Why is the Vaccination Rate Low in India?

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Abstract

India has a fully established universal immunization program since 1985, and immunization services are available for free in healthcare facilities. Despite this, it has one of the lowest vaccination rates globally and contributes to the largest pool of under-vaccinated children in the world. Why is the vaccination rate low in India? This paper explores the importance of historical events in shaping current vaccination practices in India. We examine India's aggressive family planning program implemented during the emergency rule in the 1970s, under which millions of individuals were sterilized forcefully. We find that greater exposure to the forced sterilization policy has negative effects on the current vaccination rate. We also find that institutional delivery and antenatal care are currently low in states where policy exposure was high. Together, the evidence suggests that the forced sterilization policy had a persistent effect on current health-seeking behavior in India.

Keywords: Vaccination, family planning, sterilization, institutional delivery, antenatal care

JEL Classification: N35, I15, I18, O53, Z1
1. Introduction

About one in three child deaths due to vaccine-preventable diseases globally occur in India alone (Black et al. 2010). It also contributes to the largest pool of under-vaccinated children in the world (CDC, 2013). Moreover, India has one of the lowest vaccination rates in the world. For example, India's vaccination rate is even lower than its neighbor Bangladesh, Bhutan, and Nepal, which has a lower GDP than India. According to India's National Family and Health Survey in 2015-16 (NFHS-4), only 62% of children between 12-23 months received all basic vaccinations in 2015-16. The DPT-3 coverage rate, a frequently used proxy for the success of a country's vaccination program, is 78%, well below the global average of 86%. The statistics on the lower vaccination rate is particularly puzzling because India already has a fully established Universal Immunization Program (UIP) since 1985, and immunization services are offered free in public health facilities.

Why is the vaccination rate low in India? Recent empirical studies suggest that lower vaccination rate is explained by individual-level characteristics including gender, age, and birth order, and other household factors such as family size, number of children in the household, household wealth, place of residence, caste, religion, and maternal education (Francis et al., 2018; Ghosh et al., 2017; Shrivastwa et al., 2015; Shrivastwa et al., 2020). However, it can not explain all the differences (see Figure A1 in the Appendix). For example, according to the NFHS-4 estimates, the vaccination rate is still low among male child (62.1%), a child with the lowest birth order (67.3%), urban residents (63.8%), mothers with 12 or more years of education (69.7%), Hindu households (63%), forward castes (64.5%), and among households in the highest wealth quintile (70%). Besides, a recent study highlights that the demand for vaccination is low even there is a reliable supply of free immunization services with incentives (Banerjee et al. 2010). What explains such a puzzle of the low vaccination rate in India?

The main objective of this paper is to understand the factors behind this puzzle of India's lower vaccination rate and provide plausible causal evidence. Addressing this question is

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1. WHO estimates.
2. Basic vaccination includes one dose of Bacillus Calmette Guerin (BCG; tuberculosis); three doses of Diphtheria Pertussis Tetanus (DPT); three doses of oral polio vaccine (OPV); and one dose of measles-containing vaccine (MCV). DPT-3 refers to the third dose of Diphtheria Pertussis, Tetanus vaccine.
3. These estimates are for children between 12-23 months. Therefore, they are much higher than the general average estimates, such as children between 1 and 5.
fundamental not only from a scientific standpoint, but it is also essential in terms of ethical as well as from the policy aspect for the following reasons. First, a high cost of poor vaccination exists in India. According to India's most recent estimates in 2015, about two-thirds of all types of deaths in children aged 1-59 months were due to vaccine-preventable diseases such as diarrhea, pertussis, measles, meningitis, and pneumonia (Liu et al. 2016). Second, there is a need to improve the uptake of routine vaccination in India. Therefore, an increasing number of efforts are being undertaken recently to improve India's vaccination rate through various government programs such as Mission Indradhanush, Intensified Mission Indradhanush, and Intensified Mission Indradhanush 2.0. However, little scientific evidence exists on the causal pathways through which individual and social characteristics influence decision-making for childhood vaccinations (Francis et al., 2018). Finally, considering the current state of the COVID-19 pandemic and the need for universal vaccination, policymakers and practitioners need to understand the factors affecting India's vaccination practice to carve out a pragmatic policy and maximize the uptake of a new vaccine.

This paper provides the first empirical investigation of the importance of historical events in shaping current vaccination practice in India. In particular, we examine whether the aggressive family planning program under which forced sterilization policy was implemented during the emergency rule in India in the 1970s could partly explain its lower vaccination rate today.

India went through a brief period of autocratic rule between June 1975 and January 1977 under prime minister Indira Gandhi. During this period, she proclaimed a national emergency which, under the Indian constitution, suspended a wide range of civil liberties. A distinctive feature synonym with this period that affected the general population was the aggressive family planning policy through forced sterilization (forced sterilization policy from now on) in the latter part of the emergency period. After about a year of emergency rule, the Ministry of Health and Family Planning introduced a National Population Policy (NPP) in April 1976 under which a family planning program was aggressively undertaken mostly through sterilizing individuals in several parts of India. The policy led to a sharp increase in sterilization, and about 8.3 million operations were performed between April 1976 and March 1977, more than three times the number

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4 The autocratic rule (emergency) was officially ended in March 1977. However, it was substantially relaxed in January 1977.
in the previous year. The majority of the sterilization performed during this period involved the men undergoing vasectomy—a surgical procedure for male sterilization. These sterilizations were performed by government doctors in public healthcare facilities or temporary sterilization camps established by the government. Historical records, court rulings, and anecdotal evidence suggest that incentives and disincentives were provided, coercion was enforced, and misinformation was delivered by public healthcare staff to motivate individuals to undergo sterilization during this period (Shah Commission on Inquiry 1978, Panandiker et al., 1978).

We hypothesize that the forced sterilization policy undertaken during the emergency rule period may have an unintended effect on India's vaccination practice. There are reasons to expect that the policy could have unintended consequences on vaccination practice in India. First, the same organization that implemented the forced sterilization policy a year earlier introduced the immunization program in 1978, which about a decade later become Universal Immunization Program (UIP) in 1985 that currently promote vaccination among children.\(^5\) Second, the public healthcare staff (e.g., community health workers, auxiliary nurse midwives) that provided misinformation to motivate individuals for sterilization during the emergency period are the ones that primarily engage in motivating parents to vaccinate their children. Finally, anecdotal evidence suggests that one of the main challenges for the recent vaccination campaign through Intensified Mission Indradhanush (IMI) in 2017 was concerns about the circulation of misinformation about vaccines, rumors about adverse events, and conspiracy theories, including vaccines causing sterilization (Gurnani et al., 2018). Therefore, we examine the unintended consequences of forced sterilization policy during the emergency period on India's current vaccination practice.

To measure the exposure to forced sterilization policy, we digitize the historical yearbooks published by the Ministry of Health and Family Planning, Department of Family Planning, Government of India.\(^6\) The yearbooks report statistics on family planning programs performed between April and March every year at the state and union territory level.\(^7\) Our primary measure of exposure to the forced sterilization policy is the number of excess sterilizations performed

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\(^5\) The first immunization policy was introduced in India as the Expanded Program of Immunization (EPI) in 1978. The Indian government renamed the Ministry of Health and Family Planning to the Ministry of Health and Family Welfare in 1977.

\(^6\) The name later changed to Ministry of Health and Family Welfare, Department of Family Welfare, Government of India in 1977.

\(^7\) From now on, we refer to 'states and union territories' in India as 'states' for simplicity.
between April 1976 and March 1977 (after the introduction of the New Population Policy), normalized by its performance in the previous year.\textsuperscript{8} We also corroborate our primary measure of exposure to the forced sterilization policy with different sterilization measures, including the total number of sterilizations performed in 1976-77, the excess number of sterilizations performed in 1976-77, total and excess sterilization in a natural logarithm scale, and an alternative measure of exposure to sterilization measured by vasectomy, which constituted the majority of the sterilization performed during this period.

Our primary outcome is vaccination completion rates. We examine vaccination completion rates using data from India's national representative National Family and Health Survey in 2015-16 (NFHS-4). The NFHS-4 survey reports a total of 13 vaccines for children under five.\textsuperscript{9} It categorizes these 13 vaccines into three groups: basic vaccinations (BCG, Measles, DPT 1-3, and Polio 1-3), age-appropriate vaccinations (basic vaccinations + Hepatitis-B 0-3), and other (Polio-0). We construct three vaccination indexes that measure the share of completed vaccines in each category for children under five.\textsuperscript{10} We find that higher exposure to the forced sterilization policy is associated with lower vaccination completion rates today on all vaccination index measures. Our results are robust to a variety of controls, consideration of specific cohort of children, and a number of alternative measures of exposure to the forced sterilization policy.

After establishing that forced sterilization policy has a negative association with India's current vaccination completion rate, we next turn to the task of addressing the concern of reverse causality and omitted variable bias using an instrumental variable approach. The concern of reverse causality will arise if the forced sterilization policy is strategically targeted towards places or regions where the propensity to vaccinate is low. Our second concern is the issue of omitted variable bias, which would arise if some other variable is jointly determining the exposure to the forced sterilization policy and the vaccination rate that we do not account for in our estimation.

\textsuperscript{8} We do this to account for each state's size and the effect of emergency rule in India and isolate the impact of forced sterilization policy since several policy changes were made during this period, which could affect the outcomes in various ways.

\textsuperscript{9} The reported vaccines in NFHS-4 are BCG, Hepatitis-B 0, Hepatitis-B 1, Hepatitis-B 2, Hepatitis-B 3, DPT 1, DPT 2 DPT 3, Polio 0, Polio 1, Polio 2, Polio 3, and Measles. We exclude Vitamin A supplements reported in the survey since it is not a vaccine.

\textsuperscript{10} The vaccination indexes are: basic vaccination (8 vaccines), age-appropriate vaccination (12 vaccines), and all vaccination (13 vaccines)
We construct an instrument based on the well-known insights from the emergency period that the forced sterilization policy was aggressively undertaken due to the active role played by Sanjay Gandhi: the son of the prime minister Indira Gandhi (Gwatkin 1979; Vicziany 1982; Chandra 2003; Indian National Congress 2010; Nayar 2013; Williams 2014). Family planning was a key element of his self-declared five-point program, and it became the central theme of public address during this period. Even Mr. Gandhi did not hold any formal position in government, he and his colleague in Delhi were at the center of the action and continuously influenced the regional political leaders, particularly the adjacent states to the national capital Delhi over whom they had an influence (Shah Commission on Inquiry, 1978). Consequently, northern parts of India, especially adjacent states such as Haryana, Delhi, Rajasthan, and Uttar Pradesh, were later popularly known as the vasectomy belt because of the large number of (male) sterilizations performed during this period. Gwatkin (1979) further find that distance from New Delhi (as a proxy of Mr. Gandhi's influence), which was previously irrelevant, emerged as an important determinant of excess sterilization performance and itself capable of explaining two-thirds of the variation in performance among the states. Considering these insights, we use distance from New Delhi to state capitals as an instrument to capture the variation in exposure to the forced sterilization policy.

The instrumental variable estimates suggest that the forced sterilization policy has a large, negative, and significant effect on the vaccination completion rate in India. We find that an average increase in excess sterilization (from zero to 3.45 times) decreases the completion of all vaccination by about 8.1 percentage points. This is relative to a baseline completion rate of 32.1% for our sample as a whole. Our results are also robust to clustering standard errors at different levels.

A potential concern could be that our instrument is not exogenous. To address this concern, we perform two falsification exercise. In our first falsification exercise, we formally test Gwatkin's insight. Because Mr. Sanjay Gandhi had no personal influence over sterilization before 1976, our instrumental variable should have no predictive power on sterilization performance before 1976. That is exactly what we find. We perform a placebo IV test and find that distance from New Delhi to state capitals has no predictive power for excess sterilization performed in 1975-76 in the first stage and vaccination rate in the second stage.
In the second falsification exercise, we consider female sterilization, or tubectomy, which was not the main focus during India's forced sterilization period. The main reason was that tubectomy constituted major abdominal surgery, whereas vasectomy is relatively quick to perform, and recipients can be discharged on the same day of the operation. Because sterilization was mostly performed in temporary camps and existing infrastructure struggled to cope with a large number of operations due to the increased pressure and the intention to meet the target, vasectomy was preferred over tubectomy (Shah Commission on Inquiry, 1978; Gwatkin, 1979; Scott, 2017). We test this narrative and find that our instrument variable has no predictive power for excess female sterilization performed during 1976-77 in the first stage and vaccination rate in the second stage. These falsification exercises suggest that our instrumental variable is plausibly exogenous.

We then turn to examine the heterogeneous effect of forced sterilization policy on the current vaccination rate. To do this, we explore each vaccine separately to get some insights about whether the lower vaccination rate we observe differs by some specific vaccine. We find that higher exposure to the forced sterilization policy has a negative, statistically significant, and largest effect on vaccines given at birth (i.e., Polio 0 and Hepatitis 0). Second, although not robust, the vaccination rate declines with higher doses for vaccines administered multiple times, such as hepatitis, DPT, and polio.

Finally, we examine the plausible channels through which the forced sterilization policy affects India's current vaccination rate. First, we explore whether the place of delivery is a possible channel considering the results from our heterogeneous analysis. Place of delivery – i.e., at home or a healthcare facility – is an important determinant for vaccination since some vaccines are given immediately after birth, and vaccines are mostly administered at healthcare facilities. In our sample, about 20 percent of children are born at home (non-institutional delivery). We test whether exposure to forced sterilization policy has any effect on the place of delivery. We find that the exposure to forced sterilization policy has a large, positive, and significant effect on non-institutional delivery.

Digging a little further, we also check for the reasons for non-institutional delivery. The NFHS-4 asks mothers for reasons for not delivering in a healthcare facility. The average effect size and the coefficients of individual answers suggest that the exposure to the forced sterilization policy on supply-side constraints—higher cost, the facility not open, the facility is far/
transportation, and no female provider—are minimum, sometimes negative and statistically insignificant. However, the effects on demand-side constraints—no trust in healthcare facilities/poor service quality, not allowed by husband or family, no necessity, not customary—are large, positive, and statistically significant. These results suggest that demand-side constraints, including trust in the healthcare facility, is an important mechanism.

We also test for some plausible indirect channel of information provision on vaccination behavior. Several studies have shown that information provision is essential to generate take-up rates in health-seeking behavior (see Dupas and Miguel, 2017, for a review). We test this channel because one of the main challenges of India's recent vaccination campaign was concerns about the circulation of misinformation, rumors, and conspiracy theories, including vaccines causing sterilizations (Gurnani et al., 2018). In such an environment, the provision of reliable and accurate information can help increase the vaccination rate. We study one such platform: antenatal care (ANC). ANC is not only essential to reduce the health risks for mothers and their babies during the pregnancy period, but it can also be an important source of receiving reliable and accurate information regarding a child's future health-seeking behavior, such as vaccination practice. We find that the exposure to forced sterilization policy has a large, negative, and significant effect on visiting a healthcare center for ANC and the number of visits conditional on receiving ANC. These results suggest that a lack of reliable and accurate information provision may also be an important channel.

This paper contributes to several diverse literature. First, it contributes to the literature on understanding the factors associated with India's lower vaccination rate. Several papers, particularly in medical science, have focused on exploring the association between individual and household factors and non-vaccination and under-vaccination rates in India (Francis et al., 2018, Ghosh et al., 2017; Shrivastwa et al., 2015; Shrivastwa et al., 2020). Other works have tried to understand the state and district level difference in vaccination (Shrivastwa et al., 2019; Panda et al., 2020). Additionally, recent papers have examined the economic and social factors associated with lower vaccination practice in India through randomized experiments (Banerjee et al., 2010; Pramanik et al., 2018). We build on this literature in two ways. First, we compile novel historical data and provide the first empirical investigation of the importance of historical events in shaping India's current vaccination practice. Second, we provide a causal pathway and the mechanisms through which the historical characteristics influence decision-making for childhood vaccinations.
This paper is also related to the broader literature in understanding the barriers associated with health-seeking behavior in developing countries (Dupas 2011). Recently, randomized experiments have been extensively used to examine both demand-side and supply-side barriers of healthcare utilization (see Dupas and Miguel, 2017, for a review). We contribute to this literature in understanding the demand-side barriers of health-seeking behavior, considering historical intervention as a natural experiment. India is a typical case where the demand for health-seeking behavior such as vaccination is low; even the burden is exceedingly high. For example, as recently as 2015, more than 300,000 children aged 1–59 months died due to vaccine-preventable diseases (Liu et al., 2016). We present evidence suggesting that medical intervention in the past could have a long-term persistent effect on adverse demand for health-seeking behavior.

This work is also related to the literature on the unintended consequences of health interventions. For example, Alsan and Wanamaker (2018) show that the revelation of the Tuskegee study in the US has persistent negative effects on medical mistrust, mortality, and a decrease in healthcare use for older black men. Relatedly, Lowes and Montero (2020) find that historical medical campaign during the colonial period has a long-term impact on health outcomes and trust in medicine in Africa. We build on this work by presenting evidence that how a population control policy implemented by the Indian government could have a long-term spillover effect on the use of vaccination, institutional delivery, and antenatal care in India.

Finally, this paper also contributes to the literature on understanding the importance of historical events on current development (Nunn 2009). This field has been studied extensively, starting with the seminal work by Acemoglu et al. (2001) (see Nunn (2014) for a review). We build on this literature in two ways. First, we demonstrate that a short-term policy that lasted for less than a year has a large, negative, and significant long-term impact on later development outcomes measured by healthcare indicators. Second, we present evidence showing that historical events can affect subsequent policies implemented by the same organization or the government agencies; even the policies were well-intentioned.

The remainder of the paper is structured as follows. Section 2 provides a brief background

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11 In India's case, the government implemented the forced sterilization policy in April 1976 and ended less than a year in January 1977.
of the emergency rule and the forced sterilization policy in India. Section 3 describes the historical and contemporary data used in the empirical analysis. Section 4 presents the OLS and IV results. Section 5 examines the heterogeneous effect of the forced sterilization policy on vaccination. Section 6 presents a direct and an indirect mechanism, and section 7 concludes.

2. Emergency Rule and Forced Sterilization in India

On June 25, 1975, prime minister Indira Gandhi proclaimed a national emergency in India. The exact reason for the proclamation of emergency is controversial. However, historians, sociologists, and political scientists agree that a combination of political and economic problems facing her and India could be the most predictable factor.12

In 1971, Indira Gandhi won a major national election under a radical slogan of ousting poverty (garibi hatao). However, food production was down in the succeeding years due to poor rainfall. Furthermore, the balance of payment was in turmoil due to a sharp rise in the oil price and the subsequent slump in export demand. Things became more complicated in June 1975 when Allahabad High Court found Mrs. Gandhi guilty of various corrupt election practices in the 1971 national election, jeopardizing her continuation as the Prime Minister. The court decision led the opposition leaders to carry out protests and demanded Mrs. Gandhi to resign. Instead of resigning, she seized the moment and proclaimed a national emergency justifying the situation as a threat to India's internal stability (Hewitt 2007).

The emergency rule allowed Mrs. Gandhi to suspend a wide range of civil liberties under the Indian constitution. Her government used this period to repress the opposition and institute censorship in the name of law and order. Thousands, including leading opposition leaders, were arrested, the press censored, public gatherings and strikes were declared illegal. With all the power in the prime minister's hand, she undertook a series of new legislation and constitutional amendments to govern the country and extend the emergency period. Furthermore, she delayed the parliamentary elections several times, indicating her intent to remain in power, an impression strengthened by (unofficially) elevating her younger son Sanjay Gandhi to the position of an apparent heir (Gwatkin 1979). However, in January 1977, Mrs. Gandhi unexpectedly called an election and released opposition leaders from jail, lifted press censorship, and permitted public

12 For a detailed overview of this period, see Dhar (2001) and Nayar (2013).
meetings once again. The emergency period officially ended in March after the Indian National Congress party's defeat in the Lok Sabha election (lower house of the Indian parliament).

A distinguishing characteristic synonym with this period was the aggressive family planning drive through forced sterilization. It started in April 1976, just about a year after the start of the emergency rule. It began with a New Population Policy (NPP) for India introduced by the Ministry of Health and Family Planning to the parliament on April 17. The policy's principal aim was to bring down the population growth rate by boosting the family planning program. The new policy incorporated a series of fundamental changes to reduce population growth. The legislation primarily includes a substantial increase in monetary compensation for sterilization acceptors, encouragement of state-level introduction of incentive and disincentive to family planning, disenfranchisement of states who failed to control their fertility by freezing their representation in parliament based on the 1971 census figures, allocation of central assistance to states according to family planning performance, and most controversially, the provisions for state governments to pass compulsory sterilization legislation (Singh 1976).

With the NPP's introduction, the central government authorized and endorsed various coercion measures for sterilization and, in extreme cases, the provision for compulsory sterilization. The central and state government substantially increased the financial rewards for sterilization acceptors. Through a range of incentives and disincentives, they pressured their employees to get sterilized and motivate others to do so. In some cases, quotas were imposed on government employees to produce people for sterilization. In other cases, citizens were required to produce sterilization certificates to access basic facilities, such as housing, irrigation, ration cards, and public healthcare facilities. Some extreme measures were also undertaken in some states. For example, the state government in Maharashtra passed a bill allowing compulsory sterilization of couples with three or more children (Shah Commission of Inquiry 1978; Panandiker et al. 1978).

Historical records, court rulings, and anecdotal evidence from the field suggest that quota was imposed, incentives and disincentives were provided, coercion was enforced, and

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13 For a detailed overview of the family planning program during the emergency rule period, see Panandiker et al. (1978), Shah Commission of Inquiry (1978), and Gwatkin (1979).

14 It was not approved by the central government and eventually returned to the state for revision.
misinformation was delivered to motivate individuals to undergo sterilization during this period. For example, in Uttar Pradesh, over 24000 employees of the Department of Health and Family planning were not paid their salary in June 1976 for their failure to complete their quota for the April-June quarter (Panandiker et al. 1978). Anecdotal evidence of some of the extreme coercion measures can be felt from the following incident in Uttawar, a village in the state of Haryana, on November 6, as reported in Gwatkin (1979):

the villagers of Uttawar were shaken from their sleep by loudspeakers ordering the menfolk-all above 15 to assemble at the bus-stop on the main Nuh- Hodol road. When they emerged, they found the whole village surrounded by the police. With the menfolk on the road, the police went into the village to see if anyone was hiding ... As the villagers tell it, the men on the road were sorted out into eligible cases ... and about 400 were taken to various thanas [headquarters towns], most to Palwal. Many had cases registered against them—a large number for alleged possession of illicit arms but most on suspicion of the threat of violence—and they were taken from there to clinics to be sterilized.

The aggressive family planning drive led to more than 8 million sterilizations in 1976-77, more than three times the number in the previous year. During the peak, over 1.7 million sterilizations were performed in September 1976 alone, a figure that equaled the annual average for the ten preceding years (Gwatkin 1979). The majority of the sterilization performed during this period involved the men undergoing vasectomy—a surgical procedure for male sterilization. Out of about 8.3 million sterilization performed in 1976-77, about 6.2 million (about 75%) was achieved through vasectomy.

Anecdotal evidence suggests that the forced sterilization policy's legacy remained in peoples' minds and can be felt even after the emergency rule is over. For example, to repair the family planning's legacy, the Indian government changed the name of the Department of Family Planning to the Department of Family Welfare. Basu (1985) finds that the family planning program shifted from vasectomy to tubectomy during the post-emergency period, where women emerged as the primary target. Tarlo (2000) notes that the word "emergency" itself became synonymous with "sterilization," and many citizens even today refer to the emergency period as 'nasbandi ka

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15 For a detailed discussion on quota enforcement, incentives and disincentives, coercion, misinformation, and fear towards sterilization during the emergency, see Panandiker et al. (1978) and Shah Commission of Inquiry (1978).
'vakt' (the sterilization period). The emergency period is still controversial today and regarded as one of the darkest periods in the history of Indian democracy.

The aggressive family planning program varied widely across states in India. The primary reason is the role of Sanjay Gandhi and his rapid rise to power during this period (Gwatkin 1979; Vicziany 1982; Chandra 2003; Nayar 2013; Williams 2014). Family planning was a key element of his self-declared five-point program, and it became the central theme of public address during this period. The Indian National Congress (2010) report suggests that the family planning program was pursued more vigorously due to Mr. Gandhi's support. Anecdotal evidence also suggests that he and his colleague were at the center of the action and continuously influenced the regional political leaders, particularly the adjacent states, to the national capital New Delhi over whom they had an influence (Shah Commission on Inquiry 1978). Consequently, northern parts of India, especially states adjacent to New Delhi such as Haryana, Rajasthan, Uttar Pradesh, and Bihar, were later popularly known as the 'vasectomy belt' because of the large number of male sterilizations performed during this period (Scoot 2017). Gwatkin (1979) further find that distance from New Delhi (as a proxy of Mr. Gandhi's influence), which was previously irrelevant, emerged as an important determinant of sterilization performance and itself capable of explaining two-thirds of the variation in performance among the states.

3. Data Sources and Description

3.1. Historical Data

The historical data on sterilization for this paper comes from the historical yearbooks published by the Ministry of Health and Family Planning, Department of Family Planning, Government of India. Along with various demographic and health statistics, the yearbooks report yearly statistics on family planning programs performed between April and March every year. Notably, the historical yearbooks include the number of sterilizations performed and the types of sterilization performed at the state-level.

We collected the historical yearbooks from the Ministry of Health and Family Welfare archive and digitized the sterilization data. Figure 1 presents the total number of sterilizations along with the types of sterilization performed in India every year since the starting of the program in 1956. As we can see, there is a sharp increase in the total number of sterilizations performed in
1976-77. We also see that most sterilizations performed during this period were vasectomy—a surgical procedure for male sterilization.

In Figure A2 and Figure A3 in the Appendix, we present the state-wise total number of sterilizations performed in 1975-76 and 1976-77, respectively. To provide a visual representation, we group the total number of sterilizations performed each year into four broad categories and denote a greater number of sterilizations performed by darker shades. As we can see, the number of sterilizations was higher in India's southern part in 1975-76, the year before the announcement of the New Population Policy (NPP). However, there is a shift in sterilization performance from the south to the northern part of India after the NPP's announcement in 1976-77. Figure 2 presents a better measure of state-level variation in the exposure to the forced sterilization policy as measured by the number of excess sterilizations performed in 1976-77 normalized by its performance in 1975-76. As we can see, the exposure to the forced sterilization policy was particularly higher in northern parts of India, especially states adjacent to New Delhi. This is likely because a large number of sterilizations performed during this period were due to the personal influence of Sanjay Gandhi—the son of the prime minister.

3.2. Modern Data

We combine the historical data on exposure to forced sterilization policy with India's national representative National Family and Health Survey in 2015-16 (NFHS-4). The NFHS-4 sample is a stratified two-stage sample designed to produce indicators at the district, state/union territory (UT), national levels, and separate estimates for urban and rural areas. The primary sampling units (PSU) in NFHS-4 are villages in rural areas and Census Enumeration Blocks (based on 2011 Census) in urban areas. The dataset in our main analysis includes NFHS-4 data for children. To extend our analysis and examine the mechanism, we also use the NFHS-4 dataset for women.16

We also combine data on population and healthcare to control for potential covariates that could affect both exposures to forced sterilization and vaccinations rate. We collect population data from the 2011 population census to construct state-level population density. Additionally, we collect healthcare facility and healthcare personnel data from Rural Health Statistics to construct hospital per 1000 population and doctors per 1000 population at the state level.

16 The sample of Sikkim and Nagaland are excluded from our analysis as we have incomplete information on sterilization in these two states.
Our primary outcome is the vaccination rates. The NFHS-4 data reports a total of 13 vaccination details for children under the age of five.\(^\text{17}\) The reported vaccines are against polio (Polio 0-3), tuberculosis (BCG), hepatitis B (Hepatitis-B 0-3), diphtheria, pertussis, tetanus (DPT 1-3), and measles. The NFHS-4 further categorize these vaccines into three groups: basic vaccines (BCG, Measles, DPT 1-3, and Polio 1-3), age-appropriate vaccines (basic vaccinations + Hepatitis-B 0-3), and other vaccines (Polio-0). Based on the classifications in NFHS-4, we construct three vaccination indexes for our main analysis: basic vaccination, appropriate vaccination, and all vaccination. Basic vaccination is an index that measures the share of completed vaccines of the eight possible basic vaccines. Appropriate vaccination is an index that measures the share of completed vaccines of the 12 possible age-appropriate vaccines. All vaccination is an index that measures the share of completed vaccines of all 13 possible vaccines reported in the NFHS-4 survey. The key benefit of considering vaccination index measure instead of individual vaccine is that each vaccine or a combination of doses are generally effective for preventing certain illnesses. Therefore, an index of vaccination completion can be considered as an important health indicator. In the heterogeneous analysis, we also explore each vaccine separately as our outcome variable. We test whether the lower vaccination rate we observe differs by vaccines.

We also have additional outcome variables to examine the mechanism through which the forced sterilization policy influence decision-making for childhood vaccinations. Our first additional outcome variable is the non-institutional delivery of a child from NFHS-4 data. We consider this variable because the place of delivery—at home or a healthcare facility—is an important determinant for vaccination since some vaccines are given immediately after birth, and vaccines are mostly administered at healthcare facilities. In NFHS-4, about 20 percent of children are born at home (non-institutional delivery). We test whether exposure to forced sterilization policy has any effect on the place of delivery of a child.

Our second additional outcome variable is the reasons for the non-institutional delivery from NFHS-4 data for women. We consider this variable to understand whether demand or supply-side factors are affecting a mother's intention to deliver the child at home. The NFHS-4 asks mothers the reasons for non-institutional delivery of their child and reports a total of 9 reasons.\(^\text{18}\)

\(^{17}\) We exclude Vitamin A supplements reported in the survey since it is not a vaccine.

\(^{18}\) The reasons include: cost too much, facility not open, too far/ no transport, no female provider, no trust in a healthcare facility/ poor service quality, not allowed by husband or family, not necessary, not customary, and others.
First, we consider each possible reason separately as our outcome of interest. Second, we combine the information on reasons reported and construct two indexes—demand side and supply side—and examine whether demand or supply-side factors affect the mother's intention to deliver the child at home.

Our third and final outcome variable is the mother's data on antenatal care (ANC) visits during pregnancy from NFHS-4 data for women. We consider this variable to test the channel of information provision because the antenatal visit to healthcare centers can also be an essential source of receiving reliable and accurate information regarding a child's future health-seeking behavior, such as vaccination practice. The NFHS-4 survey has information on the mother's ANC records for the last pregnancy. In our sample, about 87 percent of mothers received any ANC, and conditional on receiving ANC, the average visit was about 5.8 times. We construct two outcome variables from this data: (1) whether the mother received any ANC and (2) the number of visits conditional on receiving any ANC. We test whether the exposure to forced sterilization policy has any effect on antenatal care.

### 4. Empirical Analysis

#### 4.1. Correlation and OLS Estimates

We begin by examining the relationship between historical exposure to the forced sterilization policy and India's current vaccination rate. In Figure 3, we present a simple correlation plot between exposure to the forced sterilization policy and basic vaccination index in 2015-16. In Panel A, we present the correlation between the state-level total number of sterilizations performed in 1976-77 and the basic vaccination index in 2015-16. In Panel B, we present the correlation considering a better measure of exposure to the forced sterilization policy as measured by state-level excess sterilization performed in 1976-77 normalized by its performance a year before in 1975-76. (We discuss this variable in detail below). As we can see, a strong negative relationship between exposure to the forced sterilization policy and vaccination rate is apparent in the raw data.

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19 In Figure A4 and A5 in the Appendix, we also present the correlation plot for appropriate vaccination index and all vaccination index, respectively.
We then examine this relationship by controlling for individual, household, geographic, and health care characteristics that are also potentially important for India's current vaccination rate. Our baseline estimating equation is:

\[ y_{ithcs} = \alpha + \beta \text{Forced Sterilization}_s + \gamma_1 X'_{ics} + \gamma_2 X'_{hcs} + \gamma_3 X'_c + \gamma_4 X'_s + \epsilon_{ithcs} \]  

(1)

where \( y_{ithcs} \) denotes one of our vaccination measures for child \( i \) living in household \( h \) in NFHS-4 cluster \( c \) of Indian state \( s \). The variable \( \text{Forced Sterilization}_s \) denotes one of our measures of exposure to the forced sterilization policy in state \( s \). (We discuss this variable in more detail below).

We include \( X'_{ics} \), a vector of child-level covariates; that include an indicator variable for child's gender, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. The vector \( X'_{hcs} \), consists of household-level covariates; that include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. These child-level characteristics and household characteristics that we control here have been shown to be correlated with the vaccination rate in India. \( X'_c \) is a vector of NFHS-4 cluster-level covariates to capture the characteristics of the place where the child lives, such as altitude in meters, altitude squared, and an indicator of whether the cluster is urban. \( X'_s \) is a vector of covariates meant to capture state-level characteristics that are likely to be correlated with vaccination. They include population density per square kilometers (in log), hospital per 1000 population, and doctors per 1000 population.

We present the OLS estimates for the impact of \( \text{Forced Sterilization}_s \) on vaccination rate measured by the basic vaccination index in Table 1.\(^{20}\) In Column 1, we use the total number of sterilizations performed in a state in 1976-77 (expressed in 100,000 individuals) as our measure of the exposure to the forced sterilization policy. The estimated coefficient for \( \text{Forced Sterilization}_s \), \( \beta \), is negative and statistically significant. This suggests that higher exposure to the forced sterilization policy has an adverse effect on the basic vaccination completion rate. Because the distribution of the number of sterilizations performed in 1976-77 is left-skewed, with a small number of observations taking on large values, in Column 2, we report estimates using

\(^{20}\) In Section B in the Appendix, we present the results for the appropriate vaccination index and all vaccination index.
the natural log of the number of sterilizations performed in 1976-77. The results are similar, as we find a significant negative correlation between forced sterilization and vaccination rate.

In Columns 1 and 2, we use the total number of sterilizations performed in 1976-77 to measure the forced sterilization policy's exposure. One limitation of this measure is that it does not account for the number of sterilizations that would have happened anyway in the absence of the National Population Policy (NPP). Accounting for this difference is important because sterilization, as a family planning method, has been performed in India since the 1950s, as shown in Figure 1. In Column 3, we account for this issue and use an alternative measure of forced sterilization policy measured by excess sterilization performed in 1976-77 over and above the 1975-76 numbers. Additionally, in Column 4, we report estimates using the natural log of the excess number of sterilizations performed in 1976-77. As we see, the results are similar using these alternative forced sterilization measures.

The estimates we report in Columns 3, and 4 use the absolute number of sterilizations to measure forced sterilization policy. Some shortcomings of these measures are that they (a) do not account for the difference in the size of states and (b) do not account for any state-wise historical factors associated with the level of sterilization performance that we do not capture in our estimation. To account for these issues, in Column 5, we report the estimates normalizing the excess sterilization performed using sterilization figures in the previous year (1975-76). We normalized the previous years' figures to account for the effect of emergency rule in India and isolate the impact of forced sterilization policy from India's emergency rule. This is because India's emergency rule could itself affect our outcome in several ways since this period was largely governed by autocratic rule, and numerous policy changes were made during this period. As we see, the results we obtain in Column 5 remain robust to this alternative specification.

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21 Alternative measures of excess sterilization performed in 1976-77, such as deducting the average of the last two years or last three years, are also possible. Using such alternative measures produce nearly identical results.

22 Specifically, we define Forced Sterilization as

\[
Excess\ Sterilization_s = \frac{\text{# of sterilization in } 1976\sim77_s - \text{# of sterilization } 1975\sim76_s}{\text{# of sterilization } 1975\sim76_s}
\]

23 Using alternative measures such as normalizing by the average of the last two years or last three years produce nearly identical results.
For the remainder of our analysis, we use state-level excess sterilizations performed in 1976-77 normalized by its sterilization figure the year before in 1975-76 (the specification from Column 5). This provides a better measure that accounts for India's emergency rule and normalized by both size and state-level historical characteristics associated with sterilization performance. However, as illustrated in Table 1, our results do not rest on this choice only.

Now we turn to examine the impact of forced sterilization policy on other measures of vaccination. In Table 2, we report the OLS estimates of all three vaccination indexes. The estimates in Table 2 suggest that the forced sterilization policy is negatively correlated with all three measures of vaccination. In terms of magnitude, Column 3 of Table 2 indicates that an average increase in excess sterilization (about 3.4 times) lead to about 3 percentage points decline in all vaccination index. This is relative to a baseline completion of 32.1% for the sample as a whole. This suggests a large and significant correlation between exposure to the forced sterilization policy on India's current vaccination.

In Section C of the Appendix, we present a series of robustness tests. We present the results of Table 2, adding each set of controls sequentially for each outcome; the analysis with children between the age 12 and 23 months (to capture the Indian government's official vaccination estimate); and considering excess male sterilization (vasectomy), which constituted the majority of sterilization operation (about 75%), as an alternative measure of Forced Sterilization. The findings are robust to these alternative specifications, specific cohorts, and different measures of forced sterilization policy.

4.2. IV Estimates

In the previous section, we presented results suggesting a negative relationship between historical exposure to the forced sterilization policy and vaccination. We also showed several alternative estimations to provide robust evidence. However, the correlation we found may not necessarily identify the causal effect of forced sterilization on vaccination. For example, the correlation could also be explained by some omitted variables that both determine the exposure to the forced sterilization and vaccination rate.

To address this concern, we present results by pursuing an instrumental variable approach in this section. We need an instrument that is correlated with the sterilization performance during the force sterilization period but will not affect vaccination through any other channels than forced
sterilization. We use distance from New Delhi to state capitals as an instrument to capture the variation in exposure to the forced sterilization policy.

The history of forced sterilization policy during India's emergency rule leaves little doubt that our instrument is relevant. Various sources, including Gwatkin (1979), Vicziany (1982), Chandra (2003), Indian National Congress (2010), Nayar (2013), and Williams (2014), describe that the forced sterilization policy was aggressively undertaken due to the active role played by Sanjay Gandhi: the son of the prime minister Indira Gandhi. It is well known that family planning was a key element of his self-declared five-point program, and it became the central theme of public address during the latter part of the emergency period. He and his colleague in Delhi were at the center of the action and continuously influenced the regional political leaders, particularly the adjacent states to the national capital Delhi over whom they had an influence (Shah Commission on Inquiry 1978). Consequently, northern parts of India, especially adjacent states such as Haryana, Delhi, Rajasthan, and Uttar Pradesh, were later popularly known as the vasectomy belt because a large number of (male) sterilizations were performed in these states during this period. Gwatkin (1979) describes that distance from New Delhi to state capitals (as a proxy of Mr. Gandhi's influence), which was previously irrelevant, emerged as an important determinant of excess sterilization performance and itself capable of explaining two-thirds of the variation in performance among the states.

To provide a visual understanding, we present Gwatkin's (1979) insight on distance from New Delhi as an important determinant of excess sterilization performance in Figure 4. In panel (A), we plot the correlation between distance from New Delhi to state capitals and Forced Sterilization, measured by excess sterilization in 1976-77. In panel (B), we present the same correlation but instead consider the excess sterilization in the previous year in 1975-76. As we can see, the correlation is negative in panel (A). However, we overall do not see any correlation in panel (B). Based on these insights, we use distance from New Delhi to state capitals as an instrument to capture the variation in exposure to the forced sterilization policy.

We present the IV estimates in Table 3. Panel A presents the first stage estimates for the instrument we considered in our analysis. As we expect, the instrument highly predicts the forced sterilization policy as measured by excess sterilization. In Panel B, we present the second stage estimates. Column 3 of Table 3 indicates that an average increase in excess sterilization (from zero
to 3.45 times) decreases the completion of all vaccination by about 8.1 percentage points. The IV estimates reported in Panel B are about 2.7 times higher in magnitude in comparison with our corresponding OLS estimates. This suggests that the OLS estimates are biased downward.

4.3. **Adjusting Standard Errors for Alternative Clustering**

The NFHS-4 data that we use in this paper is a stratified two-stage sample. The PSUs in NFHS-4 are villages in rural areas and Census Enumeration Blocks (based on the 2011 Census) in urban areas.

Thus far, we have shown all our estimates by clustering our standard errors at the NFHS-4 primary sampling unit (PSU) level. We adjust our standard errors clustering at the NFHS-4 PSU level primarily because of the design and selection of the NFHS-4 sample (Abadie et al., 2017). Furthermore, individuals (or child in our case) in the same village are more likely to have been subject to common unobserved forces that may affect their current vaccination behavior.

However, it is likely that the within-group correlation of the residuals could exist at a higher level than the PSU. Additionally, many of the explanatory variables in our estimation do not vary across these clusters. Instead, we have only aggregate figures that vary at the state level, such as our treatment variable, *Forced Sterilization*ₜ, and *X'ₜ*. In particular, the instrument that we use for our IV estimation (distance) does not vary across PSUs. Therefore, we present estimates adjusting standard errors at higher levels to address the potential concern for within-group correlation of the residuals at a higher level than the PSU.

A concern about clustering at a higher level, such as state, is that we have few clusters. For example, if we cluster our standard errors at the highest aggregate levels, we will have only 34 clusters based on the number of current states in India.²⁴ In this case, the general consensus is to be conservative and avoid bias and use bigger and more aggregate clusters up to the point which there is concern about too few clusters (Cameron and Miller 2015).

Based on this conventional principle, we present the estimates with different and more aggregate levels of clustering in Table 3. We report our usual standard errors based on NFHS-4 PSU in parenthesis. In square brackets, we report the standard errors adjusted for clustering at the current district levels. In curly brackets, we report the standard errors adjusted at the current state

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²⁴ The sample of Sikkim and Nagaland are excluded from our analysis as we have incomplete data on sterilization in these two states. In particular, these two states do not have any information on the number of sterilizations performed in 1975-76, the year before the NPP.
levels. As we can observe, our results are overall robust to adjusting standard errors for these three levels of clustering. In Section D of the Appendix, we present a series of alternative analyses showing that our results are also robust to sequential inclusion of controls in Table 3, consideration of specific cohorts, and an alternative measure of Forced Sterilization. For the remainder of this paper, we consider the most conservative cluster and report standard errors adjusted for clustering at the current state-level.

4.4. Testing Exogeneity of the Instrument

In section 4.2, we presented anecdotal evidence by Gwatkin (1979) suggesting that the instrument we use (i.e., distance from New Delhi to state capital) is plausibly exogenous. We provide some evidence through a correlation plot suggesting that our instrument is not correlated with sterilization performance in the previous year. In this section, we perform two falsification exercises to examine the potential concern about the exogeneity of our instrument. First, we perform a placebo IV analysis to formally examine whether distance from New Delhi to state capitals predicts excess sterilization in 1975-76 in the first stage and vaccination rate in the second stage. Second, we perform a second placebo IV analysis to examine whether our instrument predicts excess female sterilization during the force sterilization period (which was not the main focus during this period) and subsequent vaccination rate.

4.4.1. Exposure to Sterilization Before the Forced Sterilization Period

Our first exercise consists of examining sterilization performed before 1976. Because Mr. Sanjay Gandhi had no personal influence over sterilization before 1976, our instrumental variable should have no predictive power on sterilization performance before 1976. We formally test this by estimating a placebo IV analysis considering the excess sterilization performed in 1975-76, the year immediately before the implementation of the force sterilization policy. We present the results in Columns 1-3 of Table 4. As we can see, distance from New Delhi to state capitals has no predictive power for excess sterilization performed in 1975-76 in the first stage and vaccination rate in the second stage.

4.4.2. Exposure to Female Sterilization (Tubectomy):

Our second exercise consists of female sterilization, or tubectomy, which was not the focus during India's forced sterilization period (Shah Commission on Inquiry, 1978; Gwatkin, 1979). During the emergency, the forced sterilization program mostly focused on men undergoing vasectomy, as can be seen from Figure 1. The main reason for heavy reliance on vasectomy was due to the
simplicity of the operation. Tubectomy operations constituted major abdominal surgery, whereas vasectomies are relatively quick to perform, and recipients can be discharged on the same day of the operation. Besides, during the emergency period, the authorities relied on vasectomy as sterilization was mostly performed in temporary camps. The existing infrastructure also struggled to cope with a large number of operations due to the increased pressure and the intention to meet the target (Gwatkin, 1979). Therefore, vasectomy was not a part of the constructed family planning scheme during this period but a necessity to reach the required target within the pressure of timescales (Scott, 2017).

This narrative provides a falsification test for our instrument. We formally test whether distance from New Delhi to state capitals predicts the variation in excess female sterilization performed during the force sterilization period. Columns 4-6 of Table 4 presents the results of our falsification exercise. As we can see, our instrument variable has no predictive power for excess female sterilization performed during the forced sterilization period in the first stage and vaccination rate in the second stage.

5. Heterogeneity

We next turn to examine the heterogeneous effect of forced sterilization policy on current vaccination. To do this, we explore each vaccination separately to understand whether the lower vaccination rate we observe differs by some vaccines or any particular doses. Understanding the heterogeneous effect is important since: (1) different vaccines are given to children at different points of time, and (2) multiple doses of the same vaccines are given for full immunization. For example, according to India's National Immunization Schedule, the first dose of polio and Hepatitis B vaccine (Polio 0 and Hepatitis B 0) should be given immediately after birth whereas, the measles vaccine is generally given between nine and 12 months of age. Similarly, vaccines such as hepatitis, DPT, and polio are given multiple times to children for full immunization.

We present the estimates of each vaccine separately in Table 5. The results in Table 5 suggest two interesting findings. First, from Columns 1 and 9, we find that higher exposure to the forced sterilization policy has a negative, statistically significant, and largest effect on vaccines given at birth (i.e., Polio 0 and Hepatitis 0). Second, although not robust and statistically significant, we also find that vaccination rate declines with higher doses for vaccines administered multiple times, such as hepatitis, DPT, and polio. In Section E of the Appendix, we present alternative estimates examining specific cohorts, such as those between the age of 13 and 24 months, and
alternative measures of forced sterilization policy measured by excess male sterilization. Overall, our analysis provides evidence that the forced sterilization policy has heterogeneous effects on vaccination and, in particular, has the largest and significant effects on vaccines given at birth.

6. Mechanisms

Up to this point, we found that the forced sterilization policy has a significant and sizable effect on India's vaccination rate. We also found that the policy has heterogeneous effects on different vaccines. In particular, we find that the policy has the largest and significant effect on vaccines given at birth. In this section, we turn to examine plausible channels or mechanisms through which the forced sterilization policy affects India's current vaccination rate. First, we explore whether the place of delivery of a child is a possible channel considering the results from our heterogeneous analysis. Second, we examine an indirect channel of information provision through antenatal care (ANC)—a health-seeking behavior during pregnancy.

6.1. Place of Delivery

Place of delivery—at home or a healthcare facility—is an important determinant for vaccination because some vaccines are given immediately after birth, and vaccines are mostly administered at healthcare facilities. We test whether exposure to forced sterilization policy has any effect on the place of delivery. The NFHS-4 has a question on the place of birth of the child. About 20 percent of children had non-institutional delivery in our sample, such as respondents' homes, parents' homes, and other homes.

We present the estimates of the place of delivery in Table 6. As we can see, the coefficient of excess sterilization is sizable, positive, and significant. This suggests that the exposure to forced sterilization policy has a large, positive, and significant effect on non-institutional delivery. Table F1 of the Appendix presents the results considering alternative forced sterilization policy measures measured by excess male sterilization. Again, the results are similar, suggesting that higher exposure to force sterilization policy positively affects delivering children at home.

We dig a little further and also check for the reasons for non-institutional delivery. The NFHS-4 also asks mothers for reasons for not delivering their child in a healthcare facility. Both demand, as well as supply-side, constrains are reported such as higher cost, facility not open, the facility is far/ no transportation, no female provider, no trust in a healthcare facility/ poor service
quality, not allowed by husband or family, no necessity, not customary, and others. We present each answer's estimates separately in Table 7.\(^{25}\) We also present estimates by indexing the reasons—supply-side and demand-side—in Table F3 the Appendix. The coefficients of individual answers and average effect size coefficients suggest that the exposure to the forced sterilization policy on supply-side constraints—higher cost, facility not open, the facility is far/ no transportation, and no female provider—are minimum, sometimes negative and statistically insignificant. However, the effect of forced sterilization policy on demand-side constraints—no trust in healthcare facilities/ poor service quality, not allowed by husband or family, no necessity, not customary—is large, positive, and statistically significant. These results suggest that demand-side constraints, including trust in the healthcare facility, is an important mechanism.

6.2. Information Provision through Antenatal Care (ANC)

In this section, we examine an additional mechanism of information provision. Several studies have shown that information provision is important to generate a take-up rate in health-seeking behavior.\(^{26}\) We test this channel in India's context in general and vaccination in particular because one of the main challenges for India's recent vaccination campaign was concerns about the circulation of misinformation, rumors, and conspiracy theories, including vaccines causing sterilization (Gurnani et., al 2018). We hypothesize that in such an environment, the provision of reliable and accurate information can help increase the vaccination take-up rate.

We study information provision mechanism through antenatal care (ANC)- a health-seeking behavior during pregnancy. ANC is not only important to reduce the health risks for mothers and their babies during the pregnancy period, but it can also be an essential source of receiving reliable and accurate information regarding a child's future health-seeking behavior, such as vaccination practice. The NFHS-4 asks a question on the mother's ANC records for the last pregnancy. In our sample, about 83 percent of mothers received any ANC, and conditional on receiving ANC, the average visit was about 5.6 times. We test whether the exposure to forced sterilization policy has any effect on receiving ANC.

\(^{25}\) In Table F2 of the Appendix, we present estimates showing that the results presented in Table 6 are robust to alternative measures of forced sterilization policy measured by excess male sterilization.

\(^{26}\) See Dupas and Miguel (2017) for a review.
We present the results in Table 8. Column 1 presents the results on exposure to forced sterilization policy on the probability of receiving any ANC. Column 2 reports the results on exposure to forced sterilization policy on the number of ANC visits conditional on receiving any ANC. We find that the exposure to forced sterilization policy has a large, negative, and significant effect on visiting a healthcare center for ANC and the number of visits conditional on receiving ANC. These results suggest that a lack of reliable and accurate information provision may also be an important channel. In Table F4 of the Appendix, we present estimates showing that the results presented in Table 8 are robust to alternative measures of forced sterilization policy.

7. Conclusion

In this paper, we examine the importance of historical events in shaping current vaccination practice in India. In particular, we examine whether the aggressive family planning program under which forced sterilization policy was implemented during the emergency rule in the 1970s could partly explain India's lower vaccination rates today.

We examine vaccination rates using data from the National Family and Health Survey in 2015-16 (NFHS-4). We find that greater exposure to the forced sterilization policy has negative effects on the current vaccination completion rate. In the heterogeneous analysis, we explore each vaccine separately and find that higher exposure to the forced sterilization policy has a negative, statistically significant, and largest effect on vaccines given at birth (i.e., Polio 0 and Hepatitis 0). Second, although not robust, we also find that the vaccination rate declines with higher doses for vaccines administered multiple times, such as hepatitis, DPT, and polio.

Finally, we turn to examine plausible mechanisms. First, we examine whether the place of delivery is a possible channel considering the results from our heterogeneous analysis. We find that the exposure to forced sterilization policy has a large, positive, and significant effect on non-institutional delivery. Going a bit further, we also check for the reason for non-institutional delivery. We find that demand-side constraints, including trust in the healthcare facility, is an important mechanism. Additionally, we also test some plausible indirect channels of information provision through antenatal care (ANC). We find that the exposure to forced sterilization policy has a large, negative, and significant effect on mothers' visits to healthcare centers for ANC during pregnancy and the number of visits conditional on receiving any ANC. These results suggest that a lack of reliable and accurate information provision could also be an important channel.
Our results provide robust evidence suggesting that historical events have a strong impact on shaping India's current vaccination practice. This has important implications for understanding the puzzling factors behind lower demand for health-seeking behavior such as vaccination even the burden is exceedingly high and services are available for free. Additionally, this paper highlights the unintended consequences associated with medical intervention in the past and understanding the context for designing and implementing the future intervention. Finally, considering the current state of the COVID-19 pandemic and the need for universal vaccination, our results also provide some implications for policymakers and practitioners to understand the factors affecting vaccination practice in India and carve out a pragmatic policy to maximize the uptake of a new vaccine.
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Figure 1: Total Number of Sterilizations Performed in India (1956-82)
Figure 2: Excess Sterilizations Performed in 1976-77 (Normalized by 1975-76 Numbers)
Figure 3: Correlation Plot for Basic Vaccination Index

Panel A: Association between basic vaccination index and total number of sterilizations performed in 1976-77

Panel B: Association between basic vaccination index and excess sterilizations performed in 1976-77 Normalized by 1975-76
Figure 4: Distance from New Delhi as Instrument

Panel A: Association between distance from New Delhi to state capitals and excess sterilization in 1976-77

Panel B: Association between distance from New Delhi to state capitals and excess sterilization in 1975-76 (previous year).
Table 1: OLS Estimates - Different Measures of Sterilization

| Dependent variable: Basic Vaccinations | (1)         | (2)         | (3)         | (4)         | (5)         |
|----------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Total Sterilizations Performed in 1976-77 (in 100,000) | -0.00287*** | (0.000863)  |             |             |             |
| Total Sterilizations Performed in 1976-77 (in log) | -0.00590**  | (0.00237)   |             |             |             |
| Excess Sterilization Performed in 1976-77 (in 100,000) | -0.00177**  | (0.000851)  |             |             |             |
| Excess Sterilization Performed in 1976-77 (in log) | -0.0112***  | (0.00225)   |             |             |             |
| Excess Sterilization | -0.00289*** | (0.000924)  |             |             |             |

| Individual Controls | YES | YES | YES | YES | YES | YES |
| Household Controls  | YES | YES | YES | YES | YES | YES |
| Geographic Controls | YES | YES | YES | YES | YES | YES |
| Health Facility Controls | YES | YES | YES | YES | YES | YES |
| Observations        | 234,311 | 234,311 | 229,287 | 224,679 | 229,287 |
| Mean of Dependent Variable | 0.504 | 0.504 | 0.505 | 0.505 | 0.505 |
| Mean of Explanatory variable (Sterilization measures) | 6.521683 | 13.21433 | 4.709505 | 12.82417 | 3.452456 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Total Sterilizations Performed in 1976-77 (in 100,000) measures the total number of sterilizations performed in a state in 1976-77 (expressed in 100,000 individuals). Total Sterilizations Performed in 1976-77 (in log) measures the natural log of the number of sterilizations performed in 1976-77. Excess Sterilization Performed in 1976-77 (in 100,000) measures the number of excess sterilizations performed in 1976-77 over and above the 1975-76 numbers (expressed in 100,000 individuals). Excess Sterilization Performed in 1976-77 (in log) measures the natural log of the excess number of sterilizations performed in 1976-77 over and above the 1975-76 numbers. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
# Table 2: OLS Estimates - Different Measures of Vaccination

| Dependent variables: | Basic Vaccinations | Appropriate Vaccinations | All Vaccinations |
|----------------------|--------------------|--------------------------|------------------|
|                      | (1)                | (2)                      | (3)              |
| Excess Sterilization | -0.00289*** (0.000924) | -0.00843*** (0.00102) | -0.00860*** (0.00102) |
| Individual Controls  | YES                | YES                      | YES              |
| Household Controls   | YES                | YES                      | YES              |
| Geographic Controls  | YES                | YES                      | YES              |
| Health Facility Controls | YES            | YES                      | YES              |
| Observations         | 229,287            | 226,991                  | 226,991          |
| Mean of Dependent Variable | 0.505        | 0.324                    | 0.321            |
| Mean of Excess Sterilization | 3.452456    | 3.446676                 | 3.446676         |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Table 3: IV Estimates

### Panel A: First Stage Estimates

| Distance from New Delhi (in 100km) | Column (1) | Column (2) | Column (3) |
|-----------------------------------|------------|------------|------------|
|                                   | -0.246     | -0.246     | -0.246     |
|                                   | (0.00236)  | (0.00236)  | (0.00236)  |
|                                   | [0.0125]   | [0.0125]   | [0.0125]   |
|                                   | {0.0619}   | {0.0619}   | {0.0619}   |

| Individual Controls | YES | YES | YES |
|---------------------|-----|-----|-----|
| Household Controls  | YES | YES | YES |
| Geographic Controls | YES | YES | YES |
| Health Facility Controls | YES | YES | YES |

| Observations         | 229,287 | 226,991 | 226,991 |
|----------------------|---------|---------|---------|
| Mean of Dependent Variable | 3.452   | 3.447   | 3.447   |
| F Statistics of Excluded Instrument | 15.77   | 15.75   | 15.75   |

### Panel B: Second Stage Estimates

| Dependent variables: | Basic Vaccinations (1) | Appropriate Vaccinations (2) | All Vaccinations (3) |
|----------------------|-------------------------|-------------------------------|----------------------|
| Excess Sterilization | -0.00996                | -0.0232                       | -0.0236              |
|                      | (0.00189)               | (0.00229)                     | (0.00231)            |
|                      | [0.00449]               | -0.00518                      | [0.00525]            |
|                      | {0.00965}               | {0.0111}                      | {0.0112}             |

| Individual Controls | YES | YES | YES |
|---------------------|-----|-----|-----|
| Household Controls  | YES | YES | YES |
| Geographic Controls | YES | YES | YES |
| Health Facility Controls | YES | YES | YES |

| Observations         | 229,287 | 226,991 | 226,991 |
|----------------------|---------|---------|---------|
| Mean of Dependent Variable | 0.505   | 0.324   | 0.321   |
| Mean of Excess Sterilization | 3.452   | 3.447   | 3.447   |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Below each coefficient three standard errors are reported. The first, reported in parentheses, is standard errors adjusted for clustering at the NFHS-4 cluster (PSU) level. The second, reported in square brackets, is standard errors adjusted for clustering at the current district level. The third, reported in curly brackets, is standard errors adjusted for clustering at the current state level. The reported F Statistics of Excluded Instrument is based on adjusting standard errors for clustering at the state-level.
Table 4: Test of Exogeneity of the Instrument

### Panel A: First Stage Estimates

| Dependent variables: | Excess Sterilization in 1975-76 | Excess Female Sterilization (Tubectomy) |
|----------------------|----------------------------------|----------------------------------------|
|                      | (1)                              | (2)                                    | (3) | (4) | (5) | (6) |
| Distance from New Delhi (in 100km) | -0.0115                          | -0.0116                                | -0.0116 | 0.0153 | 0.0153 | 0.0153 |
| (0.0270)             | (0.0269)                         | (0.0269)                               | (0.0123) | (0.0123) | (0.0123) |
| Individual Controls  | YES                              | YES                                    | YES | YES | YES | YES |
| Household Controls   | YES                              | YES                                    | YES | YES | YES | YES |
| Geographic Controls  | YES                              | YES                                    | YES | YES | YES | YES |
| Health Facility Controls | YES                           | YES                                    | YES | YES | YES | YES |
| Observations         | 229,287                          | 226,991                                | 226,991 | 228,992 | 226,696 | 226,696 |
| Mean of Dependent Variable | 1.597                        | 1.595                                  | 1.595 | 0.786 | 0.786 | 0.786 |
| F Statistics of Excluded Instrument | 0.180                      | 0.492                                  | 0.501 | (0.489) | (1.058) | (1.075) |

### Panel B: Second Stage Estimates

| Dependent variables: | Basic Vaccinations | Appropriate Vaccinations | All Vaccinations | Basic Vaccinations | Appropriate Vaccinations | All Vaccinations |
|----------------------|--------------------|--------------------------|------------------|--------------------|--------------------------|------------------|
|                      | (1)                | (2)                      | (3)              | (4)                | (5)                      | (6)              |
| Excess Sterilization in 1975-76 | -0.213             | -0.492                   | -0.501           | 0.160              | 0.372                    | 0.379            |
| (0.489)             | (1.058)            | (1.075)                  |                  | (0.195)            | (0.341)                  | (0.347)          |
| Excess Female Sterilization (Tubectomy) |                    |                          |                  |                    |                          |                  |
| Individual Controls  | YES                | YES                      | YES              | YES                | YES                      | YES              |
| Household Controls   | YES                | YES                      | YES              | YES                | YES                      | YES              |
| Geographic Controls  | YES                | YES                      | YES              | YES                | YES                      | YES              |
| Health Facility Controls | YES               | YES                      | YES              | YES                | YES                      | YES              |
| Observations         | 229,287            | 226,991                  | 226,991          | 228,992            | 226,696                  | 226,696          |
| Mean of Dependent Variable | 0.505            | 0.324                    | 0.321            | 0.505              | 0.324                    | 0.321            |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Sterilization n 1975-76 measures the number of excess sterilizations performed in 1975-76 (compared with 1974-75 numbers) normalized by the sterilization performed in 1974-75 at the state level. Excess Female Sterilization (Tubectomy) measures the number of excess tubectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the number of tubectomies performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. The reported F Statistics of Excluded Instrument is based on adjusting standard errors for clustering at the state-level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Table 5: Heterogenous Effects

| Dependent variables: | Hepatitis 0 | Hepatitis 1 | Hepatitis 2 | Hepatitis 3 | BCG | DPT 1 | DPT 2 | DPT 3 | Polio 0 | Polio 1 | Polio 2 | Polio 3 | Measles |
|----------------------|------------|------------|------------|------------|-----|------|------|------|-------|-------|-------|-------|--------|
|                      | (1)        | (2)        | (3)        | (4)        | (5) | (6)  | (7)  | (8)  | (9)   | (10)  | (11)  | (12)  | (13)   |
| Excess Sterilization | -0.0264**  | -0.00993   | -0.0109    | -0.0230*   | -0.00420 | -0.00379 | -0.00711 | -0.0141 | -0.0303*** | -0.00479 | -0.0101 | -0.00843 | 0.00221 |
|                      | (0.0126)   | (0.00926)  | (0.0105)   | (0.0119)   | (0.00405) | (0.00521) | (0.00671) | (0.00882) | (0.0103) | (0.00464) | (0.00696) | (0.00825) | (0.00776) |
| Individual Controls  | YES        | YES        | YES        | YES        | YES | YES  | YES  | YES  | YES   | YES   | YES   | YES   | YES    |
| Household Controls   | YES        | YES        | YES        | YES        | YES | YES  | YES  | YES  | YES   | YES   | YES   | YES   | YES    |
| Geographic Controls  | YES        | YES        | YES        | YES        | YES | YES  | YES  | YES  | YES   | YES   | YES   | YES   | YES    |
| Health Facility Controls | YES | YES    | YES        | YES        | YES | YES  | YES  | YES  | YES   | YES   | YES   | YES   | YES    |
| Observations         | 228,537    | 228,537    | 228,537    | 228,537    | 231,946 | 231,078 | 231,078 | 231,078 | 231,929 | 231,929 | 231,929 | 231,929 | 230,575 |
| Mean of Dependent Variable | 0.622 | 0.761   | 0.697       | 0.526       | 0.897  | 0.851   | 0.795   | 0.713   | 0.760   | 0.858   | 0.795   | 0.642   | 0.704   |

Notes: Data are from India’s National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Table 6: Mechanism - Non-Institutional Delivery

|                          | Dependent variable: Non-institutional Delivery |
|--------------------------|-----------------------------------------------|
|                          | (1)                       | (2)                       | (3)                       | (4)                       | (5)                       |
| Excess Sterilization    | 0.0479***                  | 0.0366***                  | 0.0254***                  | 0.0249***                  | 0.0292***                  |
|                          | (0.0146)                  | (0.0134)                  | (0.00823)                  | (0.00711)                  | (0.00699)                  |
| Individual Controls     | NO                         | YES                       | YES                       | YES                       | YES                       |
| Household Controls       | NO                         | NO                        | YES                       | YES                       | YES                       |
| Geographic Controls      | NO                         | NO                        | NO                        | YES                       | YES                       |
| Health Facility Controls | NO                         | NO                        | NO                        | NO                        | YES                       |
| Observations             | 242,328                    | 242,328                   | 232,943                   | 232,481                   | 232,481                   |
| Mean of Dependent Variable | 0.204                    | 0.204                    | 0.203                     | 0.203                     | 0.203                     |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Non-institutional Delivery is an indicator variable for a child born at home in the NFHS-4 data. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
## Table 7: Mechanism - Reasons for Non-Institutional Delivery

| Dependent variables: | Cost too much | Facility not open | Too far/ no transport | No female provider | Do not trust facility/ poor service | Husband/family did not allow | Not necessary | Not customary | Others |
|----------------------|---------------|-------------------|-----------------------|-------------------|-------------------------------------|-----------------------------|---------------|--------------|--------|
| Supply Side Factors  | (1)           | (2)               | (3)                   | (4)               | (5)                                 | (6)                         | (7)            | (8)          | (9)    |
| Excess Sterilization| -0.000113     | 0.000643          | 0.000687              | 0.000504**        | 0.00138***                         | 0.00277***                  | 0.00582**     | 0.000774***  | 0.00338*** |
|                      | (0.00106)     | (0.000417)        | (0.00119)             | (0.000240)        | (0.000361)                          | (0.00103)                   | (0.00270)     | (0.000238)   | (0.000827) |
| Individual Controls  | YES           | YES               | YES                   | YES               | YES                                 | YES                         | YES            | YES          | YES    |
| Household Controls   | YES           | YES               | YES                   | YES               | YES                                 | YES                         | YES            | YES          | YES    |
| Geographic Controls  | YES           | YES               | YES                   | YES               | YES                                 | YES                         | YES            | YES          | YES    |
| Health Facility Controls | YES   | YES               | YES                   | YES               | YES                                 | YES                         | YES            | YES          | YES    |
| Observations         | 232,481       | 232,481            | 232,481               | 232,481           | 232,481                             | 232,481                     | 232,481        | 232,481      | 232,481 |
| Mean of Dependent Variable | 0.0216 | 0.0135            | 0.0249               | 0.00489           | 0.00836                             | 0.0248                      | 0.0542         | 0.00518      | 0.0121 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Table 8: Mechanism - Antenatal Care (ANC)

| Dependent variables: | Received any Antenatal Care | Number of Visits |
|----------------------|-----------------------------|------------------|
|                      | (1)                         | (2)              |
| Excess Sterilization | -0.0198**                   | -1.282***        |
|                      | (0.00843)                   | (0.329)          |
| Individual Controls  | YES                         | YES              |
| Household Controls   | YES                         | YES              |
| Geographic Controls  | YES                         | YES              |
| Health Facility Controls | YES                     | YES              |
| Observations         | 177,040                     | 146,167          |
| Mean of Dependent Variable | 0.832                    | 5.685            |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a mother. Received Antenatal Care is an indicator variable for mother's who received antenatal care in the last pregnancy in the NFHS-4 data. Number of Visits measures the number of times the mother received antenatal care conditional on receiving any antenatal care in the last pregnancy. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Appendix for

Why is the Vaccination Rate Low in India?

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Section A: Figures

This section presents the figures. Figure A1 presents the basic vaccination completion rate for children between 12-23 months by their background characteristics. Figure A2 presents the state-level total number of sterilizations performed in 1975-76. Figure A3 presents the state-level total number of sterilizations performed in 1976-77. Figure A4 presents the correlation plot for appropriate vaccination Index. Figure A5 presents the correlation plot for all vaccination Index.

Figure A1: Basic Vaccination Completion Rate by Child’s Background Characteristics in India

Data Source: National Family Health Survey (NFHS-4), 2015-16
https://dhsprogram.com/pubs/pdf/FR339/FR339.pdf
Figure A2: Total Number of Sterilizations Performed in 1975-76 (*Previous year*)
Figure A3: Total Number of Sterilizations Performed in 1976-77
Figure A4: Correlation Plot for Appropriate Vaccination Index

Panel A: Association between appropriate vaccination index and total number of sterilizations performed in 1976-77

Panel B: Association between appropriate vaccination index and excess sterilizations performed in 1976-77 normalized by 1975-76 figures
Figure A5: Correlation Plot for All Vaccination Index

Panel A: Association between all vaccination index and total number of sterilizations performed in 1976-77

Panel B: Association between all vaccination index and excess sterilizations performed in 1976-77 normalized by 1975-76 figures
Section B: Robustness to OLS Estimates - Different Measures of Sterilization

This section presents the robustness results to OLS estimates reported in Table 1. In Table B1, we present results considering different measures of sterilization for appropriate vaccination. In Table B2, we present results considering different measures of sterilization for all vaccination.

Table B1: Appropriate Vaccinations

|                                      | (1)          | (2)          | (3)          | (4)          | (5)          |
|--------------------------------------|--------------|--------------|--------------|--------------|--------------|
| Dependent variable: Appropriate Vaccinations |              |              |              |              |              |
| Total Sterilizations Performed in 1976-77 (in 100,000) | -0.00837***   |              |              |              |              |
|                                       | (0.00106)    |              |              |              |              |
| Total Sterilizations Performed in 1976-77 (in log) |              | -0.00694**   |              |              |              |
|                                       |              | (0.00314)    |              |              |              |
| Excess Sterilization Performed in 1976-77 (in 100,000) |              |              | -0.00816***  |              |              |
|                                       |              |              | (0.000978)   |              |              |
| Excess Sterilization Performed in 1976-77 (in log) |              |              |              | -0.0175***   |              |
|                                       |              |              |              | (0.00277)    |              |
| Excess Sterilization                 |              |              |              |              | -0.00843***  |
|                                       |              |              |              |              | (0.00102)    |
| Individual Controls                   | YES          | YES          | YES          | YES          | YES          |
| Household Controls                    | YES          | YES          | YES          | YES          | YES          |
| Geographic Controls                   | YES          | YES          | YES          | YES          | YES          |
| Health Facility Controls              | YES          | YES          | YES          | YES          | YES          |
| Observations                          | 231,984      | 231,984      | 226,991      | 222,393      | 226,991      |
| Mean of Dependent Variable            | 0.324        | 0.324        | 0.324        | 0.324        | 0.324        |
| Mean of Explanatory variable (Sterilization measures) | 6.520471     | 13.21386     | 4.704912     | 12.82287     | 3.452456     |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Appropriate vaccinations include BCG, measles, and three doses each of DPT, polio vaccine (excluding polio vaccine given at birth), and four doses of hepatitis B. Total Sterilizations Performed in 1976-77 (in 100,000) measures the total number of sterilizations performed in a state in 1976-77 (expressed in 100,000 individuals). Total Sterilizations Performed in 1976-77 (in log) measures the natural log of the number of sterilizations performed in 1976-77. Excess Sterilization Performed in 1976-77 (in 100,000) measures the number of excess sterilizations performed in 1976-77 over and above the 1975-76 numbers (expressed in 100,000 individuals). Excess Sterilization Performed in 1976-77 (in log) measures the natural log of the excess number of sterilizations performed in 1976-77 over and above the 1975-76 numbers. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Table B2: All Vaccinations

| Dependent variable: All Vaccinations | (1) | (2) | (3) | (4) | (5) |
|-------------------------------------|-----|-----|-----|-----|-----|
| Total Sterilizations Performed in 1976-77 (in 100,000) | -0.00843*** (0.00107) | | | | |
| Total Sterilizations Performed in 1976-77 (in log) | -0.00712** (0.00317) | | | | |
| Excess Sterilization Performed in 1976-77 (in 100,000) | -0.00827*** (0.000983) | | | | |
| Excess Sterilization Performed in 1976-77 (in log) | -0.0178*** (0.00279) | | | | |
| Excess Sterilization | | -0.00860*** (0.00102) | | | |

| Individual Controls | YES | YES | YES | YES | YES |
|---------------------|-----|-----|-----|-----|-----|
| Household Controls  | YES | YES | YES | YES | YES |
| Geographic Controls | YES | YES | YES | YES | YES |
| Health Facility Controls | YES | YES | YES | YES | YES |

Observations | 231,984 | 231,984 | 226,991 | 222,393 | 226,991 |
Mean of Dependent Variable | 0.321 | 0.321 | 0.321 | 0.321 | 0.321 |
Mean of Explanatory variable (Sterilization measures) | 6.520471 | 13.21386 | 4.704912 | 12.82287 | 3.452456 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. All vaccinations include BCG, measles, and three doses each of DPT, polio vaccine including polio vaccine given at birth, and four doses of hepatitis B. Total Sterilizations Performed in 1976-77 (in 100,000) measures the total number of sterilizations performed in a state in 1976-77 (expressed in 100,000 individuals). Total Sterilizations Performed in 1976-77 (in log) measures the natural log of the number of sterilizations performed in 1976-77. Excess Sterilization Performed in 1976-77 (in 100,000) measures the number of excess sterilizations performed in 1976-77 over and above the 1975-76 numbers (expressed in 100,000 individuals). Excess Sterilization Performed in 1976-77 (in log) measures the natural log of the excess number of sterilizations performed in 1976-77 over and above the 1975-76 numbers. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Section C: Robustness to OLS Estimates - Different Measures Vaccination

This section presents the robustness results to OLS estimates reported in Table 2. In Table C1, we present results for basic vaccinations adding each set of controls sequentially. In Table C2, we present results for appropriate vaccinations adding each set of controls sequentially. In Table C3, we present results for all vaccinations adding each set of controls sequentially. In Table C4, we present results for the cohort of children between 12-23 months. In Table C5, we present results considering excess male sterilization (vasectomy) as an alternative measure of forced sterilization policy.

### Table C1: Basic Vaccinations

|                  | (1)          | (2)          | (3)          | (4)          | (5)          |
|------------------|--------------|--------------|--------------|--------------|--------------|
| Excess Sterilization | -0.0135***  | -0.00978*** | -0.00470***  | -0.00475***  | -0.00289***  |
|                  | (0.000942)   | (0.000944)   | (0.000930)   | (0.000928)   | (0.000924)   |
| Individual Controls | NO           | YES          | YES          | YES          | YES          |
| Household Controls  | NO           | NO           | YES          | YES          | YES          |
| Geographic Controls  | NO           | NO           | NO           | YES          | YES          |
| Health Facility Controls  | NO           | NO           | NO           | NO           | YES          |
| Observations       | 238,895      | 238,895      | 229,723      | 229,287      | 229,287      |
| Mean of Dependent Variable | 0.506        | 0.506        | 0.505        | 0.505        | 0.505        |

Notes: Data are from India’s National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Table C2: Appropriate Vaccinations

| Dependent variable: Appropriate Vaccinations | (1) | (2) | (3) | (4) | (5) |
|---------------------------------------------|-----|-----|-----|-----|-----|
| Excess Sterilization                        | -0.0177*** | -0.0143*** | -0.00897*** | -0.0104*** | -0.00843*** |
|                                            | (0.00101)   | (0.000999)  | (0.000984)  | (0.000990)  | (0.00102)   |
| Individual Controls                         | NO   | YES  | YES  | YES  | YES  |
| Household Controls                          | NO   | NO   | YES  | YES  | YES  |
| Geographic Controls                         | NO   | NO   | NO   | YES  | YES  |
| Health Facility Controls                    | NO   | NO   | NO   | NO   | YES  |
| Observations                                | 236,537 | 236,537 | 227,422 | 226,991 | 226,991 |
| Mean of Dependent Variable                  | 0.323 | 0.323 | 0.324 | 0.324 | 0.324 |

Notes: Data are from India’s National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Appropriate vaccinations include BCG, measles, and three doses each of DPT, polio vaccine (excluding polio vaccine given at birth), and four doses of hepatitis B. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Table C3: All Vaccinations

|                          | (1)         | (2)          | (3)         | (4)          | (5)          |
|--------------------------|-------------|--------------|-------------|--------------|--------------|
| Excess Sterilization     | -0.0178***  | -0.0144***   | -0.00910*** | -0.0105***   | -0.00860***  |
|                          | (0.00102)   | (0.001000)   | (0.000985)  | (0.000992)   | (0.00102)    |
| Individual Controls      | NO          | YES          | YES         | YES          | YES          |
| Household Controls       | NO          | NO           | YES         | YES          | YES          |
| Geographic Controls      | NO          | NO           | NO          | YES          | YES          |
| Health Facility Controls | NO          | NO           | NO          | NO           | YES          |
| Observations             | 236,537     | 236,537      | 227,422     | 226,991      | 226,991      |
| Mean of Dependent Variable| 0.320       | 0.320        | 0.321       | 0.321        | 0.321        |

Notes: Data are from India’s National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. All vaccinations include BCG, measles, and three doses each of DPT, polio vaccine including polio vaccine given at birth, and four doses of hepatitis B. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
### Table C4: Children Between 12-23 Months

| Dependent variables: | Basic Vaccinations | Appropriate Vaccinations | All Vaccinations |
|----------------------|--------------------|--------------------------|------------------|
|                      | (1)                | (2)                      | (3)              |
| Excess Sterilization | 0.000990           | -0.00341*                | -0.00373**       |
|                      | (0.00168)          | (0.00181)                | (0.00181)        |
| Individual Controls  | YES                | YES                      | YES              |
| Household Controls   | YES                | YES                      | YES              |
| Geographic Controls  | YES                | YES                      | YES              |
| Health Facility Controls | YES            | YES                      | YES              |
| Observations         | 45,639             | 45,252                   | 45,252           |
| Mean of Dependent Variable | 0.624         | 0.439                    | 0.435            |
| Mean of Excess Sterilization | 3.437      | 3.432                    | 3.432            |

**Notes:** Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child between 12-23 months. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Table C5: Alternative Measures of Force Sterilization Policy - Male Sterilization

|                                | Basic Vaccinations (1) | Appropriate Vaccinations (2) | All Vaccinations (3) |
|--------------------------------|------------------------|------------------------------|----------------------|
| Excess Male Sterilization      | -0.00291***            | -0.00275***                  | -0.00279***          |
| (Vasectomy)                    | (0.000385)             | (0.000430)                   | (0.000431)           |
| Individual Controls            | YES                    | YES                          | YES                  |
| Household Controls             | YES                    | YES                          | YES                  |
| Geographic Controls            | YES                    | YES                          | YES                  |
| Health Facility Controls       | YES                    | YES                          | YES                  |
| Observations                   | 229,287                | 226,991                      | 226,991              |
| Mean of Dependent Variable     | 0.505                  | 0.324                        | 0.321                |
| Mean of Excess Male Sterilization (Vasectomy) | 7.29167 | 7.284252 | 7.284252 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Male Sterilization (Vasectomy) measures the number of excess vasectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the vasectomy performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the NFHS-4 cluster (PSU) level. *** p<0.01, ** p<0.05, * p<0.1
Section D: Robustness to IV Estimates

This section presents the robustness results to IV estimates reported in Table 3. In Table D1, we present results for basic vaccinations adding each set of controls sequentially. In Table D2, we present results for appropriate vaccinations adding each set of controls sequentially. In Table D3, we present results for all vaccinations adding each set of controls sequentially. In Table D4, we present results for the cohort of children between 12-23 months. In Table D5, we present results considering excess male sterilization (vasectomy) as an alternative measure of forced sterilization policy.

Table D1: Basic Vaccinations

|                      | (1)        | (2)        | (3)        | (4)        | (5)        |
|----------------------|------------|------------|------------|------------|------------|
| Excess Sterilization| -0.0374    | -0.0194    | -0.0121    | -0.0134    | -0.00996   |
|                      | (0.00186)  | (0.00184)  | (0.00187)  | (0.00177)  | (0.00189)  |
|                      | [0.00504]  | [0.00530]  | [0.00474]  | [0.00451]  | [0.00449]  |
|                      | {0.0140}   | {0.0136}   | {0.0116}   | {0.0116}   | {0.00965}  |
| Individual Controls  | NO         | YES        | YES        | YES        | YES        |
| Household Controls   | NO         | NO         | YES        | YES        | YES        |
| Geographic Controls  | NO         | NO         | NO         | YES        | YES        |
| Health Facility Controls | NO   | NO         | NO         | NO         | YES        |
| Observations         | 238,895    | 238,895    | 229,723    | 229,287    | 229,287    |
| Mean of Dependent Variable | 0.506    | 0.506      | 0.505      | 0.505      | 0.505      |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Below each coefficient three standard errors are reported. The first, reported in parentheses, is standard errors adjusted for clustering at the NFHS-4 cluster (PSU) level. The second, reported in square brackets, is standard errors adjusted for clustering at the current district level. The third, reported in curly brackets, is standard errors adjusted for clustering at the current state level.
Table D2: **Appropriate Vaccinations**

|                      | (1)                      | (2)                      | (3)                      | (4)                      | (5)                      |
|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Excess Sterilization| -0.0398                  | -0.0276                  | -0.0242                  | -0.0254                  | -0.0232                  |
|                      | (0.00214)                | (0.00212)                | (0.00214)                | (0.00212)                | (0.00229)                |
|                      | [0.00523]                | [0.00532]                | [0.00460]                | [0.00472]                | [0.00518]                |
|                      | {0.0171}                 | {0.0174}                 | {0.0124}                 | {0.0121}                 | {0.0111}                 |
| Individual Controls  | NO                       | YES                      | YES                      | YES                      | YES                      |
| Household Controls   | NO                       | NO                       | YES                      | YES                      | YES                      |
| Geographic Controls  | NO                       | NO                       | NO                       | YES                      | YES                      |
| Health Facility Controls | NO          | NO                       | NO                       | NO                       | YES                      |
| Observations         | 236,537                  | 236,537                  | 227,422                  | 226,991                  | 226,991                  |
| Mean of Dependent Variable | 0.323                 | 0.323                    | 0.324                    | 0.324                    | 0.324                    |

Notes: Data are from India’s National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Appropriate vaccinations include BCG, measles, and three doses each of DPT, polio vaccine (excluding polio vaccine given at birth), and four doses of hepatitis B. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Below each coefficient three standard errors are reported. The first, reported in parentheses, is standard errors adjusted for clustering at the NFHS-4 cluster (PSU) level. The second, reported in square brackets, is standard errors adjusted for clustering at the current district level. The third, reported in curly brackets, is standard errors adjusted for clustering at the current state level.
|                          | (1)             | (2)             | (3)             | (4)             | (5)             |
|--------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Excess Sterilization** | -0.0399         | -0.0278         | -0.0245         | -0.0258         | -0.0236         |
|                          | (0.00214)       | (0.00213)       | (0.00215)       | (0.00213)       | (0.00231)       |
|                          | [0.00525]       | [0.00534]       | [0.00463]       | [0.00477]       | [0.00525]       |
|                          | {0.0172}        | {0.0175}        | {0.0124}        | {0.0121}        | {0.0112}        |
| **Individual Controls**  | NO              | YES             | YES             | YES             | YES             |
| **Household Controls**   | NO              | NO              | YES             | YES             | YES             |
| **Geographic Controls**  | NO              | NO              | NO              | YES             | YES             |
| **Health Facility Controls** | NO              | NO              | NO              | NO              | YES             |
| **Observations**         | 236,537         | 236,537         | 227,422         | 226,991         | 226,991         |
| **Mean of Dependent Variable** | 0.320          | 0.320          | 0.321          | 0.321          | 0.321          |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. All vaccinations include BCG, measles, and three doses each of DPT, polio vaccine including polio vaccine given at birth, and four doses of hepatitis B. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Below each coefficient three standard errors are reported. The first, reported in parentheses, is standard errors adjusted for clustering at the NFHS-4 cluster (PSU) level. The second, reported in square brackets, is standard errors adjusted for clustering at the current district level. The third, reported in curly brackets, is standard errors adjusted for clustering at the current state level.
Table D4: Children Between 12-23 Months

### Panel A: First Stage Estimates

| Dependent variable: Excess Sterilization | (1) | (2) | (3) |
|-----------------------------------------|-----|-----|-----|
| Distance from New Delhi (in 100km)      | -0.268 | -0.268 | -0.268 |
|                                          | (0.00308) | (0.00308) | (0.00308) |
|                                          | [0.0137] | [0.0137] | [0.0137] |
|                                          | \{0.0662\} | \{0.0662\} | \{0.0662\} |
| Individual Controls                      | YES | YES | YES |
| Household Controls                       | YES | YES | YES |
| Geographic Controls                      | YES | YES | YES |
| Health Facility Controls                 | YES | YES | YES |
| Observations                             | 45,639 | 45,252 | 45,252 |
| Mean of Dependent Variable               | 3.437 | 3.432 | 3.432 |
| F Statistics of Excluded Instrument      | 16.35 | 16.36 | 16.36 |

### Panel B: Second Stage Estimates

| Dependent variables: | Basic Vaccinations | Appropriate Vaccinations | All Vaccinations |
|----------------------|--------------------|--------------------------|------------------|
|                      | (1)                | (2)                      | (3)              |
| Excess Sterilization | -0.0213            | -0.0267                  | -0.0272          |
|                      | (0.00301)          | (0.00333)                | (0.00333)        |
|                      | [0.00498]          | [0.00589]                | [0.00591]        |
|                      | \{0.0118\}        | \{0.0146\}               | \{0.0147\}      |
| Individual Controls  | YES                | YES                      | YES              |
| Household Controls   | YES                | YES                      | YES              |
| Geographic Controls  | YES                | YES                      | YES              |
| Health Facility Controls | YES       | YES                      | YES              |
| Observations         | 45,639             | 45,252                   | 45,252           |
| Mean of Dependent Variable | 0.624 | 0.439                  | 0.435            |
| Mean of Excess Sterilization | 3.437 | 3.432                  | 3.432            |

Notes: Data are from India’s National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child between 12-23 months. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Below each coefficient three standard errors are reported. The first, reported in parentheses, is standard errors adjusted for clustering at the NFHS-4 cluster (PSU) level. The second, reported in square brackets, is standard errors adjusted for clustering at the current district level. The third, reported in curly brackets, is standard errors adjusted for clustering at the current state level. The reported F Statistics of Excluded Instrument is based on adjusting standard errors for clustering at the state-level.
Table D5: Alternative Measures of Force Sterilization Policy - Male Sterilization

### Panel A: First Stage Estimates

|                          | (1)      | (2)      | (3)      |
|--------------------------|----------|----------|----------|
| Distance from New Delhi (in 100km) | -0.478   | -0.478   | -0.478   |
|                          | (0.00769)| (0.00769)| (0.00769)|
|                          | [0.0394] | [0.0394] | [0.0394] |
|                          | [0.191]  | [0.191]  | [0.191]  |
| Individual Controls      | YES      | YES      | YES      |
| Household Controls       | YES      | YES      | YES      |
| Geographic Controls      | YES      | YES      | YES      |
| Health Facility Controls | YES      | YES      | YES      |
| Observations             | 229,287  | 226,991  | 226,991  |
| Mean of Dependent Variable| 7.292    | 7.284    | 7.284    |
| F Statistics of Excluded Instrument | 6.25     | 6.25     | 6.25     |

### Panel B: Second Stage Estimates

|                          | Basic Vaccinations (1) | Appropriate Vaccinations (2) | All Vaccinations (3) |
|--------------------------|------------------------|------------------------------|----------------------|
| Excess Male Sterilization (Vasectomy) | -0.00513   | -0.0119                      | -0.0121              |
|                          | (0.000978)            | (0.00121)                    | (0.00122)            |
|                          | [0.00233]             | [0.00274]                    | [0.00277]            |
|                          | {0.00514}             | {0.00614}                    | {0.00618}            |
| Individual Controls      | YES                    | YES                          | YES                  |
| Household Controls       | YES                    | YES                          | YES                  |
| Geographic Controls      | YES                    | YES                          | YES                  |
| Health Facility Controls | YES                    | YES                          | YES                  |
| Observations             | 229,287               | 226,991                      | 226,991              |
| Mean of Dependent Variable| 0.505                 | 0.324                        | 0.321                |
| Mean of Excess Male Sterilization (Vasectomy) | 7.292     | 7.284                        | 7.284                |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Basic vaccinations include BCG, measles, and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth). Appropriate vaccinations include all basic vaccinations plus four doses of hepatitis B. All vaccinations include all appropriate vaccination plus polio vaccine given at birth. Excess Male Sterilization (Vasectomy) measures the number of excess vasectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the vasectomy performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Below each coefficient three standard errors are reported. The first, reported in parentheses, is standard errors adjusted for clustering at the NFHS-4 cluster (PSU) level. The second, reported in square brackets, is standard errors adjusted for clustering at the current district level. The third, reported in curly brackets, is standard errors adjusted for clustering at the current state level. The reported F Statistics of Excluded Instrument is based on adjusting standard errors for clustering at the state-level.
Section E: Robustness to Heterogenous Effects

This section presents the robustness results to estimates reported in Table 5. In Table E1, we present results for the cohort of children between 12-23 months. In Table E2, we present results considering excess male sterilization (vasectomy) as an alternative measure of forced sterilization policy.

Table E1: Children Between 12-23 Months

| Dependent variables: | Hepatitis 0 (1) | Hepatitis 1 (2) | Hepatitis 2 (3) | Hepatitis 3 (4) | BCG (5) | DPT 1 (6) | DPT 2 (7) | DPT 3 (8) | Polio 0 (9) | Polio 1 (10) | Polio 2 (11) | Polio 3 (12) | Measles (13) |
|---------------------|-----------------|-----------------|-----------------|-----------------|---------|-----------|-----------|-----------|------------|-------------|-------------|-------------|-------------|
| Excess Sterilization | -0.0230* (0.0136) | -0.00765 (0.0109) | -0.0102 (0.0126) | -0.0209 (0.0140) | -0.00281 (0.00359) | -0.00292 (0.00491) | -0.00704 (0.00682) | -0.0152 (0.00941) | -0.0249** (0.0106) | -0.00735* (0.00441) | -0.0135** (0.00621) | -0.0160* (0.00845) | -0.00913 (0.00756) |
| Individual Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Household Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Geographic Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Health Facility Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 45,533 | 45,533 | 45,533 | 45,533 | 46,094 | 45,951 | 45,951 | 46,089 | 46,089 | 46,089 | 46,089 | 46,089 | 45,850 |
| Mean of Dependent Variable | 0.668 | 0.829 | 0.779 | 0.639 | 0.920 | 0.896 | 0.860 | 0.790 | 0.905 | 0.860 | 0.734 | 0.815 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child between 12-23 months. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Table E2: Alternative Measures of Force Sterilization Policy - Male Sterilization

| Dependent variables: | Hepatitis 0 | Hepatitis 1 | Hepatitis 2 | Hepatitis 3 | BCG | DPT 1 | DPT 2 | DPT 3 | Polio 0 | Polio 1 | Polio 2 | Polio 3 | Measles |
|---------------------|------------|------------|------------|------------|-----|-------|-------|-------|--------|--------|--------|--------|--------|
| (1)                 | (2)        | (3)        | (4)        | (5)        | (6) | (7)   | (8)   | (9)   | (10)   | (11)   | (12)   | (13)   |
| Excess Male Sterilization (Vasectomy) | -0.0136* | -0.00511 | -0.00559 | -0.0119* | -0.00216 | -0.00195 | -0.00366 | -0.00724 | -0.0156** | -0.00246 | -0.00520 | -0.00434 | 0.00114 |
| (0.00709)           | (0.00517)  | (0.00585)  | (0.00694)  | (0.00224)  | (0.00278)  | (0.00369)  | (0.00505)  | (0.00653)  | (0.00244)  | (0.00382)  | (0.00425)  | (0.00400)  |
| Individual Controls | YES        | YES        | YES        | YES        | YES | YES   | YES   | YES   | YES    | YES    | YES    | YES    | YES    |
| Household Controls  | YES        | YES        | YES        | YES        | YES | YES   | YES   | YES   | YES    | YES    | YES    | YES    | YES    |
| Geographic Controls | YES        | YES        | YES        | YES        | YES | YES   | YES   | YES   | YES    | YES    | YES    | YES    | YES    |
| Health Facility Controls | YES       | YES        | YES        | YES        | YES | YES   | YES   | YES   | YES    | YES    | YES    | YES    | YES    |
| Observations        | 228,537    | 228,537    | 228,537    | 228,537    | 231,946 | 231,078 | 231,078 | 231,078 | 231,929 | 231,929 | 231,929 | 230,575 |
| Mean of Dependent Variable | 0.622 | 0.761 | 0.697 | 0.526 | 0.897 | 0.851 | 0.795 | 0.713 | 0.760 | 0.858 | 0.795 | 0.642 | 0.704 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Excess Male Sterilization (Vasectomy) measures the number of excess vasectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the vasectomy performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Section F: Robustness to Mechanisms

This section presents the robustness results to the mechanism reported in Section 6. In Table F1, we present the robustness results to Table 6, considering excess male sterilization (vasectomy) as an alternative measure of forced sterilization policy. In Table F2, we present the robustness results to Table 7, considering excess male sterilization (vasectomy) as an alternative measure of forced sterilization policy. In Table F3, we present the estimates indexing the reasons for non-institutional delivery. In Table F4, we present the robustness results to Table 8, considering excess male sterilization (vasectomy) as an alternative measure of forced sterilization policy.

Table F1: Robustness to Non-institutional Delivery Using Alternative Measures of Force Sterilization Policy - Male Sterilization

|                          | (1)          | (2)          | (3)          | (4)          | (5)          |
|--------------------------|--------------|--------------|--------------|--------------|--------------|
| Excess Male Sterilization (Vasectomy) | 0.0255**     | 0.0191**     | 0.0125**     | 0.0124***    | 0.0151***    |
|                          | (0.0109)     | (0.00891)    | (0.00502)    | (0.00447)    | (0.00514)    |
| Individual Controls      | NO           | YES          | YES          | YES          | YES          |
| Household Controls       | NO           | NO           | YES          | YES          | YES          |
| Geographic Controls      | NO           | NO           | NO           | YES          | YES          |
| Health Facility Controls | NO           | NO           | NO           | NO           | YES          |
| Observations             | 242,328      | 242,328      | 232,943      | 232,481      | 232,481      |
| Mean of Dependent Variable | 0.204       | 0.204        | 0.203        | 0.203        | 0.203        |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Non-institutional Delivery is an indicator variable for a child born at home in the NFHS-4 data. Excess Male Sterilization (Vasectomy) measures the number of excess vasectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the vasectomy performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
## Table F2: Robustness to Reasons for Non-institutional Delivery Using Alternative Measures of Force Sterilization Policy - Male Sterilization

| Dependent variable: | Cost too much | Facility not open | Too far/ no transport | No female provider | Do not trust facility/ poor service | Husband/family did not allow | Not necessary | Not customary | Others |
|---------------------|---------------|-------------------|-----------------------|-------------------|-----------------------------------|-----------------------------|--------------|--------------|--------|
| Supply Side Factors |               |                   |                       |                   |                                   |                             |              |              | (1)    |
| (1)                 | -0.0000583    | 0.000331          | 0.000353              | 0.000259*         | 0.000709***                      | 0.00142**                   | 0.00300**    | 0.000398***| 0.00174***|
|                      | (0.000549)    | (0.000203)        | (0.000621)            | (0.000137)        | (0.000251)                        | (0.000648)                  | (0.00152)    | (0.000131)  | (0.000597)|
| Demand Side Factors |               |                   |                       |                   |                                   |                             |              |              | (2)    |
| (2)                 | YES           | YES               | YES                   | YES               | YES                               | YES                         | YES          | YES          | YES    |
| Individual Controls |               |                   |                       |                   |                                   |                             |              |              | (3)    |
| (3)                 | YES           | YES               | YES                   | YES               | YES                               | YES                         | YES          | YES          | YES    |
| Household Controls  |               |                   |                       |                   |                                   |                             |              |              | (4)    |
| (4)                 | YES           | YES               | YES                   | YES               | YES                               | YES                         | YES          | YES          | YES    |
| Geographic Controls |               |                   |                       |                   |                                   |                             |              |              | (5)    |
| (5)                 | YES           | YES               | YES                   | YES               | YES                               | YES                         | YES          | YES          | YES    |
| Health Facility Controls |           |                   |                       |                   |                                   |                             |              |              | (6)    |
| (6)                 | YES           | YES               | YES                   | YES               | YES                               | YES                         | YES          | YES          | YES    |
| Observations        | 232,481       | 232,481            | 232,481               | 232,481           | 232,481                           | 232,481                     | 232,481      | 232,481      | 232,481 |
| Mean of Dependent Variable | 0.0216     | 0.0135             | 0.0249                | 0.00489           | 0.00836                           | 0.0248                      | 0.0542       | 0.00518      | 0.0121 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Excess Male Sterilization (Vasectomy) measures the number of excess vasectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the vasectomy performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1
Table F3: Robustness to *Indexing the Reasons for Non-institutional Delivery*

| Dependent variables          | Supply Side | Demand Side |
|------------------------------|-------------|-------------|
| Excess Sterilization        | 0.00194     | 0.00995***  |
|                             | (0.00167)   | (0.00357)   |
| Individual Controls         | YES         | YES         |
| Household Controls          | YES         | YES         |
| Geographic Controls         | YES         | YES         |
| Health Facility Controls    | YES         | YES         |
| Observations                | 232,481     | 232,481     |
| Mean of Dependent Variable  | 0.0548      | 0.0855      |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a child below the age of 5. Supply Side is an index that include Cost too much, Facility not open, Too far/ no transport, and No female provider. Demand Side is an index that include Do not trust facility/ poor service, Husband/family did not allow, Not necessary, and Not customary. Excess Sterilization measures the number of excess sterilizations performed in 1976-77 (compared with 1975-76 numbers) normalized by the sterilization performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level.

*** p<0.01, ** p<0.05, * p<0.1
Table F4: Robustness to Information Provision through Antenatal Care (ANC) Using Alternative Measures of Force Sterilization Policy - **Male Sterilization**

| Dependent variables: | Received Any Antenatal Care (1) | Number of Visits (2) |
|----------------------|---------------------------------|----------------------|
| Excess Male Sterilization (Vasectomy) | -0.0101** (0.00505) | -0.649*** (0.230) |
| Individual Controls | YES | YES |
| Household Controls | YES | YES |
| Geographic Controls | YES | YES |
| Health Facility Controls | YES | YES |
| Observations | 177,040 | 146,167 |
| Mean of Dependent Variable | 0.832 | 5.685 |

Notes: Data are from India's National Family and Health Survey 2015-16 (NFHS-4). The unit of observation is a mother. Received Antenatal Care is an indicator variable for mothers who received antenatal care in the last pregnancy in the NFHS-4 data. Number of Visits measures the number of times the mother received antenatal care conditional on receiving any antenatal care in the last pregnancy. Excess Male Sterilization (Vasectomy) measures the number of excess vasectomies performed in 1976-77 (compared with 1975-76 numbers) normalized by the vasectomy performed in 1975-76 at the state level. Individual controls are for a gender indicator variable of the child, month by year of birth fixed effects, an indicator for whether the child is twin, and birth order of the child. Household controls include age and sex of the household head, household size, number of household members below the age 5, seven religion fixed effects, four caste fixed effects, 20 education of the mother fixed effects, four household wealth index fixed effects, and an indicator for whether any household member is covered by health insurance. Geographic controls include altitude of the cluster in meters, altitude squared, state-level population density per square kilometers (in log), and an indicator of whether the place of residence is urban. Health facility controls include hospital per 1000 population and doctors per 1000 population at the state level. Robust standard errors in parentheses clustered at the state level. *** p<0.01, ** p<0.05, * p<0.1