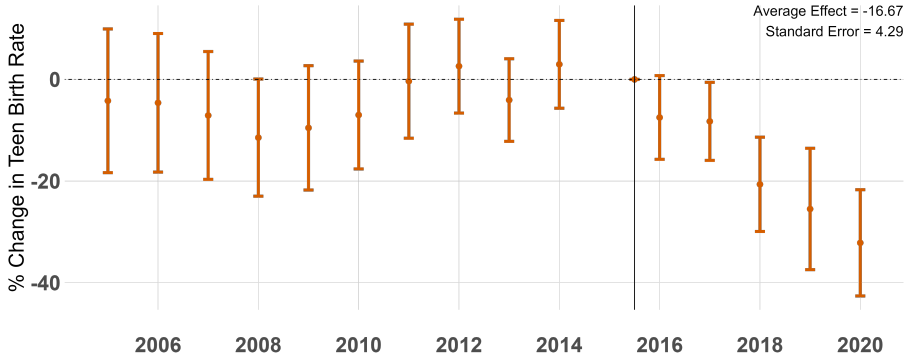
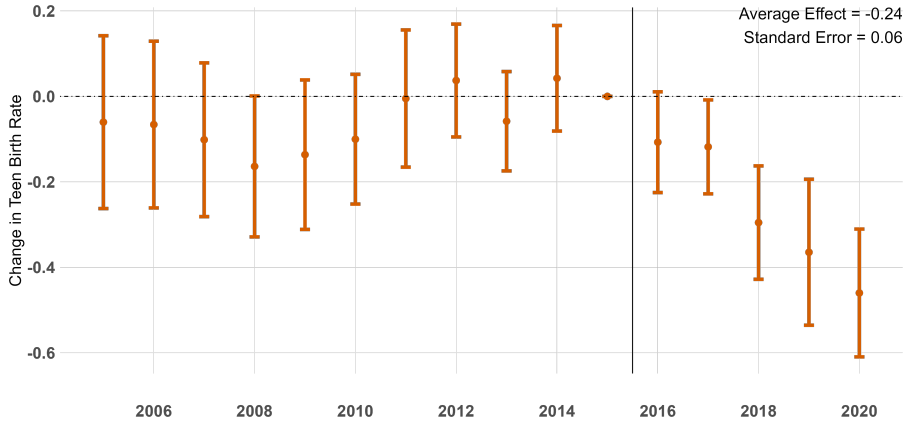
A Appendix A: Further results

Figure A1: Change in Teen Birth Rate



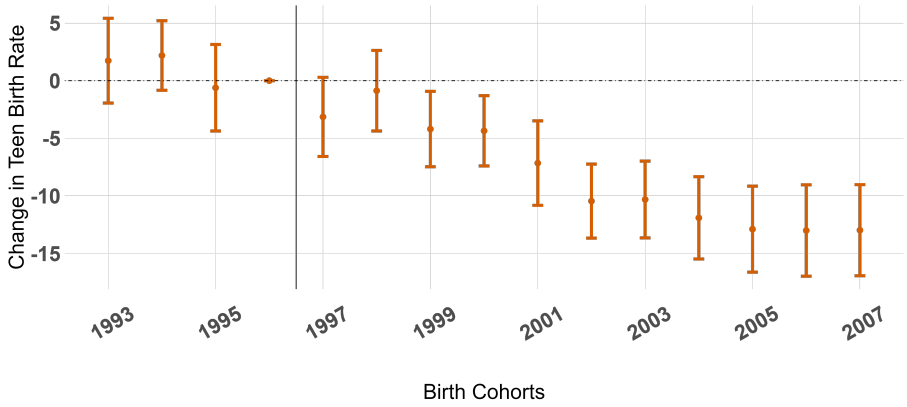
(a) Change in percentages



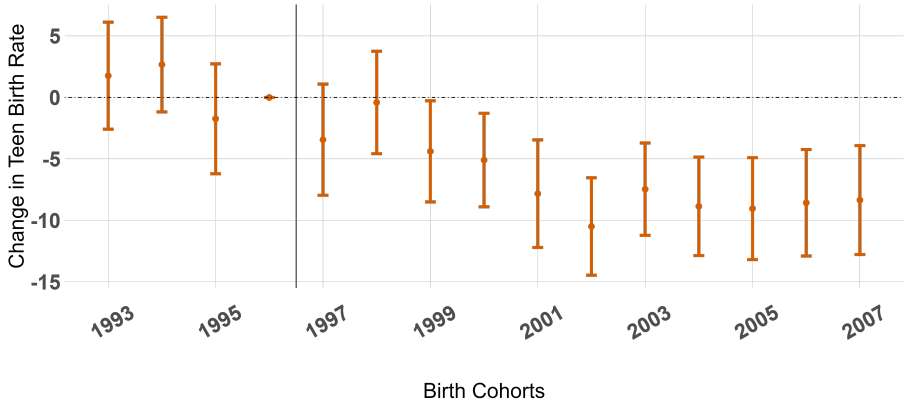
(b) Baseline model (not controlling for SDI)

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

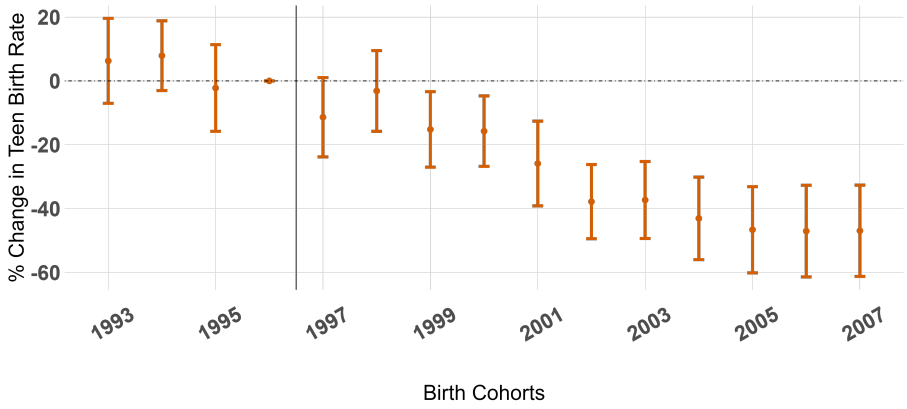
Figure A2: Change in Teen Birth Rate by Cohorts



(a) Baseline model (without for SDI)



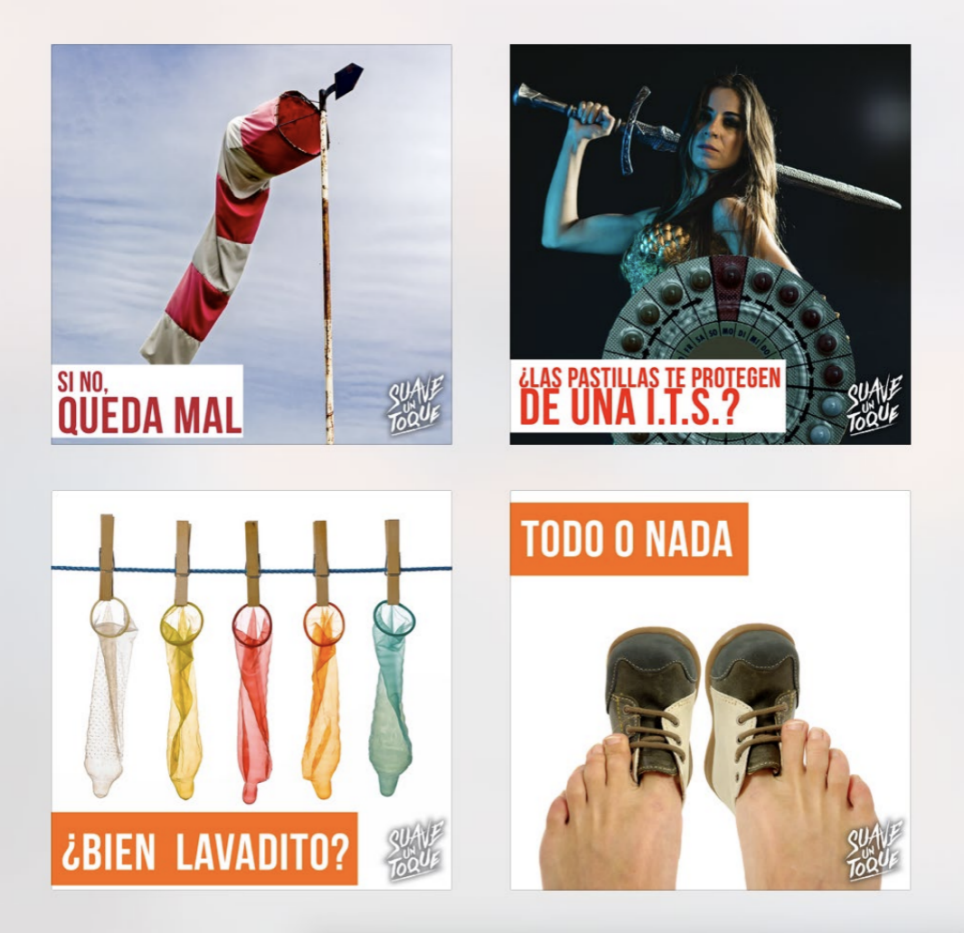
(b) Baseline model (controlling for SDI)



(c) The impact in percentages

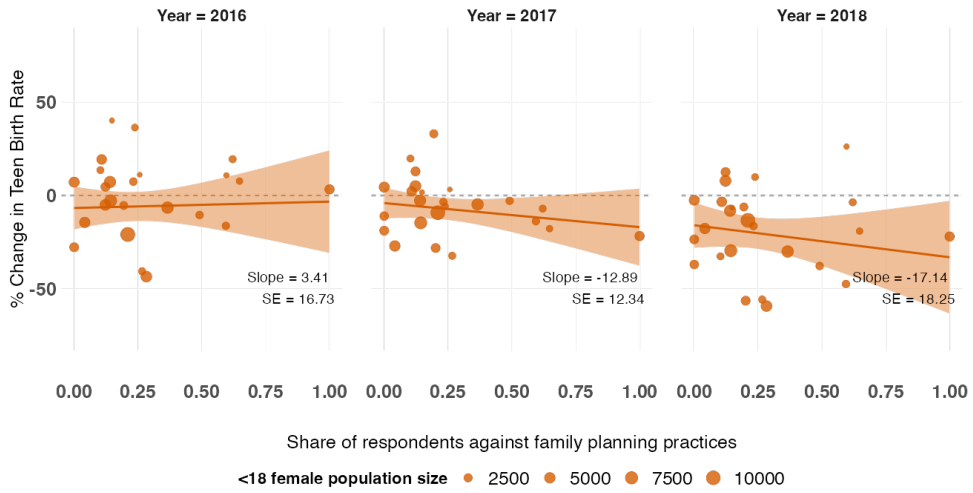
Notes: This figure plots the difference in adolescent birth rates between treatment and control regions over cohorts. Figure A2a represents the estimations without controlling for SDI. Figure A2b represents the estimations while controlling for SDI (our baseline model), but in cohorts structure. Figure A2c plots the difference in percentages, where percentages were computed by dividing the estimated coefficient by the mean birth rate of cohort 1996, which is our reference cohort (since they were not covered by the policy as can be seen in Figure B3. Standard errors are clustered at the district level. The lines are 95% confidence intervals. The vertical line marks the youngest cohort that was not covered by the policy, 1996, and the horizontal line marks 0.

Figure A3: Visual material provided in information campaigns



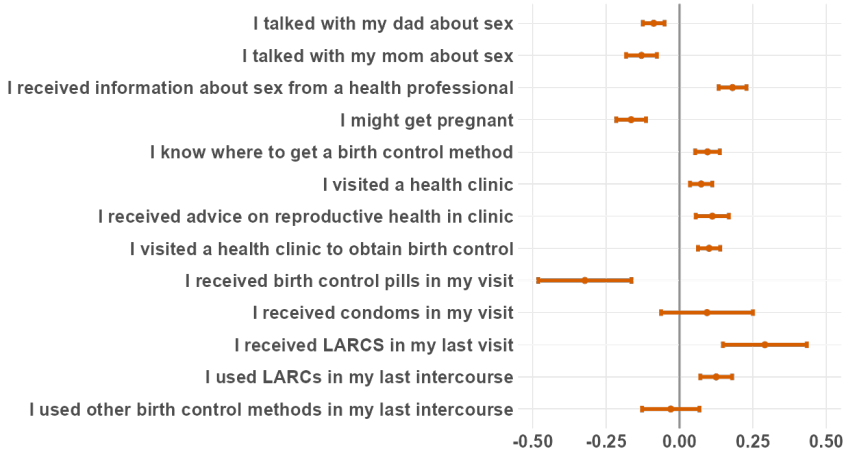
Notes: This figure shows an exemplary exhibit that was provided to teenagers in the information campaigns in high schools (in Spanish). The statements in the panels maps to the true-false statements that was provided in baseline survey of SM initiative in 2013, which can be seen in Figure 3a.

Figure A4: The district level treatment effects vs share against family-planing

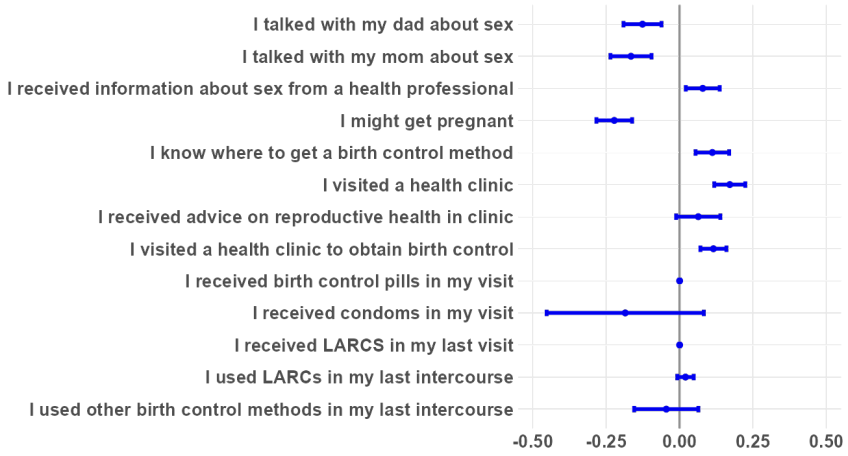


Notes: This figure correlates district-level treatment effects against the share of respondents against family planning programs in 2010 in each district. The y-axis presents the percent change in teen birth rate due to the SM initiative, normalized to the baseline levels of teen pregnancy in 2015, following Equation 5. The x-axis plots the share of respondents in the district that are against family planning programs, measured by the NSRH survey in 2010, before the SM initiative. The observations were weighted by the size of the female teenage population in 2014 while estimating the regression slope, and the size of each observation signifies these weights.

Figure A5: The change source and quality of information on sexual health by genders



(a) Change in reply 'Yes' post-initiative for girls



(b) Change in reply 'Yes' post-initiative for boys

Notes: This figure summarizes key questions regarding sexual information source and knowledge from the SM Initiative's surveys and the NSRH surveys. Figure A5a highlights the change in the share of female students who responded 'yes' to the given question from pre- to post-initiative. The last measure records students who responded incorrectly to one of the seven birth control methods questions above. Figure A5b 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 marks 0.

B Appendix B: Impact of exposure to the SM Initiative

B.1 Variation in exposure to information campaigns by districts

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

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

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

$$TBR_{dt} = \alpha_d + \delta_t + \sum_{k \neq 2015, \infty} \tau_{dk} + \epsilon_{dt} \tag{5}$$

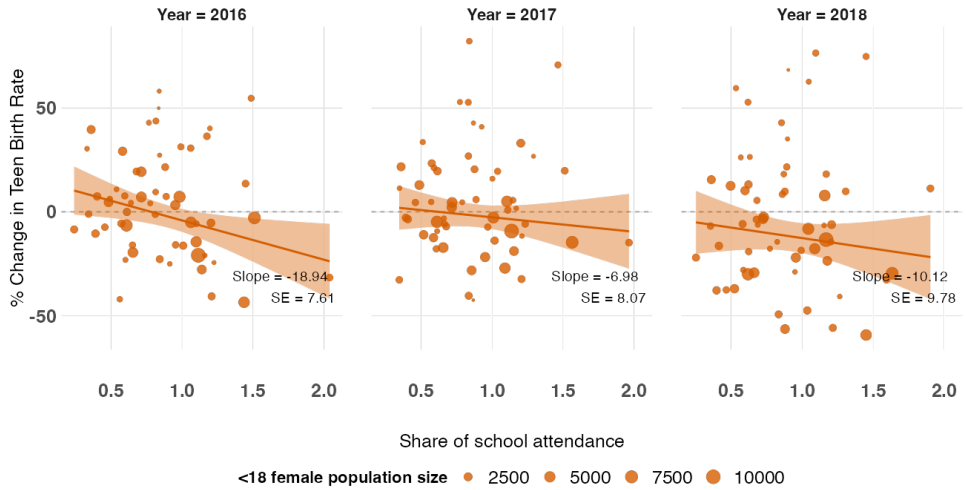
where TBR_{dt} stands for the teen birth rates per district d and year t, α_d are district-fixed effects and δ_t are year-fixed effects. As in Section 3.1 we define the reference year as 2015, as births that took place in 2015 are likely the result of conceptions in 2014, a year before the policy took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

We perform a heterogeneous treatment effect analysis by high-schools attendance rates by using the estimated district-level treatment effects τ_{dk} against the high school baseline attendance rate for each district (Figure B1).[20] Figure B1 shows that the decline in teenage pregnancy is larger in districts with higher school attendance. These results suggest that higher exposure to related sexual educational content results in a

[20] We opt to illustrate the results up to the year 2018 to be comparable with the results from the SM initiative's follow-up survey, which we will use in subsequent sections.

stronger decline in teen birth rates, highlighting the importance of information campaigns. In Section 4.1 we explore whether these results can be explained by a shift in the source, and hence the quality of teenagers' sexual education. Furthermore, a level shift downward in the change in teen pregnancy is observed over the years, indicating that the decline becomes more pronounced over time. This might suggest that receiving information persistently for a long period might normalize the use of LARCs, changing norms about sexual health and contraception among teenagers; which we explore in Section 3.2.

Figure B1: District level treatment effects versus high-school attendance



Notes: This figure correlates district-level treatment effects against high school attendance rate in each district for three years post the SM initiative. The y-axis presents the percent change in teen birth rate with respect to 2015 levels due to the SM initiative, following Equation 5. 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 while 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. Horizontal line marks 0.

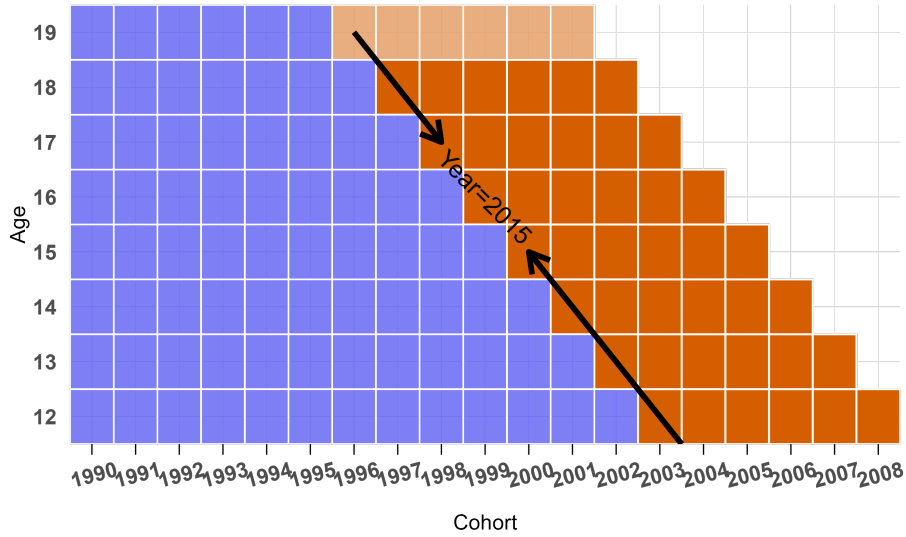
B.2 Variation in exposure to information campaigns by cohorts

In this section, we study the impact of an extra year of exposure on the teen birth rate. The cohort structure of the exercise in Equation 2 can be found in Figure B3. We repeat this exercise including all age groups in Equation 6 - the cohort structure in this exercise can be seen in Figure B2.

$$\begin{aligned} \text{TBR}_{dtc} =& \phi_d + \gamma_t + \lambda_c + \tau_1 \text{Treat}_d \cdot \text{Post}_t + \tau_2 \text{Treat}_d \cdot \text{Age}_{ct} \\ &+ \tau_3 \text{Post}_t \cdot \text{Age}_{ct} + \tau_4 \text{Treat}_d \cdot \text{Post}_t \cdot \text{Age}_{ct} + \alpha \text{Exp}_{dtc} + \epsilon_{dt}, \end{aligned} \tag{6}$$

where TBR_{dtc} is the teen birth rate in district d at time t for cohort c, Treat_d is the

Figure B2: Variation in exposure to LARCs access versus information campaigns (all age groups)



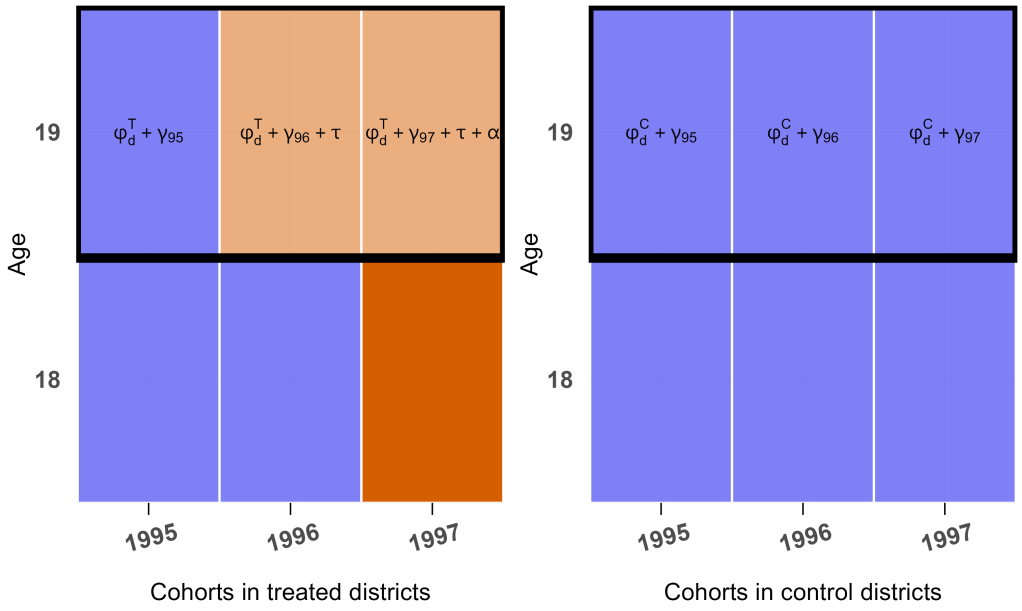
Notes: This figure represents the cohort structure in our sample, by birth year and age. Blue blocks represent our control group: years before the implementation of the SM initiative (before 2015). Orange blocks represent our treatment group: years where the affected cohorts were treated by the SM initiative. Darker orange blocks represent exposure to information campaigns in schools (which cover ages 12-18). The blocks represent the cohort structure of the entire sample, which was used in the analysis of Equation 6, allowing for different levels of exposure across ages. The vertical line marks the blocks that belong to the year 2015.

treatment indicator for district d, Post_t is a post-initiative indicator (after 2015), Age_{ct} denotes the age of cohort c at time t (normalized to start at 0 instead of 12), and Exp_{dtc} is a variable that captures how many years a cohort in district d in time t has been exposed to the information campaign - we formalize the definition of Exp_{dtc} in Equation 7.

$$\text{Exp}_{dtc} = \text{Treat}_d \cdot \text{Post}_t \cdot \begin{cases} (t-2014) - \mathbb{1}(t-c=19) & \text{if } 1997 \leq c \leq 2003 \\ t-(c+12) & \text{if } c > 2003 \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

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

Figure B3: Variation in exposure by cohort to LARCs access versus information campaigns (19 year olds)



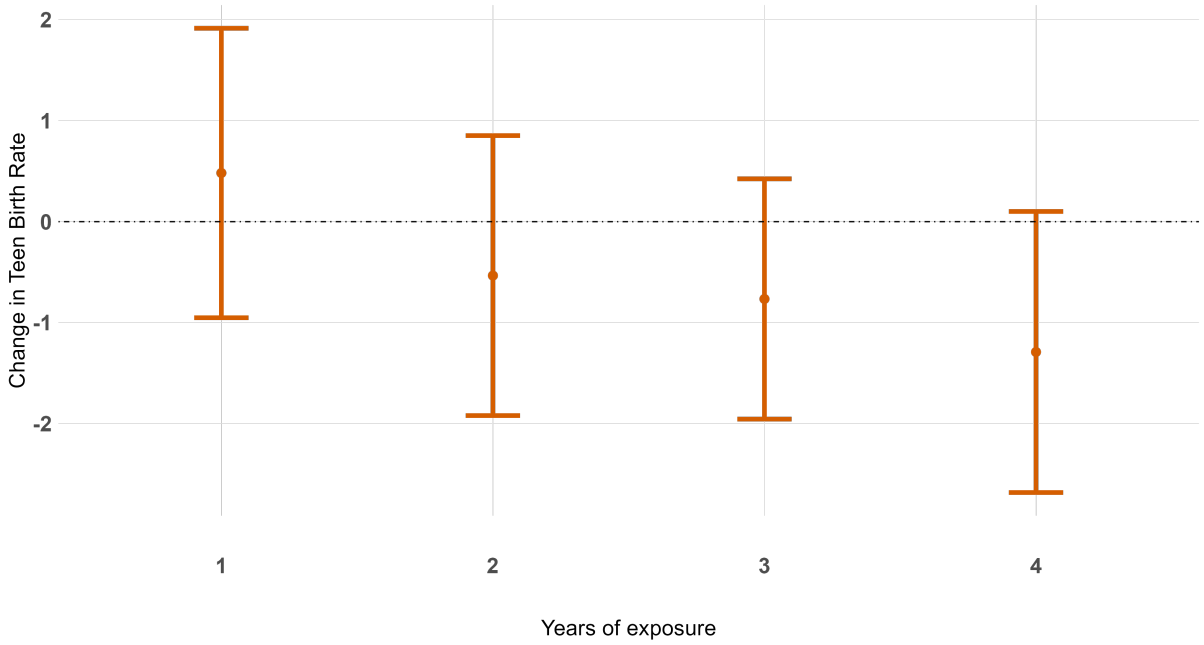
Notes: This figure explains the variation in exposure to LARCs access versus information campaigns, corresponding to out empirical strategy in Equation 2. Specifically, it illustrates the cohort structure in our sample, by birth year and age. Blue blocks represent our control group: years before the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

Table B1: Impact of Exposure to the SM initiative

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

Notes: This table presents the impact of exposure to the SM initiative. The first and second columns represent the coefficients estimated from Equation 6, including all age groups. The mean is calculated using teenage birth rates in 2014, just before the SM initiative took place for the respective sample. Exposure levels are calculated using Equation 6, which tracks how many years each cohort has been exposed to the SM initiative since the SM initiative's start. Levels of conservatism are calculated using responses from NSRH surveys, as explained in subsection 4.2. Standard errors in parenthesis are clustered by district level. Significance levels according to p values are as follows: 0 '***' 0.001 '**' 0.01 '*'.

Figure B4: Impact of Exposure to information campaigns by year



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