Maternal cash for better child health?

The impacts of India's conditional maternity benefit scheme*

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Abstract

We assess the effects of the thus-far largest conditional cash transfer program (CCT) in India, the country's maternity benefit program introduced as Indira Gandhi Matritva Sahyog Yojana IGMSY in 2011 and renamed Pradhan Mantri Matriva Sahyog Yojana (PMMVY) in 2017. We approach its geographically targeted pilot phase as a natural experiment and use data from a large national health survey to estimate the program's effects via a matched difference-in-differences approach. Consistent with some of the programs' objectives we find reliable positive effects on long-term health care utilization, and infant immunization.

Keywords: conditional cash transfer, child health, maternal health, India

JEL classification codes: I15, I18, I12, O15, O12

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1. Introduction

While there has been considerable progress in the worldwide reduction of child mortality, absolute mortality remains high, with more than 15000 children under five perishing each day (WHO 2018b). The majority of these deaths occur in low and middle income countries (LMICs) (WHO 2018a), which also lag behind in terms of health risk and disease burden (Black et al. 2008; WHO 2009). 80 percent of under-five child deaths in LMICs are caused by communicable diseases as well as perinatal and nutritional conditions (WHO 2018a). While many communicable diseases can be prevented by vaccination, immunization rates as high as 95 percent are necessary in order to locally eliminate an illness (Andre et al. 2008), a number that has not yet been reached by most low-income countries (WHO 2018b). Perinatal conditions contribute to persisting deficits in child health owing to an intergenerational vicious cycle in which unhealthy mothers are more likely to give birth to unhealthy children (Black et al. 2008). Poor health, nutrition and health care in early childhood in turn affect long-term physical and cognitive development (Currie 2009; Maluccio and Flores 2005; Maluccio et al. 2009; Miguel and Kremer 2004) which is again reflected in poor maternal health.

For these reasons, the Millennium Development Goals (MDGs) and the ensuing Sustainable Development Goals (SDG) emphasized universal vaccination coverage and maternal and child health. After most LMICs fell short of the MDG's targeted reduction of maternal and infant mortality (United Nations Development Program 2015), many governments sought novel ways to strengthen maternal and child health in order to ensure progress towards the subsequent SDGs. In the wake of this, many LMICs adopted conditional cash transfer (CCT) policies (Fiszbein and Schady 2009). While these can in principle support mothers during the critical phase of pregnancy and childbirth and incentivize health-enhancing behavior, few explicitly target pregnant women.

One scheme which is tailored to the needs of women and children in the critical phase around delivery is India's maternity benefit scheme introduced in 2011 as *Indira Gandhi Matritva Sahyog Yojana* (IGMSY) and renamed *Pradhan Mantri Matru Vandana Yojana* (PMMVY) in 2017. The IGMSY/PMMVY scheme has, in terms of expenditures, become India's largest conditional cash transfer program thus far. The program was implemented at a time when India showed marked deficits in health service use and poor child health outcomes. In particular, in a comparison of 16 indicators of health service coverage at the time around 2010, India lies below the world median in 15 of these (WHO 2012). The country's performance at the time with respect to child nutritional outcomes is similarly desolate: out of 119 and 109 countries, India had the third and second highest percentage of low birth weight and underweight children below 5 years of age, respectively (WHO 2012). During its five-year long pilot phase, IGMSY offered cash transfers for all pregnant and lactating women above 18 years of age for their first and second live births in selected districts (Ministry of Women and Child Development 2011). The scheme's conditions include growth monitoring and immunizations of the child as well as nutrition supplements and participation in counselling sessions for the mother.

We conduct a comprehensive evaluation of this program using a large, nationally representative sample from the fourth wave of India's National Family Health Survey (NFHS-4). Our focus is on primary health care use, immunization, child health and mortality. The extended pilot phase of five years and the timing of the survey, which was fielded four years after IGMSY's introduction, provide the unique opportunity to also estimate longer-term and indirect effects of a CCT whose cash transfers end six months after a child's birth.

We approach IGMSY's pilot phase as a natural experiment employing a matched-pair difference-in-differences estimator, similar to the methodology of Ghosh and Kochar (2018). We exploit the feature that the 52 pilot districts were selected based on district scores computed from a previous health survey, to identify 52 control districts, one for each program district. We estimate intent-to-treat (ITT) effects of the program by comparing the within-district difference in health outcomes between younger birth cohorts exposed to the program and older cohorts not exposed to IGMSY across pilot and control districts.

Studies most closely related to ours are, first, Powell-Jackson et al. (2015), who evaluate India's JSY program, which pays a cash transfer conditional on institutional or assisted delivery. By exploiting differences in the intensity of JSY coverage, they find that JSY fails to affect mortality rates of newborn children. In addition, the authors document a modest increase in institutional delivery and unintended side effects of the program such as increased breastfeeding, higher fertility and lower demand for private health services. Second, Ghosh and Kochar (2018) evaluate the IGMSY program for Bihar, India's most destitute state, where the program was poorly implemented. Despite inordinate delays in cash transfers, the authors find that the program had a large effect on children's weight-for-age and birth spacing but not height-for-age. Our contribution relative to that study is that we cover the majority of India's states, the data comes from a nationally representative sample, and we consider important additional perinatal and infant outcomes, namely birthweight, anemia, mortality, and vaccination and other health service use, as well as maternal health as secondary outcome. We further complement this analysis by investigating whether the program affects various sub-groups to a different extent.

Our study also contributes to a broader literature on the effectiveness of conditional cash transfers on child health and health service use. This literature provides strong evidence for the nexus between conditional cash transfers and increased health service use, documented in a systematic review by Ranganathan and Lagarde (2012) (RanganathanandLagardeÉ). This has recently been confirmed for maternal health services in a randomized controlled trial by Grépin et al. (2019). However, studies of CCTs geared at promoting infant immunizations are available only for some Latin American countries (Lagarde et al. 2009).[3] Regarding the effect

[3] However, in a small-scale randomized intervention in rural Rajasthan, conditional *in-kind* gifts vastly increased village child immunization rates (Banerjee et al. 2019).

of CCTs on child health, thus far, the literature has accumulated inconclusive evidence. Ranganathan and Lagarde (2012) offer an overview of evidence stemming from five Latin American CCT programs: they document positive effects on height-related measures, predominantly positive effects on weight-for-age related measures and mixed evidence for anemia. Impacts of CCT programs in Indonesia, Uruguay and Mexico on birthweight have been found to be positive but often small and insignificant (Amarante et al. 2011; Barber and Gertler 2010; Triyana 2016). Similarly, rigorous evidence of the effect of CCTs on child mortality is largely absent in the literature (Hunter et al. 2017), particularly for South Asia (Glassman et al. 2013; Hunter et al. 2017). An exception is the aforementioned study by Powell-Jackson et al. (2015).

Consistent with IGMSY's objectives, we find that the program increases recent interactions of mothers with local public health centers by fourteen percent and complete infant immunization by nine percent. This suggests that the program entails substantial and persistent gains in health services use, well beyond the period covered by the cash transfers. Furthermore, we present less robust evidence that children are less likely to be born with low birthweight and that the incidence of underweight in children aged between one and five years drops significantly, from around 37 to 32 percent. Our results indicate that the effect on vaccination is concentrated among girls, whereas children from disadvantaged social groups benefit more in terms of underweight reduction. We find no reliable comparable improvements with respect to other health and health service use indicators.

Overall, the evaluation shows a mixed record, with solid improvement in health service use, potential improvements in weight-related outcomes but no further health improvements. The effect on health care and immunization is to be commended given India's dismal record on these indicators up until the first decade of the 21st century(WHOÉ. Moreover, our estimates show that the program has the potential to enable India to achieve the SDG's targeted 95% full immunization (among children under five) by 2030. Apart from this, the program design successfully avoids unintended side-effects on fertility. Thus, our findings are of importance to policy makers because they can serve to support but also to improve the design of IGMSY/PMMVY and similar programs. In particular, it becomes clear that an increase in the supply and demand of health care is not sufficient to lastingly improve several health outcomes in children and mothers. Accordingly, policies are warranted which tackle the root causes of these health risks and simultaneously raise the quality of health services.

The rest of the paper is structured as follows: Section 2 introduces the IGMSY/PMMVY program. Section 3 lays out the theory of change while section 4 sets out the empirical strategy. Section 5 describes the data and discusses its limitations. We present balancing tests and the main results in section 6. Section 7 concludes.

2. The IGMSY/PMMVY conditional cash transfer program

The Indian government started a first mother and child health related conditional cash transfer in 2005 for incentivizing safe deliveries. This program, the *Janani Suraksha Yojana* (JSY), which literally translated means Safe Motherhood Scheme, pays a one-time cash transfer to mothers conditional on institutional delivery or skilled assistance for delivery at home. It was partially motivated by the fifth millennium development goal (MDG), improve maternal health, whereby one of two progress indicators is the proportion of births attended by skilled personnel (United Nations Development Program 2015). This program has not been universal: while all births of mothers have been eligible for a transfer of Rs. 1,400 in rural and Rs. 1,000 in urban areas of ten "low-performing states", only the first two births of mothers in below-the-poverty-line households or from disadvantaged social groups have been eligible for Rs. 700 and Rs. 600 in all other states (Lim et al. 2010). While the said MDG indicator improved rapidly, from 46.6 percent in 2005/06 to 81.4 percent in 2015/16 (Ministry of Statistics and Programme Implementation 2017, 2011), policymakers recognized that complications during delivery are not the only risk to maternal and child health. Poor nutrition and health during pregnancy and lactation can have negative health consequences that affect mother and child throughout their lives. Moreover, JSY fails to cover the wage loss of mothers during pregnancy and lactation and does not directly incentivize behavioral practices beneficial to both mother and child health that go beyond safe delivery, such as adequate nutrition or preventive health care such as vaccination (Ministry of Health and Family Welfare).

The *Indira Gandhi Matritva Sahyog Yojana* (Indira Gandhi Motherhood Support Scheme) has been an attempt to fill this gap. It aims to improve maternal and infant health through a conditional cash support during the time of pregnancy and lactation. Unlike JSY, this program has been universal, covering the first two live births of all women in India with the exception of government employees. The cash benefit of initially Rs 4,000 (approximately USD 65) is equivalent to 7.3 (6.0) times the monthly rural (urban) poverty line or 31 female unskilled agricultural daily wages in 2011. It is funded by the national government via the state and district branches of the integrated women and child development scheme (ICDS). Originally, the transfer has been sent to the mother's bank account in three installments, at the last trimester of the pregnancy and three and six months after the delivery, conditional on the program conditions.

All activities related to the conditions of IGMSY take place at local primary health care centers, known as *Anganwadi* centers. The compliance with these conditions is monitored there and *Anganwadi* staff also receives a monetary incentive of Rs. 100 to 200 per completed case. The comprehensive list of conditions and the timing of the cash transfers under the original scheme is included in Table A1 in the appendix. Apart from one antenatal check-up and tetanus immunization for mothers, IGMSY directly incentivizes three child immunizations: one dose of

BCG (Bacillus Calmette-Guérin), which protects primarily against tuberculosis, and three doses of polio and DPT (diphtheria, pertussis and tetanus) vaccine, respectively. In addition, IGMSY features various nutrition-related conditions: during pregnancy, mothers have to collect iron and folic acid (IFA) tablets and attend a nutrition and health counseling session. After the delivery, the child's weight is to be recorded four times and the mother has to participate in four infant feeding counseling sessions.

With more than 1.3 million Anganwadi centers all over the country, the public primary health care infrastructure necessary to fulfill the program conditions is dense and, at least in principle, free of charge. In addition, part of the government's budget allocation for IGMSY was dedicated to hiring of additional staff in Anganwadi centers of pilot districts, so that an undersupply of the incentivized services is unlikely (Press Information Bureau 10/20/2010).

During a pilot phase, the program was geographically targeted and implemented in only 52[5] of India's 640 districts (Ministry of Women and Child Development 2019). Unlike the vast majority of geographically targeted welfare programs in India, the pilot phase of IGMSY has not focused on the country's most destitute areas. Instead, a deliberate attempt was made to identify a set of districts representative for the country as a whole. The following stratified selection procedure was employed (Ghosh and Kochar 2018; Ministry of Women and Child Development 2011): First, an index of six health and development indicators was calculated from the third round of the District Level Household and Facility Survey (DLHS-3), fielded in 2007 and 2008. Second, according to this index, all 640 districts of India were categorized as either low, medium or high-performing. From these three groups, the pilot districts were randomly selected, eleven from the high and low-performing categories, and twenty-six from the medium-performance categories. The remaining four districts were union territories (UTs).

In October 2010, the program was approved for implementation by the central government, with budgetary allocations of Rs. 3.9 and Rs. 6.1 billion for the fiscal years 2010/11 and 2011/12 (Press Information Bureau 10/20/2010). According to our calculations, the latter amount corresponds to roughly Rs. 4,600 per eligible birth. However, less than this amount was eventually spent: in the states in our analysis, state expenditure per eligible child was Rs 6 in 2010/11 and 3,190 in 2011/12, rising to 3,438 and 8,458 in the following years[6]. The actual implementation of the scheme started not before April 2011. Program guidelines were agreed upon between the center and the states in April 2011 and training of implementation staff on the ground was scheduled for late May 2011 (Ministry of Women and Child Development 2011). Moreover, transfers from the central to the state governments were often delayed and not reaching before September (Sinha et al. 2016). Accordingly, in the first months of 2010-11, there were virtually no beneficiaries of the scheme (none in the states in our analysis) and about 28, and 59 percent of the 1.2 million target beneficiaries were reached in the two

[5] Due to the separation of Kundagaon from the pilot district Bastar, this number increased to 53 districts in 2012.
[6] For our definition of program expenditure per eligible case and data sources see appendix A6.

subsequent years (Falcao et al. 2015). In 2013, the cash transfer increased from Rs 4,000 to Rs 6,000 and was paid in two rather than three installments.

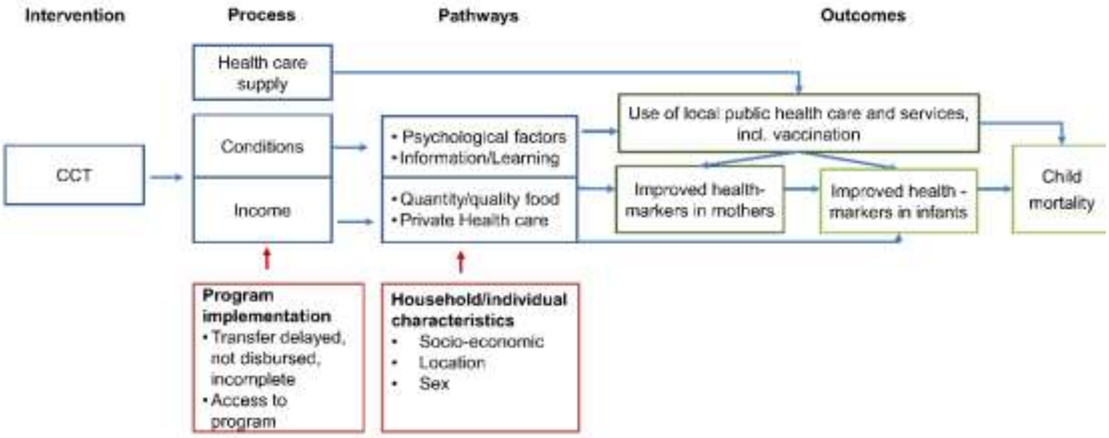
In 2017, the program was renamed *Pradhan Mantri Matritva Vandana Yojana* (PMMVY), in English the Prime Minister's Reverence for Maternity Scheme, and expanded to all districts of India with a cash transfer of Rs. 5,000 per woman paid in three installments, two during pregnancy and one after. Only the first live birth is eligible under PMMVY. The stated objectives of this program are, first, to provide "partial compensation for the wage loss [...] so that the woman can take adequate rest before and after delivery". Second, "the cash incentive provided would lead to improved health seeking behavior amongst the pregnant women and lactating mothers" (Press Information Bureau 12/28/2017), more explicitly, safe delivery and immunization of firstborn children (Press Information Bureau 12/6/2019).

In terms of expenditures, with a budget allocation in 2017/18 of 27 billion Rupees (USD 400 million), PMMVY is India's largest conditional cash transfer program ever, accounting for 0.13 percent of government expenditures. In comparison, the older JSY CCT program, which has paid a maximum of Rs. 2,000 for an institutional delivery as of 2015, had a budget allocation of 20 billion Rupees in 2017/18. On the other hand, according to administrative data, JSY reached out to 10,04 million women during the financial year 2018/19, while there were 7.5 million beneficiaries under PMMVY. Still, unlike the IGMSY pilot, PMMVY appears underfunded relative to the program entitlements. According to a simple back-of-the-envelope calculation, around twice the allocated budget would be needed to adequately fund the roughly 9.5 million first births in India in 2018.

3. Theory of change

We now turn to the possible pathways of an effect of CCTs on health service use and child health. Gaarder et al. (2010) develop a theory of change for the impact of CCTs on health. We adapt this below to the setting of perinatal health and the Indian social context. The beneficial effects of CCTs on maternal and child health outcomes can run through several channels, depicted in Figure 1. First, conditions for the receipt of cash transfers may directly incentivize healthy behaviors in the form of increased demand for maternal and child health inputs. In the case of IGMSY, the program conditions require the repeated interaction with a health worker during antenatal care, collection of IFA tablets and weight monitoring sessions. This raises the probability of prevention, early detection and treatment of health deficiencies. Moreover, preventive health service seeking is stimulated through conditioning on vaccinations against communicable diseases. Second, IGMSY may indirectly promote healthy behaviors through the trainings in the incentivized educational sessions. Third, there can be an income effect due to the cash transfer, whose funds might be spent on additional healthcare and food during the critical phase of pregnancy, childbirth and lactation. While the cash transfer can in principle be spent on non-health related items, the literature suggests that expanding mother's income increases expenditure on child nutrition and health (Quisumbing and Maluccio 2000). Finally, the additional income may also contribute to maternal health by reducing the labor supply of beneficiary women during pregnancy. The expansion of Anganwadi center coverage with the onset of IGMSY may also lift barriers in access to health care and thus increase health care use unrelated to either the cash transfer or its conditions.

Figure 1: Theory of change



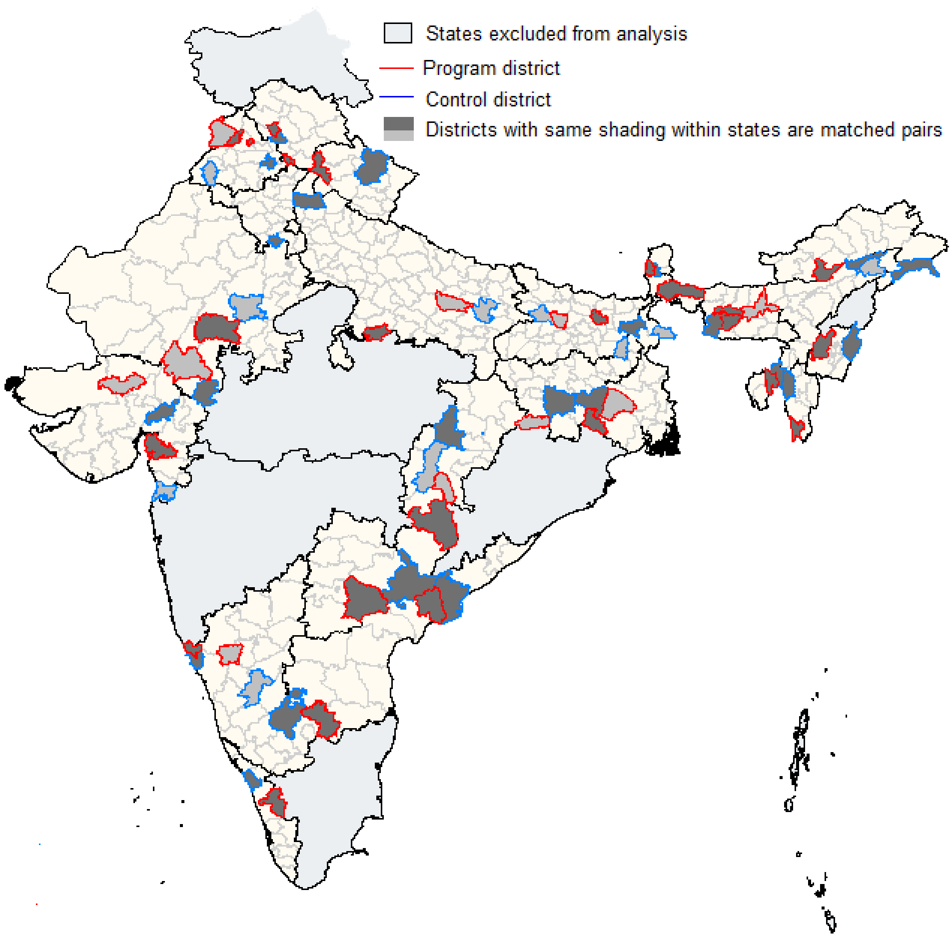
Source: own depiction, based on Gaarder et al. (2010)

The relevance of these pathways and their nexus to health has been affirmed by Gaarder et al. (2010) and Attanasio et al. (2015). Thus, to different extents, each of these effects can improve several infant and child health indicators that are affected by these infectious diseases, poor maternal health, inadequate nutrition and other unhealthy behaviors: birthweight, underweight (low weight-for-age), stunting (low height-for-age) and anemia, as well as mortality (WHO 2010, WHO 2014b). Of course, the impacts of the program through each of these channels largely depend on the quality of its implementation as well as on individual and household characteristics. Regarding the former, the effect of the cash transfer will be mitigated if the transfer does not or only incompletely reach the eligible women due to poor implementation. We also predict that benefits are concentrated on first and second born children if the eligibility rules are enforced and spillover effects to later-born siblings are small. With respect to other individual and household characteristics, we expect traditionally disadvantaged households- those that are poor, from a scheduled caste or tribe (SC/ST) or living in the rural sector (Balarajan et al. 2011)- to profit more from the program (Gaarder et al. 2010) – unless these characteristics restrict their access to the program (Powell-Jackson and Hanson 2012). In addition, effects may disproportionately benefit girls as Indian parents tend to invest more in boys' than in girls' health (Asfaw et al. 2010).

4. Empirical approach

We approach the pilot phase of the program as a natural experiment which exploits the differential access of children to the program. We elicit intention to treat effects (ITT) of IGMSY through a matched-pairs difference-in-differences approach. The effect of the program on children which had access to the program and those who had not is compared along two dimensions: first by taking the difference between eligible and ineligible cohorts within each district and second by comparing program to control districts.

Figure 2: Matched pairs of program and control districts



Note: Based on geospatial data from GADM database (2015). Excluded from analysis are states with state-specific, state-wide maternity programs in 2011-12, UTs and Jammu and Kashmir, where districts could not be identified unequivocally.

We identify one control district for each pilot (here: program) district through a matched-pair design. This is done by recalculating, for all districts, the health development index used by the Indian government to select pilot districts, based on data from DLHS-3 reports (International Institute for Population Sciences (IIPS) 2010). Index scores of all districts in our analysis are set out in Table A8 in the appendix. Next, we select within each state the nearest neighbor to each program district in terms of the index.[8] If selection of treatment districts within each stratum was non-random but politically or need-driven, this could bias estimates of the program effect. While government officials interviewed by Ghosh and Kochar (2018) report that treatment districts were chosen randomly, we mitigate in addition any selection bias through our matched selection of control districts. Moreover, we rely not solely on the comparison of pilot and control districts but also compare birth cohorts, as differences between the latter are unaffected by administrative selection.

In principle, all women who fulfilled the eligibility criteria in December 2010 and thereafter were eligible to receive IGMSY benefits (Ministry of Women and Child Development 2011). However, registration of beneficiaries (possible until the fourth month of pregnancy) and disbursement of benefits would have started at the earliest in June, when the training of the ICDS staff was scheduled to be completed. Accordingly, no beneficiaries were registered in the states in our sample before the fiscal year 2011/12 (Falcao et al. 2015). Moreover, only one state in our analysis (Meghalaya) spent any funds on IGMSY in 2010 and despite identical numbers of target beneficiaries in 2011 and 2012, the amount of funds expended by state governments in 2011 was only half of those spent in 2012 (Falcao et al. 2015). This insinuates that the program only took off in the 2nd half of the financial year. For these reasons we take the conservative approach and assume that the first cohort of children that was sure to profit from IGMSY during pregnancy and lactation was born in January 2012 or later.

Our estimator compares the difference in outcomes of children born before 2012 and children born in 2012 or later within program districts to the same difference in control districts of the same state. Due to our fuzzy design, in which some children in our control cohort might nonetheless have had access to the program, the estimator represents a lower bound of the program effect.

The regression equation is

$$H_{sdit} = \alpha_{sd} + \mu_t + (\delta_s \times eligbirth_t) + \beta(T_d \times eligbirth_t) + \gamma X_{sdti} + u_{sdit}, \quad (1)$$

where i indexes children, d districts and s states, while t stands for the birth year and; H_{sdti} is a health service use, vaccination or health outcome. The coefficient β gives the ITT effect of

[8] For the selection of control districts within states we treat Telangana, which separated from Andhra Pradesh in 2014, as part of Andhra Pradesh.

IGMSY: T_d is a dummy variable indicating whether a child lives in a program district, $eligbirth_t$ specifies whether a child was born in the year 2012 or later; X_{sdti} is a vector of individual and household-level control variables.[9]; α_{sd}, μ_t and δ_s are district, birth year and state fixed effects: μ_t captures average cohort-specific differences between children common to both program and control districts (and thus includes spatially independent differences between children born before and after the program launch); district fixed effects, α_{sd}, account for cohort-independent differences between districts (thus absorbing cohort-independent differences between program and control districts); finally $\delta_s \times eligbirth_t$ captures state-specific time trends; u_{sdti} is a stochastic error term. In line with common practice, we cluster standard errors at the level at which program status varies, the district (Abadie et al. 2017). Fehler! Linkreferenz ungültig.

We account for the threat of falsely rejecting the null-hypothesis of no effect when estimating several outcome variables with the same sample by adjusting the p-values for the respective null hypotheses for families of local health service outcomes (Table 2), vaccination outcomes (Table 3) and health outcomes (Table 4) as suggested by Romano and Wolf (2005). This method corrects for multiple inference by applying bootstrapping to stepdown adjusted p-values that control for the familywise error rate.

5. Data

5.1 The National Family Health Survey

Our main source of data for use of health services as well as health outcomes is the seventh round of the Demographic and Health Survey (IIPS and IFG 2018) conducted in India, commonly known as the fourth National Family and Health Survey (NFHS-4). This survey of more than half a million households, was fielded between January 2015 and December 2016. We derive our outcome and control variables from the children's dataset, which contains data on 259,627 children born five years before the survey took place and later. This means our data covers roughly half of the 2010 birth cohort and all children in later cohorts. We use the sampling weights included in the data throughout to make all figures representative for the respective populations.

We use only a subset of the observations in the NFHS children's module. First, in order to avoid spillovers to control districts, we eliminate states that offered additional state-specific and state-wide maternity benefit programs which included cash transfers in 2011 or 2012.[11]

[9] We do not control for father's characteristics as these are only available for a small subsample.

[11] These states (programs) are Madya Pradesh (Mukhyamantri Mazdoor Suraksha Yojana), Maharashtra (Matrutva Anudan Yojana), Odisha (Mamata) and Tamil Nadu (Dr. Muthulakshmi Maternity Assistance Scheme).

Second, we exclude UTs[12], which are nationally governed and only consist of one district, as well as Jammu and Kashmir since districts in the latter cannot be matched unequivocally with districts in the NFHS. Third, in accordance with IGMSY's eligibility rules, we restrict the analysis to children of mothers aged at least 19 years at the time of birth of the child. Fourth, to make the cohorts exposed to the program as comparable as possible to the older cohorts not exposed to IGMSY we focus on children born in the four years around January 2012, the year in which the first cohort which fully profited from the program was born. We hence restrict the children's sample to the birth cohorts 2010, 2011, 2012 and 2013. Finally, we exclude observations with a missing value among the control variables.[13] We do not restrict our sample to the officially eligible first and second born children due to the possibility of imperfect compliance with this rule and potential spillover effects to later born siblings. Spillovers to younger siblings are particularly likely when payments are delayed, evidence of which exists in several states (Niti Aayog and DMEO 2017). The dataset for our empirical analyses contains 13,367 children in 70 districts (35 program and control districts each) of 24 states, which host around 70 percent of India's population.

5.2 Outcome variables

The outcomes of interest we consider can be partitioned into two broad categories. First, use of health services conducive to maternal and child health. These comprise self-reported use of state health care and completion of basic vaccinations. The second set of outcomes measures the health status of children. It includes one indicator of early child health, low birthweight, and several medium-term health outcomes. The latter are anthropometric and hemoglobin measurements taken at the survey interview, and mortality.

As we have laid out in Section 2, a central objective of IGMSY/PMMVY is to improve pregnant women's and lactating mothers' use of health services. The program's implementation rules mandate that the corresponding incentivized activities – those that are conditions for obtaining cash transfers – are provided by Anganwadi centers. Therefore, we include all survey questions in the NFHS children's dataset which literally contain the word "Anganwadi" and are administered either for all children aged five and younger or all women aged 15 to 49. These are four: first and second, the incidence of benefits from Anganwadi centers, essentially health services and products, received by the mother during pregnancy or lactation, which we take as measures of use of antenatal and postnatal health care, respectively. Third and fourth, the incidence of Anganwadi benefits among children as well as contacts of their mothers with Anganwadi staff three and six months preceding the survey interview, which we take as measures of the program's longer term effects on access to state health care.

[12] Chhandigarh, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep, Puducherry, Andaman and Nicobar Islands

[13] Detailed observation numbers documenting how we arrive at our estimation sample contains Table A9 of the appendix.

Regarding immunization, our principal interest is in the incidence of complete child immunization by India's national definition, which comprises one dose of BCG, typically given right after birth, three shots of DPT (DPT-3) and polio (polio-3), given within the first four months, and one dose of measles vaccine, which should be administered after nine months at the earliest (Ministry of Health and Family Welfare 2019). Since all these vaccinations should be completed by the age of two at the latest, our sample, in which children are on average 3 years old, is well suited to assess complete immunization status. We also consider the vaccinations BCG, DPT-3, polio-3, and measles separately. Under IGMSY/PMMVY, BCG, DPT-3 and polio-3 are directly incentivized, while the measles immunization is beyond the program's scope, which ends six months after the delivery. We thus view any effects on measles immunization status as an indirect or spillover effect of the program.

We define our health outcomes following WHO standards. According to these, a child exhibits low birth weight, if it weighs less than 2,500 grams at birth (WHO 2014a). A child is underweight at the time of the survey if its weight-for-age z-score (WAZ), the number of standard deviations from the WHO reference population's median, is smaller than -2 (WHO 2018b). Similarly, a child is stunted if its height-for-age z-score (HAZ) is smaller than -2. We code a child as anemic if its hemoglobin level falls short of 11 g/dl. (WHO 2011). While these binary health indicators have the disadvantage over continuous ones that small health changes far from the threshold cannot be detected, they enable us to define and measure a state of deprivation, which facilitates policy guidance. Finally, mortality is measured through a binary variable indicating that a child is no longer alive at the time of interview.

According to the summary statistics set out in Table A11 of the appendix, the districts in our research design are comparable to all-India averages of the outcome variables (Dhirar et al. 2018). While the NFHS includes a number of measures of activities incentivized by IGMSY/PMMVY in addition to the ones just discussed, we choose to ignore them in our analysis because they cover only the last delivery of a woman.

6. Results

6.1 Balancing test

For an unbiased estimate of the program effect, children from our control and program districts must be similar in observable and unobservable characteristics. We assert this in a balancing test in Table 1. Except for the percentage of children with low birth weight, there are no significant differences in outcomes and other observable characteristics between children in program and control districts. Thus, we argue that most outcomes were similar between program and control districts before the start of the program. However, the balancing test

Table 1: Balancing test

	Control districts		Program districts			
	Mean	Stand. dev.	Mean	Stand. dev.	Pr |T|>t difference in means	Obs.
Outome variables						
AWC benefits during pregnancy (%)	52.39	49.95	56.71	49.56	0.599	4666
AWC benefits during breastfeeding (%)	48.04	49.97	52.29	49.96	0.621	4657
AWC benefits in last 12 months (child) ('	49.22	50.01	55.63	49.69	0.329	4482
Mother saw AWW in last 3 months (%)	40.27	49.06	41.48	49.28	0.844	4669
BCG vaccinated (%)	90.29	29.61	91.6	27.74	0.542	4482
DPT-3 vaccinated (%)	79.62	40.29	80.58	39.57	0.825	4482
Polio-3 vaccinated (%)	67.5	46.85	69.52	46.04	0.712	4482
Measles vaccinated (%)	83.83	36.83	85.14	35.57	0.704	4482
Complete vaccination (%)	59.11	49.17	61.21	48.74	0.743	4482
Low birth weight (%)	9.96	29.95	14.32	35.04	0.056	4482
Underweight (%)	36.61	48.19	39.45	48.89	0.441	4190
Stunted (%)	38.89	48.76	37.96	48.54	0.867	4190
Anemic (%)	47.49	49.95	47.1	49.93	0.919	4203
Mortality (%)	3.75	19	3.98	19.54	0.837	4669
Other observable characteristics	3.72	0.45	3.72	0.45	0.955	4482
Child age	45.58	49.82	47.09	49.93	0.452	4669
Female (%)	151.19	6.24	151.44	5.89	0.879	4669
Mother's height (cm)	28.96	4.69	28.89	4.74	0.696	4669
Mother's age	65.67	47.49	65.5	47.55	0.981	4669
Mother formally educated (%)	32.33	46.78	35.73	47.93	0.475	4669
SC/ST (%)	81.25	39.04	81.64	38.72	0.935	4669
Hindu (%)	26.24	44	28.05	44.93	0.843	4669
Wealth index quantile	22.85	42	19.82	39.87	0.403	4669
First	17.97	38.4	19.33	39.5	0.656	4669
Second	17.99	38.42	18.26	38.64	0.954	4669
Third	14.94	35.66	14.54	35.26	0.941	4669
Fourth	70.89	45.43	76.78	42.23	0.551	4669
Fifth	36.87	21.68	37.72	23.41	0.685	3041
Rural (%)	45.29	49.79	43.25	49.55	0.842	4669

Note: p-values obtained by clustering standard errors at the district level. All estimates computed using sampling weights provided by NFHS-4. Sample: children born 2010-2011 by mothers aged at least 19 at birth of child. 70 districts.

indicates that program effects on low birthweight found in our main analysis likely reflect initial differences between treatment and control districts.

Another potential threat to our identification strategy would be selection bias introduced by families moving from control to program districts in order to profit from the program. However, we find no effect of IGMSY on years of residence in the current location (results not shown).

6.2 Effects of IGMSY/PMMVY on health services utilization

Our results regarding local health provider contact and vaccination indicate that IGMSY increased health service use. Table 2 presents the findings regarding the program's impact on use of health services and products provided by Anganwadi centers. While we find no significant evidence that children benefit more from these during pregnancy, lactation or in the medium term, the probability that a child's mother met an Anganwadi worker in the three months before the interview increases by roughly 6 percentage points. This result is significant at the 1% level even when p-values are adjusted for multiple inference. Table 3 sets out the ITT effect on immunization. The coefficients all have the expected positive sign. Column five shows that children eligible for the program are on average 5.3 percentage points more likely to be fully immunized, an eight percent improvement. Interestingly, despite this significant overall improvement, and a significant point estimate for polio-3 vaccination, we find no statistically significant effects for the individual vaccinations (columns 1 - 4) when we adjust p-values for multiple inference.

Table 2: Program effect on Anganwadi center contact

	(1)	(2)	(3)	(4)
	AWC/ICDS contact			
	Prenatal benefits mother	Postnatal benefits mother	Mother met AWW last 3 months	Child benefits in last 12 months
Program District x Birth Year 2012 or Later	1.85	0.97	5.56***	0.91
	(1.26)	(1.35)	(1.08)	(1.27)
	{0.31}	{0.71}	{0.00}	{0.71}
Control Mean (Percent)	52.4	48.0	40.3	49.2
Observations	13886	13854	13897	13308
No. Clusters	70	70	70	70

Note: Linear probability models. Outcomes are dummy variables indicating that mother received Anganwadi center benefits or services during pregnancy, during lactation, child received benefits or services in the last 12 months and mother met an Anganwadi worker in the last 3 months. Coefficients in percentage points. Birth year in 2012 or later is a dummy variable equal to 1 when a child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are birth order of the child, mother's educational level, age, squared age and height, household religion and wealth index factor score, and dummy variables equal to 1 if the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: children alive at time of interview born 2010-2013 to mothers aged at least 19 at birth of child, 70 districts. All estimates are computed using sampling weights, birth year and district fixed effects as well as cohort-specific state fixed effects. Robust standard errors clustered at the district level in parentheses. Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference in columns (1)-(4)) in curly brackets.

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

Table 3: Program effect on child vaccination

	(1)	(2)	(3)	(4)	(5)
	Vaccinations				
	BCG	DPT-3	Polio-3	Measles	Complete Vacc.
Program District x Birth Year 2012 or Later	0.92	2.97	2.23	2.03	5.34**
	(1.22)	(1.96)	(2.06)	(1.42)	(2.32)
	{0.47}	{0.33}	{0.47}	{0.33}	
Control Mean (Percent)	90.7	80.6	69.3	84.2	61.0
Observations	12796	12796	12796	12796	12796
No. Clusters	70	70	70	70	70

Note: Linear probability models. Outcomes are dummy variables indicating BCG (Bacillus Calmette-Guèrin vaccine, primarily employed against tuberculosis); DPT-3 (third diphtheria, pertussis and tetanus vaccination dose); Polio-3 (third Polio vaccination dose); measles and complete vaccination (child has completed all four of the above vaccinations). Coefficients in percentage points. Birth year in 2012 or later is a dummy variable equal to 1 when a child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are birth order of the child, mother's educational level, age, squared age and height, household religion and wealth index factor score, and dummy variables equal to 1 if the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: children alive at time of interview born 2010-2013 to mothers aged 19-39 at interview and at least 19 at birth of child, 70 districts. All estimates are computed using sampling weights, birth year and district fixed effects as well as cohort-specific state fixed effects. Robust standard errors clustered at the district level in parentheses. Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference in columns (1)-(4)) in curly brackets.

* p<0.10 ** p<0.05 *** p<0.01

6.3 Effects of IGMSY/PMMVY on child health outcomes

Table 4 provides estimates of the program effect on child health outcomes. IGMSY significantly decreases the incidence of low birth weight by 4 percentage points (column 1). This effect is significant at the 1 percent level when applying a conventional p-value and at the five percent level when adjusting for multiple inference. Notwithstanding this, these results are to be taken with caution as the balancing test (Table 1) suggests that this effect is largely due to a systematically higher birthweight of children in treatment districts before program implementation.

More reliable are the results for underweight at the time of interview, when children are one to five years old. We find that the program decreases underweight by 4.6 percentage points (column 2). This result is significant at the 1 percent level with conventional p-values and at the 5 percent level for multiple inference adjusted p-values. The point estimates for stunting and anemia are positive (columns 3-4). However, they are statistically insignificant when accounting for multiple inference. According to column 5 of Table 4, there is a small beneficial effect on child mortality which dissipates when p-values are adjusted for multiple inference.

Table 4: Program effect on child health

	(1)	(2)	(3)	(4)	(5)
	Health Outcomes				
	Low Birth Weight	Underweight	Stunting	Anemia	Mortality
Program District x Birth Year 2012 or Later	-4.03***	-4.63***	0.43	3.90**	-1.02*
	(1.17)	(1.66)	(2.10)	(1.90)	(0.56)
	{0.01}	{0.02}	{0.83}	{0.12}	{0.13}
Control Mean (Percent)	10.0	36.6	38.9	47.5	3.7
Observations	13308	12390	12390	12523	13897
No. Clusters	70	70	70	70	70

Note: Linear probability models. Outcomes are dummy variables indicating underweight (WAZ below -2); stunting (HAZ below -2); anemia (hemoglobin level below 11 g/dl) and mortality. Coefficients in percentage points. Birth year in 2012 or later is a dummy variable equal to 1 when a child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are birth order of the child, mother's educational level, age, squared age and height, household religion and wealth index factor score, and dummy variables equal to 1 if the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: children born 2010-2013 to mothers aged at least 19 at birth of child, 70 districts. Except for column (5), which comprises all livebirths, the sample consists only of children alive at the time of interview. All estimates are computed using sampling weights, birth year and district fixed effects as well as cohort-specific state fixed effects. Robust standard errors clustered at the district level in parentheses. Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference in columns (1)-(4) and columns (6)-(9)) in curly brackets.
* p<0.10 ** p<0.05 *** p<0.01

6.4 Heterogeneous program effects

In our exploration of potential differences in program effects for various sub-groups, we focus on the reliable effects we find in the previous section, namely Anganwadi center use and full vaccination (heterogeneous effects on low birth weight and underweight can be found in Table A12 and Table A13). For these we estimate heterogeneous program effects by child and household characteristics as well as program implementation. We define a state as high implementation state if it has an above-median (Rs 1,578) expenditure per eligible case in 2012 and 2013 (see section A6 in the appendix for a derivation of this measure). The p-values of the differences of individual and household characteristics in the analysis of heterogeneous effects are adjusted for multiple inference with Benjamini and Hochberg's (1995) method.

Table 5 displays the effect of the program on Anganwadi center use for various sample splits and the differences between corresponding subsamples. the coefficients for children of the first two birth orders, girls and children living in wealthy, SC/ST and rural households and in states with low expenditure per eligible population are of larger magnitude than those of ineligible children, boys, children from advantaged social groups, living in poorer, urban households and in high-expenditure states. However, none of the differences between the corresponding subsamples is significant.

The corresponding heterogeneous effects for full vaccination rates are presented in Table 6. Comparable to Anganwadi center use, coefficient size is larger for first and second borns, girls, and children living in wealthy, SC/ST and rural households. However, the coefficient is larger

Table 5: Heterogeneous program effects on Anganwadi service use

Sample split by:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Individual and Household Characteristics										Intensity of Program Implementation (by State)	
	Birth order		Sex		Wealth		Social Group		Residence			
	First/Second	Third/higher	Female	Male	Bottom 40%	Upper 60%	SC/ST	Other	Rural	Urban	Low	High
Program District x Birth	6.00***	2.39	6.22***	5.01**	4.33**	5.99***	5.40***	5.26***	4.98***	-1.02	7.72***	3.90**
Year 2012 or later	(1.67)	(2.77)	(2.02)	(2.08)	(1.88)	(2.00)	(1.86)	(1.78)	(1.51)	(4.26)	(1.82)	(1.48)
Difference	3.85		1.21		-1.66		0.29		6.06		-3.80	
	[0.31]		[0.73]		[0.60]		[0.92]		[0.21]		[0.10]	
Benjamini-Hochberg q-value	{0.922}		{0.922}		{0.922}		{0.922}		{0.922}			
Control Mean (Percent)	41.1	40.3	44.8	37.4	47.4	34.6	44.8	38.8	45.8	27.0	44.8	42.3
Observations	9382	4515	6734	7163	6891	7006	6173	7724	10753	3144	6812	6799
No. Clusters	70	70	70	70	69	70	70	68	67	70	34	34

Note: Linear probability model. Outcome is a dummy variable equal to 1 if the mother met an Anganwadi worker in the three months before the survey interview. Coefficients in percentage points. Birth year 2012 or later is a dummy variable equal to 1 if the child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Sample: children born to mothers aged 19-39 between 2010-2013, 70 districts. Subsamples: Wealth comprises children in households that belong to the poorest 40 percent (wealthiest 60 percent) of sample households, based on factor score of an asset index. Social group comprises children in households belonging (not belonging) to a Scheduled Caste or Tribe. Residence comprises children living in a rural (urban) area. Birth order comprises first and second (third or later) born children. Low (high) intensity of program implementation consists of children in states with Rs. total expenditure 2012 and 2013 per eligible case (first and second births of mothers aged at least nineteen years old in pilot districts) below (equal to /above) median. Additional controls included but not reported in the table are sex (except in male/female subsamples) and birth order of the child, mother's educational level, age, squared age and height; household religion, wealth index factor score and whether the household belongs to a Scheduled Caste or Tribe (except in SC/ST subsamples) and whether it is situated in a rural/urban area respectively (except in rural/urban subsamples). All estimates are computed using sampling weights, year and district fixed effects as well as cohort specific state fixed effects. Robust standard errors clustered at the district level in parentheses, p-values for differences between subgroups in columns (1) and (2); (3) (4); (5) (6); (7) (8); (9) (10); (11) (12) respectively in square brackets, Benjamini-Hochberg q-value (p-value of subgroup difference adjusted for multiple inference of individual/household characteristics in columns (1)-(10)) in curly brackets.

* p<0.10 ** p<0.05 *** p<0.01

Table 6: Heterogeneous program effects on complete vaccination

Sample split by:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Individual and Household Characteristics										Intensity of Program Implementation (by State)	
	Birth order		Sex		Wealth		Social Group		Residence			
	First/Second	Third/higher	Female	Male	Bottom 40%	Upper 60%	SC/ST	Other	Rural	Urban	Low	High
Program District x Birth	6.64***	1.84	7.98***	2.47	4.05**	5.51**	8.13**	4.02**	6.00***	-0.97	2.30	5.61***
Year 2012 or later	(1.91)	(3.12)	(2.02)	(2.31)	(1.82)	(2.44)	(3.22)	(1.94)	(1.77)	(4.14)	(3.45)	(2.01)
Difference	4.73		5.49		-1.46		3.95		6.92		3.24	
	[0.21]		[0.07]		[0.62]		[0.33]		[0.13]		[0.42]	
Benjamini-Hochberg q-value	{0.625}		{0.350}		{0.625}		{0.625}		{0.512}			
Control Mean (Percent)	63.2	53.0	59.3	60.8	54.3	65.4	61.0	59.6	59.0	63.1	63.3	61.0
Observations	9016	4292	6476	6832	6536	6772	5888	7420	10257	3051	6515	6510
No. Clusters	70	70	70	70	69	70	70	68	67	70	34	34

Note: see previous table. Outcome is a dummy variable equal to 1 if a child has completed one dose of BCG and measles as well as three doses of DPTand polio vaccination.
* p<0.10 ** p<0.05 *** p<0.01

for states with high program expenditure. Only for sex do we find an at conventional levels statistically significant difference between the two corresponding subsamples. The program increases the likelihood of a full vaccination for girls on average by 5.5 percentage points more than for boys. These estimates are significant at the ten percent level but not robust to multiple inference.

For our weight-related outcomes which yielded significant but less reliable results in the previous section, we find significantly higher effects low birthweight in first born and wealthy children when adjusting for multiple inference (Table A12), as well as significantly larger effects on underweight of children from scheduled castes and tribes (Table A13). However, this differential effect disappears when adjusting p-values for multiple inference

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6.5 Robustness

To assess whether the key assumption underlying our matched-pair difference-in-differences approach, parallel trends in outcomes absent IGMSY, is internally valid, we conduct a placebo test. To this end, we repeat our main analysis with data from India's third District Level Household Survey, DLHS-3, which was fielded in 2007 and 2008, well before the onset of IGMSY. We choose this survey for the following reasons. The preceding demographic and health survey NFHS-3, fielded in 2005 and 2006, contains only state but no district identifiers. On the other hand, the latest DLHS, the DLHS-4 from 2012, does not cover nine major Indian states which feature prominently in our main estimation sample. The complementary AHS (Annual Health Survey), which covers those nine states, does not allow to combine the household, woman and children's modules. We therefore select the DLHS-3. While its household sample is twenty percent larger than in NFHS-4, it contains no information on child anthropometrics and no comparable information about Anganwadi service use, and vaccinations as well as mortality are recorded for children only up to three years of age instead of five in NFHS-4. More precisely, DLHS-3 contains only the birth cohorts 2004, 2005 and 2006, while the cohorts 2010-2016 are featured in NFHS-4. In parallel to our main estimations, where the oldest two cohorts featured by the survey constitute the ineligible children in treated districts, we use the oldest two cohorts in DLHS-3 for this purpose – which leaves us with only the 2006 cohort as placebo eligible children.

Descriptive statistics for the placebo sample are set out in Table A11 and the estimation results in Table 7. Consistent with the relatively large sample size in DLHS-3 and a higher fertility rate in the 2000s compared to the 2010s, there are around 25 percent more observations in the placebo than in our main sample. Among the five outcomes there is a single one, DPT-3, which is negative and borderline significant. However, the p-value equals merely 0.22 when adjusting for multiple hypotheses.

As discussed in the empirical approach, some children born between June and December 2011 may have profited early from the program, leading us to underestimate the program effect. In order to test whether our definition of treated cohorts influences our results, we exclude children

Table 7: Placebo test using DLHS-3 data for children born 2004-2006

	(1)	(2)	(3)	(4)	(5)	(6)
	Vaccinations					Health
	BCG	DPT-3	Polio-3	Measles	Complete Vacc.	Mortality
Program District x Birth Year 2006 or	0.15	-2.59*	-1.39	-0.13	-0.42	-0.05
	(1.17)	(1.47)	(1.33)	(1.26)	(1.44)	(0.58)
	{0.99}	{0.22}	{0.59}	{0.99}		
Control Mean (Percent)	80.7	62.9	57.7	73.3	50.2	3.4
Observations	17990	17990	17990	17990	17990	18676
No. Clusters	70	70	70	70	70	70

Note: See tables 3 and 4. Birth year in/after 2006 is a dummy variable equal to 1 when a child is born in 2006 or later. Outcomes represent percentages. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are identical to tables 3 and 4 except that mother's height is not included. Sample: First and second children born 2004-2006 to mothers aged at least 19 at birth of child.

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

that could have potentially benefited from the program (those born June to December 2011) from our control group. This avoids contamination of the control group but renders our program and control group slightly less comparable, e.g. regarding their age. As expected, the magnitude of the point estimates in Table A21 overall increases for all health and vaccination outcomes. One surprising exception is the coefficient for underweight which decreases and as a result becomes insignificant. Due to this sensitivity, we judge our results regarding underweight as less reliable.

Finally, to assess whether our main results are sensitive to the specification of the estimating equation, we conduct two robustness checks. First, we estimate equation (1) without control variables and, second, we employ a logit instead of a linear probability model. The results for the former are set out in Table A15 - Table A17. The results for all measures of child health and immunization are virtually unchanged. The estimated marginal effects of the logit model, set out in Table A18 -Table A20, are very similar from the ones reported in Table 2 - Table 4.

6.6 Side results: Program impact on maternal health and fertility

We also explore the program's impact on two maternal health outcomes - underweight and anemia- and an indicator of fertility, birth spacing. The results are displayed in Table A24 and

Table A25 respectively. Table A13 reveals that the program has no significant impact on mother's current health outcomes such as underweight or anemia.

Among first born children, we document a significant 17% decrease in the hazard rate of birth of younger siblings through IGMSY (Table A25). This corresponds roughly to an increase of the median expected birth interval by 5.2 months. While we also detect a weakly significant 11% decrease in the birth hazard rate in the whole sample (an increase in the median birth interval by 7.3 months), no significant effects are observed within subsamples of second born; and later born children.

6.7 Discussion and cost-effectiveness

Magnitude and accordance with literature

While we find no significant effect on Anganwadi-facilities use during pregnancy and lactation, the throughout positive coefficients and the large, significant estimates for an indicator of recent Anganwadi service use suggest that health service utilization expanded through IGMSY. This conclusion is further supported by our results regarding vaccination. On the one hand, the comparatively large standard errors require the effect size to be substantial in order to be statistically significantly detectable. In particular, the high initial BCG vaccination rates left little scope for significant improvement. On the other hand, the overall significant effect on full vaccination combined with the positive albeit in some instances insignificant coefficients for the single vaccinations suggests that conditioning directly on vaccination positively influences vaccination rates. This interpretation is supported by the meta-analysis of Ranganathan and Lagarde (2012), who present evidence that, though effects vary by program and age-group, cash transfers significantly affect DPT-3, polio and measles vaccination. The importance of our results regarding vaccination is illustrated by the fact that the increase in full vaccination induced by the program is equivalent to 8.9 percent of the share of fully immunized children in our control group. If vaccination coverage consistently rose by this factor (assuming that most vaccinations take place in the first two life years, as is the case in our sample), the program could close the gap towards the crucial 95 percent immunization coverage of children in this age group within 15 years following program nationalization. Taken together, our results regarding AWC service use and vaccination suggest that health service use expanded through IGMSY, either because of the with IGMSY associated expansion of Anganwadi resources and corresponding access to health service providers or because of a change in health care seeking behavior triggered by the program conditions. Thus, our results corroborate the conclusion of Ranganathan and Lagarde (2012) that CCTs increase health service use.

In addition to the strong evidence on health service use above, we present less robust evidence of an improvement in weight-related child health outcomes and (adjusting for multiple inference) insignificant results for other child health outcomes and mortality. Our results regarding height and weight related outcomes are consistent with effects found by Ghosh and Kochar (2018) for IGMSY and a meta-analysis of Manley et al. (2013) for other cash transfers. The decrease in the share of underweight children corresponds to an impressive 12.6 percent of the control mean. The program's failure to decrease stunting in children is unlikely due to communicable infections, undernutrition during pregnancy or inadequate breastfeeding, since we find evidence that the program improves vaccination rates and undernutrition at birth and 92 percent of mothers in our sample exclusively breastfeed for six months. Instead, the three most likely culprits for the non-significant effects that we observe in stunting and anemia are micro-nutrient deficiency transmitted to children from mothers during pregnancy and lactation, dissipation of initial health gains through inadequate feeding in the aftermath of the program, and failure of the program to address the true causes of anemia and stunting. The first pathway is supported by the fact that the program has no significant impact on mother's current health outcomes (Table A13). However, as a non-negligible 79 percent of mothers report taking iron supplements during pregnancy, initial health gains in mothers may have existed but worn off. Regarding the second pathway, a considerable time span of on average three years passed between the end of the cash transfer and the measurement of stunting and anemia, enough time for any short run-effects on these to dissipate, as has been observed by Rivera et al. (2004) for anemia. Third, stunting and anemia may be rooted in underlying causes which IGMSY does not address. For stunting, these include hypertension, malaria and intestinal worms during pregnancy, and for anemia chronic inflammation, genetic disposition, malaria or hookworms (United Nations (UN) 2015; WHO 2019). We find only a weakly significant effect on child mortality, which disappears once we adjust for multiple hypotheses testing. This is consistent with findings by Powell-Jackson et al. (2015).

Contrary to the JSY program (Powell-Jackson et al. 2015), but in line with Ghosh and Kochar (2018), we document a stretching of birth intervals for first born children. This is positive as short birth spacing contributes to adverse health outcomes for children and mothers (Cleland et al. 2012).

We also present less precise evidence that girls benefit more than boys from the program in terms of the directly conditioned-on vaccination, whereas disadvantaged castes and tribes profit most in terms of underweight, which the program can only indirectly affect through monitoring, learning and income effects. While heterogeneous effects differ for the various outcomes, there emerges a clear pattern that coefficients for first and second born children are throughout higher than for later born children, indicating that the targeting of the program to first and second born children is functioning to some extent. However, likely due to the uneven sample split and accordingly large standard error for third and higher born children, the difference is not significant.

Cost effectiveness

How cost-effective is IGMSY/PMMVY compared to other policies? Below we compare the cost-effectiveness with respect to two of our outcomes, complete immunization and underweight, to one alternative policy, a direct vaccination intervention by Banerjee et al. (2010) and an intervention comparable to IGMSY/PMMVY, evaluated by Maluccio and Flores (2005). The estimated cost per additional fully immunized child in IGMSY/PMMVY amounts to 49906 rupees, approximately 659,88 USD[15]. These costs are high compared to Banerjee et al. (2010), who estimate the costs for non-cash incentives and recruiting per fully immunized child in their study with Rs 2010.60. The discrepancy is not surprising, given that a policy tailored to improve a particular indicator is usually more cost-effective than a cash transfer, which can be spent in a number of ways and thus may improve a range of indicators but each only to a limited extent (Banerjee et al. 2019). Moreover, treatment effects, as estimated by Banerjee et al. (2010), usually surpass ITT effects such as ours. In order to compare the program's cost-effectiveness with another conditional cash transfer program, we turn to Maluccio and Flores' (2005) evaluation of a the Nicaraguan Red de Protecciòn Social. A rough estimate based on their findings arrives at US$ 6161.29 per child lifted out of underweight. This is slightly lower than our estimated cost of Rs. 71571.49 per child prevented from being underweight in IGMSY/PMMVY but does not include administrative costs of running the program.

7. Conclusion

We assess the effects of the Indian conditional cash transfer program IGMSY/PMMVY on health care and services use as well as child health. For this purpose, we employ a difference-in-difference approach that exploits geographical variation in program roll-out and cohorts of children born before and after implementation of the program. We discover that the program has a positive effect on health service use. This is reflected in a higher likelihood of a mother recently having had contact with a local health worker and an increase in full child immunization. In addition, we find less robust evidence that the program also improves indicators of child weight. Further, weak evidence suggests that girls benefit more than boys in outcomes that the program directly conditions on such as vaccination, while children from disadvantaged social groups profit more in terms of underweight reduction. This suggests that the program removes income and other group-related factors which pose a constraint on nutrition, but that direct conditions overcome gender preferences in parents' allocation of preventive health care among their children. Despite these encouraging results, the program does not statistically significantly improve other indicators of immunization, local health service use, stunting, anemia and mortality. Sizable reliable long-term improvements in child

[15] See A12 for the derivation of our results in this sub-section

health outcomes may be inhibited by the short-term nature of the transfer, medical conditions that are not addressed in the transfer conditionalities or, possibly, by continuing deficits in maternal health.

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Appendix

A1. Timing of disbursement and conditions for the IGMSY cash transfer

Table A1: Timing of conditions and transfer disbursement in IGMSY

Install-ment	Timing of disbursement	Amount	Conditions
		2011-2013	
1	At the end of six months of pregnancy	1500	(1) Pregnancy registered within four months at the Anganwadi Center (AWC) or Health Center (2) Mother participated in min. one antenatal check-up (3) Mother picked up IFA tablets (4) Mother received at least one tetanus vaccination (5) Mother attended a nutrition and health counseling at least once
2	At the end of three months after delivery	1500	(6) Child birth is registered (7) Child has received Polio 0 and BCG vaccination (8) Child has received Polio-1 and DPT-1 vaccination (9) Child has received Polio-2 and DPT-2 vaccination (10) Child has been weighed at least twice since birth (11) After delivery, mother participated in at least two infant and young child feeding (IYCF) counseling meetings
3	At the end of six months after delivery	1000	(12) Child has been exclusively breastfed for first six months, unless advised otherwise by a medical doctor (13) After six months, the child has been started to be fed complementary foods (14) Child has received Polio-3 and DPT-3 vaccination (15) Child has been weighed at least twice between three and six months

			(16) Between three and six months after birth the mother participated in at least two infant and young child feeding (IYCF) counseling meetings
With increase of transfer amount in 2013			
1	At the end of six months of pregnancy	3000	(1) Pregnancy registered (2) Mother participated in at least two antenatal care visits where she received iron and folic acid tablets and tetanus vaccination
2	At the end of six months after delivery	3000	(3) Child birth is registered (4) Child is immunized against BCG, Polio 1-3 and DPT 1-3 (5) In the first three months after delivery, mother participates in at least three IYCF meetings and had the child's growth measured at least three times (6) Mother exclusively breastfeeds for six months, afterwards child is introduced to complimentary food.

Note: source: Niti Aayog and DMEO (2017; Ministry of Women and Child Development).

A2. Ranking of index scores, program and control districts

Table A8: Ranking of index scores of program and matched control districts

District	State	Maternity Index	Performance Group	Treatment / Control	District	State	Maternity Index	Performance Group	Treatment / Control
Katihar	Bihar	139.2	low	C	Dehradun	Uttarakhand	348.2	middle	T
Saharsa	Bihar	139.3	low	T	Purbi Singhbhum	Jharkhand	349.2	middle	T
Godda	Jharkhand	165.2	low	C	West District	Sikkim	352.7	middle	T
Simdega	Jharkhand	165.9	low	T	South	Delhi	356.8	middle	C
Tamenglong	Manipur	179.7	low	T	North West	Delhi	359.5	middle	T
Vaishali	Bihar	191.8	low	T	Dhamtari	Chhattisgarh	359.6	middle	T
Saran	Bihar	192.6	low	C	South District	Sikkim	362.7	middle	C
Muzaffarnagar	Uttar Pradesh	192.9	low	C	Rewari	Haryana	364.8	middle	C
Mahoba	Uttar Pradesh	194.1	low	T	Panchkula	Haryana	368.3	middle	T
Sultanpur	Uttar Pradesh	203.6	low	T	Patan	Gujarat	372.4	middle	T
Azamgarh	Uttar Pradesh	207.3	low	C	Fatehgarh Sahib	Punjab	373.7	middle	C
East Garo Hills	Meghalaya	210.8	low	T	Kapurthala	Punjab	374.0	middle	T
West Garo Hills	Meghalaya	231.8	low	C	Valsad	Gujarat	374.2	middle	C
Banswara	Rajasthan	246.1	low	C	Kamrup	Assam	376.8	middle	T
Ukhrul	Manipur	248.9	low	C	Dibrugarh	Assam	379.5	middle	C
Bilaspur	Chhattisgarh	251.0	low	C	Kheda	Gujarat	379.7	middle	C
Bhilwara	Rajasthan	251.7	low	T	West	Delhi	382.6	middle	T
Udaipur	Rajasthan	252.7	low	T	Bharuch	Gujarat	382.7	middle	T
Dhalai	Tripura	252.8	low	T	East	Delhi	383.6	middle	C
Bastar	Chhattisgarh	257.5	middle	T	Nalgonda	Telangana	391.2	middle	T
Tonk	Rajasthan	257.7	middle	C	Y.S.R.	Andhra Pradesh	392.4	middle	C
Dhemaji	Assam	263.7	middle	C	Davangere	Karnataka	401.4	high	C
Goalpara	Assam	266.5	middle	T	Bilaspur	Himachal Pradesh	413.7	high	C
Ranchi	Jharkhand	276.1	middle	C	Dharwad	Karnataka	421.0	high	T
North Tripura	Tripura	280.2	middle	C	Muktsar	Punjab	421.6	high	C
Changlang	Arunachal Prades	286.7	middle	C	Amritsar	Punjab	426.5	high	T
Lawngtlai	Mizoram	307.8	middle	T	Kolar	Karnataka	428.6	high	T
Chamoli	Uttarakhand	313.4	middle	C	Rangareddy	Telangana	431.6	high	C
Purulia	West Bengal	320.5	middle	C	West Godavari	Andhra Pradesh	435.8	high	T
Jalpaiguri	West Bengal	328.5	middle	T	Tumkur	Karnataka	442.2	high	C
Durg	Chhattisgarh	329.0	middle	C	Hamirpur	Himachal Pradesh	476.1	high	T
Bankura	West Bengal	343.5	middle	T	Palakkad	Kerala	488.1	high	T
Mamit	Mizoram	345.3	middle	C	Kozhikode	Kerala	501.1	high	C
Dakshin Dinajpur	West Bengal	346.2	middle	C	North Goa	Goa	502.3	high	T
Papumpare	Arunachal Prades	347.2	middle	T	South Goa	Goa	517.8	high	C

Note: Index calculated from District Level Household Survey 2007-08. Components: (i) % literate female population (age 7 +), (ii) % mothers registered their pregnancy in the 1st trimester , (iii) % mothers who had at least 3 antenatal care visits during their last pregnancy, (iv) % institutional births, (v) % children (12-23 months) fully immunized (BCG, 3 DPTs, Polio and measles), and (vi) % children breastfed within one hour of birth.

A3. Data restrictions and number of observations

Table A9: Data restrictions and number of observations

Restriction	*N children*
Original dataset (NFHS-4, children schedule)	259,627
Excluding UTs	252,064
Restricted to program and control districts	32,741
Excluding states with other maternity programs	26,573
Excluding Jammu and Kashmir because districts cannot be matched unequivocally	25,170
Restricted to children of mothers who were at least 19 at the birth of the respective child	23,762
Restricted to children born between 2010 and 2013	14,721
Restricted to observations for which data is available for at least one main outcome	14,721
Restricted to observations for which data is available for all controls	13,897

A4. Description of variables

Table A10: Description of variables

Unit of observation	Variable	Description	Source
		Outcome variables	
Child		Dummy variable, equals one if the child has mild, severe or moderate anemia (hemoglobin level below 11 g/dl)	Generated from NFHS-4
Child	BCG	Dummy variable, equals one if a child has been administered the Bacillus-Calmette-Guèrin-vaccination. Following standard DHS procedure, "Don't know" is recoded to "No" for all vaccinations	NFHS-4
Child	Complete vaccination	Dummy variable, equals one if the child has been administered one BCG, one measles, three DPT and three polio doses	
Child	DPT-3	Dummy variable, equals one if child has been administered the last combined diphtheria, pertussis and tetanus vaccination dose	NFHS-4

Child	Measles	Dummy variable, equals one if the child has been administered one measles dose	NFHS-4
Child	Mortality	Dummy variable, equals one if the child has perished	Calculated from NFHS-4
Child	Polio-3	Dummy variable, equals one if child has been administered the last polio vaccination dose	
Child	Low birth weight	Dummy variable, equals one if weight at birth lies below 2.5 kg	Calculated from NFHS-4
Child	Stunted	Dummy variable, equals one if the height for age z-score (using the WHO reference population) (HAZ) lies below -2 The HAZ is equal to the number of standard deviations below or above the reference median and calculated as follows: (observed height/age) – (median height/age of the reference population) / standard deviation of the reference population	NFHS-4
Child	Underweight	Dummy variable, equals one if weight for age z-score (using the WHO reference population) (WAZ) below -2	NFHS-4
Mother	Anemia	Dummy variable, equals one if the mother has mild, severe or moderate anemia (hemoglobin level below 11 g/dl for pregnant women and below 12 g/dl for all other adult women.)	Generated from NFHS-4
Mother	Underweight	Dummy variable, equals one if Body Mass Index lies below 18.5	NFHS-4
Control variables and variables employed for heterogeneous effects estimation			
Child	Birth order	Birth order of the child	NFHS-4
Child	Sex	Dummy variable, equals one if the child is female	NFHS-4
Mother	Age	Age in years	NFHS-4

Mother	Squared age	Squared age in years	Calculated from NFHS-4
Mother	Educational level	Woman's highest educational level. Consists of the following categories: no education, primary education, secondary education, higher education	NFHS-4
Mother	Height	Height in cm	NFHS-4
Mother	Marital status	Marital status of the mother, consists of the following categories: never in union, married, widowed/separated	Generated from NFHS-4
Household	Poor	Dummy variable, equals one if a household belongs to the poorest 40% in the NFHS-4 sample in terms of the wealth index	NFHS-4
Household	Residence (rural)	Dummy for living in a rural area	NFHS-4
Household	Religion	Religion of the household. Consists of the following categories: Hindu, Muslim, Christian, Sikh, Buddhist, no or other religion	Generated fom NFHS-4
Household	SC/ST	Dummy variable, equals one if household belongs to a scheduled caste or tribe	Generated from NFHS-4
Household	Wealth	Quintiles of a continuous measure of relative wealth of a household equal to the factor score of an index of owned assets (Range of index: -2.25822 to 2.86687)	NFHS-4
State	State implementation	Dummy variable, equals one for states with average IGMSY expenditure between 2011-2014 per eligible woman above the median (eligible women are defined as women in program districts aged 19-49)	Generated from expenditure (source: Falcao et al. (2015)) and population data (source: World Bank (2019))
Treatment and eligibility variables			

Child	Birth year 2012 or later (Elig_birth)	Dummy variable, equals one if child was born in 2012 or later	Generated from NFHS-4
District	Program district	Dummy variable, equals one for districts in which IGMSY was implemented in 2011. The variable takes on zero if the district is a control district (district which is nearest neighbor in terms of the maternity and child health index score used for selection of program districts, in the same state)	Pilot districts (source: Ministry of Women and Child Development 2019), control districts matched by authors

A5. Summary statistics full sample (NFHS-4)

Table A11: Summary statistics NFHS-4 (full sample)

	Full sample		
	Mean	SD	N
Child Outcome Variables			
Anganwadi contact			
AWC benefits during pregnancy (%)	56.82	49.53	13886
AWC benefits during breastfeeding (%)	51.73	49.97	13854
AWC benefits in last 12 months (child) (%)	56.32	49.60	13308
Mother saw AWW in last 3 months (%)	41.41	49.69	13897
Vaccination			
BCG vaccinated (%)	91.30	28.18	13308
DPT-3 vaccinated (%)	81.25	39.03	13308
Polio-3 vaccinated (%)	72.29	44.76	13308
Measles vaccinated (%)	84.60	36.10	13308
Complete vaccination (%)	63.76	48.07	13308
Health			
Low birth weight	13.60	34.28	13308
Underweight (%)	37.95	48.53	12390
Stunted (%)	40.80	49.15	12390
Anemic (%)	55.68	49.68	12523
Mortality (%)	4.41	20.53	13897
Child Characteristics			
Female (%)	47.54	49.94	13897
Age (months)	40.17	11.61	13125
Mother Characteristics			
Height (cm)	151.40	6.13	13897
Age (years)	28.05	4.79	13897
Education			
No education (%)	32.96	47.01	13897
Primary education (%)	14.28	34.99	13897
Secondary education (%)	42.21	49.40	13897
Higher education (%)	10.52	30.68	13897
Household Characteristics			
Rural (%)	72.65	44.57	13897
SC/ST (%)	34.35	47.49	13897
Religion			
Hindu (%)	80.40	39.70	13897
Muslim (%)	13.91	34.61	13897
Christian (%)	2.78	16.43	13897
Sikh (%)	2.05	14.18	13897
Buddhist (%)	0.22	4.72	13897
None or other religion (%)	0.63	7.92	13897
Wealth quintile			
First	26.51	44.14	13897
Second	20.96	40.71	13897
Third	18.74	39.03	13897
Fourth	18.05	38.46	13897
Fifth	15.74	36.42	13897
Eligibility Variable			
Born 2012 or later (share)	0.65	0.48	13897

Note: AWC benefit: received goods or services from Anganwadi center. DPT-3: child completed the third diphteria, pertussis and tetanus vaccination. BCG: child completed the Bacillus Calmette-Guérin vaccination (primarily employed against tuberculosis). Polio-3: child completed the third polio vaccination. Wealth index quintiles derived from the factor score of principal component analysis of the NFHS-4 household asset index. SC/ST indicates whether the child's household belongs to a Scheduled Caste or Tribe. Summary statistics are based on data from NFHS-4 and constructed using state mother/child sampling weights provided by NFHS-4. Sample: Children born 2010-2013 to mothers aged at least 19 at birth of child, 70 districts.

A6. Measure of program implementation

In order to detect heterogeneous program effects by intensity of implementation, we use each states' disbursements per potentially eligible woman between 2011 and 2014 under IGMSY. For state-wise program expenditures we draw on data from (Falcao et al. 2015). We define the number of eligible cases in each state by calculating the state-wise share of first and second births of mothers aged at least nineteen years old in pilot districts (years 2012 and 2013) in the overall number of births for the same period using NFHS – 4 data and then multiplying it with the Indian population (in thousands) and the Indian birthrate (sourced from World Bank (2019)). The share of eligible children in all births in program districts is roughly 65 percent. A state is considered a high implementation state if it has an above-median (Rs1,578) expenditure per eligible case in 2012 and 2013. We choose this measure instead of the state-wise number of beneficiaries reported by the government since our measure is more strongly correlated with survey measures of program coverage from Niti Aayog and DMEO (2017). Moreover, it corresponds more closely to the ITT effects we are estimating.

A7. Further heterogeneous effects

Table A12: Heterogeneous program effects on low birth weight

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Sample split by:	Individual and Household Characteristics										Intensity of Program Implementation (by State)	
	Birth order		Sex		Wealth		Social Group		Residence			
	First/Second	Third/higher	Female	Male	Bottom 40%	Upper 60%	SC/ST	Other	Rural	Urban	Low	High
Program District x Birth Year 2012 or later	-5.91***	0.21	-3.17**	-5.03**	-1.03	-6.35***	-0.94	-5.07***	-3.69***	-5.26	-5.68**	-4.06**
	(1.54)	(1.83)	(1.48)	(2.17)	(1.22)	(1.79)	(1.85)	(1.47)	(1.10)	(3.61)	(2.15)	(1.56)
Difference	-5.86		1.85		5.33		3.94		1.42		1.53	
	[0.02]		[0.52]		[0.02]		[0.12]		[0.68]		[0.56]	
Benjamini-Hochberg q-value	{0.061}		{0.681}		{0.061}		{0.351}		{0.681}			
Control Mean (Percent)	13.8	7.9	12.0	12.0	9.1	14.6	11.5	12.3	10.9	15.6	10.7	12.8
Observations	9016	4292	6476	6832	6536	6772	5888	7420	10257	3051	6515	6510
No. Clusters	70	70	70	70	69	70	70	68	67	70	34	34

Note: see previous table. Outcome is a dummy variable equal to 1 if a child is born with a weight of less than 2.5 kg.
* p<0.10 ** p<0.05 *** p<0.01

Table A13: Heterogeneous program effects on underweight

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Sample split by:	Individual and Household Characteristics										Intensity of Program Implementation (by State)	
	Birth order		Sex		Wealth		Social Group		Residence			
	First/Second	Third/Higher	Female	Male	Bottom 40%	Upper 60%	SC/ST	Other	Rural	Urban	Low	High
Program District x Birth Year 2012 or later	-5.49***	-2.70	-2.76	-5.96**	-7.41**	-2.25	-9.05***	-1.91	-4.82**	-5.55	-7.00*	-2.68
	(1.68)	(3.22)	(2.95)	(2.35)	(3.00)	(2.30)	(3.02)	(1.80)	(2.11)	(4.07)	(3.45)	(2.12)
Difference	-3.01		3.28		-5.15		-6.89		0.68		4.16	
	[0.35]		[0.42]		[0.16]		[0.04]		[0.89]		[0.29]	
Benjamini-Hochberg q-value	{0.844}		{0.844}		{0.648}		{0.295}		{0.888}			
Control Mean (Percent)	35.1	44.2	41.7	34.7	47.2	29.3	41.4	36.2	40.7	30.4	34.6	41.6
Observations	8381	4009	6013	6377	6096	6294	5473	6917	9566	2824	6160	6029
No. Clusters	70	70	70	70	69	70	70	68	67	70	34	34

Note: see previous table. Outcome is a dummy variable equal to 1 if a child is underweight (WAZ below -2).
* p<0.10 ** p<0.05 *** p<0.01

A8. Summary statistics DLHS-3

Table A14: Summary statistics DLHS-3

	Full sample		
	Mean	SD	N
Child Outcome Variables			
Vaccination			
BCG vaccinated (%)	82.00	38.42	17990
DPT-3 vaccinated (%)	64.16	47.96	17990
Polio-3 vaccinated (%)	58.99	49.19	17990
Measles vaccinated (%)	74.38	43.66	17990
Complete vaccination (%)	51.51	49.98	17990
Health			
Mortality (%)	3.62	18.67	18676
Child Characteristics			
Female (%)	47.55	49.94	18676
Mother Characteristics			
Age (years)	27.52	4.87	18676
Education			
No education (%)	39.09	48.80	18676
Primary education (%)	31.18	46.32	18676
Secondary education (%)	15.57	36.26	18676
Higher education (%)	14.16	34.86	18676
Household Characteristics			
Rural (%)	69.81	45.91	18676
SC/ST (%)	42.14	49.38	18676
Religion			
Hindu (%)	68.65	46.39	18676
Muslim (%)	11.86	32.33	18676
Christian (%)	11.58	32.00	18676
Sikh (%)	4.30	20.28	18676
Buddhist (%)	1.82	13.36	18676
None or other religion (%)	1.79	13.26	18676
Wealth quintile			
First	23.52	42.42	18676
Second	19.34	39.50	18676
Third	19.08	39.30	18676
Fourth	18.71	39.00	18676
Fifth	19.34	39.50	18676
Eligibility Variable			
Born 2005 or later (share)	0.72	0.45	18676

Note: DPT-3: child completed the third diphteria, pertussis and tetanus vaccination. BCG: child completed the Bacillus Calmette-Guèrin vaccination (primarily employed against tuberculosis). Polio-3: child completed the third polio vaccination. Wealth index quintiles derived from the factor score of principal component analysis of the DLHS-3 household asset index. SC/ST indicates whether the child's household belongs to a Scheduled Caste or Tribe. Summary statistics are based on data from DLHS-3 and constructed using state mother/child sampling weights provided by DLHS-3. Sample: Children born 2004-2006 to mothers aged at least 19 at birth of child, 70 districts.

A9. Robustness tests

Table A15: Program effect on Anganwadi service use (without additional controls)

	(1)	(2)	(3)	(4)
	AWC/ICDS contact			
	Prenatal benefits mother	Postnatal benefits mother	Mother met AWW last 3 months	Child benefits in last 12 months
Program District x Birth Year 2012 or Later	1.69	0.76	5.25***	0.82
	(1.37)	(1.44)	(1.10)	(1.30)
	{0.44}	{0.76}	{0.00}	{0.76}
Control Mean (Percent)	52.4	48.0	40.3	49.2
Observations	13886	13854	13897	13308
No. Clusters	70	70	70	70

Note: see table 2. Without additional control variables.

* p<0.10 ** p<0.05 *** p<0.01

Table A16: Program effect on child vaccinations (without additional controls)

	(1)	(2)	(3)	(4)	(5)
	Vaccinations by Type				Complete Vacc.
	BCG	DPT-3	Polio-3	Measles	
Program District x Birth Year 2012 or Later	0.90	1.51	2.49*	1.08	5.22***
	(1.08)	(1.57)	(1.33)	(1.24)	(1.57)
	{0.58}	{0.58}	{0.17}	{0.58}	
Control Mean (Percent)	90.3	79.6	67.5	83.8	59.1
Observations	13308	13308	13308	13308	13308
No. Clusters	70	70	70	70	70

Note: see table 3. Without additional control variables.

* p<0.10 ** p<0.05 *** p<0.01

Table A17: Program effect on child health and mortality (without additional controls)

	(1)	(2)	(3)	(4)	(5)
	Health Outcomes				
	Low Birth Weight	Underweight	Stunting	Anemia	Mortality
Program District x Birth Year 2012 or Later	-3.96***	-4.86***	0.17	3.61*	-1.04*
	(1.20)	(1.62)	(2.06)	(1.89)	(0.53)
	{0.01}	{0.01}	{0.93}	{0.14}	{0.14}
Control Mean (Percent)	10.0	36.6	38.9	47.5	3.7
Observations	13308	12390	12390	12523	13897
No. Clusters	70	70	70	70	70

Note: see table 4. Without additional control variables.

* p<0.10 ** p<0.05 *** p<0.01

Table A18: Program effect on Anganwadi service use (Logit model)

	(1)	(2)	(3)	(4)
	ICDS/AWC contact			
	Prenatal benefits mother	Postnatal benefits mother	Mother met AWW last 3 months	Child benefits in last 12 months
Program District x Birth Year 2012 or Later	1.95*	1.46	4.50***	0.91
	(1.12)	(1.27)	(1.02)	(1.37)
Control Mean (Percent)	13886	13854	13897	13308
Observations	70	70	70	70
No. Clusters	13886	13854	13897	13308

Note: see table 2. Average marginal effects of Logit model. Coefficients multiplied by 100 for comparability with linear probability model. Differences in observations to LPM model arise from some instances of perfect prediction. Computation of multiple inference adjusted p-values in logit model not possible due to large number of fixed effects.

* p<0.10 ** p<0.05 *** p<0.01

Table A19: Program effect on child vaccination (Logit model)

	(1)	(2)	(3)	(4)	(5)
	Vaccinations				
	BCG	DPT-3	Polio-3	Measles	Complete Vacc.
Program District x Birth Year 2012 or Later	0.73	1.09	2.73**	0.96	5.22***
	(1.22)	(1.55)	(1.23)	(1.35)	(1.52)
Control Mean (Percent)	90.3	79.6	67.5	83.8	59.1
Observations	12825	13308	13308	13308	13308
No. Clusters	66	70	70	70	70

Note: see table 3. Average marginal effects of Logit model. Coefficients multiplied by 100 for comparability with linear probability model. Differences in observations to LPM model arise from some instances of perfect prediction. Computation of multiple inference adjusted p-values in logit model not possible due to large number of fixed effects.

* p<0.10 ** p<0.05 *** p<0.01

Table A20: Program effect on child health and mortality (Logit model)

	(1)	(2)	(3)	(4)	(5)
	Health Outcomes				
	Low Birth Weight	Underweight	Stunting	Anemia	Mortality
Program District x Birth Year 2012 or Later	-4.45***	-4.52***	0.64	4.06**	-0.88
	(1.13)	(1.66)	(2.12)	(1.88)	(0.66)
Control Mean (Percent)	10.0	36.6	38.9	47.5	3.7
Observations	13308	12390	12390	12523	13799
No. Clusters	70	70	70	70	69

Note: see table 4. Average marginal effects of Logit model. Coefficients multiplied by 100 for comparability with linear probability model. Differences in observations to LPM model arise from some instances of perfect prediction. Computation of multiple inference adjusted p-values in logit model not possible due to large number of fixed effects.

* p<0.10 ** p<0.05 *** p<0.01

Table A21: Anganwadi service use - Excluding children born June-December 2011

	(1)	(2)	(3)	(4)
	AWC/ICDS contact			
	Prenatal benefits mother	Postnatal benefits mother	AWW last 3 months	Child benefits in last 12 months
Program District x Birth Year 2012 or Later	1.85	0.97	5.56***	0.91
	(1.26)	(1.35)	(1.08)	(1.27)
	{0.31}	{0.71}	{0.00}	{0.71}
Control Mean (Percent)	52.4	48.0	40.3	49.2
Observations	13886	13854	13897	13308
No. Clusters	70	70	70	70

Note: Linear probability models. Outcomes are dummy variables indicating that mother received AWW benefits or services during pregnancy, during lactation, child received benefits or services in the last 12 months and mother met an Anganwadi worker in the last 3 months. Coefficients in percentage points. Birth year in 2012 or later is a dummy variable equal to 1 when a child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are birth order of the child, mother's educational level, age, squared age and height, household religion and wealth index factor score, and dummy variables equal to 1 if the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: children alive at time of interview born 2010-2013 to mothers aged at least 19 at birth of child, 70 districts. All estimates are computed using sampling weights, birth year and district fixed effects as well as cohort-specific state fixed effects. Robust standard errors clustered at the district level in parentheses, Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference in columns (1)-(4)) in curly brackets.

Table A22: Vaccination - Excluding children born June-December 2011

	(1)	(2)	(3)	(4)	(5)
	Vaccinations				
	BCG	DPT-3	Polio-3	Measles	Complete Vacc.
Program District x Birth Year 2012 or Later	0.93	1.53	2.58**	1.11	5.31***
	(1.15)	(1.68)	(1.28)	(1.38)	(1.56)
	{0.60}	{0.60}	{0.12}	{0.60}	
Control Mean (Percent)	90.3	79.6	67.5	83.8	59.1
Observations	13308	13308	13308	13308	13308
No. Clusters	70	70	70	70	70

Note: Linear probability models. Outcomes are dummy variables indicating BCG (Bacillus Calmette-Guèrin vaccine, primarily employed against tuberculosis); DPT-3 (third diphtheria, pertussis and tetanus vaccination dose); Polio-3 (third Polio vaccination dose); measles and complete vaccination (child has completed all four of the above vaccinations). Coefficients in percentage points. Birth year in 2012 or later is a dummy variable equal to 1 when a child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are birth order of the child, mother's educational level, age, squared age and height, household religion and wealth index factor score, and dummy variables equal to 1 if the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: children alive at time of interview born 2010-2013 to mothers aged at least 19 at birth of child, 70 districts. All estimates are computed using sampling weights, birth year and district fixed effects as well as cohort-specific state fixed effects. Robust standard errors clustered at the district level in parentheses, Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference in columns (1)-(4)) in curly brackets.

* p<0.10 ** p<0.05 *** p<0.01

Table A23: Health - Excluding children born June-December 2011

	(1)	(2)	(3)	(4)	(5)
	Health Outcomes				
	Low Birth Weight	Underweight	Stunting	Anemia	Mortality
Program District x Birth Year 2012 or Later	-4.78**	-2.82	2.46	3.81	-2.05***
	(1.90)	(2.07)	(3.39)	(2.46)	(0.63)
	{0.05}	{0.29}	{0.50}	{0.29}	{0.01}
Control Mean (Percent)	10.0	38.6	41.1	46.8	3.0
Observations	10920	10146	10146	10281	11407
No. Clusters	70	70	70	70	70

Note: Linear probability models. Outcomes are dummy variables indicating underweight (WAZ below -2); stunting (HAZ below -2); anemia (hemoglobin level below 11 g/dl) and mortality. Coefficients in percentage points. Birth year in 2012 or later is a dummy variable equal to 1 when a child is born in 2012 or later. Program district is a dummy variable equal to 1 when a child lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are birth order of the child, mother's educational level, age, squared age and height, household religion and wealth index factor score, and dummy variables equal to 1 if the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: children born 2010-2013 to mothers aged at least 19 at birth of child, 70 districts. Except for column (5), which comprises all livebirths, the sample consists only of children alive at the time of interview. All estimates are computed using sampling weights, birth year and district fixed effects as well as cohort-specific state fixed effects. Robust standard errors clustered at the district level in parentheses, Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference in columns (1)-(4) and columns (6)-(9)) in curly brackets.

* p<0.10 ** p<0.05 *** p<0.01

A10. Empirical approach and results for mothers' outcomes

Whether a mother is eligible is measured in regressions with underweight, stunting and anemia as outcomes via a dummy variable that takes on one if the mother gave birth to a first or second born child after the year 2011.

$$H_{pdti} = \alpha_{pd} + \mu_t + (\delta_p \times elig\_w_{pdti}) + \beta(T_d \times elig\_w_d) + \gamma X_{pdti} + u_{pdti} \qquad (3)$$

where subscript i indicates mother, d district, p matched program and control district pair, t indicates birth year of mother

- H: health outcome (underweight, anemia)
- $\boldsymbol{\beta}$: ITT effect
- T: dummy for program district
- $elig\_w$: eligibility of the mother
- X_{pdti}: control variables
- α_{pd} : district fixed effects
- δ_p : matched pair fixed effects
- μ_t: mother's birth year fixed effects
- u_{pdti} : robust standard errors clustered at the pair level
- Sample for regressions with nutrition-related health outcomes: mothers aged at least 19 who had a first or second child between 2010 and 2014 (in order to assure a relatively even sample split and comparability)

Table A24: Program effect on mothers' health outcomes

	(1)	(2)
	Health Outcomes	
	Underweight	Anemia
Program District x Eligible Mother	-1.91	0.62
	(1.35)	(1.59)
	{0.28}	{0.69}
Control Mean (Percent)	19.09	57.83
Observations	12339	12281
Clusters	70	70

Note: Dependent variable: underweight equals one if Body Mass Index lies below 18.5, anemia equals one if hemoglobin level lies below 10.9 g/dl for pregnant 11.9 g/dl for other women (coefficients in percentage points). Main predictor: eligible mother equals one if the mother gave birth to a first or second born child in 2012 or later. Program district is a dummy variable equal to 1 when a woman lives in a district where IGMSY was active from 2011 onward. Additional controls included but not reported in the table are educational level, marriage status, religion, wealth index factor score of the household, and whether the household belongs to a Scheduled Caste or Tribe and is situated in a rural area respectively. Sample: mothers aged at least 19 with first or second children born between 2010 and 2013. All estimates are computed using sampling weights, district fixed effects, mother's birth year fixed effects and child-cohort specific state fixed effects. Robust standard errors clustered at the district level in parentheses. Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference of models (1) -(2)) in curly brackets.

* p<0.10 ** p<0.05 *** p<0.01

A11. Program effect on birth spacing

Table A25: Program effect on birth spacing

	(1)	(2)	(3)	(4)
Sample (by Birth Order):	All	First born	Second born	Third or higher
Program District x Birth Year 2012 or Later	0.89**	0.83***	1.01	1.10
	(0.05)	(0.06)	(0.10)	(0.11)
		{0.02}	{0.93}	{0.63}
Control Median Birth Interval (months)	59	35	censored	censored
Observations	13897	4880	4502	4515
No. Clusters	70	70	70	70

Note: see table 3. Non-parametric Cox proportional hazard model with separate baseline hazards by sex (columns (1)-(4)) and birth order (columns (1) and (4)). Outcome is a birth. Reported are hazard rates (probability of birth of a sibling taking place contingent on succeding birth interval). Romano-Wolf bootstrapped q-values (p-values adjusted for multiple inference of models (2) -(4)) in curly brackets.

* $p<0.10$ ** $p<0.05$ *** $p<0.01$

A12. Cost effectiveness calculation

The cost effectiveness of the intervention was estimated as follows:

$$\frac{Average\ program\ expenditure\ per\ eligible\ case\ \ 2012 - 2013/14}{Program\ effect\ \ (share)}$$

For a description of how we arrive at the yearly expenditure per eligible case, see A6. Maluccio and Flores (2005) find a 6.2 percentage point reduction in underweight (ITT-effect) and their reported average value of received direct cash transfer and health related in-kind benefits per year amount in total to US$ 382 per child. Note that this cost estimate does not include administrative costs for running the program, as does our estimated cost for IGMSY.