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Has the Demand and Supply-side Components of Janani Suraksha Yojana Augmented the Uptake of Maternal Health Care Services among Poor Women in India ? : An Application of Hybrid Matching Technique

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Abstract

Financial barriers pose significant and detrimental effects on the utilisation of maternal and child health care services. The Janani Suraksha Yojana (JSY) implemented in India provides an opportunity to explore if and how differential incentive patterns augment the utilisation of maternal health care services. This study aims to capture the impact of the demand side (DD), supply side (SS) component and integrated impact of demand and supply side (DS) of JSY on the utilisation of antenatal care services (ANC), facility-based delivery (FBD) and postnatal care services (PNC). National Family Health Survey (2015-16) was used and a novel hybrid matching technique was adopted to ascertain the effects of the program. The impact of the demand and supply side intervention varied across regions and maternal health care services. Compared to other regions, the performance of DD is notably high in north-east and northern regions. DD substantially influenced the utilisation of FBD, while SS and DS had greater influence on PNC.

Key Words : Health Behavior; Public Health ; Impact Evaluation
JEL Classification : I12; D04; I18

Has the Demand and Supply-side Components of Janani Suraksha Yojana Augmented the Uptake of Maternal Health Care Services among Poor Women in India ? : An Application of Hybrid Matching Technique

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Introduction

The continuum of maternal health care services (CMHS) which comprises utilisation of antenatal care services (ANC), facility based delivery (FBD) and postnatal care services (PNC) is majorly hampered by the catastrophic health expenditure, lack of awareness and motivation. Cash-based incentives and dissemination of information through community based programs are considered as efficient and equitable ways of addressing these challenges and reaching out to the vulnerable population (Fiszbein et al., 2009). These programs evolved at a prodigious rate since the 1990s, with some of the early implementers being Bangladesh, Pakistan, China and Nepal (Agha, 2011; Ahmed & Khan, 2011; Powell-Jackson & Hanson, 2012; Hemminki, 2013). Different forms of cash benefit schemes, namely unconditional cash transfers, conditional cash transfers, vouchers based schemes and community based interventions have been implemented to resolve the problem of limited utilisation of maternal health care services and poor maternal and child health outcomes across the globe (Powell-Jackson & Hanson, 2012; Hemminki, 2013). Although their common objective is to improvise maternal and child health care utilisation, its impact varies across geographic horizons.

Janani Suraksha Yojana (JSY), one the world's largest cash benefit programs, was implemented in India in the year 2005-06. The program catered to more than 104 lakh beneficiaries within a time span of 10 years (MoHFW, 2018). The main objective of this program was to reduce maternal and neonatal mortality rates by promoting institutional deliveries. This program encompasses two components - performance based incentives to

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Accredited Social Health Activist (ASHA)[4]/supply-side component (SS) and direct cash benefit to pregnant/demand-side component (DD). The performance based incentives are provided to ASHA workers for identifying pregnant women, registering them for ANC, counselling and escorting pregnant women to FBD and PNC. Whereas under the demand-side component, the government provides cash incentives for the uptake of institutional deliveries. Apart from having a direct impact on FBD, the JSY program is also expected to have an unintended impact on the utilisation of ANC and PNC services (Rahman et al., 2018). Even though JSY has imbibed both demand and supply side components, the researchers have conducted separate analysis discerning the impact of demand and supply side components of JSY(Gupta, S. K et al., 2012; Paul, L& Chellan, R, 2013; Vora et al., 2015; Vellakkal et al., 2017; Aggarwal et al., 2019; Pallikadavath et al., 2020). Some have gauged the impact of the demand-side component of JSY on institutional delivery alone (Gupta, S. K et al., 2012; Paul, L& Chellan, R, 2013; Vellakkal et al., 2017), while others have investigated the impact of the supply side component on the complete utilisation of maternal health care services in India (Vora et al., 2015; Aggarwal et al., 2019; Pallikadavath et al., 2020). Limited attention has been rendered to the measurement of impact of JSY on those falling under the lowest income horizon for whom the program was actually intended to cater (Vora et al., 2015). This is the first study to unravel the treatment effects of integration of demand and supply-side components of JSY on maternal healthcare for the poor. Region-wise and state level disaggregation was ascertained to elucidate geographic variations.

Novelty of this study also relies on its methodological approach. Till now the evaluation studies have been conducted using Propensity Score Matching (PSM), Difference in Difference model (DID), Inverse propensity score weighting regression (IPW), Instrumental variables regression (IV) and Fuzzy regression discontinuity design (Lim et al., 2010; Powell-Jackson et al., 2015; Nandi & Laxminarayan, 2016; Rahman & Pallikadavath, 2018; Pallikadavath et al., 2020). Earlier, PSM was claimed to be the most superior and feasible approach, especially when large datasets or different callipers are imposed (Caliendo and Kopeinig, 2008; Lim et al., 2010). However, a recent work by King and Nielsen (2018) highlighted that PSM, after a certain point of matching, generates more imbalances in the covariates- insinuating a “PSM paradox”. Hence the authors suggested that this approach should be avoided and alternative matching techniques

[4] ASHA workers act as an interface between community and public health systems by encouraging and escorting pregnant women to hospital.

like Mahalanobis Distance Matching (MDM) can be adopted (Stuart, 2010; King and Neilsen, 2018). To our knowledge none of the existing studies have adopted this approach.

We have conducted a comprehensive analysis by integrating demand and supply side components of JSY to elucidate its impact on the continuum of maternal health care services. We have employed a hybrid matching technique - a combination of complete randomized experimental design and fully blocked experimental design. This technique encompasses the properties of MDM and PSM. The Kernel matching algorithm has been used for matching which gives larger weight to the controls with smaller distances. Additionally, Bootstrapping was conducted to check the robustness of our results and cross validation was ensured by adopting MDM and PSM matching methods individually.

Materials and Methodology

Data Source

Data from the recent Demographic Health Survey of India (2015-16). The sampled populations are representative at District, State/ Union territory (UT). The dataset is specifically designed to provide information on reproductive and child health. Two-stage stratified sampling technique was employed. In the first stage, primary sampling units in the rural (village), and urban (census enumeration blocks) areas were selected using probability proportional to sample size (PPS) technique. In the second stage, 22 households were randomly selected using a systematic sampling methodology. In the final stage, a total of 6,01,509 households and 6,99,686 women were interviewed. For our analysis, household and women files were merged, which entailed a total sample size of 6,99,686. Of this, 1,90,898 women reported pregnancy in the previous five years (starting from the date of interview). After dropping the missing values, we obtained a final sample of 1, 81,195 pregnant women.

Variable Description

Outcome Variable

The outcome variables of this study are 4 ANC visits, FBD and PNC and analysis is conducted separately for each of these outcome indicators.

Treatment Variable

Multiple treatment variables were chosen for our analysis. They are *cash benefits to pregnant women* (DD), *Contact with ASHA workers* (SS), and the *integration of demand and supply side components of JSY*; this was created by interacting demand and supply side components of JSY(DS) .

Individual- Level Covariates

Individual level covariates include variables measuring eligibility criteria (age of the mother, below poverty line (BPL) card, caste and birth-order) to avail the benefits of the program and other relevant demographic and socio-economic characteristics, such as place of residence, mother's education, religion, age at marriage, media exposure, household size and number of under-five children in the household were included in the study.

Methodology

In this study, we have adopted a quasi-experimental design as we have used observational data. Data generation process (DGP) is conducted to gather a randomized dataset from observational data (Iacus et al., 2011; Imai et al., 2008). The randomized dataset can provide the control and treatment population with lower imbalance in counterfactual cases (statistical twins).

The quasi-experimental design can be broadly divided into Fully Blocked randomized Experimental Design (FB) and Completely Randomized Experimental Design (CR). In the case of FB experimental design, treatment and control groups are blocked at the initial stage of DGP generating zero imbalance in the dataset without pruning any observation:$I(x_{FB}) = 0$, where $I(x_{FB})$ represents imbalance in covariates (x) after matching through FB design. While in the case of CR, treatment assignment (T) depends only on the scalar probability of treatment for all units, indicating randomness across covariates (x). But in reality, randomness of covariates does not necessarily ensure zero imbalance:$I(x_{CR}) \geq 0$.

The difference between the two experimental designs is pivotal to the quasi-experimental analysis. Compared to a CR experimental design, a FB experimental design has greater power, efficiency and robustness, less imbalance in the counterfactual cases. Most importantly, FB

experimental design has lower model dependency (Hunter and Hunter, 1978; Greevy et al., 2004; Imai et al., 2008; Imai et al., 2009).

Under FB experimental design, MDM is considered to be the most reliable matching technique (Rubin, 1976). MDM matches treatment and control group based on a distance metric - measuring the proximity between control and treatment group by considering the differences (distance) in the measured (observed) characteristics between control and treatment group. MDM uses the complete variance and covariance matrix, thereby ensuring that the relationship between the variables is fully captured in the analysis. Propensity Score Matching (PSM), on the other hand, stores information about the relationship between covariates. After reaching a point of complete randomization, the application of PSM technique imbalances the original data.

We have employed both the experimental designs to ensure the efficacy of the result. This study adopted a hybrid matching approach where the main matching technique is MDM but Propensity Score is included as an additional covariate with double weight. Variables indicating the eligibility criteria of JSY has been matched using MDM technique, while other socio-economic covariates were matched using propensity score by assigning double weightage. The adoption of hybrid matching is similar to genetic matching with propensity score (King and Nielsen, 2016; Diamond and Sekhon, 2013). Adoption of genetic matching technique accounts for differences in the specification of a variable. For instance, results of MDM are more efficient when the continuous variables are used in matching (King and Nielsen, 2018), while the performance of PSM is better for categorical variables. Hence, the adoption of hybrid matching technique is more sensible because the covariates used for matching encompass a combination of categorical and continuous variables. The robustness was ensured by conducting MDM and PSM separately .

Matching: Distance Measures

Matching methods identify the counterfactual cases in the control group for those in the treatment group in such a way that covariate values (X) of the counterfactual cases (control group) and treatment group are similar. We have defined MDM and PSM matching techniques through the *distance* (D_{ij}) between individual i (treatment) and j (control).

Mahalanobis Distance Matching (MDM)

$$D_{ij} = \left(X_i - X_j\right)' \Sigma^{-1} (X_i - X_j)$$

If quantity of interest is Average Treatment Effect on Treated (ATT), Σ is the variance covariance matrix of *X* in the full control group (Stuart, 2010).

Propensity Score Matching (PSM)

Propensity score reflects the probability of receiving a treatment given the observed characteristics (confounders) of an individual. Propensity score can be viewed as a "confounder summary score" that contains information on multiple confounders. Propensity score model needs to be evaluated based on the balance in potential confounders between treated (e_i) and untreated (e_j) individuals with similar propensity score levels.

$$D_{ij} = |e_i - e_j|$$

The propensity score for individual *i* is the probability of availing the treatment given the observed covariates (*X*). The minimum distance ($D_{ij} \leq \delta$) between e_i and e_j creates the counterfactual cases in treatment and control groups.

After matching through different matching techniques, the causal quantities of interest can be estimated from matched treatment and control groups. Let's denote matched outcomes as $\widehat{y_{i0}}$ *and* $\widehat{y_{i1}}$ for treatment group (who availed JSY/ASHA/combination of both) and control group (who did not avail JSY/ASHA/neither JSY nor ASHA), respectively. To fix the quantities of interest, we assume Stable Unit Treatment Value Assumption (SUTVA) (Rubin, 1976; Vander Weele and Herman, 2012), which states that the value of Y_I will not change if T_i *or* $T_j \; \forall j \neq i$, changes from 1 to 0. The causal quantity of interest to evaluate the impact of the scheme is Average Treatment Effect on Treated (ATT). It is the simple mean difference between $\hat{y}_{i0}$ and $\hat{y}_{i1}$ over the population of the treatment group (N_1). We can compute the value of ATT using the following formula.

$$\widehat{\tau_{att}} = N_1^{-1} \sum_{i=1}^{N} T_i (\widehat{y_{i1}} - \widehat{y_{i0}})$$

Where N is the number of women in the total sample (both treatment and control group) and N_1 is the number of women in the treatment group. Assuming X as the set of observable covariates, the quantity of interest (ATT) could be determined by satisfying following assumptions.

Assumption 1: Conditional independence

The assumption is also referred to as un-confoundedness assumption or ignorable treatment assignment. The values of the potential outcomes (Y_{i0} andY_{i1}) are determined in a manner conditionally independent of the treatment assignment ($T_i|X_i$).

$$[Y_{i0}, Y_{i1}] \perp T_i|X_i$$

The possible way to satisfy the assumption is inclusion of covariates which affect either Y (outcome) or T (treatment), if any subset of these variables satisfies un-confoundedness, this set will also satisfy the same (Vander Weele & Shpitser, 2011). The most reliable way to satisfy this assumption is to include all relevant covariates discussed in the previous research (Rubin, 2001).

Assumption 2: Common support or Overlap condition

The assumption states that any unit actually assigned treatment could have been assigned to control.

$$0 < Pr\,(T_i = 1|X_i) < 1 \;\forall\, i$$

The assumption ensures that the individuals with similar covariate values X_i have a positive probability of being in the treatment and control groups. The treatment units will have to be similar to non-treatment units in terms of observed characteristics unaffected by participation and some of the non-treatment units may have to be dropped to balance the treatment and control group with similar characteristics. The common support assumption has been estimated and details are given in supporting documents.

A number of matching algorithms are available to ascertain the potential matches by determining the matching weights based on distance measured by MDM and PSM methods. The Kernel matching algorithm is used for the matching. It is a non-parametric matching algorithm that uses weighted average of women who did not avail any benefits from the JSY program (control group) to construct the effect of JSY on ANC, FBD and PNC. One of the major advantages of the Kernel matching algorithm is that it generates lower variance as more information is used. In addition, the performance of PSM is relatively much better under Kernel matching than other matching algorithms involving random pruning. Finally, the logit model is employed on the matched dataset to estimate the impact of interventions on ANC, FBD, and PNC. We have used a direct method of generation of bootstrap samples, and the bootstrapped ATTs are reported in the result section. The empirical analysis was conducted in STATA-15.0 using kmatch (Jann, 2017) and GeoDa (1.14.0) was used to generate maps. The map surface is modelled using the survey boundary of the spatial data repository of DHS. Shape-file can be availed from public access[5].

Results

Table 1 presents the descriptive statistics of selected variables. These variables are disaggregated into three categories: treatment variables, outcome variables, and covariates. It can be discerned that the maternal entitlement scheme or DD was utilised by 30% of pregnant women (2015-16). The usage of maternal health care services like ANC (51%) is very limited. While, the FBD and PNC has been availed by 81% and 70% of pregnant women, respectively. Most of the pregnant women belonged to the age group of 20-29 years (69%). Nearly 71% of the surveyed population had their abode in rural areas. Close to 65% of the population were from poorest, poor and middle income quintile groups. Most of them hailed from other backward castes (44 %) and as high as 79% of surveyed women were affiliated to Hindu religion. Close to 47% of women attained secondary education and 28% did not receive any education. Around 32.5% of pregnant women did not have any exposure to the media.

[5] http://spatialdata.dhsprogram.com/boundaries/#view=table&countryId=IA

Table 1. Descriptive Statistics

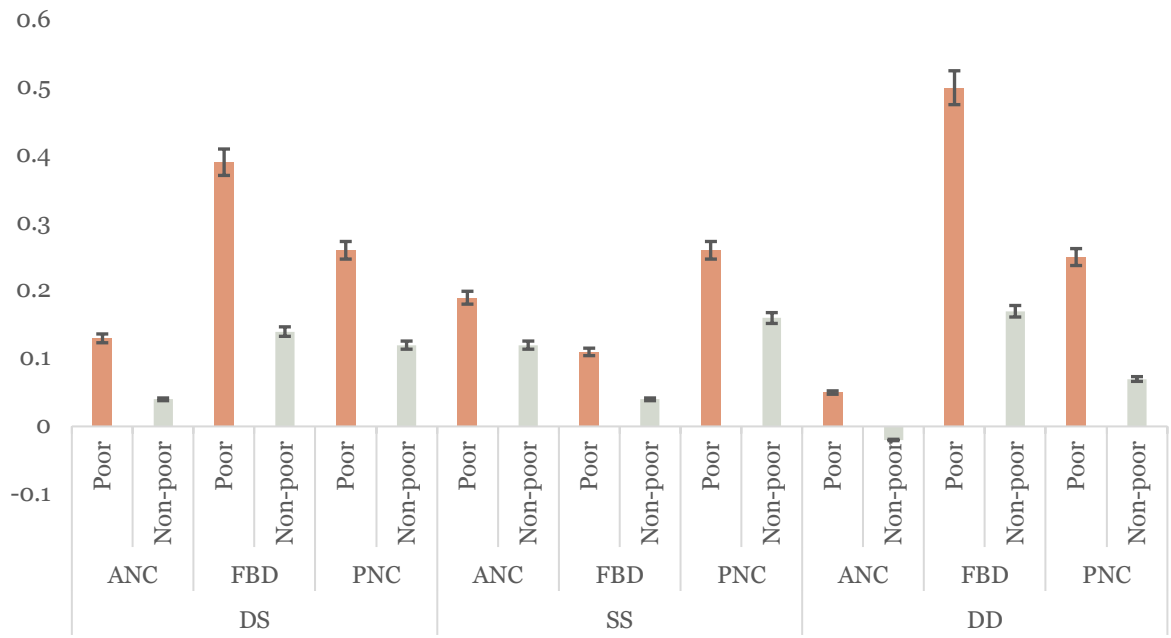
	N	Proportion (95% CI)	DD	SS	DS
Outcome variables					
ANC					
No	85855	0.486 (0.483 - 0.488)	33.411	42.364	17.348
Greater than 4	90975	0.514 (0.512 - 0.517)	26.725	57.582	19.047
FBD					
Non-institutional	33432	0.189 (0.187 - 0.191)	0.000	40.803	0.000
Institutional	143397	0.811 (0.809 - 0.813)	36.959	52.382	22.470
PNC					
No	52780	0.298 (0.296 - 0.301)	23.872	33.316	9.975
Yes	124049	0.702 (0.699 - 0.704)	32.566	57.374	21.731
Eligibility Criteria					
Age					
15-19 years	6084	0.034 (0.034 - 0.035)	28.352	55.154	17.523
20-24 years	55716	0.315 (0.313 - 0.317)	31.515	54.341	19.838
25-29 years	66503	0.374 (0.378 - 0.378)	30.028	50.337	18.376
30-34 years	32236	0.182 (0.181 - 0.184)	28.880	45.766	16.752
35-49 years	16290	0.092 (0.091 - 0.093)	27.225	42.328	15.231
BPL					
No	68618	0.388 (0.386 - 0.390)	44.097	54.931	20.852
Yes	108211	0.612 (0.610 - 0.614)	21.014	47.189	16.554
Caste					
SC	37326	0.211 (0.209 - 0.213)	34.959	55.087	22.195
ST	18102	0.102 (0.101 - 0.104)	34.107	56.398	23.291
OBC	77690	0.439 (0.437 - 0.442)	30.986	48.922	18.184
Others	43711	0.247 (0.245 - 0.249)	22.196	45.704	12.797
Birth order					
<=2	120118	0.679 (0.677 - 0.681)	29.771	51.963	18.861

>2	56712	0.321 (0.319 - 0.323)	30.396	46.445	16.867
Demographic and Socio-economic characteristics of mothers					
Residence					
Urban	50670	0.287 (0.284 - 0.289)	19.949	39.992	11.149
Rural	126160	0.713 (0.711 - 0.716)	33.997	54.290	21.062
Mother's education					
No education	48956	0.277 (0.275 - 0.279)	33.054	44.384	17.865
Primary	23797	0.135 (0.133 - 0.136)	33.998	53.371	20.718
Secondary	83015	0.469 (0.467 - 0.472)	29.786	54.962	19.485
Higher	21062	0.119 (0.118 - 0.121)	18.986	41.308	11.252
Religion					
Hindu	139552	0.789 (0.787 - 0.791)	31.944	51.237	19.632
Muslim	28389	0.161 (0.159 - 0.162)	23.353	43.880	12.688
Christian	3668	0.021 (0.020 - 0.021)	23.351	51.143	16.318
Others	5220	0.030 (0.029 - 0.030)	17.878	55.955	11.955
Wealth quintiles					
Poorest	41761	0.236 (0.234 - 0.238)	36.216	47.124	20.409
Poor	37908	0.214 (0.212 - 0.216)	37.286	55.381	23.535
Middle	35284	0.200 (0.198 - 0.201)	31.835	56.342	20.509
Rich	33396	0.189 (0.187 - 0.191)	24.527	50.902	15.031
Richest	28481	0.161 (0.159 - 0.163)	15.153	39.339	8.850
Age at marriage					
8- 17 years	66028	0.373 (0.371 - 0.376)	31.656	50.285	18.532
18-23 years	93083	0.526 (0.524 - 0.529)	30.019	51.216	18.678
24-34 years	17546	0.099 (0.098 - 0.101)	23.481	44.559	14.701
35-49 years	173	0.001 (0.001 – 0.001)	19.183	36.209	11.662
Media exposure					
No media	57547	0.325 (0.323 – 0.328)	34.857	44.689	18.706
At least 1 media	119282	0.675 (0.672 - 0.677)	27.614	52.849	17.988
Number of under-five children					
<=2	157033	0.888 (0.887 - 0.889)	30.111	50.712	18.494
>2	19796	0.112 (0.111 - 0.113)	28.862	46.074	16.064

Household size					
>6	110309	0.624 (0.622 - 0.626)	30.356	51.680	18.957
<=6	66521	0.376 (0.374 - 0.378)	29.333	47.728	17.002

Figure 1 elucidates the impact of DD, SS & DS on the continuum of maternal health care services across two extreme wealth groups (poor and non-poor). Overall, the impact of DD and SS was greater for the poor (poorest and poor quintile) compared to the non-poor (middle, rich and richest quintile) population. The individual effect of DD on ANC for the poor was 0.05, while for the non-poor, the impact was -0.02. Similarly, the ATT of DD on FBD was 0.50 for the poor population, while it was 0.17 for women belonging to the non-poor category. The average treatment effects of DD on PNC services were 0.25 for the poor population and 0.07 for the richer population. The impact of SS was also high for the poor population compared to their non-poor counterparts. For instance, the impact of SS on ANC was 0.19 for poor and 0.12 for non-poor. For FBD, the ATT of SS was 0.11 for poor and 0.04 for non-poor. Overall, the impact of SS was highest for PNC services with a treatment effect of 0.26 for poor and 0.16 for non-poor category. Those who availed DS had higher treatment effects for FBD and the magnitude was more for poor (0.39) compared to non-poor (0.14). The impact of DS on ANC and PNC services was more than double for the poor compared to the non-poor.

Figure 1. Impact of DD, SS, and DS on ANC, FBD, and PNC



Note: Error bars denote the 95% confidence intervals.

Impact of DD, SS, and DS on ANC, FBD, and PNC: Across Geographical Regions

Impact of Demand and Supply Side Components of JSY: Region-wise estimation

Table 2 indicated that the impact of DD was highest for FBD services - maximum impact was witnessed in central (0.46) and eastern India (0.44), while southern regions (0.04) experienced lower treatment effects. The influence of DD on ANC was comparatively much lower. Region-wise estimates manifest greater impact values for north-eastern region (0.15) in comparison to other regions.

The performance of SS was relatively higher for PNC. Region wise estimates discerned that the impact was high in north-eastern region, central region and eastern region reporting an ATT value of around 0.25. While in other regions, ATT values for PNC hovered around 0.16. Impact of SS on ANC was highest in the eastern region (0.21), while in the southern region (0.05) the treatment effect of the program was lowest. SS had a limited impact on FBD.

We found that the impact of DS was higher on FBD. The estimated treatment value was around 0.35 in central and eastern regions of India. However, in the southern region (0.03), the treatment effects were abysmally low. The treatment effect of combined intervention on PNC was highest in the north-east (0.25), whereas the treatment effects were lowest in the southern region (0.10).

Table 2. Impact of DD, SS, and DS on ANC, FBD, and PNC: Across Region

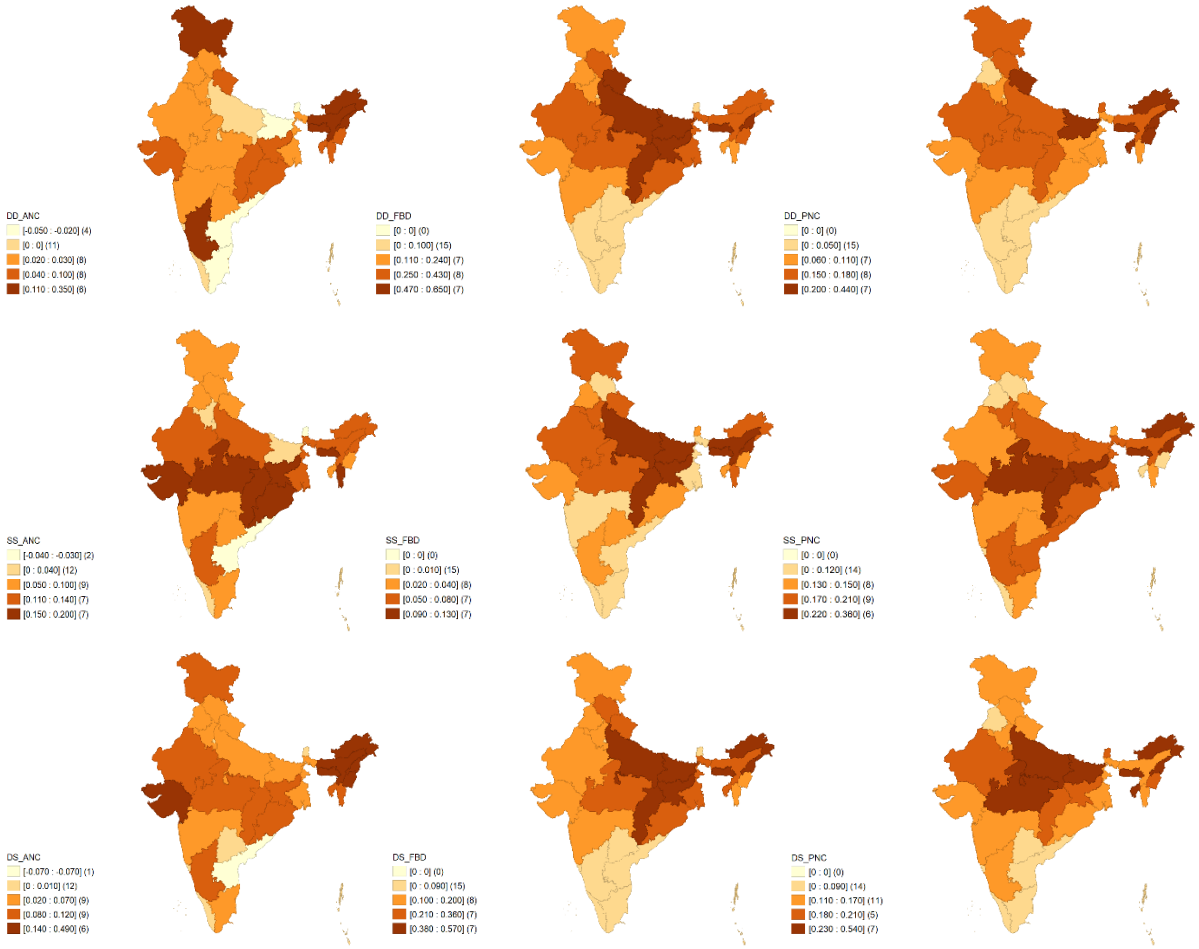
Region	DD			SS			DS		
	ANC	FBD	PNC	ANC	FBD	PNC	ANC	FBD	PNC
South	0.02[b]	0.04[a]	0.05[a]	0.05[a]	0.01[b]	0.16[a]	0.03[a]	0.03[a]	0.10[a]
North East	0.15[a]	0.39[a]	0.24[a]	0.16[a]	0.12[a]	0.25[a]	0.17[a]	0.32[a]	0.25[a]
East	0.05[a]	0.44[a]	0.19[a]	0.21[a]	0.09[a]	0.24[a]	0.14[a]	0.34[a]	0.23[a]
Central	0.04[a]	0.46[a]	0.16[a]	0.16[a]	0.09[a]	0.24[a]	0.12[a]	0.35[a]	0.23[a]
West	0.06[a]	0.16[a]	0.09[a]	0.13[a]	0.02[b]	0.16[a]	0.11[a]	0.15[a]	0.12[a]
North	0.06[a]	0.28[a]	0.16[a]	0.11[a]	0.06[a]	0.15[a]	0.09[a]	0.21[a]	0.16[a]

[a]1% level of significance, [b]5% level of significance, [c]10% level of significance

Impact of Demand and Supply Side Components of JSY: State-wise estimation

In Figure 2 we have mapped the independent and integrated impact of JSY and ASHA on ANC, FBD and PNC across states. The maps indicate that the impact of DD is evidently low in the eastern ghats, while a comparatively higher treatment effects are witnessed in central highlands and parts of gangetic plains. The impact of SS is quite prominent across the parts of gangetic plains and north-eastern region. The impact of DS is much lower in eastern ghats, deccan plateau and western ghats politically defined as southern regions of India.

Figure 2. ATT of DD, SS, and DS on ANC, FBD, and PNC across States of India



Impact of Demand and Supply Side Components of JSY on Poor: State-wise estimation

Impact of Demand-side Component of JSY

Table 3 presents state wise estimation results of DD on maternal health interventions for poor (results for non-poor category is provided in supplementary document). Impact of DD on the utilisation of ANC is suboptimal in India. State-wise estimation indicates that, impact of DD on ANC was high in Arunachal Pradesh (0.36), Meghalaya (0.23) and Assam (0.21), while in Rajasthan (0.05) and Uttar Pradesh (0.03), the treatment effect was much lower.

The impact of DD on FBD was the highest in Nagaland (0.84), Uttarakhand (0.72), Chhattisgarh (0.69), Arunachal Pradesh (0.67), Mizoram (0.66), Meghalaya (0.65) and Bihar (0.60). As against this, in Tamil Nadu (0.01), the ATT value was negligible. The impact of DD on PNC was highest in Arunachal Pradesh and Nagaland with an equal treatment effect of 0.50. In Tamil Nadu, the treatment effect was lowest with a value of 0.06.

Table 3. Impact of DD across States: Poor

Region/State	ANC	FBD	PNC
North			
Haryana	0.19[b]	0.37[a]	0.26[a]
Himachal Pradesh	0.04	0.58[a]	0.28[b]
Jammu and Kashmir	0.19[a]	0.46[a]	0.34[a]
Punjab	0.12	0.28[a]	0.14[b]
Rajasthan	0.05[a]	0.39[a]	0.25[a]
Uttarakhand	0.03	0.72[a]	0.31[a]
Central			
Chhattisgarh	0.12[a]	0.69[a]	0.18[a]
Madhya Pradesh	0.07[a]	0.50[a]	0.23[a]
Uttar Pradesh	0.03[a]	0.58[a]	0.23[a]
East			
Bihar	0.00	0.60[a]	0.30[a]
Jharkhand	0.07[a]	0.57[a]	0.15[a]
Odisha	0.07[a]	0.45[a]	0.09[a]
West Bengal	0.08[a]	0.36[a]	0.11[a]

North East			
Arunachal Pradesh	0.36[a]	0.67[a]	0.50[a]
Assam	0.21[a]	0.58[a]	0.23[a]
Manipur	0.15[a]	0.47[a]	0.37[a]
Meghalaya	0.23[a]	0.65[a]	0.35[a]
Mizoram	0.19[a]	0.66[a]	0.33[a]
Nagaland	0.12[a]	0.84[a]	0.50[a]
Sikkim	0.13	0.28[a]	0.33[a]
Tripura	0.12[b]	0.33[a]	0.36[a]
South			
Andhra Pradesh	0.01	0.19[a]	0.09[b]
Telangana	0.09	0.21[a]	0.12[a]
Karnataka	0.14[a]	0.11[a]	0.05
Kerala	0.00	0.05	0.17[b]
Tamil Nadu	0.00	0.01[b]	0.06[a]
West			
Gujarat	0.18[a]	0.29[a]	0.13[a]
Maharashtra	0.03	0.25[a]	0.12[a]

[a]1% level of significance, [b]5% level of significance, [c]10% level of significance

Impact of Supply Side Component of JSY

Table 4 demonstrates that the impact of SS was highest for PNC and ANC. ATT values indicate that the impact of SS on ANC was highest in Mizoram (0.26) and Meghalaya (0.22). The performance of SS on ANC was extremely low in Bihar (0.05) and Uttarakhand (0.06). Overall, the impact on FBD was lower than 0.20 with an exception being Mizoram (0.25) and Sikkim (0.27). SS exhibited the highest impact on PNC compared to ANC and FBD. The impact values for PNC were highest in Chhattisgarh (0.41) and Arunachal Pradesh (0.38). Whereas, in Uttarakhand, Manipur, Telangana and Maharashtra the impact of SS on PNC is much lower.

Table 4. Impact of SS across States: Poor

Region/State	ANC	FBD	PNC
North			
Haryana	0.20[a]	0.14[b]	0.20[a]
Himachal Pradesh	0.19[b]	0.11	0.22[b]
Jammu and Kashmir	0.17[a]	0.14[a]	0.23[a]
Punjab	0.19[b]	0.05	0.25[a]
Rajasthan	0.18[a]	0.09[a]	0.19[a]
Uttarakhand	0.06[b]	0.11[a]	0.17[a]
Central			
Chhattisgarh	0.19[a]	0.11[a]	0.41[a]
Madhya Pradesh	0.16[a]	0.10[a]	0.25[a]
Uttar Pradesh	0.12[a]	0.13[a]	0.25[a]
East			
Bihar	0.05[a]	0.11[a]	0.22[a]
Jharkhand	0.14[a]	0.13[a]	0.24[a]
Odisha	0.21[a]	0.05[a]	0.20[a]
West Bengal	0.18[a]	0.01	0.20[a]
North East			
Arunachal Pradesh	0.14[a]	0.10[b]	0.38[a]
Assam	0.15[a]	0.13[a]	0.27[a]
Manipur	0.16[a]	0.06[b]	0.15[a]
Meghalaya	0.22[a]	0.14[a]	0.33[a]
Mizoram	0.26[a]	0.25[a]	0.32[a]
Nagaland	0.04	0.13[b]	0.24
Sikkim	0.14	0.27[b]	0.26[b]
Tripura	0.05	0.05	0.07
South			
Andhra Pradesh	-0.05	0.02	0.08
Telangana	0.12b	0.08[b]	0.15[a]
Karnataka	0.09[a]	0.04[b]	0.24[a]
Kerala	-0.15[c]	-0.03	0.15

Tamil Nadu	0.16[a]	0.01	0.20[a]
West			
Gujarat	0.28	0.05[b]	0.21[a]
Maharashtra	0.14[a]	0.04[c]	0.17[a]

[a]1% level of significance, [b]5% level of significance, [c]10% level of significance

Impact of DS

In Table 5 we elucidate the state level variations of the impact of DS on maternal health interventions. The impact of DS was highest on FBD compared to ANC and PNC. The impact on ANC was highest in Arunachal Pradesh (0.58) and Haryana (0.30), and lowest impact was witnessed in Uttar Pradesh (0.09) and Bihar (0.02). In Nagaland (0.80) and Arunachal Pradesh (0.67), the impact of DS was significantly high for FBD, while Karnataka (0.09) and Telangana (0.16) lagged much behind in terms of its performance. Overall the combined impact of DD and SS on PNC was highest in the north-eastern part of India with Nagaland (0.77) and Arunachal Pradesh (0.63) being the outperformers, however lowest performance was witnessed in the states of Tamil Nadu (0.12) and Andhra Pradesh (0.09).

Table 5. Impact of DS across States: Poor

Region/State	ANC	FBD	PNC
North			
Haryana	0.30[a]	0.36[a]	0.27[a]
Himachal Pradesh	0.23	0.54[a]	0.24
Jammu and Kashmir	0.17[a]	0.33[a]	0.29[a]
Punjab	0.15	0.25[b]	0.17[b]
Rajasthan	0.13[a]	0.24[a]	0.23[a]
Uttarakhand	0.03	0.19[a]	0.26[a]
Central			
Chhattisgarh	0.15[a]	0.60[a]	0.27[a]
Madhya Pradesh	0.13[a]	0.35[a]	0.30
Uttar Pradesh	0.09[a]	0.43[a]	0.29[a]
East			
Bihar	0.02[a]	0.44[a]	0.32[a]
Jharkhand	0.10[a]	0.50[a]	0.23[a]
Odisha	0.11[a]	0.35[a]	0.13[a]
West Bengal	0.10[a]	0.33[a]	0.14[a]
North East			

Arunachal Pradesh	0.58[a]	0.67[a]	0.63[a]
Assam	0.22[a]	0.43[a]	0.24[a]
Manipur	0.18[a]	0.37[a]	0.36[a]
Meghalaya	0.26[a]	0.63[a]	0.35[a]
Mizoram	0.28[a]	0.54[a]	0.41[a]
Nagaland	0.20	0.80[a]	0.77[a]
Sikkim	0.10	0.24[a]	0.26[a]
Tripura	0.13[b]	0.27[a]	0.30[a]
South			
Andhra Pradesh	0.03	0.19[a]	0.09[c]
Telangana	0.13	0.16[a]	0.14[a]
Karnataka	0.17[a]	0.09[a]	0.13[a]
Kerala	-0.03	0.04	0.16[b]
Tamil Nadu	0.00	0.01	0.12[a]
West			
Gujarat	0.26[a]	0.28[a]	0.16[a]
Maharashtra	0.08[b]	0.23[a]	0.15[a]

[a]1% level of significance, [b]5% level of significance, [c]10% level of significance

Discussion

The findings of this study have shown that the demand side component of JSY had a significant and positive impact on FBD, while the supply side component of JSY impacted the utilisation of ANC and PNC more. This indicates that direct cash benefits are an effective nudging strategy to increase the utilisation of that particular service. Positive impact of cash benefit program on institutional delivery has been found by other studies also conducted in India across different time horizons (Lim et al., 2010; Powell-Jackson et al., 2015; Rahman et al., 2018). The authors have clearly stated that the impact of the cash benefit program on institutional delivery is magnanimous.

Our study also indicates that the impact of cash benefits for pre and post- delivery care services are less effective. For these services, the impact of SS has been more. It could be possible because a woman might be in dire need of emotional support after undergoing the strenuous delivery procedure and for pre-delivery care, escorting to health facilities and basic awareness of benefits of ANC is helpful. On the other hand, performance based incentives to ASHA workers is proving to be an efficient mechanism to increase the utilisation of ANC and PNC services. These results are in tandem with the previous studies conducted in India (Aggarwal

et al., 2019). These authors reiterated the positive impact of ASHA on maternal health care services.

Our study provides compelling evidence highlighting the combined impact of DD (cash based incentive program) and SS (community level intervention) on FBD and PNC, particularly for women belonging to the poor quintile. Higher impact on poor women can be explained by the fact that the main aim of JSY was to provide financial support to poor and vulnerable women. Since available studies conducted an impact evaluation of individual components of JSY, the difficulty in comparison prevails. The positive impact of these interventions on poor women has been reiterated in the existing studies evaluating the impact of these programmatic interventions on poor (Vellakal et al., 2017; Agarwal et al., 2019). One of the recent studies investigating the regional disparities of the implementation of JSY found that the impact of JSY on FBD is much lower amongst poor compared to their wealthier peers (Mishra et al., 2021).

We also found that, neither SS nor DD have been efficient in increasing utilisation of ANC services. It could be possibly explained by reasons- First, the cash benefits of JSY are not provided to increase the utilisation of ANC and second, adequate utilisation of ANC entails multiple visits exacerbating the travel costs and opportunity cost in terms of greater time investment. Sub-optimal utilisation of ANC services in India has been highlighted as a serious concern by various studies conducted in India (Miteniece et al., 2018; Kumar et al., 2019)
Our regional investigation elucidated that the impact of DD, SS and DS are more pronounced in the central, eastern and north-eastern region of India. This could be possibly explained by the fact that the share of central government is comparatively much higher in these regions indicating that financially supporting the economically poor regions are proving to be more beneficial.

Regional-wise disaggregation indicates that impact of DD on FBD and SS on PNC was highest for the bottom quintile population of central region (Chhattisgarh, Madhya Pradesh and Uttar Pradesh), north-eastern region (such as, Sikkim, Assam and Nagaland) and northern region (Uttarakhand, Jammu and Kashmir and Rajasthan). These states or regions are experiencing a massive coverage of the demand side component of JSY(Carvalho et al., 2014; Rahman & Pallikadavath, 2018). In contrast to western and southern regions which show partial coverage of DD components of JSY. Previous studies suggest that despite poor-socio economic

conditions, the households of western and southern regions are still lacking access to JSY services in these regions (Mishra et al., 2021). Despite this, the southern and western regions are able to increase the uptake of maternal health care services mainly due to the state-level initiatives/ policies undertaken to address this issue (Smith et al., 2014). Moreover, southern states have introduced state-based financial incentive programs with equal instalment schemes swayed across different stages of pregnancy and a comparatively greater monetary benefits compared to the JSY scheme. Lower treatment effects of JSY in the southern region are greatly discussed in the existing studies (Sen et al., 2020; Mishra et al., 2021).

State-level estimation revealed some interesting insights. We have found that the impact of DD was quite pronounced in the eastern and central region with Bihar and Chhattisgarh being its major contributor. In these states, the impact of cash benefit schemes on poor women was quite prominent, but the impact of SS is very limited. The estimates show that the treatment effects of DD on FBD was around 0.60 and 0.69 in Bihar and Chhattisgarh respectively, but on ANC, the impact was much less. On the other hand, the impact of SS was very limited for all these three services with an exception being Chhattisgarh which has witnessed a maximum treatment effects of SS on PNC (0.41) . It could be attributed to the prevalence of lower levels of education and limited exposure to mediums of information among poor women. Moreover, the percentage of women who met ASHA workers was also abominably low in these state and those who met ASHA have apparently been uninfluenced by them. One of the possible explanations could be that, it is possible that the ASHA workers in these two states are not well trained or their incentives are not sufficient to influence pregnant women to undertake maternal health care services. The secondary level dataset is insufficient to understand the reasons for the remarkable performance of Chhattisgarh on PNC, an explorative study entailing primary survey can be conducted to understand the reasons behind it.

We also found that the states with a mountainous or rigid geographical terrain have experienced a positive impact of ASHA on maternal health services. For instance, the states of Jammu and Kashmir, Himachal Pradesh, Meghalaya and Mizoram recorded higher ATT values of SS on ANC. This could be mainly attributed to the importance of the role of ASHA workers as grassroots health advocates mobilizing the community and inculcating action to alleviate hindrances the utilisation. The importance of ASHA and their roles in extending services to marginalised communities and especially in difficult terrain are widely discussed in the literature (Lehman et al., 2004; Perez & Martinez, 2008; NHRC, 2011). The findings of our

study contributes to the existing literature by providing empirical evidence on the role of ASHA on ANC.

Policy Recommendations

This study indicates that, to increase in uptake of continuum of maternal health care services, it is essential for the government to provide incentives to both pregnant women and health workers at each stage of the life cycle of pregnancy. Based on our study, we suggest following policy prescriptions to improve maternal healthcare utilisation. First, government should strengthen the role of ASHA, special attention should be rendered on selection of ASHA worker, monetary incentives should be released in a timely manner and proper training program should be conducted to update their skills and knowledge. States with minimal ATT values for SS pay immediate attention in providing proper training and increase the incentives to ASHA workers. Second, Proper tracking system should be in place to understand the women who have missed their ANC visits. Third, conditional cash benefit schemes can be increased and expanded for utilisation of ANC and PNC services, in doing so states can follow the models adopted by better performing states (For instance, Muthu Lakshmi Scheme in Tamil Nadu), schemes aiming to achieve similar objectives can be merged to increase its effectiveness (For instance, Jharkhand which merged Mukhya Mantri Janani Shishu Swasthya Abhiyan with JSY). Finally, role of central government should be strengthened and their financial contribution should be increased for the states performing poor in terms of economic indicators.

Conclusion

In this study we have adopted a genetic matching model with a combination of PSM and MDM to elucidate the impact of demand and supply components of JSY on the continuum of maternal health care services. Overall, the demand component of JSY has been higher for FBD, while the supply component influenced PNC more. Both these components had very limited impact on the utilisation of ANC. The impact varied widely across regions and states. The low performing states responded well to the conditional cash benefit scheme, while better performing states, such as southern states did not experience much impact due to the conditional cash benefit program. ASHA/community health program, otherwise known as the supply side component of the scheme had a greater influence on PNC across all the regions. This study has two limitations, both are related to the dataset. First one is regarding the unavailability of data about the cash based incentive programs operating at state-level in

NFHS-4. Moreover, the amount of cash benefits received under each of the state-level programs are unavailable. Second, we were unable to conduct an impact evaluation at district level because the sample size of JSY beneficiaries at district level was insufficient for an empirical evaluation.

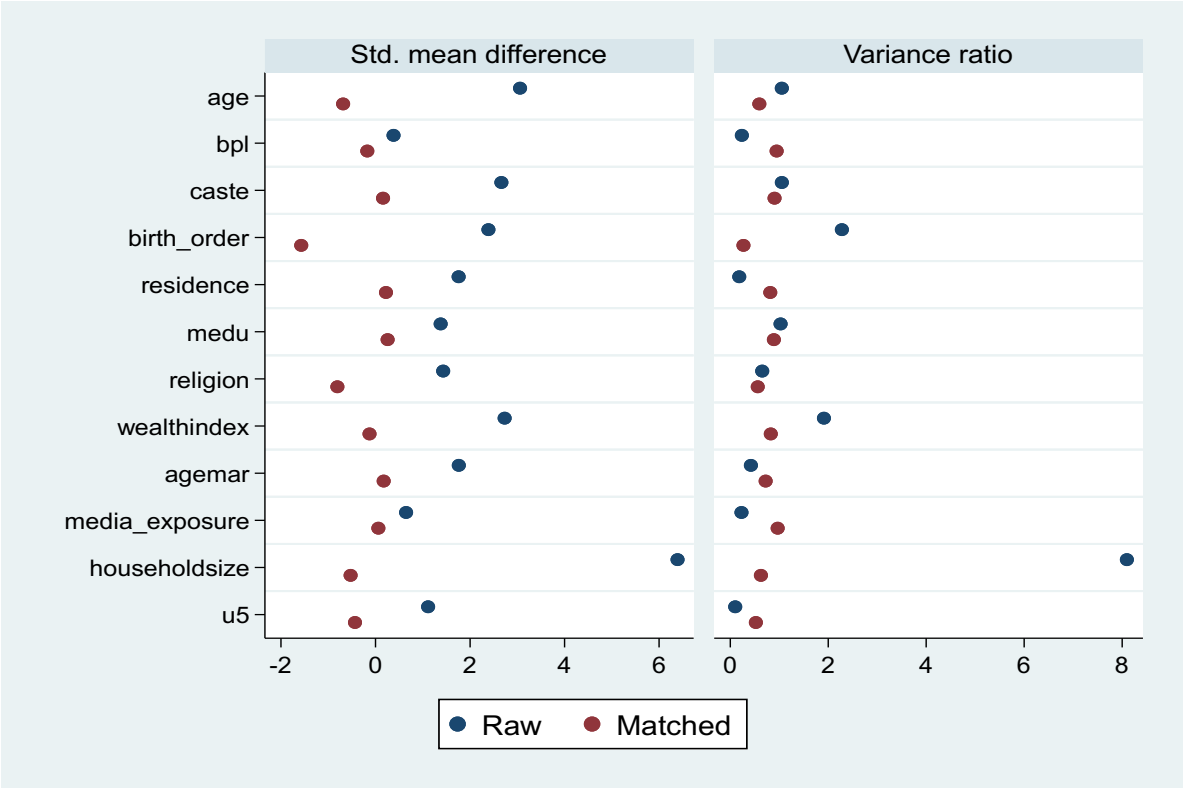
Appendix

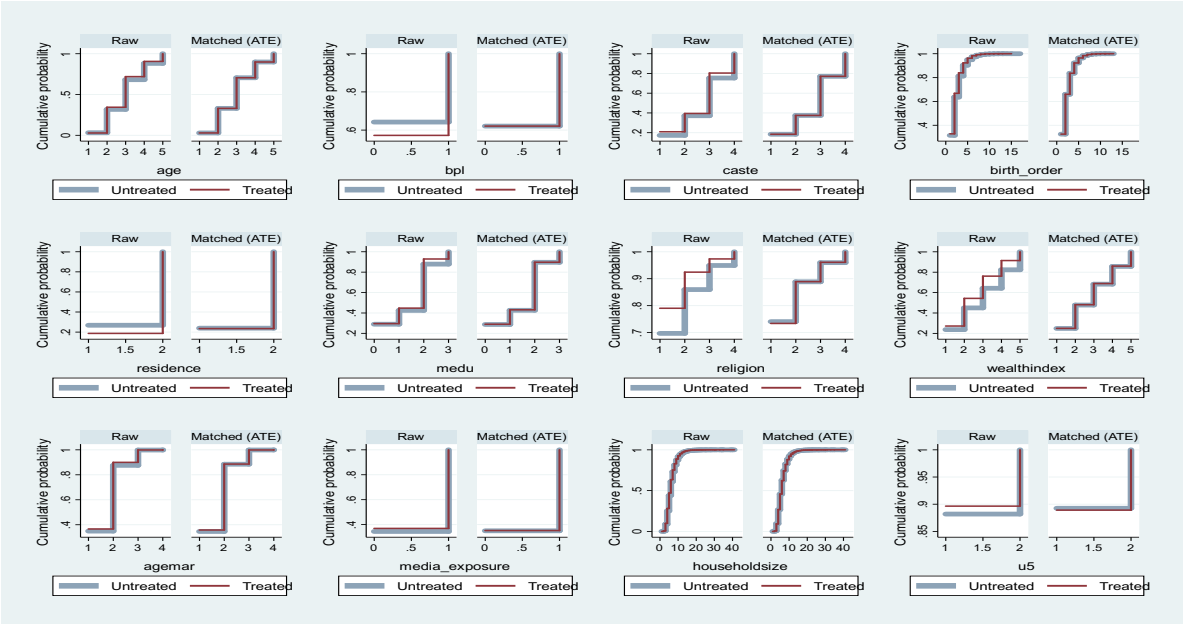
The Government of India demarcated the states of India as high and non-high focused group states and imposed eligibility criteria accordingly. States with less than 25% of institutional deliveries are categorized as high focussed group states and others belong to non-high focussed group states. The details of these two components are elucidated in the Table 1.

Table 1. Various components of Janani Suraksha Yojana

Category	**Rural Areas**		**Urban Areas**	
	Mother's Package (in INR)	ASHA Package (in INR)	Mother's Packages (in INR)	ASHA Package (in INR)
High-Focussed	1400	600	1000	400
Non-high focussed	700	600	600	400

Figure 1: Standardised Mean Difference and Variance ratio of Covariates : Raw and Matched





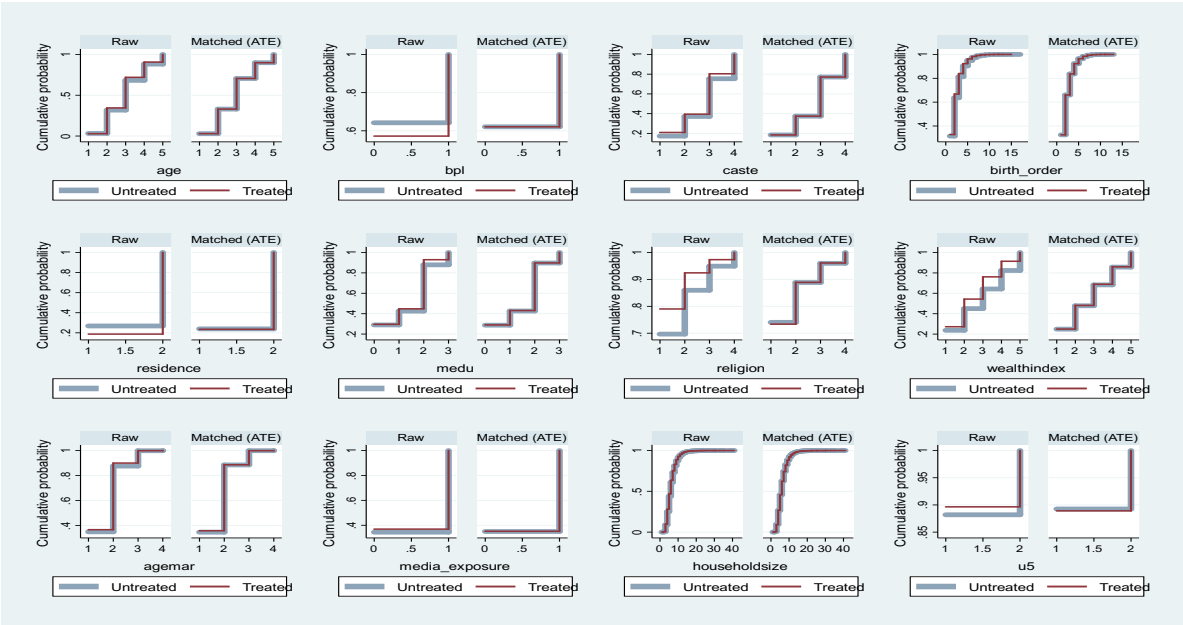


Table 2: Impact of DD on Non-poor categories

Region/State	ANC	FBD	PNC
North			
Haryana	0.02	0.14[a]	0.10[a]
Himachal Pradesh	0.03	0.21[a]	0.14[a]
Jammu and Kashmir	0.07[a]	0.14[a]	0.11[a]
Punjab	0.02	0.11[a]	0.05[a]
Rajasthan	-0.01	0.18[a]	0.10[a]
Uttarakhand	0.03	0.39[a]	0.16[a]
Central			
Chhattisgarh	0.01	0.33[a]	0.06[a]
Madhya Pradesh	-0.03[b]	0.14[a]	0.06[a]
Uttar Pradesh	-0.07[a]	0.32[a]	0.06[a]
East			
Bihar	-0.11[a]	0.25[a]	0.05[a]
Jharkhand	-0.01	0.25[a]	0.01
Odisha	0.05[b]	0.11[a]	0.01
West Bengal	-0.05[c]	0.09[a]	0.03
North East			
Arunachal Pradesh	0.32[a]	0.25[a]	0.37[a]
Assam	0.10[a]	0.17[a]	0.05[b]
Manipur	0.06	0.15[a]	0.12[a]
Meghalaya	0.12[a]	0.28[a]	0.16[a]
Mizoram	0.06[a]	0.17[a]	0.08[a]

Nagaland	0.11[b]	0.55[a]	0.38[a]
Sikkim	-0.04	0.05[a]	0.17[a]
Tripura	0.03	0.08[a]	0.15[a]
South			
Andhra Pradesh	-0.07[b]	0.07[a]	0.08[a]
Telangana	-0.01	0.06[a]	0.02
Karnataka	0.08[a]	0.04[a]	0.08[c]
Kerala	0.00	0	0.04[a]
Tamil Nadu	-0.04[b]	0.01[a]	0.04[a]
West			
Gujarat	0.01	0.08[a]	0.07[b]
Maharashtra	0.00	0.06[a]	0.10[a]

Table 3: Impact of SS on Non-poor categories

Region/State	ANC	FBD	PNC
North			
Haryana	0.14[a]	0.04[a]	0.19[a]
Himachal Pradesh	0.11[a]	0.02	0.10[a]
Jammu and Kashmir	0.07[a]	0.03[a]	0.11
Punjab	0.05[b]	0.02[b]	0.11[a]
Rajasthan	0.11[a]	0.04[a]	0.11[a]
Uttarakhand	0.04	0.05[b]	0.11[a]
Central			
Chhattisgarh	0.13[a]	0.03	0.17[a]
Madhya Pradesh	0.14[a]	0.02[a]	0.18[a]
Uttar Pradesh	0.11[a]	0.04[a]	0.16[a]
East			
Bihar	0.00	0.07[a]	0.15[a]
Jharkhand	0.08[a]	0.03	0.17
Odisha	0.11[a]	0.00	0.12
West Bengal	0.04[c]	0.00	0.12[a]
North East			
Arunachal Pradesh	0.17[a]	0.07[b]	0.33[a]
Assam	0.09[a]	0.04[a]	0.09[a]
Manipur	0.06[b]	0.01	0.06[a]
Meghalaya	0.19[a]	0.08[a]	0.22[a]
Mizoram	0.14[a]	0.04[b]	0.11[a]
Nagaland	0.15[b]	0.14[b]	0.27[a]

Sikkim	-0.06[c]	0.01	0.10[a]
Tripura	0.02	-0.05	0.00
South			
Andhra Pradesh	-0.02	0.00	0.18[a]
Telangana	0.02	0.03	0.13[a]
Karnataka	0.04[a]	0.01[c]	0.17[a]
Kerala	0.02[b]	0.00	0.06[a]
Tamil Nadu	0.06	0.00	0.11[a]
West			
Gujarat	0.11[a]	0.02[b]	0.18[a]
Maharashtra	0.08[a]	0.00	0.12[a]

Table 4: Impact of DS on Non-poor categories

Region/State	ANC	FBD	PNC
North			
Haryana	0.04	0.13[a]	0.16[a]
Himachal Pradesh	0.06	0.19[a]	0.13[a]
Jammu and Kashmir	0.09[a]	0.10[a]	0.13[a]
Punjab	0.02	0.09[a]	0.06[a]
Rajasthan	0.08[a]	0.12[a]	0.13[a]
Uttarakhand	0.04[c]	0.30[a]	0.17[a]
Central			
Chhattisgarh	0.05[b]	0.29[a]	0.08[a]
Madhya Pradesh	0.07[a]	0.10[a]	0.15[a]
Uttar Pradesh	0.03[b]	0.27[a]	0.16[a]
East			
Bihar	-0.06[b]	0.19[a]	0.15[a]
Jharkhand	-0.01	0.22[a]	0.11[a]
Odisha	0.08[a]	0.07[a]	0.07[a]
West Bengal	-0.02	0.09[a]	0.05
North East			
Arunachal Pradesh	0.43[a]	0.23[a]	0.48
Assam	0.10[a]	0.13[a]	0.07[a]
Manipur	0.07[a]	0.12[a]	0.13[a]
Meghalaya	0.15[a]	0.28[a]	0.17[a]
Mizoram	0.08[a]	0.13[a]	0.10[a]
Nagaland	0.17[c]	0.41[a]	0.43[a]
Sikkim	-0.02	0.04[b]	0.16[a]
Tripura	0.07	0.08[a]	0.12[c]
South			
Andhra Pradesh	-0.08[b]	0.06[a]	0.10

Telangana	-0.03	0.04[a]	0.07[a]
Karnataka	0.07[b]	0.03[a]	0.09[a]
Kerala	0.02	0.00	0.03[c]
Tamil Nadu	-0.02	0.01[a]	0.07[a]
West			
Gujarat	0.04	0.07[a]	0.09[a]
Maharashtra	0.02	0.06[a]	0.12[a]

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