Research Article

Susmita Baulia*

Unpacking the Financial Incentives in Health by Revisiting India's "Safe Motherhood Program"

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Abstract: This paper investigates India's nationwide health reform to understand its various channels of effect. The reform entitled socio-economically backward mothers with cash transfer if they chose to give birth at public health institutions, and simultaneously employed ASHAs as a direct link between pregnant women and the public healthcare delivery system. Using variations in mothers' eligibility and differential implementation of ASHAs across states, birth-related outcomes are evaluated in a difference-in-difference framework. Results show that eligible mothers with both cash transfer and ASHA's guidance outperformed those receiving only cash transfer, in institutional birth rate and timely initiation of breastfeeding. An improved outcome in the ASHA's presence alongside the conditional cash transfer argues for the vitality of the former's role in spreading information on the importance of health and the uptake of public healthcare.

Keywords: conditional cash transfer, Janani Suraksha Yojana, maternal health, child health, difference-in-difference

JEL Classification: I10, I38

1 Introduction

Conditional Cash Transfer (CCT) is one of the proven methods for increasing human capital investment by resource-constrained households in low-income countries.

***Corresponding author: Susmita Baulia**, Department of Economics, Turku School of Economics, University of Turku, FI-20014, Turku, Finland, E-mail: susmita.baulia@utu.fi

Besides short-term poverty reduction through income transfer, it serves as a powerful incentive for households in adopting a behavior that could positively affect their well-being and break the cycle of poverty in the long run. First successfully adopted by several Latin American countries in the early '90s, CCTs are essentially targeted to address the demand-side problems of inadequate investment in human capital and/or the use of health and education-promoting services.[1] However, in many of these socio-economic settings of our interest, problems could be at the supply end (too), e.g. mediocrity of the service delivery system.[2] Under such circumstances, a CCT-based program addressing only demand-side factors is likely to leave behind mixed outcomes and bigger unanswered questions on whether the underutilization is triggered by a lack of demand or of supply. The *Janani Suraksha Yojana* ("Safe Motherhood Program") in India is a healthcare reform that, by its unique features, helps investigate such an unanswered question. This reform incentivized mothers and community health workers to improve maternal and neonatal health outcomes. Thus, it offers a clearer picture of both the demand and supply sides. By exploiting these features, this paper aims to understand what was more effective – conditional cash transfer to mothers, employing the health worker in guiding mothers, or both?

The *Janani Suraksha Yojana* (henceforth, JSY) was initiated in April 2005 by the Ministry of Health and Family Welfare in India. The number of beneficiaries of the program increased from 0.738 million in 2005–2006 to 10.438 million in 2014–2015, with about 0.9 million health workers involved. In 2010, it had a budget of 15 billion INR (≡325.5 million USD).[3] The reform officially divided the states into high-focus and non-high-focus ones formally termed low-performing states (LPS) and high-performing states (HPS). The cash incentives were to vary according to that categorization.[4] In both the LPS and HPS, pregnant women above 19 years of age, belonging to *below-poverty-line* households, and giving birth at public health facilities were eligible for cash transfer for up to two live births. On the other hand,

1 Mexico's *PROGRESA* (later named *Oportunidades*), Brazil's *Bolsa Família* are the major CCTs in the world that have influenced millions of beneficiaries to date (Fiszbein et al. 2009).

2 In several African countries, where the health service delivery often suffers from lack of organization and management (WHO 2007), CCTs would not be optimal.

3 Fifteen years later, in 2020, with the introduction of parallel programs and redistribution of budgets, JSY has 4.28 million beneficiaries and works parallel to another nationwide maternity benefit scheme, the *Pradhan Mantri Matru Vandana Yojana*.

4 The LPS were Uttar Pradesh, Uttaranchal, Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Assam, Rajasthan, Orissa and Jammu and Kashmir, where institutional delivery rates were alarmingly low (less than 25 %) compared to the HPS, which comprised of the remaining states. (See Online Appendix B Figure B1 for the categorization of the states and Figure B2 for a distribution of institutional birth rates across states in the pre-reform period).

incentives were offered to village-based health workers, known as the *Accredited Social Health Activists* (ASHAs), to act as direct links between local communities and the public health system. The ASHA's primary duties were identifying the pregnant women in the community and helping them throughout the antenatal, birth and postnatal phases. However, in the initial years, ASHAs were introduced only in the LPS, which were the primary target states. This paper primarily aims to exploit the absence of ASHAs in the HPS in the early years, along with the eligibility criteria of mothers for cash transfer, and understand the extent to which these factors can affect birth-related outcomes.[5]

Using data from the second and third cross-sectional waves of the District Level Household Survey (DLHS), I analyze a sample of over 255,000 rural mothers with their latest births during 2001–2008. Restricting the analysis to the rural population serves two purposes – one, to concentrate on the most vulnerable target groups of the reform, and two, to minimize confounding effects while comparing effects across LPS and HPS. In a difference-in-difference (DiD) framework, I use multiple treatment groups categorizing "eligible mothers in low-performing states with ASHA" and "eligible mothers in high-performing states without ASHA", and compare them with a control group of "mothers ineligible for any assistance". I find that the rural mothers receiving both cash transfer and ASHA's counseling outperformed the rural mothers receiving only cash transfer, in institutional birth rate and in early initiation of breastfeeding.[6] To put the difference in perspective, the eligible mother in the high-performing state experienced a 2.4 percentage points (pp.) greater increase in institutional births than the ineligible mother. In contrast, for an eligible mother in a low-performing state, this increase in the difference with the ineligible mother was 5.1 pp. These are equivalent to changes of about 10 % and 21.25 % in institutional birth rates compared to what an ineligible mother would experience in the pre-reform period.

By comparing socio-economically similar mothers (who were above 19 years old, belonged to below-poverty-line households, and had less than two births) across LPS and HPS, I attempt to minimize confounding channels of interpretation and to understand if the ASHA potentially drives the bigger effects observed in the LPS. An additional analysis with the eligible mothers only in the high-performing states, who received the ASHA's guidance post-2008, argues for a similar positive effect of the ASHA on institutional birth rates. However, acknowledging

5 Note, this study is not evaluating the incentive per se given to the ASHA but rather her presence as a supply-side factor.

6 The term 'institutional birth' implies birth at a public healthcare facility affiliated to the JSY program.

some caveats to those interpretations, this paper only confirms that receiving guidance from the health worker around the time of birth, besides direct cash transfers, could be more effective for the mother in achieving better all-round health practices.

The literature on JSY's overall impact evaluation is quite rich, reporting positive effects, such as reduced perinatal and neonatal deaths (Lim et al. 2010), increased uptake of maternity services with an increase in implementation rate, especially by women of low socio-economic status (Powell-Jackson, Mazumdar, and Mills 2015), and better post-birth health choices (Carvalho et al. 2014). Some evidence of moderate effects also exists, such as only a small increase in medically supervised births but no change in perinatal care among the eligible mothers (Joshi and Sivaram 2014), and a slower decline in maternal mortality rate in poorer areas *vis-à-vis* wealthier areas in low-performing states (Randive et al. 2014). Despite this evidence, there is still a lack of investigation on the different components of the reform, i.e. the mother's conditional cash transfer and the health worker's employment in the state-types. This paper attempts to explore and document the extent to which their contributions can be understood.

Debnath (2021) complements this study by analyzing the mother's and the ASHA's incentives in the reform from a correlational perspective. Debnath exploits the variation in the cash amounts given to eligible mothers and ASHAs and finds that more cash amounts paid to the health workers were associated with higher utilization of these services, than that transferred to the mothers.[7] However, the author maintains that the effects of the two incentives are hard to disentangle. In this paper, I provide causal validation that the most vulnerable and targeted group of the reform, who received both the cash transfer and the ASHA's support, saw bigger improvements compared to those who received cash transfer only. To my knowledge, no other study has causally explored the effects of the different treatment arms of the reform (i.e. only cash transfer versus joint cash transfer and ASHA). Nevertheless, this paper is also limited in separating the effects of the mother's cash transfer and the ASHA's role. A causal identification of the pure ASHA effect is perhaps impossible due to the sheer design of the reform; nonetheless, this paper attempts to draw out some suggestions.

As another contribution, this paper uniquely captures the medium-run effects of the reform's treatment arms, which covers the post-2008 period when ASHA

7 The amounts in cash given as incentives to both the parties are not considered in my study. Instead, I exploit the mother's eligibility for the conditional cash transfer and the presence of the ASHA to guide her.

was introduced in HPS. For this exercise, I include the latest round of the DLHS survey.[8]

Finally, this paper contributes to some key topics in health economics and public health. My study lies at the junction of two strands of literature that acknowledge the indispensability of community health workers in improving health outcomes in developing countries – one is on the effectiveness of health workers as a knowledge source (Block 2007; Hirvonen et al. 2017), and the other, on the improvement of their service delivery through incentives (Ashraf, Bandiera, and Jack 2014; Banerjee, Duflo, and Glennerster 2008; Basinga et al. 2011). This paper also contributes to the literature on health-based CCTs in terms of maternal and neonatal health outcomes (other contributions being in preventive healthcare and healthy behavior (e.g. vaccination coverage for children (Barham and Maluccio 2009), cervical cancer screening and annual HIV tests (Ranganathan and Lagarde 2012), and nutritional outcomes in adults (Fernald, Gertler, and Neufeld 2008a) and children (Behram and Hoddinott 2005; Fernald, Gertler, and Neufeld 2008b)). In addition, I contribute to the literature on the impact evaluation of welfare programs that explore the complementarity between supply- and demand-side nudges and incentives (other studies being by Banerjee et al. 2010, examining the impact on child immunization by setting up immunization camps in rural India versus providing food incentives to parents besides setting up camps; and by Singh 2015, studying the effect on children's nutritional outcomes by incentivizing the health worker through performance-based pay versus providing information to mothers besides worker incentives).

The remainder of the paper is structured as follows. Section 2 sketches the institutional background and the details of the reform. Section 3 introduces the data and discusses the main empirical strategy, followed by the main results in Section 4. In Section 5, I discuss an additional analysis using only the high-performing states. Finally, Section 6 contains discussion and conclusion.

2 The Indian Context

2.1 Maternal and Child Health in India

In the early '90s, in India, the maternal mortality ratio (MMR) per 100,000 live births was 556, accounting for almost 19.7 % of deaths of women (≡152,000 deaths) in

8 The other few studies using this latest wave DLHS-4 (e.g. Rahman and Pallikadavath 2018) explore the reform's overall effect.

their reproductive age due to complications in pregnancy. The neonatal mortality ratio (NMR) per 1000 live births was 57.4. A decade later, MMR had reduced to 374, equivalent to 13 % of women's deaths due to maternity, and NMR was still 45.1.[9]

High mortality rates often result from the missed utilization of several necessary steps of care during maternity. Giving birth under the skilled supervision of health professionals is crucial to necessitate the mother's and the child's safety. However, during 2001–2004, only 7.4 % of Indian women gave birth in the presence of any trained professional, and almost 3 % did not give birth at a health facility due to the lack of transportation. In the same period, only 48.5 % of expecting mothers received the three universally-recommended antenatal care check-ups to track their own and their child's health.

In postnatal care, evidence of the positive effect of breastfeeding on child health, particularly in developing nations (Attanasio 2015), confirms that early initiation of breastfeeding reduces the chances of child mortality. WHO recommends mothers start breastfeeding at the first hour of birth, followed by exclusive and continued breastfeeding until the first six months. However, only 27.2 % of the pre-reform sample were breastfed at birth. Additional pre-reform years' statistics reveal that only 10 % of the new mothers received any postnatal visit by a health worker within two weeks of giving birth.[10]

For these inferior outcomes, both the demand and the supply ends are responsible. Although India's public healthcare system allows for free and low-cost maternal and child healthcare, the uptake remains relatively low (and often, only constricted to mothers of upper socio-economic background, urban residence and sometimes, certain religions). Some contributing factors to healthcare underutilization are high indirect costs, the practice of informal payments, sociocultural norms, and broadly prevalent economic inequality.[11] Moreover, gender inequality, together with traditional patriarchal norms in society, often deprives women of their right to access primary healthcare (Drèze and Sen 2002). At the same time, the quality of healthcare provision has not been cooperative either, with issues such as inadequacy of medical equipment in healthcare facilities and absenteeism of health professionals.[12]

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9 Source: WHO, UNICEF, UNFPA, World Bank Group, and United Nations Population Division Maternal Mortality Estimation Inter-Agency Group.

10 These birth statistics for pre-reform years are calculated by the author using the entire sample of DLHS-2 and 3. The corresponding statistics for only the rural sample are somewhat worse.

11 See Joshi and Sivaram (2014) for an overview.

12 The rate of usage of public healthcare is strongly correlated with the absenteeism of health professionals from health facilities (Banerjee Deaton, and Duflo 2004; Banerjee and Duflo 2007).

2.2 The Janani Suraksha Yojana Program

The Government of India introduced this nationwide reform to address the demand- and supply-related blockages leading to poor maternal and child health in the country. The JSY program, as a part of the *National Rural Health Mission*, took off in April 2005. The objective was to reduce maternal and neonatal mortality by promoting institutional delivery among poor women. The reform was ambitious with a dual focus. It intended to increase the use of maternal and neonatal healthcare services by providing conditional cash transfer to mothers for institutional delivery and, simultaneously, improving maternal healthcare service delivery by employing ASHAs as community-based health workers. However, the program's primary focus lay on the low-performing states, which were performing worse in maternal and child health indicators than the high-performing states (see Online Appendix B Figures B1 and B2). The "low-" and "high-performing" categorizations of the states were done within the official guideline of the reform itself, based on the states' past performance in maternal and neonatal health and their public healthcare use (less than 25 % institutional births).[13] Thus, the LPS were designated to receive more attention through cash transfer and also ASHA's counseling to eligible mothers, so they can converge with the other states faster.

During its initial few years, the reform underwent a few rounds of revision. The first guideline took effect nationwide in April 2005. Soon after, it underwent a second revision in October 2006 and a third in April 2009. The reform is still in action and has been joined by similar programs at the state level over the years.

2.3 Eligible Mothers

According to the first guideline[14] published in April 2005, cash incentives to mothers were to vary between the low- and high-performing states (including the union territories). In both the LPS and HPS, pregnant women above 19 years of age and belonging to *below-poverty-line* households[15] were eligible for the cash transfer

13 In my study sample, the average institutional birth rate in the pre-reform years was 13 % in LPS and a little over 25 % in HPS.

14 Retrieved in November 2019 from "www.ilo.org/dyn/travail/docs/683/JananiSurakshaYojana Guidelines/MinistryofHealthandFamilyWelfare.pdf".

15 A *below-poverty-line* household is one, which has insufficient income to purchase two basic meals per day. This *poverty line* value differs across rural and urban areas and states. According to Tendulkar, Radhakrishna, and Sengupta (2009), the *poverty line* based on per capita consumption expenditure per month was 446.68 INR (≡9.85 USD) in rural and 578.8 INR (12.77 USD) in urban areas in 2004–2005. In 2009–2010, these figures were equivalent to 672.8 INR (13.9 USD) and 859.6 INR (17.76 USD).

for up to two live births, conditional on giving birth in public healthcare facilities. However, the eligibility criteria for the LPS and HPS were different. Since the LPS received extra attention, the women from both the rural and urban areas in the LPS could avail of the cash transfer, but the women from only rural areas could do so in the HPS. However, these rules were soon criticized since they did not effectively encompass all the socio-economically backward women in the country, among whom the institutional birth rates were low. As a result, the eligibility criteria were made less restrictive. Consequently, from October 2006 onwards, all women in the LPS, irrespective of their residence type, income level and birth history, could avail of the cash transfer if they chose to give birth at public healthcare facilities. In the HPS, the previous eligibility also spread across the urban areas; women who belonged to socially disadvantaged groups like *Scheduled Caste* or *Scheduled Tribe*[16] also came under the coverage now.[17,18] The mother's eligibility structures remained the same in the LPS and HPS when the third guideline was introduced in April 2009.

Figure 1 summarizes the eligibility structures of the program.

In the main empirical analysis discussed in Section 3.2, I consider the mothers' eligibility (in terms of their socio-economic indicators, residence type and birth history) for receiving the cash transfer as per the first and second guidelines of the reform.[19] Considering the revisions on eligibility, I formulate two categories of eligible mothers. The *first phase eligible mothers* satisfy the eligibility criteria of the first guideline that started from April 2005, and the *second phase eligible mothers* do not satisfy the eligibility criteria of the first guideline but that of the second guideline effective from October 2006.

2.4 ASHAs

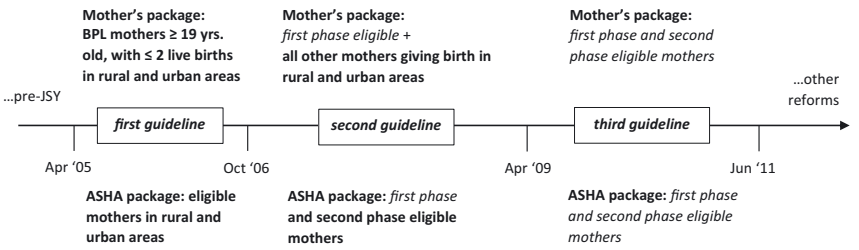
The village-based health workers called the *Accredited Social Health Activists* or ASHAs constituted an integral part of the reform. They were employed only in the

16 They are socio-economically disadvantaged groups recognized in the Constitution of India. See more in Appendix A Definitions.

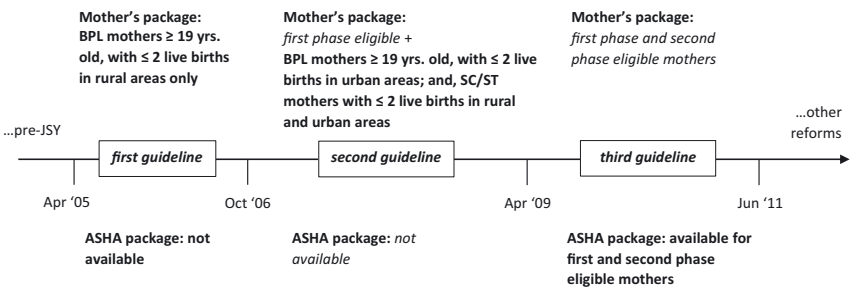
17 Retrieved in March 2021 from "https://main.mohfw.gov.in/sites/default/les/FEATURES%20FREQUENTLY%20ASKED%20QUESTIONS.pdf".

18 See Appendix A for definitions of "union territories", "public health facility" and "Scheduled Castes and Tribes".

19 The reason is data on both LPS and HPS is available only until end-2008, which broadly covers the period of the first two guidelines. (in DLHS-3).



(a) Low performing states (LPS)



(b) High performing states (HPS)

Figure 1: JSY program details – the first three guidelines. This is a simple representation of the eligibilities of the new mothers according to the first three guidelines for the mother's package (cash transfer) and the ASHA's package (her counseling). BPL is *below-poverty-line*, SC, ST are *Scheduled Caste* and *Scheduled Tribe* classes. A more detailed guideline that also includes the scale of monetary incentives is provided in Online Appendix B Figure B3.

LPS, according to the first two guidelines.[20] In April 2009, the ASHAs were introduced in the HPS as the third guideline took effect.

Typically, an ASHA was a female village resident with primary education. Her primary duties in maternal and child healthcare were identifying a pregnant woman in the community and registering her with the JSY program. Besides, she was to facilitate prenatal care, escort the expecting mother to the health center for delivery or other pregnancy-related complications that needed medical help, and ensure postnatal care.

20 However, it is unclear from the official guideline if the ASHAs were employed in the union territories. Therefore, later in the analysis, I exclude the union territories.

As a treatment variation in the main estimation strategy in Section 3.2, I use the presence of ASHA in the LPS and her consequent absence in the HPS during the period of the first two guidelines.

Therefore, the analysis described in Section 3.2 focuses on the effects during the post-reform period of the first two guidelines and uses treatment variations along two planes – one, the mother's eligibility status for the cash transfer and two, the ASHA's availability at the state-type level.

Note, Online Appendix B provides a thorough background description of the JSY program and the ASHA.

3 Data and Empirical Strategy

3.1 Data

The District Level Household Survey is the most useful health-related data source at India's district level. The second and third rounds of this repeated cross-sectional survey (henceforth, DLHS-2 and 3) provide information on births by mothers across all districts around the reform.[21] The DLHS-2 covers 507,622 married women sampled in 2002–2004, and DLHS-3 covers 643,944 married and unmarried women sampled in 2007–2008. The survey contains birth information (including the receipt of JSY cash transfer) and antenatal and postnatal care of mothers' most recent birth during 1998–2004 and 2004–2008. Additionally, the survey contains information on the household's demographic composition and socio-economic characteristics. By merging DLHS-2 and 3, and selecting only rural mothers, my study sample comprises every woman with a rural residency who was married and was of age 15–49 years and had her most recent birth during 2001–2008. It leaves a sample of a little over 255,000.[22]

In the analysis, I use information from the woman's questionnaire on the mother's characteristics, which include her age while giving birth, maximum schooling years, her total number of births, if she was a Hindu or Muslim, if she belonged to one of the socially disadvantaged groups, and her household wealth

21 The DLHS was administered by the Institute for International Population Studies (Mumbai, India) and its partner organizations. To date, they have implemented four rounds of the survey.

22 Although DLHS-2 has information on deliveries since 1998, I restrict the model from 2001 onward to have the *pre* and *post* windows equally distributed around the reform. In addition, it makes sense to consider only the *Millennium Development Goals* era.

status (given in deciles of wealth distribution). The wealth index is formulated by principal component analysis with a variety of assets owned by the household.[23]

For information on village health infrastructure, I use information on the presence of early childhood development services[24] in the village, thus controlling for whether the mother benefited from any other welfare and early-childcare-related programs. Further controls are for distance to the nearest primary health center, community health center and public district hospital, the information on which are also available from the village questionnaire.

Administrative data on state-level supply side, such as yearly net state domestic product per capita is obtained from the Central Statistics Office database.

Among the binary outcome variables, I use (1) institutional births, and (2) if the mother started breastfeeding within an hour or two of giving birth. The choice of these variables is driven by the fact that these can be immediately affected by the reform and can potentially contribute to the long-run alleviation of maternal and child morbidity and mortality.[25] In Online Appendix F, I discuss other outcomes such as the probability of the mother having a stillbirth and the living status of the lastborn child some years after birth.

The binary variable on institutional birth is denoted by whether the mother had her latest birth at a public health facility. The binary variable on early breastfeeding is denoted by whether she started breastfeeding the baby within 1–2 h of birth. I obtain both information from the women's questionnaire of DLHS.

Lastly, for additional analysis on the introduction of ASHA in the HPS (in Section 5), I combine with DLHS-2 and 3 the latest DLHS-4 wave undertaken in 2012–2014. Here, I use similar information on rural mothers aged 15–49 years who had their latest birth from 2001 to May 2011, only in the high-performing states. The relevant sample contains about 100,000 observations. Note that the DLHS-4 wave only covers the HPS.

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23 Since DLHS-2 does not have direct information on the *below-poverty-line* status, I compute this wealth index and use the bottom-most quintile of the distribution to define the poor. (Joshi and Sivaram 2014 use a similar methodology.) As per India's Planning Commission figures of poverty in 2004–2005, the rural and urban percentages below the poverty line were 22.7 % and 21.9 %. In line with this, it is logical to define the poor as the bottom-most quintile of wealth distribution.

24 E.g. *Integrated Child Development Services*. See details in Appendix A Definitions.

25 I also examine outcomes such as three antenatal check-ups received by the mother and BCG vaccination to the newborn, but as the causality in the effects cannot be stressed, I do not report them here.

3.2 Econometric Specification

The paper aims to understand the effect of the JSY program, through its various treatment arms, on the birth outcomes of the mother and newborn. Given the reform's rollout, I consider two major phases of the reform – one when the first guideline determined the mother's eligibility, and the other when the second guideline did. This is because, after the second guideline was introduced, the new eligibility status then encompassed more mothers who would otherwise be in the 'control' group should I only consider the first guideline's eligibility. This essentially gives rise to two sets of eligible mothers along the timeline, – the ones who became eligible according to the first guideline, and then the ones who were not eligible according to the first guideline, but became so after the second guideline took effect. Alongside them, remains a set of mothers who never became eligible.

Then comes the state-level variation in the availability of the ASHA. Throughout the period of first and second guidelines, ASHAs were available to counsel the eligible mothers only in the low-performing states and not in the high-performing states.

Considering the above variations, I have four treatment groups – "eligible mothers according to the first guideline without the presence of ASHA", "eligible mothers according to the first guideline with the presence of ASHA", "newly eligible mothers according to the second guideline without the presence of ASHA" and "newly eligible mothers according to the second guideline with the presence of ASHA". The control group consists of mothers who never become eligible for any assistance. Note that I consider only rural mothers for this analysis. This gives a set of demographically similar mothers eligible in LPS and HPS in the first phase. I justify this choice at the end of this subsection.

Here is a formal DiD specification. For a mother i giving birth in a state j in a year t, I estimate the following:

$$\begin{aligned} Y_{ijt} = {} & \alpha + \beta_1 Eligible without ASHA_{ij} + \beta_2 Eligible with ASHA_{ij} \\ & + \beta_3 (Eligible without ASHA_{ij} * Post1_t) \\ & + \beta_4 (Eligible with ASHA_{ij} * Post1_t) + \beta_5 Add Eligible without ASHA_{ij} \\ & + \beta_6 Add Eligible with ASHA_{ij} + \beta_7 (Add Eligible without ASHA_{ij} * Post2_t) \\ & + \beta_8 (Add Eligible with ASHA_{ij} * Post2_t) + X'_{ij}\delta + \Omega S_{jt} + \mu_t + \gamma_j + \epsilon_{ijt} \end{aligned} \quad (1)$$

Y_{ijt} is the outcome variable of the rural mother i in the state j with latest birth in the year t. $EligiblewithoutASHA_{ij}$ is one of the treatment variables taking value 1 for the mother who is eligible for cash transfer according to the first guideline in the state where ASHA is not available, i.e. the HPS. Similarly, $EligiblewithASHA_{ij}$

is her counterpart group in the state where ASHA is available, i.e. the LPS. They are whom I refer to as the *first phase eligible mothers*. β_1 and β_2 capture the difference in means of these two groups with the control group (i.e. the *Ineligibles*) before the reform. $Post1_t$ takes value 1 for the births that took place after April 2005 till end-2008. An interaction of $Post1_t$ with each of these two eligible groups gives the difference in the mean change in outcome pre- and post-introduction of first guideline, between the respective eligible group and the control group. In other words, β_3 gives the treatment effect of only the mother's package on the first phase mother in the HPS, and β_4 gives the treatment effect of the mother's package and the ASHA's presence on the first phase eligible mother in the LPS.

Then comes the $AddEligiblewithoutASHA_{ij}$, *which* is a binary variable for the rural mother who was not eligible according to the first guideline but newly eligible for cash assistance according to the second guideline in the HPS (where ASHA remained unavailable). Similarly, $AddEligiblewithASHA_{ij}$ is a binary variable for her counterpart in the LPS. They are whom I refer to as the *second phase eligible mothers*. β_5 and β_6 capture the difference in means of these two groups with the Ineligibles before the intervention. $Post2_t$ takes value 1 for the births occurring after October 2006 till end-2008. An interaction of $Post2_t$ with the $AddEligiblewithoutASHA_{ij}$ and $AddEligiblewithASHA_{ij}$ respectively, gives the difference-in-difference effect of the program on the second phase eligible mothers, in comparison to the control group. Essentially, β_7 gives the treatment effect of only the mother's package on the second phase eligible mother in the HPS, and β_8 gives the treatment effect of the mother's package and ASHA's presence on the second phase eligible mother in the LPS.

To consider any confounding effect arising from the heterogeneity in the reform's rollout across states, I include state fixed effects denoted by γ_j.[26] Furthermore, any unobservable effect arising due to specific birth-years of the latest births by mothers is absorbed by a birth-year fixed effect denoted by μ_t. Finally, X_{ij} constitutes the set of control variables at individual level (mother's total number of births, maximum schooling years, and age during the latest birth), at household level (wealth decile, socially-backward-group status and religion), and at village level (the presence of any child welfare program, and the distances to the nearest

26 It is worth mentioning here that a few other maternity programs were in effect during JSY's study period. To my knowledge, *Dr Muthulakshmi Maternity Benefit Scheme*, which was launched in 1987 in the state of Tamil Nadu, continued to be in effect during JSY. The state of Orissa launched a conditional electronic cash transfer program *Mamata* in October 2011. However, these programs were implemented at the state level and continued evenly throughout my study period; therefore, a state fixed effect should eliminate any confounding effect arising from their availability.

primary health center, community health center and district-level public hospital). Even after conditioning on these detailed set of controls, some time-varying supply-side characteristics at the state level could still affect the outcomes. For that, I further control for annual net state domestic product per capita denoted by S_{jt}

Returning to the discussion of understanding the effects of the different treatments from the empirical strategy used above, one could perhaps go one step further and compare the observed effects in LPS and HPS to understand the "added" effect of the ASHA in the LPS. The assumption underlying this inference is: without the ASHA, the effect of the cash transfer would be the same in LPS as in HPS. A positive difference between β_4 and β_3, and between β_8 and β_7 in Equation (1) would suggest that the ASHA had some role in driving the take-up of maternal and neonatal services, and therefore, incentivizing the health workers provided an effective solution in this reform.

However, this above argument is reasonable if the mothers being compared across the two state-types are as identical as possible, and so are other related factors. Now, in the rural sample, the first phase groups – $EligiblewithoutASHA_{ij}$ (in HPS) and $EligiblewithASHA_{ij}$ (in LPS) are demographically identical, i.e. they are below-poverty-line, above 19 years old, have less than two births and belong to rural areas (See Appendix A Figure A1). Also, Appendix A Table A1 shows that the two groups of eligible mothers of the rural HPS and LPS are similar in religious representation, total births, social group status and wealth quintile, which validates that their socio-economic opportunities are similar.[27] Simultaneously, I also verify that other related factors, such as costs and availability of public health facilities, were not significantly different for these mothers across the two state-types. In fact, the mother's cash amount from the JSY program was also the same across the state-types in the first phase. This balance between the first phase eligible mothers in the rural LPS and HPS, narrows down the chances that some of the difference in the observed effects of the reform is potentially due to the ASHA.[28] However, drawing a similar inference about the second phase eligible mothers $AddEligiblewithoutASHA_{ij}$ and $AddEligibleASHA_{ij}$, by comparing β_8 and β_7 is not plausible, as the groups vary substantially in their socio-economic composition across the state-types.

27 The standardized difference in mean is less than the rule-of-thumb 0.25 (Imbens and Wooldridge 2009; Rellstab et al. 2020), thus negating statistically significant differences among the first phase rural eligible mothers across state-types.

28 However, note that when comparing *all* mothers in LPS versus HPS, there exist significant differences in their demographic indicators and social opportunities (See Appendix A Table A2).

Finally, even after restricting to the first phase rural eligible mothers in understanding the effect of the ASHA, two caveats remain: (1) There could be systematic differences between LPS and HPS in terms of how the reform was implemented, i.e. the strategy and rollout of funding and other resources could have varied in the two state-types based on their previous trends in maternal and neonatal health or other factors. Then the mothers of the two places do not qualify for a meaningful comparison. (2) The LPS being worse performers in the pre-reform period (with a baseline rate of 6 % institutional birth *vis-à-vis* 21 % in HPS), are simply more responsive to the cash transfer than their counterpart in the HPS, i.e. the effect size of the cash transfer alone is probably higher in LPS than HPS. These two alternative explanations could confound my interpretation of the "sole" effect of ASHA, which comes from the difference in the observed effects of LPS and HPS. In Section 5, I attempt to address these issues through an analysis with the HPS only.

3.3 Summary Statistics

In Table 1, I present the pre-reform summary statistics of the dependent variables and various covariates related to the mother and the household across the five comparison groups. Some of the covariates' means are significantly different across these groups because of the very nature of the groups' composition that depended on the residence, wealth status, social status, age and birth history. Moreover, it can be seen from the mean values of the dependent variables that the first phase eligible mothers in the LPS, denoted by *EligiblewithASHA* in Column (3) of Table 1, were the worst performers in the pre-reform years. Naturally, on them lay the highest focus of the program. The summary statistics of mothers pre- and post-reform (Online Appendix B Table B1) show that the composition of mothers giving birth did not change considerably due to the reform.

4 Results

4.1 Pre-Reform Trends

The identifying assumption of a DiD approach is that the dependent variables would follow the same trend in the treatment and control groups in the absence of the intervention. Under this assumption, it is possible to decipher the average causal effect on the treated in the post-intervention period. A close validation of this otherwise untestable assumption is obtained by checking if the dependent variables

Table 1: Summary statistics of key variables in the pre-reform period (rural mothers).

Variables	(1) Ineligibles Mean (SD)	(2) *EligiblewithoutASHA* Mean (SD)	(3) *EligiblewithASHA* Mean (SD)	(4) *AddEligiblewithoutASHA* Mean (SD)	(5) *AddEligiblewithASHA* Mean (SD)
Dependent variables					
Institutional births	0.24 (0.42)	0.21 (0.41)	0.06 (0.23)	0.24 (0.43)	0.12 (0.32)
Breastfed at birth	0.42 (0.49)	0.39 (0.49)	0.14 (0.34)	0.40 (0.49)	0.20 (0.40)
Individual control variables					
Total births by mother	1.45 (1.08)	1.07 (0.25)	1.04 (0.19)	1.07 (0.26)	1.79 (1.70)
Mother's age at last birth	23.05 (4.63)	24.23 (4.61)	25.79 (5.26)	22.02 (4.59)	23.93 (5.82)
Mother's schooling yrs.	5.83 (4.74)	1.89 (3.56)	0.89 (2.47)	4.14 (4.51)	2.83 (4.15)
Hindu	0.77 (0.42)	0.80 (0.40)	0.88 (0.32)	0.83 (0.38)	0.86 (0.34)
Muslim	0.13 (0.34)	0.15 (0.36)	0.10 (0.30)	0.01 (0.11)	0.12 (0.32)
SC/ST/OBC	0.58 (0.49)	0.79 (0.40)	0.87 (0.33)	1 (0)	0.79 (0.41)
Wealth quintile	3.42 (1.13)	1 (0)	1 (0)	2.92 (1.00)	2.61 (1.12)
Observations	25,822	4124	22,986	11,110	58,049

Data from DLHS-2 and 3. The sample consists of rural mothers with reported last birth during 2001–2004.

evolved with the same or a parallel trend in the treatment and control groups in the pre-intervention years.

A visual inspection of the mean institutional birth rates and early breastfeeding in Appendix A Figure A2 suggests that from the turn of the millennium to 2004, the first phase rural mothers in both LPS and HPS followed somewhat similar trends as their ineligible counterparts. However, the second phase eligible mothers may have followed a different trend. Figure A3 which gives the entire picture of pre-and post-reform years imply that all the eligible groups saw an increased effect in the dependent variables after reform.

For a robust verification, we examine the point estimates of the difference of each eligible group and the ineligible in each birth-year, in a regression specification that considers all treatment groups. Figures 2 and 3 plot the difference-in-difference coefficients across time for the first phase eligible *vis-à-vis* the ineligible. Figure 2 shows no statistically significant difference in institutional birth rates of the first phase eligible mothers in both the high- and the low-performing states compared to the ineligible mothers before the reform. It is only post-2005, i.e. after the first phase's rollout, one can see some positive differences in these two eligible groups' institutional birth rates. Similarly, Figure 3 confirms the presence of parallel pre-trends in early breastfeeding among the first phase eligible and the ineligible, both in HPS and LPS. However, the reform's effect can only be seen in LPS.

To sum up, the above two exercises validate that these comparison groups – at least, the first phase eligible both in LPS and HPS and the ineligible, evolved in parallel in their birth outcomes and would have continued in the same way without

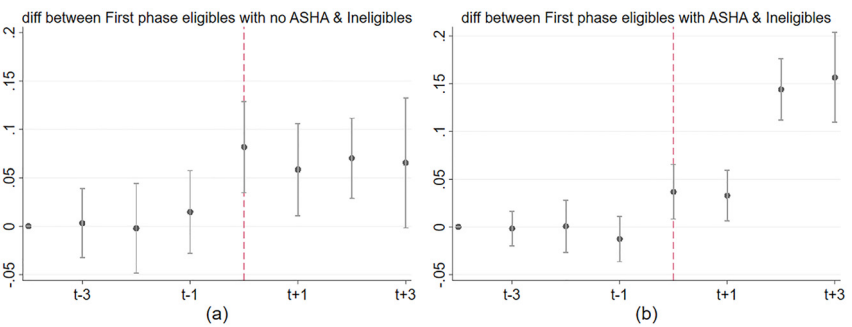

Figure 2: Time-varying difference (with 95 % CIs) in institutional births between the rural first phase eligible and ineligible mothers. Plot (a) shows the difference between eligible mother in HPS and the ineligible in the probability of giving birth at public healthcare institutions during 2001–2008. Plot (b) shows a similar difference between eligible mother in LPS and the ineligible. The red dash-line marks the intervention onset in $t = 2005$ for the first phase eligible.

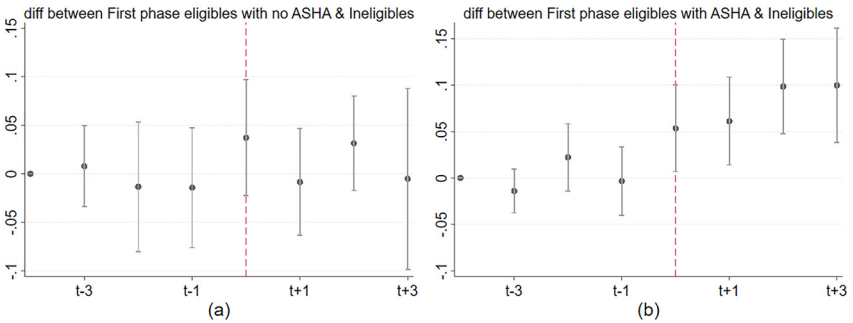

Figure 3: Time-varying difference (with 95 % CIs) in early breastfeeding between the rural first phase eligible and ineligible mothers. Plot (a) shows the difference between eligible mother in HPS and the ineligible in the probability of initiating breastfeeding right after their latest birth that occurred during 2001–2008. Plot (b) shows a similar difference between eligible mother in LPS and the ineligible. The red dash-line marks the intervention onset in $t = 2005$ for the first phase eligible.

the reform. Therefore, the effects of the treatment arms, i.e. the cash transfer in the HPS and the joint cash transfer and ASHA's guidance in the LPS, are expected to be causal. As far as causal evidence on the direct effect of ASHA is concerned, it is hard to have one in this setting due to the absence of an appropriate counterfactual. (Nevertheless, I attempt to draw some suggestions on the ASHA's role in the reform).

Also, note that I emphasize the parallel pre-trends for the first phase eligible mothers only. It should be kept in mind that confirming the parallel pre-trends for the first phase eligible mothers is sufficient in asserting that the reform's introduction had a causal effect on institutional births and early breastfeeding, at least for the main target population of the program. Perhaps it is futile to expect clean parallel pre-trends for the second phase eligible since the likelihood of some spillover effect is high from a nationwide reform of this stature. Thus, the scope of this paper in teasing out the causal effect per se remains limited to the first phase eligible mothers.[29]

Based on the pre-reform trend analysis, the reader should focus on the estimates of the first phase eligible mothers for causal interpretation in the following section.

29 The DiD plots of the second phase eligible are shown in Online Appendix C Figures C1 and C2.

4.2 Regression Results

4.2.1 Institutional Births

Table 2 Column (1) reports the effect on public institutional births. The coefficient of interaction between *Eligible without ASHA* and *Post1* indicates that the increase in institutional birth rate among the first phase eligible rural mothers in a high-performing state where ASHA was not available was 2.4 pp. ($p = 0.061$) greater than that among the control group of rural *Ineligibles*. In contrast, the coefficient of interaction between *Eligible with ASHA* and *Post1* indicates that the increase among the

Table 2: Effects on institutional birth and early breastfeeding in LPS and HPS.

Dependent variable	Institutional birth (1)	Early breastfeeding (2)
First phase eligibles		
Eligible without ASHA	0.018*	0.034**
	(0.010)	(0.014)
Eligible with ASHA	−0.048	−0.263***
	(0.049)	(0.054)
Eligible without ASHA*Post1	0.024*	−0.010
	(0.012)	(0.018)
Eligible with ASHA*Post1	0.051***	0.026***
	(0.007)	(0.010)
Second phase eligibles		
Additional eligible without ASHA	0.047***	0.010
	(0.007)	(0.009)
Additional eligible with ASHA	−0.036	−0.259***
	(0.049)	(0.055)
Additional eligible without ASHA*Post2	0.022**	−0.004
	(0.009)	(0.011)
Additional eligible with ASHA*Post2	0.065***	0.024***
	(0.006)	(0.007)
State FE	Yes	Yes
Birth year FE	Yes	Yes
Controls	Yes	Yes
***F*-test of equality between interaction coefficients of first phase eligibles**		
F-statistic	3.82	3.01
p-value	0.051	0.084

Table 2: (continued)

Dependent variable	Institutional birth (1)	Early breastfeeding (2)
***F*-test of equality between interaction coefficients of second phase eligibles**		
F-statistic	14.49	3.92
p-value	0.000	0.048
Baseline mean of ineligibles	0.24	0.42
Observations	255,432	242,111
R^2	0.124	0.176

(1) The unit of observation is a rural mother who had her latest birth during 2001–2008. (2) Column (1) presents the estimates for dependent variable institutional birth (binary variable: 1 if birth at JSY-affiliated public health facility, 0 otherwise). Column (2) presents estimates for dependent variable early breastfeeding (binary variable: 1 if mother started breastfeeding 1–2 h after birth, 0 otherwise). (3) Explanatory/treatment variables **EligiblewithoutASHA** and **EligiblewithASHA** denote the respective pre-reform difference in means of the first phase eligible mothers in HPS and LPS with the control group (Ineligibles). **EligiblewithoutASHA*Post1** and **EligiblewithASHA*Post1** denote the respective difference-in-difference effects of the reform's treatment arms on the first phase eligible mothers in HPS and LPS. **Add.EligiblewithoutASHA** and **Add.EligiblewithASHA** denote the respective pre-reform difference in means of the second phase eligible mothers in HPS and LPS with the control group (Ineligibles). **Add.EligiblewithoutASHA*Post2** and **Add.EligiblewithASHA*Post2** denote the respective difference-in-difference effects of the reform's treatment arms on the second phase eligible mothers in HPS and LPS. **Post1** and **Post2** denote the births taking place after the onset of first guideline (Apr 2005) and the ones after the onset of the second guideline (Oct 2006). (4) An *F*-test of equality between the coefficients **EligiblewithoutASHA*Post1** and **EligiblewithASHA*Post1** (i.e. the first phase eligibles) shows that they are significantly different from each other (at 5 % and 10 % levels for institutional birth and early breastfeeding). A similar *F*-test of equality between the coefficients **Add.EligiblewithoutASHA*Post2** and **Add.EligiblewithASHA*Post2** (i.e. the second phase eligibles) shows that they are significantly different from each other (at 1 % and 5 % levels for institutional birth and early breastfeeding). (5) Control variables include mother's total live births, her maximum schooling years, her age during last birth, her religion, if her household belongs to one of the socially backward groups, her household's wealth quintile; and village-specific health infrastructure controls like presence of any other child welfare program, distance to the nearest primary health center, community health center, to the nearest district hospital; and, time-varying net state domestic product per capita. (6) Standard errors clustered at district level are within parentheses. (7) The unadjusted R^2 values are reported here. (8) The mean of the outcome variable in the control group (Ineligibles) in the pre-reform period is reported. (9) ***, **, * imply $p < 0.01$, <0.05, <0.10 respectively.

first phase rural eligibles in a low-performing state where ASHA was available was 5.1 pp. ($p = 0.000$) larger than that among *Ineligibles*. Therefore, the first phase mothers who were eligible for the cash transfer and the ASHA's advice experienced about two times increase in institutional birth rate than that by the first phase mothers

who only received cash transfer. Given a 24 % pre-reform institutional birth rate of ineligible mothers, this increase was about 10 % in HPS and 21.25 % in LPS.

Now, we look at the mothers who were not eligible for the reform benefits in the earlier phase but became eligible from the end of 2006. Among them, the ones who only received cash transfer (i.e. in HPS) experienced a 2.2 pp. ($p = 0.017$) increase in institutional births, and the ones who received both the cash transfer and ASHA's guidance experienced 6.5 pp. ($p = 0.000$) increase relative to the ineligible mothers.

4.2.2 Early Breastfeeding Practices

In Table 2 Column (2), there is no statistically significant difference in the average increase in effect for the first phase eligible mothers in the HPS. However, the first eligible mothers in the LPS (who were 26.3 pp. ($p = 0.000$) less likely than the ineligible mothers to start breastfeeding within an hour in the baseline) experienced a disproportionately large increase of 2.6 pp. ($p = 0.013$) in the probability of early breastfeeding post-reform. In the second phase too, a similar pattern exists. Therefore, to summarize, it is only the eligible mother in the LPS in both phases, with the cash transfer and ASHA by her side, who experienced a statistically significant effect of the program on early breastfeeding practices.[30] There was no effect of the mother's package alone on the HPS mothers.[31]

Note, since the second phase eligible mothers do not satisfy the parallel pre-trends assumption, I repeat the regressions by omitting the second phase eligible

30 However, the estimated post-reform difference in means with the control group remains negative for the eligibles of LPS in both phases (main effect + interaction effect < 0).

31 Here is some further reflection on the difference in early breastfeeding outcome in LPS versus HPS. It is quite a valid argument that the HPS mothers were already at a decent baseline rate (39 %) in early breastfeeding, and thus, the reform effect on them was not significantly large like in the LPS where baseline rate was 14 %. At the same time, another argument could hold: With the upsurge in institutional deliveries, the public health facilities were probably in shortage of medical staff who would guide the mother in the following steps (Chaturvedi, De Costa, and Raven 2015). There the ASHA's presence by the mother possibly made the most difference, as is reflected in the early initiation of breastfeeding in LPS *vis-à-vis* HPS. One could counterargue that LPS being the reform's primary target states, might have received an increased supply of other medical staff besides ASHA, which aggregately contributed to the better results of the LPS. However, this last scenario is improbable as I find some descriptive evidence that LPS had a lower nurse-to-registered pregnancy ratio in health centers than in HPS in the post-reform period (Online Appendix D Figure D1). Therefore, the chances that the ASHA's presence is associated with the improved post-birth outcome in the LPS remain.

mothers from the sample (see Appendix A Table A3). The results remain consistent and DiD estimates of first phase mothers are even larger.[32]

Let us now summarize the results of Section 4.

First, given that the parallel pre-trends assumption only holds for the first phase eligible mothers, we draw causal inference for these mothers only. Among them, the eligible mothers in a low-performing state experienced significantly large effects on institutional birth rate and early breastfeeding. In contrast, the eligible mothers in a high-performing state had a smaller effect on institutional birth and no effect on breastfeeding.

Second, since the comparison groups of first phase eligible mothers are similar in their socio-economic status and other observable surrounding parameters (e.g. indirect costs, proximity to health facilities, etc.) and also in the amount received as cash transfer in LPS and HPS, I argue that the ASHA likely plays a crucial role in driving this difference.

However, one cannot rule out the possibility of heterogeneous effects of the cash transfer alone in the two state-types. Thus, an alternative explanation remains: the LPS mothers simply respond better to the cash transfer than the HPS mothers. In light of this, it is perhaps wise to conclude that the ASHA most likely has additional effects; however, it is hard to quantify in the absence of an appropriate counterfactual.

Another caveat while drawing inference from this DiD setup is that if underlying systematic differences between LPS and HPS affected the reform's implementation in the two state-types, to begin with, it could lead to a meaningless comparison between the two.

I attempt to bypass these caveats to some extent in the following section.

5 Alternative Analysis with HPS Only

A shortcoming of the previous analysis is that it does not solve the potential heterogeneity in effects of only the cash transfer among the mothers in LPS *vis-à-vis* HPS. The effect observed among the LPS mothers could only be a bigger response rate to the cash transfer, as they have had significantly worse outcomes in the pre-reform period. So, it is hard to single out the ASHA's effect by comparing the effect sizes between the eligible mothers in the LPS versus HPS.

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32 In another robustness check, I restrict the sample to mothers with less than two births since more experienced mothers potentially have different birth patterns. The results are more or less consistent, except the estimate for the first phase eligible mothers in HPS becomes imprecise. See Online Appendix E.

The previous analysis also does not solve the potential underlying systematic differences between the low- and high-performing states that could bias my results. To elucidate further, the regions with the reform's central focus were the low-performing states due to their poor performance on maternal and neonatal outcomes in the pre-reform period. Therefore, even after comparing the eligible mothers of LPS versus HPS with a careful identification strategy, one could still argue that the reform's implementation, e.g. the rollout of funding and other resources, could have differed in the two places. That is, if the determinants of the reform's implementation are systematically related to underlying trends in the institutional births in LPS and HPS, one should worry about unobserved differences in the characteristics of the two state-types that could potentially lead to a biased conclusion, as a state fixed effect analysis would not simply take care of it.

To get around these issues, I present an alternative analysis with only the HPS sample before and after the introduction of ASHA. I explore if the introduction of ASHAs later in 2009 in the HPS, led to similar improved outcomes as seen in the LPS. For this exercise, I utilize the fourth and latest wave of DLHS, which had only collected data from the HPS.[33] I study the eligible mothers in the HPS who were exposed to the cash transfer from the beginning of JSY, and then received an ASHA's guidance too from April 2009 onwards.[34] Through this analysis, I am able to purge the regression of any potential issue of differential trends in LPS *vis-à-vis* HPS that could have biased my results in Section 4.2.

At this stage, I emphasize that the goal of this exercise is not to precisely replicate Section 4.2 results but to provide an extension to it with a suitable econometric specification. It is interesting to examine if the eligible mothers, especially the first phase ones, reacted similarly to the introduction of ASHA in the HPS. Recall from Figure 1 Panel (b) that according to the first guideline, only the mother's package was introduced to economically disadvantaged mothers. These mothers were above the age of 19, had up to two live births and belonged to below-poverty-line households in rural areas. In the second guideline, these eligibility criteria were relaxed to include an identical cohort from the urban areas; with them, mothers with up to two live births belonging to either of the two socially backward groups – *Scheduled Caste* and *Scheduled Tribe*, were also made eligible. From April 2009, a third guideline came into effect; now, the mother's package continued to be available to the first and second phase eligible mothers, however ASHAs were newly introduced to guide them. In the following analysis, I consider the timeline

33 The DLHS-4 survey in the LPS was abandoned due to budgetary reasons.

34 The information on the initiation of this phase is available from a national report "Four years of NRHM 2005–2009" by the Ministry of Health and Family Welfare, retrieved from "https://nhm.gov.in" in August 2019.

until May 2011 (as afterwards, other health reforms were initiated and bridged with JSY).

Although it is not crucial anymore to consider only a rural sample for identification purposes in this particular analysis, I continue using it for some comparability across results. In the rural sample within HPS, the relevant second phase eligible mothers are those from socially backward groups with less than two births.

I consider the following DiD specification for estimation:

$$\begin{aligned} Y_{ijt} = \alpha &+ \beta_1 Eligible_{ij} + \beta_2 AddEligible_{ij} + \beta_3 (Eligible_{ij} * Post1_t) \\ &+ \beta_4 (AddEligible_{ij} * Post2_t) + \beta_5 (Eligible_{ij} * Post3_t) \\ &+ \beta_6 (AddEligible_{ij} * Post3_t) + X'_{ij}\delta + \Omega S_{jt} + \mu_t + \gamma_j + \epsilon_{ijt} \end{aligned} \tag{2}$$

Y_{ijt} is the outcome variable of the rural mother i in the HP state j with her latest birth in the year t. $Eligible_{ij}$ takes value 1 for the rural mother who was eligible for cash transfer in HPS according to the first guideline. $AddEligible_{ij}$ takes value 1 for the additional rural mother who was not eligible for the cash transfer in the first phase but became so in the second phase. $Post1_t$ takes value 1 for all births during April 2005 – March 2009, that is the pre-ASHA period. An interaction of $Eligible_{ij}$ with $Post1_t$ gives the treatment effect of only the mother's cash transfer on the first phase eligible mother. Similarly, $Post2_t$ takes value 1 for all births during October 2006 – March 2009 (pre-ASHA period). The interaction of $AddEligible_{ij}$ with $Post2_t$ gives the treatment effect of only the mother's cash transfer on the second phase eligible mother. Finally, $Post3_t$ takes value 1 for the births from April 2009 onwards, when all eligible rural mothers received the ASHA's counseling besides cash transfer. From the respective interactions of $Post3_t$ with the two treatment groups, we obtain the combined effect of the mother's cash transfer and the ASHA's guidance for each of the groups. Thus, the coefficients of interest here are β_3, β_4, β_5 and β_6. The remaining notations of this equation indicate the same as in Equation (1).[35]

Here too, a pre-trend analysis (Online Appendix C Figure C3) confirms the causality in the effect for the first phase eligible through the presence of parallel pre-trends with the ineligible, in contrast to the second phase eligible. Thus, again it is worthwhile to focus our inference on the first phase mothers.

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35 Equation (2) is considerably different than Equation (1), with the number of treatment categories being reduced to *Eligible* and *Additional Eligible* and the control group of *Ineligible*. Essentially, the $Eligible_{ij}$ of Equation (2) is equivalent to $EligiblewithoutASHA_{ij}$ of Equation (1) and $AddEligible_{ij}$ of Equation (2) is equivalent to $AddEligiblewithoutASHA_{ij}$ of Equation (1). Moreover, since $Post1_t$ and $Post2_t$ vary in time frame in the two equations, in addition to the presence of other variables, one cannot expect effects of similar magnitude in the two corresponding analyses.

The estimates reported in Table 3 suggest that the effect of the mother's cash transfer on institutional birth was significantly positive whereas the effect on early breastfeeding was not significantly different from null. These mothers showed a substantially large difference in institutional birth rate when ASHA was introduced besides the cash transfer (effect size being almost double post-versus pre-ASHA). The introduction of ASHA, however, made no difference in breastfeeding practices.[36]

Table 3: Effects on institutional birth and early breastfeeding in high-performing states only.

Dependent variable	Institutional birth (1)	Early breastfeeding (2)
First phase eligibles		
Eligible	−0.039***	0.015
	(0.009)	(0.013)
Eligible*Post1	0.064***	0.016
	(0.012)	(0.017)
Eligible*Post3	0.124***	0.008
	(0.018)	(0.020)
Second phase eligibles		
Additional eligible	0.018***	0.003
	(0.007)	(0.008)
Additional Eligible*Post2	0.054***	0.019*
	(0.009)	(0.010)
Additional Eligible*Post3	0.048***	−0.026*
	(0.014)	(0.014)
State FE	Yes	Yes
Birth year FE	Yes	Yes
Controls	Yes	Yes
***F*-test of equality between the coefficients of Eligible*Post1 & Eligible*Post3**		
F-statistic	8.90	0.18
p-value	0.003	0.671
***F*-test of equality between the coefficients of Add.Eligible*Post2 & Add.Eligible*Post3**		
F-statistic	0.17	11.47
p-value	0.681	0.001

36 A robustness check by omitting the second phase eligible mothers, do not change the implications of the results (Appendix A Table A4).

Table 3: (continued)

Dependent variable	Institutional birth (1)	Early breastfeeding (2)
Baseline mean of ineligibles	0.284	0.469
Observations	100,301	96,018
R^2	0.090	0.116

(1) Sample contains observations from rural areas in high-performing states only. The unit of observation is the mother in rural HPS, who had her latest birth during 2001 – May 2011. (2) Column (1) presents the estimates for dependent variable institutional birth (binary variable: 1 if birth at JSY-affiliated public health facility, 0 otherwise). Column (2) presents estimates for dependent variable early breastfeeding (binary variable: 1 if mother started breastfeeding 1–2 h after birth, 0 otherwise). (3) Explanatory/treatment variable **Eligible** denotes the pre-reform difference in means of the first phase eligible mothers with the control group (Ineligibles). **Additional Eligible** denotes the pre-reform difference in means of the second phase eligible mothers with the control group (Ineligibles). **Eligible*Post1** and **Additional Eligible*Post2** denote the respective difference-in-difference effects of the mother's cash transfer only on the first phase and second phase eligible mothers respectively. **Eligible*Post3** and **Additional Eligible*Post3** denote the respective difference-in-difference effects of the mother's cash transfer and ASHA's presence on the first phase and second phase eligible mothers respectively. **Post1** denotes the births taking place in Apr 2005–Mar 2009, **Post2** denotes the births taking place between Oct 2006–Mar 2009, and **Post3** denotes the births taking place in Apr 2009–May 2011. (4) An *F*-test of equality between the coefficients **Eligible*Post1** and **Eligible*Post3** (i.e. the DiD effect on first phase eligibles with one package and with two packages) shows that they are significantly different from each other (below 1 %) for institutional birth but not for early breastfeeding. A similar *F*-test of equality between the coefficients **Add.Eligible*Post2** and **Add.Eligible*Post3** (i.e. the DiD effect on second phase eligibles with one package and with two packages) shows that they are significantly different from each other (below 1 %) for early breastfeeding but not for institutional birth. (5) Control variables include mother's total live births, her maximum schooling years, her age during last birth, her religion, if her household belongs to one of the socially backward groups, her household's wealth quintile; and village-specific health infra-structure controls like presence of any other child welfare program, distance to the nearest primary health center, community health center, to the nearest district hospital; and, time-varying net state domestic product per capita. (6) Standard errors clustered at district level are within parentheses. (7) The unadjusted R^2 values are reported here. (8) The mean of the outcome variable in the control group (Ineligibles) in the pre-reform period is reported. (9) ***, **, * imply $p < 0.01$, <0.05, <0.10 respectively.

To sum up, the takeaway from this analysis is that with ASHA by their side, the rural HPS mothers of first phase experienced a larger increase in institutional birth rate than without her. The first phase eligible mothers in the rural HPS are those below-poverty-line, and with less than two live births. As discussed earlier in the paper, these mothers are in the most vulnerable group, and according to the main findings of Section 4.2 they benefited more in the ASHA's presence in the LPS. Similarly, now within the HPS sample, this particular group improved in

institutional birth rate after the ASHA's introduction. However, in early breastfeeding, the findings vary compared to Section 4.2 results. While there the joint effect of cash transfer and ASHA on early breastfeeding was evident on first phase eligible mothers in LPS, in the current analysis no significant joint effect is found in HPS (the effect size even decreases post-ASHA). It is hard to distinguish if this difference potentially arises from the different specifications of the two models in Equations (1) and (2) or that the mothers across the two state-types simply respond differently (especially because their baseline rates are so different). Another aspect, which is not properly explored in this paper but cannot be ruled out, is that there may not be sufficient supply-side adjustments immediately after the ASHA's introduction in HPS to facilitate better post-birth outcome.[37]

Finally, this analysis with only the HPS sample is not compelling either when trying to understand the effect of ASHA. Caution should be taken when inferring that the difference in effect observed among the eligible mothers pre- and post-ASHA introduction is attributed to the ASHA, which is only possible if we assume that the effect of the cash transfer is static in all post-reform years. However, that is quite unlikely and we cannot rule out the possibility that the effect of the cash transfer itself increases over time on the similar mothers in HPS. In that case, the additional effect observed in the post-ASHA period is not just due to ASHA.

6 Discussion and Conclusion

This study investigates a national health reform in India, which had the unique feature of incentivizing both the demand and the supply end of maternal and child healthcare. The alarmingly high rates of maternal and neonatal mortality in the country expedited the need for it. The reform introduced a one-time cash transfer

37 It is plausible that if the infrastructure of public health facilities in HPS was not quickly adjusted for this steep rise in institutional birth rate that probably resulted from the introduction of ASHAs (and also if the mother-to-ASHA ratio was initially very high), then that could have led to a sub-optimal outcome post-birth. It means that although the ASHA prepared the mothers for institutional delivery, a shortage of medical staff (including ASHA) per mother within an overstrained infrastructure at the health facility could have impeded thorough childbirth guidance to the mother and in turn, she may not have initiated breastfeeding on time. In a simple exercise with DLHS-4 health facility-level data, I illustrate that in several HPS, the annual mean number of pregnancies registered at the primary health centers rose sharply around 2009; however, the mean number of nurses stationed at the facilities did not change much (Online Appendix D Figure D2) (It is beyond the scope of this data to verify the number of ASHAs introduced there.) Also, Dongre (2012) provides some evidence that JSY did not lead to an increase in the number of public health facilities in the initial years, which further supports this argument.

to mothers to give birth at public healthcare facilities with trained personnel. Also, performance-based pay was offered to trained health workers – ASHAs, appointed through the reform to counsel the expecting mothers in the community during pregnancy, birth and postnatal phase.

The reform was heterogeneous in terms of eligibility of the mother entitled to the cash transfer, which depended on her social and economic status, residence and the number of births. Simultaneously, there was a heterogeneous implementation of the health workers across state-types, i.e. the low- and the high-performing states. I exploit these two variations in the reform implementation and try to understand through a difference-in-difference identification strategy the extent to which the various channels of the reform improved maternal and neonatal health.

In particular, I investigate the outcomes – birth at public health facilities and timely initiation of breastfeeding, as the cash incentives to the mother or the ASHA were tied to these. Therefore, in a short-run analysis, these outcomes should experience immediate effects, if any. By considering all the intricacies in the reform's implementation in its initial years, I investigate the differential effects of the mother's eligibility for the cash transfer and the ASHA's state-level presence on the outcomes. The most important result of this study shows that the rural mothers eligible for both the cash transfer and the ASHA's guidance in the low-performing states experienced significantly positive effects on institutional birth and early breastfeeding than their counterpart receiving the cash transfer only in the high-performing states.

For ease of comparability, I restrict my analysis to the sample of only rural mothers. It makes the groups of the first phase eligible mothers in LPS and HPS demographically identical. The first phase eligible mothers have been most highlighted throughout the study because firstly, they satisfy the parallel pre-trend assumption for drawing any causal inference for them, and second, the homogeneity in their socio-economic indicators and other surrounding factors (and also the receipt of the same monetary amount of cash transfer), helps in closing several confounding channels and concluding that the ASHA is vital in explaining at least some difference in the observed outcomes of LPS versus HPS mothers if not all.

Despite restricting to this balanced sample of the first phase eligible mothers across the two state-types, we should use caution in isolating the ASHA's effect from the difference in their observed effects. The reason is the possible heterogeneous effects of the cash transfer alone, which could be disproportionately more in the LPS. The LPS mothers have been worse performers historically, and thus being the "neediest" of the reform, merely showed more improvement. Secondly, there could be systematic differences between the LPS and HPS that affected the reform rollout in the two places to start with, and this also potentially biases my findings.

To overcome these caveats, I utilize the rural sample only in the HPS and study them over an extended period, which includes the late introduction of ASHA in those states. The results of this specification support that the institutional birth rate of the first phase eligible mothers improved in the ASHA's presence. However, this specification is not perfect either since the combined effects of the cash transfer and ASHA could be simply fraught with the increased effect of the cash transfer alone over time. As a result, yet again, it is hard to isolate the direct effect of ASHA.

Acknowledging the possible pitfalls in the study's analyses, it is perhaps wise to conclude that the presence of the ASHA together with the cash transfer led to better improvement in institutional birth rate and early birth outcomes, such as breastfeeding. The study finds causal evidence on this for the mothers who were the reform's primary target group (i.e. those who were below-poverty-line and above 19 years, rural and with less than two births, and became eligible at the *very* first phase).[38] The finding that the first phase eligible rural mothers faced the most gains in their birth outcomes from the reform is somewhat in line with others' findings: that is, poor women in rural areas with no formal education experienced disproportionate gains from this reform (Joshi and Sivaram 2014; Powell-Jackson, Mazumdar, and Mills 2015). When it comes to the channels of effect, my finding echoes what Debnath (2021) finds some suggestive evidence for – that is, improvement in institutional birth among poorer and less-informed women when both cash and ASHA assistance are offered.

All in all, only cash transfer to a mother for giving birth at public health facilities under skilled supervision may be insufficient to motivate her (or to overcome the costs). Guidance by the (community) health worker could help attain all-round health improvement of herself and the newborn. This underlines that information barrier to good health practices and healthcare services remains a potential challenge to the poor and vulnerable mothers, besides household credit constraint. Information barrier in itself is a demand-side problem, however incentivizing the supply side, e.g. the community health workers is a potential solution. Here, it is promising to combine the takeaways of this study and that of Debnath's: while my study argues that having the ASHA alongside the cash transfer helped attain more institutional births, Debnath suggests that higher monetary incentive to the ASHA was more responsive in increasing institutional births. Therefore, together they highlight how incentivizing the supply side could be more efficient.

Nevertheless, these effects may only exist in the uptake of public healthcare services and the short-run birth outcomes. While investigating long-term outcomes – such as the living status of the child about 3–4 years after birth, I find no

38 In Online Appendix G, I discuss that the joint package of cash transfer and ASHA for the first phase eligible mothers was also cost-effective as a policy.

significant effect in either of the state-types. More research is needed to understand the long-term consequences of these channels.

Lastly, a final limitation of this study remains. This paper is only able to provide some basic descriptive evidence on the lack of updated infrastructure and management in public health facilities in adjusting to the steep rise in the institutional birth rate due to the reform. This could have disrupted proper post-birth guidance of the mother by the ASHA or medical personnel, such as timely initiation of breastfeeding. Future research with rich supply-side data is necessary to conclude better on this pathway.

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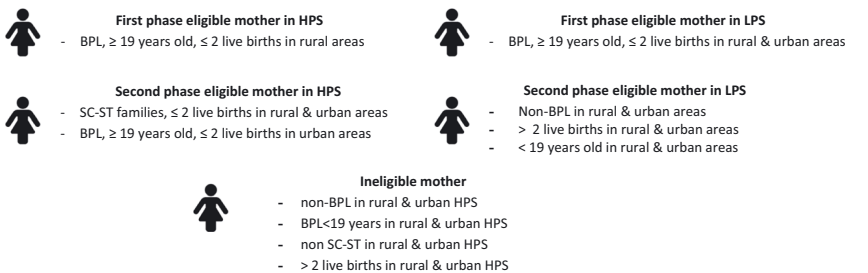
Appendix A

Definitions

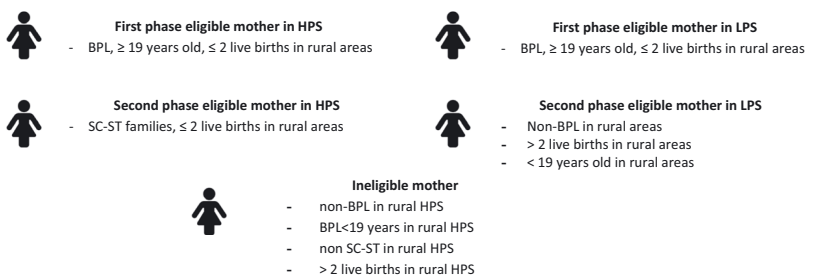
1. **Union Territories**: The *union territories* of India come directly under the Central Government administration, whereas *states* of the country have decentralized governments. The union territories of India during this study period were Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Delhi, Lakshadweep and Puducherry. According to Census of India 2011, they together covered 1.32 % of the total population of India.
2. **Scheduled Caste, Scheduled Tribe and Other Backward Classes**: Also denoted as SC/ST/OBC, these terms are recognized in the Constitution of India. These are officially designated groups of people who are most disadvantaged in

socio-economic terms in India. The Constitution follows protectionary and developmental principles and affirmative action toward these groups.

3. **Public Health Facility**: A public health facility, approved by the *Janani Suraksha Yojana* (JSY) program, includes a public hospital, dispensary, primary health center, community health center, urban health facilities (Urban Health Center/Urban Health Post/Urban Family Welfare Center), AYUSH hospital/clinic.
4. **ICDS**: Since 1975, the *Integrated Child Development Services (ICDS)* scheme has been one of the flagship programs undertaken by the Government of India on early childhood care and development. The beneficiaries under this scheme are children of 0–6 years, pregnant women and lactating mothers. The offered health services are – supplementary nutrition, health check-up, referral services and immunization. Auxiliary Nurse Midwives and *Anganwadi* workers (*Anganwadi* being a rural childcare center in India) usually provide the services. Other development services include preschool and non-formal education.



(a) Entire sample



(b) Only rural sample

Figure A1: Composition of the treatment groups. Figure (a) describes the groups in the entire sample, and Figure (b) describes the groups with only the rural sample. In both cases, the eligible groups in LPS had further guidance from ASHA while the eligible groups in HPS did not. In this paper, the rural sample is used for analysis.

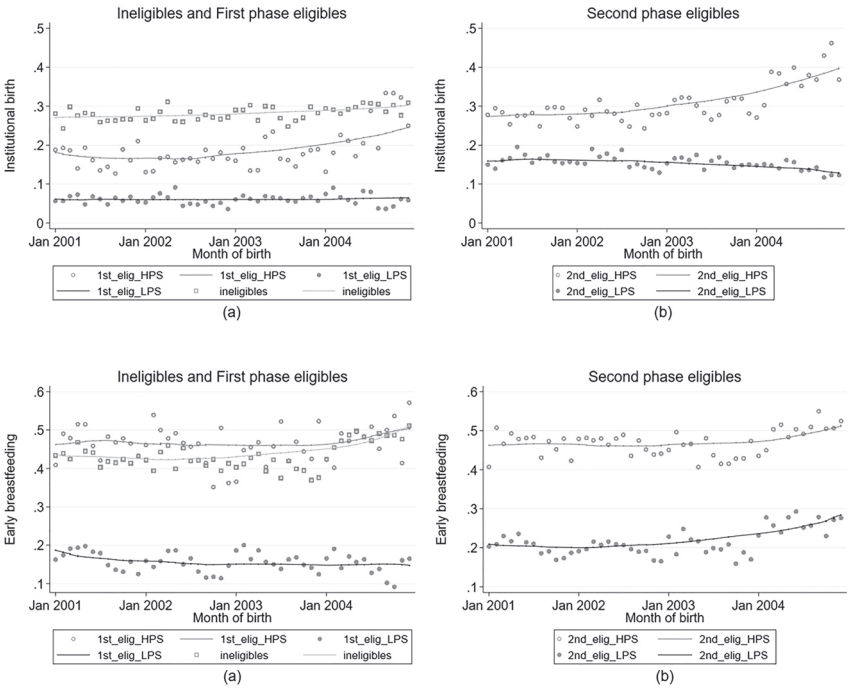


Figure A2: Raw trends in public institutional births and early breastfeeding during 2001–2004. Data used from DLHS-2 and 3. The sample consists of rural mothers with reported last birth during 2001–2004. Top panel shows institutional births and bottom panel shows early breastfeeding. The curves are fitted through points in the scatter plots by using local weighted regression with running-line least squares smoothing.

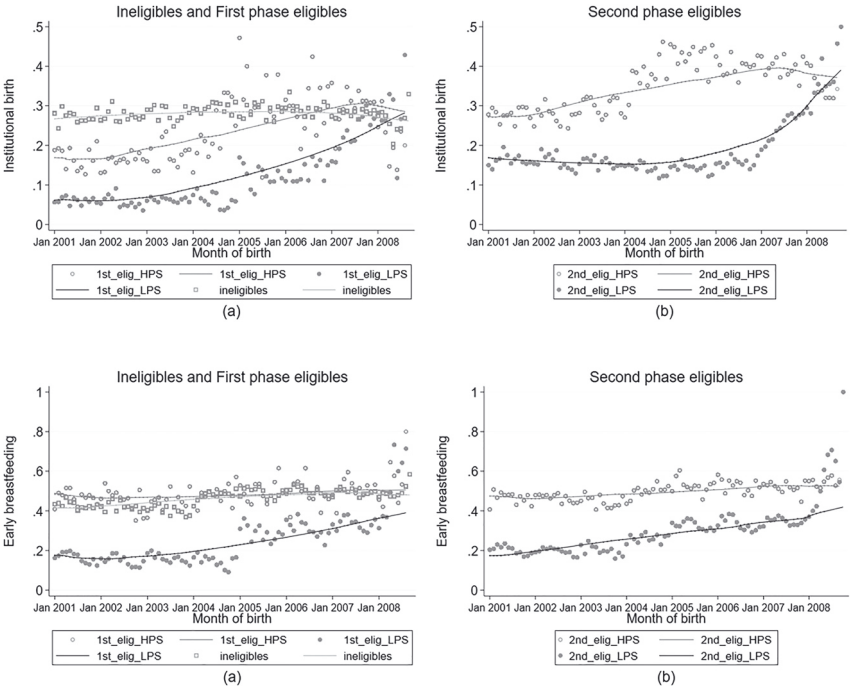


Figure A3: Raw trends in public institutional births and early breastfeeding during 2001–2008. Data used from DLHS-2 and 3. The sample consists of rural mothers with reported last birth during 2001–2008. Top panel shows institutional births and bottom panel shows early breastfeeding. The curves are fitted through points in the scatter plots by using local weighted regression with running-line least squares smoothing.

Table A1: Summary statistics of socio-economic variables of first phase rural eligible mothers (pre- & post-reform).

Variables	LPS Mean (SD)	HPS Mean (SD)	Std. Difference
Mother-specific variables			
Total births by mother	1.19 (0.38)	1.26 (0.43)	−0.15
Mother's age at last birth	24.83 (5.00)	23.56 (4.32)	0.27
Max. schooling yrs. of mother	1.07 (2.61)	2.18 (3.53)	−0.35
Hindu	0.88 (0.32)	0.81 (0.39)	0.19
Muslim	0.10 (0.29)	0.14 (0.34)	−0.12
SC/ST/OBC	0.89 (0.31)	0.80 (0.40)	0.24
Wealth quintile	1 (0)	1 (0)	–
State-specific variables			
Presence of child welfare program in village	0.90 (0.30)	0.95 (0.22)	−0.18
Presence of public dispensary in village	0.10 (0.29)	0.04 (0.18)	0.23
Presence of district public hospital	0.11 (0.31)	0.07 (0.59)	0.08
Transportation cost to public health center	354.88 (486.11)	254.68 (426.60)	0.22
Costs related to giving birth at public health center[1]	1903.80 (2500.34)	2262.42 (2995.59)	−0.13
Transportation + birth-related costs	2258.69 (2638.12)	2517.07 (3090.55)	−0.09
Observations	32,674	6283	

(1) Data from DLHS-2 and 3. The sample consists of rural mothers eligible from the first phase of the reform, with reported last birth during 2001–2008. (2) The variables on cost are given in Indian Rupees. (3) The last column gives the standardized difference in means. Standardized difference in mean >0.25 implies statistically significant difference between the groups (Imbens and Wooldridge 2009; Rellstab et al. 2020). (4) [1] Costs related to giving birth in public health institution usually include – out-of-pocket expenditures on medicines and supplies, lab tests, blood transfusion, food, tips, etc.

Table A2: Summary statistics of socio-economic variables of all mothers in the low- and high-performing states (pre- & post reform).

Variables	LPS Mean (SD)	HPS Mean (SD)	Std. Difference
Mother-specific variables			
Total births by mother	2.25 (1.89)	1.67 (1.20)	0.36
Mother's age at last birth	24.87 (5.54)	23.55 (4.62)	0.26
Max. schooling yrs. of mother	3.19 (4.54)	6.16 (5.08)	−0.62
Hindu	0.83 (0.38)	0.77 (0.42)	0.14
Muslim	0.15 (0.35)	0.13 (0.33)	0.06
SC/ST/OBC	0.79 (0.41)	0.70 (0.46)	0.22
Wealth quintile	2.49 (1.36)	3.41 (1.30)	−0.69
Rural	0.82 (0.39)	0.72 (0.45)	0.23
State-specific variables			
Presence of child welfare program in village	0.91 (0.30)	0.95 (0.22)	−0.18
Presence of public dispensary in village	0.06 (0.24)	0.06 (0.25)	−0.01
Presence of district public hospital	0.07 (0.25)	0.05 (0.46)	0.04
Transportation cost to public health center	361.76 (563.95)	250.59 (418.18)	0.22
Costs related to giving birth at public health center[1]	2297.24 (2849.57)	3432.02 (3646.91)	−0.35
Transportation + birth-related costs	2658.99 (2998.80)	3682.60 (3701.35)	−0.30
Observations	213,147	113,194	

(1) Data from DLHS-2 and 3. The sample consists of all mothers with reported last birth during 2001–2008. (2) The variables on cost are given in Indian Rupees. (3) The last column gives the standardized difference in means. Standardized difference in mean >0.25 implies statistically significant difference between the groups (Imbens and Wooldridge 2009; Rellstab et al. 2020). (4) [1] Costs related to giving birth in public health institution usually include – out-of-pocket expenditures on medicines and supplies, lab tests, blood transfusion, food, tips, etc.

Table A3: Effects on institutional birth and early breastfeeding in LPS and HPS – considering the first phase eligible mothers only.

Dependent variable	Institutional birth (1)	Early breastfeeding (2)
First phase eligibles		
Eligible without ASHA	−0.041***	0.017
	(0.009)	(0.015)
Eligible with ASHA	−0.237***	−0.195**
	(0.080)	(0.094)
Eligible without ASHA*Post1	0.045***	0.018
	(0.012)	(0.018)
Eligible with ASHA*Post1	0.082***	0.056***
	(0.011)	(0.017)
Second phase eligibles	Omitted	Omitted
State FE	Yes	Yes
Birth year FE	Yes	Yes
Controls	Yes	Yes
***F*-test of equality between interaction coefficients of first phase eligibles**		
F-statistic	6.04	2.66
p-value	0.014	0.103
Baseline mean of ineligibles	0.24	0.42
Observations	94,694	89,715
R^2	0.103	0.192

(1) The unit of observation is a rural mother who had her latest birth during 2001–2008. The sample omits the mothers who became eligible only from the second phase of the reform. (2) Column (1) presents the estimates for dependent variable institutional birth (binary variable: 1 if birth at JSY-affiliated public health facility, 0 otherwise). Column (2) presents estimates for dependent variable early breastfeeding (binary variable: 1 if mother started breastfeeding 1–2 h after birth, 0 otherwise). (3) Explanatory/treatment variables **EligiblewithoutASHA** and **EligiblewithASHA** denote the respective pre-reform difference in means of the first phase eligible mothers in HPS and LPS with the control group (Ineligibles). **EligiblewithoutASHA*Post1** and **EligiblewithASHA*Post1** denote the respective difference-in-difference effects of the reform's treatment arms on the first phase eligible mothers in HPS and LPS. **Post1** denotes the births taking place after the onset of first guideline (Apr 2005). (4) An *F*-test of equality between the coefficients **EligiblewithoutASHA*Post1** and **EligiblewithASHA*Post1** (i.e. the first phase eligibles) shows that they are significantly different from each other (at 5 % and 10 % levels for institutional birth and early breastfeeding). (5) Control variables include mother's total live births, her maximum schooling years, her age during last birth, her religion, if her household belongs to one of the socially backward groups, her household's wealth quintile; and village-specific health infrastructure controls like presence of any other child welfare program, distance to the nearest primary health center, community health center, to the nearest district hospital; and, time-varying net state domestic product per capita. (6) Standard errors clustered at district level are within parentheses. (7) The unadjusted R^2 values are reported here. (8) The mean of the outcome variable in the control group (Ineligibles) in the pre-reform period is reported. (9) ***, **, * imply $p < 0.01$, <0.05, <0.10 respectively.

Table A4: Effects on institutional birth and early breastfeeding in high-performing states only – considering the first phase eligible mothers only.

Dependent variable	Institutional birth (1)	Early breastfeeding (2)
First phase eligibles		
Eligible	−0.058***	0.009
	(0.009)	(0.015)
Eligible*Post1	0.078***	0.017
	(0.012)	(0.018)
Eligible*Post3	0.136***	0.010
	(0.019)	(0.020)
Second phase eligibles	Omitted	Omitted
State FE	Yes	Yes
Birth year FE	Yes	Yes
Controls	Yes	Yes
***F*-test of equality between the coefficients of Eligible*Post1 & Eligible*Post3**		
F-statistic	8.34	0.152
p-value	0.004	0.697
Observations	77,123	73,582
Baseline mean of ineligibles	0.284	0.469
R^2	0.082	0.115

(1) The sample contains observations from rural areas in high-performing states only, omitting the mothers who became eligible only from the second phase of the reform. The unit of observation is the mother in rural HPS, who had her latest birth during 2001 – May 2011. (2) Column (1) presents the estimates for dependent variable institutional birth (binary variable: 1 if birth at JSY-affiliated public health facility, 0 otherwise). Column (2) presents estimates for dependent variable early breastfeeding (binary variable: 1 if mother started breastfeeding 1–2 h after birth, 0 otherwise). (3) Explanatory/treatment variable **Eligible** denotes the pre-reform difference in means of the first phase eligible mothers with the control group (Ineligibles). **Eligible*Post1** denotes the difference-in-difference effect of the mother's cash transfer only on the first phase eligible mothers. **Eligible*Post3** denotes the difference-in-difference effect of the mother's cash transfer and ASHA's presence on the first phase eligible mothers. **Post1** denotes the births taking place in Apr 2005–Mar 2009 and **Post3** denotes the births taking place in Apr 2009–May 2011. (4) An *F*-test of equality between the coefficients **Eligible*Post1** and **Eligible*Post3** (i.e. the DiD effect on first phase eligibles with one package and with two packages) shows that they are significantly different from each other (below 1 %) for institutional birth but not for early breastfeeding. (5) Control variables include mother's total live births, her maximum schooling years, her age during last birth, her religion, if her household belongs to one of the socially backward groups, her household's wealth quintile; and village-specific health infra-structure controls like presence of any other child welfare program, distance to the nearest primary health center, community health center, to the nearest district hospital; and, time-varying net state domestic product per capita. (6) Standard errors clustered at district level are within parentheses. (7) The unadjusted R^2 values are reported here. (8) The mean of the outcome variable in the control group (Ineligibles) in the pre-reform period is reported. (9) ***, **, * imply $p < 0.01$, <0.05, <0.10 respectively.

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