Regional inequality in the Janani Suraksha Yojana coverage in India: A Geo-spatial Analysis

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Abstract

Introduction

Although India has made significant progress in institutional delivery after the implementation of the National Rural Health Mission under which the Janani Suraksha Yojana (JSY) is a sub-programme which played a vital role in the increase of institutional delivery in public facilities. Therefore, this paper aims to provide an understanding of the JSY coverage at the district level in India. Further, it tries to carve out the factors responsible for the regional disparity of JSY coverage at district levels.

Methods

The study used the National Family Health Survey data, which is a cross-sectional survey conducted in 2015-16, India. The sample size of this study was 148,145 women aged 15-49 years who gave last birth in the institution during five years preceding the survey. Bivariate and multivariate regression analysis was used to fulfill the study objectives. Additionally, Moran's I statistics and bivariate Local Indicator for Spatial Association (LISA) maps were used to understand spatial dependence and clustering of JSY coverage. Ordinary least square, spatial lag and spatial error models were used to examine the correlates of JSY utilization.

Results

The value of spatial-autocorrelation for JSY was 0.71 which depicts the high dependence of the JSY coverage over districts of India. The overall coverage of JSY in India is 36.4% and it highly varied across different regions, districts, and even socioeconomic groups. The spatial

error model depicts that if in a district the women with no schooling status increase by 10% then the benefits of JSY get increased by 2.3%. Similarly, if in a district the women from poor wealth quintile, it increases by 10% the benefits of JSY also increased by 4.6%. However, the coverage of JSY made greater imperative to understand it due to its clustering among districts of specific states only.

Conclusion

It is well reflected in the EAGs states in terms of spatial-inequality in service coverage. There is a need to universalize the JSY programme at a very individual level. And, it is required to revisit the policy strategy and the implementation plans at regional or district levels.

Keywords: Janani Suraksha Yojana; spatial analysis; LISA; India.

Introduction

Despite given efforts by international, national, and local governments and agencies, the utilization status of maternal and child health (MCH) care services is still low in many developing countries, including India [1–6]. Although India has made considerable progress in reducing maternal mortality through the interventions of different health policies and programs, the national rural health mission (NRHM) is one of them and act as mandating's multi-strategic programme interventions to promote health care accessibility while reducing health inequity across the groups [7,8], however, kinds of literature show that the effectiveness and efficiency of the programs are not the same across socio-economic groups and regions that led to slow, uneven and unequal distribution of health and health care practices [9–13]. Further, a large proportion of women and children in low-and middle-income countries are still, not covered under the essential health care services [13–18] and particularly those who are from the poor and marginalized groups of the communities [10,19,20]. India is also facing the same issue of health inequality, and even worse in the case of MCH care services [8,20–21].

Furthermore, in India, huge health disparities exist across different socio-economic groups, regions, states, and districts level among women and children. And it is due to low accessing and under-utilizing of maternal and child health care services [24]. States like Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, Jharkhand, Chhattisgarh, Uttarakhand, and Orissa are going through tremendous inequality in accessing equitable health care services [11,23-24]. These states are also together named as EAGs (Empowered Action Group) states, with low performing in socio-economic and health indicators, and that eventually lead to high maternal and child mortality compared to other states [22-24,17,48-50].

Further, higher maternal mortality rates and its variations across socio-geographical regions show that there is inaccessibility, unavailability, and unaffordability of essential maternity

services that lead to under-utilization of MCH services among the poor and marginalized women [17,19]. For example, institutional delivery is an important maternity care service that prevents maternal and neonatal mortality. In India, still, 21% of childbirth delivery occurs at home [23]. Although, institutional delivery in India has increased to 79% in 2015 from 39% in 2005; however, still, the gap has remained wide and persistent across socio-economic groups, regions, and states [23]. For example, women belong to a higher wealth quintile have gone to 95% of institutional delivery as compared to 60% of a lower wealth quintile mothers. Similar differences can also be found in mother's education levels [23]. Therefore, for plummeting health inequity and fostering health equality development by promoting institutional delivery, the *Janani Suraksha Yojana* (JSY) or 'Safe Motherhood scheme' was introduced in 2005, under the National Rural Health Mission (NRHM), in which the poor and marginalized women are provided with an incentive for delivering their child in public health facilities. It is a conditional cash transfer scheme to promote institutional delivery in order to reduce mother and child deaths [24,26].

The economic burden is one of the most important factors that restrict poor pregnant women from delivering their childbirth at health institutions [25-27,29-30]. Further, socio-economically vulnerable and marginalized women also suffer from multiple deprivations/vulnerabilities in seeking maternal health care services, such as prenatal, natal, post-natal care, and child immunization [30–31,33,48-50]. The JSY scheme is one of the most far-reaching demand-side financing programs in the world [12,21,53]. And, it is associated with increasing institutional delivery among the most deprived groups of people. Further, it has significantly improved institutional delivery in the low performing states (EAGs states) in the last one decade 2005-2015, however, the state and regional level variations still continue to persist [20-23,52–55].

The provision of conditioning JSY cash payment scheme to all pregnant women is marked as an irregularity to the beneficiaries and it has been found that after a decade of implementation of the JSY scheme, a huge gap persists in terms of coverage and utilization [5,7,55], not only across socio-economic groups but also at regional and district-levels [7,20,53]. Several studies found that the increasing trend of inequity and inequality in access to JSY services and its coverage has created policy concerns [7,8,20,25]; therefore, it requires putting forth many questions against the policies and programme for its overall coverage [4,7]. Further, there is also supply-side barriers women face in accessing JSY services [6]. Women belong to a marginalized and disadvantaged community are unable to meet the required MCH services available in the public domains in India [25,30,33-34], although the community health workers (CHWs) are the key to improve the service coverage in the community, however, there are evidences show that CHWs are biased in providing healthcare services in the community across the social groups [34,50-51]. The literature also shows that there is a significant variation in coverage of health policy and programs interventions across the communities due to unawareness and lack of knowledge [5,20,37,33]. Due to the policy coverage gap and lack of programme effectiveness across the groups, regions, and states have made substantial increments in the health disparity. It is evident in the study conducted by Vellakkal et al., that the use of JSY conditioning cash transfer during pregnancy is varied considerably across socio-economic groups, and not all eligible women get access to it [33]. Moreover, it also varies across geographic regions and states in India [6,20,24]. Spatial disparity matters in the MCH services coverage and its utilization [23,39–41,45]. Studies show that there is a strong correlation between the proximate determinants of spatial clustering and service coverage [40,41,45].

As it was found that a huge gap persists in the JSY coverage across various socio-economic groups, states, and regions of India. Therefore, this paper aims to provide an understanding of

142 the JSY coverage at the district level. Moreover, it tries to carve out the factors responsible for
143 regional disparity for JSY coverage at the district level. The study hypothesized that there was
144 no spatial auto-correlation between JSY coverage and districts of India.

145 ***Janani Suraksha Yojana* (*Safe Motherhood Programme*):** India has launched several health
146 policies and programs to protect mother and child health and to improve their survival. India's
147 flagship scheme of JSY launched in 2005 under the auspicious program of the National Rural
148 Health Mission (NRHM) with a particular focus on reducing maternal and infant mortality
149 through promoting antenatal, natal, and postnatal care. JSY is a safe motherhood intervention
150 under the NRHM being implemented with the objective to reduce maternal and neonatal
151 mortality by promoting institutional delivery among poor pregnant women. It is a 100%
152 centrally sponsored scheme and it integrates cash assistance with delivery and post-delivery
153 care [24]. It is a conditioning cash-incentive scheme that promotes pregnant women to deliver
154 their children at public health institutions. Since, in India, one-fifth of childbirths still take place
155 at home delivery [23]. It ensures safe delivery to all women who belong to Scheduled Castes,
156 Scheduled Tribes, and those women who are living below the poverty line (BPL) with the age
157 of 19 years and above during delivery. The ASHA as a community health worker (Accredited
158 Social Health Activist) acts as an intermediate person to track from pregnancy to childbirth and
159 postnatal care in the community in this scheme. In this way, ASHA is engaged with the JSY
160 scheme to set up a linkage between the government health system and the beneficiary woman
161 [24]. Each beneficiary registered under this scheme must have a JSY card along with an MCH
162 card.

163 **Methods**

164 The data from the National Family Health Survey round four (NFHS-4) was used to understand
165 the spatial pattern and correlates affecting the JSY service utilization in India. NFHS is a cross-

sectional national representative survey, conducted in 2015-16 under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India. The survey provides detailed information on population, fertility, family planning, reproductive right and health issue, HIV/AIDS, gender issues, women empowerment, and domestic violence. NFHS used a two-stage stratified sampling design in both rural and urban areas to give the estimates at state [36] as well as district level [640]. In rural areas, villages were selected in the first stage using a Probability Proportional to Size (PPS) scheme. In the second stage, 22 HHs were selected using systematic sampling. In urban areas, census enumeration blocks (CEBs) were selected in the first stage using the PPS scheme, and in the second stage, 22 HHs were selected using systematic sampling. The detailed methodology and complete information on the survey design and data collection published elsewhere [23]. The survey collected information from 601,509 households, 699,686 women, and 112,122 number of men for the response rate of 98 percent, 97 percent, and 92 percent respectively. The study restricts sample size (n=148,145) to the women aged 15-49 years who gave last birth in the institution during five years preceding the survey.

Outcome variable

The outcome variable for the analysis is the coverage (percentage) of the JSY scheme. The question was asked to the women 'did you receive any financial assistance for delivery care? Further, the question was asked 'from where did you get assistance? The responses were (a). Janani Suraksha Yojana (JSY), (b). Other Government Schemes, (c). Other. For the analysis purpose, the study made a dichotomous variable and which was coded as 1 'Yes (received JSY assistance)' and 0 'No (not receive)'.

Independent variable

The predictor variables for this were women's age, meeting with community health worker (CHW), education of the women, the wealth of the households, caste, religion, mass media exposure and place of residence. Age of the women was divided into two categories: less than 25 years and 25 years or more. Meeting with community health worker (CHW) was coded as yes and no. Women's educational level was categorized as no education and educated. A household wealth index was calculated in the survey by combining household amenities, assets and durables and characterizing households in a range varying from the poorest to the richest, corresponding to wealth quintiles ranging from the lowest to the highest. Further, the study grouped wealth of the household into two categories such as poor (included poorest and poorer) and non-poor (included middle, richer, and richest). Place of residence was given as rural and urban in the survey. Caste was divided into two categories: Scheduled caste/scheduled tribe and other (included other backward class caste group). Religion was categorized as Hindu and non-Hindu (including Christian, Sikh, Buddhist/Neo-Buddhist, Jain, Jewish, Parsi/Zoroastrian, no religion, and other). Women's exposure to mass media: how often they read newspapers, listened to the radio and watched television; responses on the frequencies were: almost every day, at least once a week, less than once a week, or not at all; women were considered to have any exposure to mass media if they had exposure to any of these sources and as having no exposure if they responded with 'not at all' for all three sources of media [41-42].

Statistical analysis

Bivariate and multivariate logistic regression analysis was used to analyze the data. Additionally, for spatial analysis in terms of coverage of JSY among women in India univariate and bivariate Moran's I index measurements were used along with the usage of spatial regression models [44]. Spatial auto-correlation is being measured by using Moran's I statistics. Spatial autocorrelation represents the extent to which data points are similar or dissimilar to their spatial neighbours [43,46-47].

Univariate Moran's I measure the spatial auto-correlation of neighborhood values around a specific spatial location. It determines the extent of spatial non-stationary and clustering present in the data. Bivariate Moran's I examine the local correlation between an outcome variable and certain characteristics of the region. While both univariate and bivariate Moran's I aim to measure similarities and dissimilarities of spatial data, they are found to be less useful in case of uneven spatial clustering [44,47]. The formula to calculate the Moran's I statistic is as follows:

$$\text{Univariate Moran's I} = \frac{n}{S_O} \times \frac{\Sigma_i \Sigma_j W_{ij}(x_i - \bar{X})[x_j - \bar{X}]}{\Sigma_i [x_i - \bar{X}]^2}$$

Where x is the variable of interest and $\bar{X}$ is the mean of x; n is the number of spatial units; W_{ij} is the standardized weight matrix between observation i and j with zeroes on the diagonal; and S_O is the aggregate of all spatial weights, i.e. $S_O = \Sigma_i \Sigma_j W_{ij}$

$$\text{Bivariate Moran's I} = \frac{n}{S_O} \times \frac{\Sigma_i \Sigma_j W_{ij}(x_i - \bar{X})[Y_j - \bar{Y}]}{\Sigma_i [y_i - \bar{Y}]^2}$$

Where x and y are the variables of interest; $\bar{X}$ is the mean of x; $\bar{Y}$ is the mean of y; n is the number of spatial units; W_{ij} is the standardized weight matrix between observation i and j with zeroes on the diagonal; and S_O is the aggregate of all spatial weights, i.e. $S_O = \Sigma_i \Sigma_j W_{ij}$.

Value of Moran's- I range from −1 (indicating perfect dispersion) to +1 (perfect correlation). A zero value indicates a random spatial pattern. Negative (positive) values indicate a negative (positive) spatial autocorrelation. Positive autocorrelation indicates that points with similar attribute values are closely distributed in space, whereas negative spatial autocorrelation indicates that closely associated points are more dissimilar [44-47].

Univariate LISA calculates the spatial-correlation of neighborhood values around the specific spatial location [47]. It determines the extent of spatial randomness and clustering present in the data. The measure $[I_i]$ is given by the following:

$$\text{Univariate LISA: } I_i = \frac{n.[x_i - \bar{X}]}{\Sigma_i [x_i - \bar{X}]^2} \Sigma_j w_{ij} [x_j - \bar{X}]$$

Bivariate Local Indicator of Spatial Association (LISA) measures was estimated to analyze the association of certain characteristics of regions with JSY coverage. The bivariate LISA presented as below:

$$\text{Bivariate LISA: } I_i = \frac{n.[x_i - \bar{X}]}{\Sigma_i [y_i - \bar{Y}]^2} \Sigma_j w_{ij} [y_i - \bar{Y}]$$

Four types of spatial auto-correlation were generated based on the four quadrants of Moran's I scatter plots which are defined as follows:

- **Hot Spots**: districts with high values, with similar neighbors (High-High).
- **Cold Spots**: districts with low values, with similar neighbors (Low-Low).
- **Spatial Outliers**: districts with high values, but with low-value neighbors (High-Low) and districts with low values, but with higher values of neighbors (Low-High).

The spatial weights W_{ij} are non-zero when i and j are neighbors, else it remains zero [43,46]. The weight used in the analysis is Queen Contiguity weights which represents whether spatial units share the boundary or not. If the set of boundary points of unit I is denoted by the band (i), then the Queen Contiguity Weight is defined by:

$$W_{ij} = \begin{cases} 1 \ , bnd(i) \cap bnd\ (j) \neq \ \emptyset \\ 0 \ , \ bnd(i) \cap bnd\ (j) \neq \ \emptyset \end{cases}$$

However, this allows the possibility that spatial units share only a single boundary point (such as a shared corner point on a grid of spatial units). Hence a stronger condition is to require that some *positive* portion of their boundary be shared.

In order to determine the significant correlates of coverage of Janani Suraksha Yojana (JSY) in India, a set of regression models had been used. The spatial ordinary least square (OLS) regression model was used to see the extent of autocorrelation in the error term. Since the OLS confirmed spatial autocorrelation in its error term for the dependent variable, we further estimated the spatial lag model (SLM) and spatial error model (SEM) [44,46]**.** The underlying assumption of a spatial lag model is that the observations of the outcome variable are affected in the neighborhood areas whereas the spatial error model is used to consider the effect of those variables which are absent in the regression model but had an effect on the outcome variable. The basic difference between the two models is that the spatial lag model unlike the spatial error model does not consider the spatial dependence of the error term.

The basic equation for OLS is as follows:

$$Y=\alpha + BX + \mathcal{E}$$

Where Y is the outcome variable, X is the vector of predictor variables and α is the model intercept and β is the corresponding coefficient vector.

The spatial lag model suggests that the units are spatially dependent on each other and lagging to each in the nearby spatial locations [44,47]. A typical spatial lag model can be written as follows:

$$Y_i = \delta \sum_{j \neq 1} W_{ij} Y_j + \beta X_j + \varepsilon_j$$

Here Y_i denotes the JSY coverage for the ith district, δ is the spatial autoregressive coefficient, W_{ij} denotes the spatial weight of proximity between district i and j, Y_j is the JSY coverage in the jth district, β_j denotes the coefficient, X_j is the predictor variable and εj is the residual. The spatial error model, on the other hand, considers the contribution of omitted variables that are not included in the model but can have a significant effect in the analysis [47]**.** A Spatial Error Model (SEM) is expressed as follows:

$$Y_i = \beta X_j + \lambda \sum_{j \neq 1} W_{ij} Y_j \, \varepsilon_j + \varepsilon_i$$

Here, Y_i denotes the JSY coverage for the ith district, λ is the spatial autoregressive coefficient, W_{ij} denotes the spatial weight of proximity between district i and j, Y_j is JSY coverage in the jth district, β_j denotes the coefficient, X_j is the predictor variable and ε_i is the residual.

Results

Background analysis

Table-1 represents the socio-economic profile of the study population in India. As per 2015-16 estimates, 36.4% of women in India got benefited from Janani Suraksha Yojana (JSY). About 68.9% of women were aged 25 years and more. Nearly, 51.9% of women met community health worker (CHW). Of the total women selected, 21.6% were having no schooling. Every 3 in 10 women were from the Scheduled Caste/Scheduled Tribe caste category. About 8 in 10 women were from the Hindu religion. About 37.6% of women belonged to the poor wealth quintile and 19% of women had no media exposure. Further, about 67% of women belonged to rural areas in India.

Table-2 depicts bivariate and logistic regression analysis to find an association between JSY and background factors in India, 2015-16. Women aged 25 years and more were 6% significantly more likely to receive the benefit of JSY (OR: 1.06; $p<0.01$) than women aged 24 years or less. Women who met CHW were 71% significantly more likely to receive the benefit of JSY (OR: 1.71; $p<0.01$) than women who did not met CHW. Women who were educated were having significantly lower odds for receiving JSY benefits in reference to women who had no schooling (OR: 0.80, $p<0.01$). Odds for JSY benefits were higher among women from the Scheduled Caste/Scheduled Tribe category than women from non-Scheduled Caste/ Scheduled Tribe (OR: 0.80, $p<0.01$). Women from the non-Hindu religion were 25% significantly less likely to receive benefits from JSY in comparison to women from the Hindu religion (OR: 0.75, $p<0.01$). Women from non-poor wealth quintiles were 52% significantly less likely to receive JSY benefits in comparison to women from the Poor wealth quintile (OR: 0.48, $p<0.01$). Women who had some media exposure had lower odds of receiving JSY benefits than women who had no media exposure (OR: 0.90, $p<0.01$). Odds for receiving JSY benefits were higher for women from a rural place of residence than women from urban areas (OR: 1.56, $p<0.01$).

Table-3 presents the values of univariate and bivariate Moran's I statistics. Univariate Moran's I statistics represent the spatial auto-correlation of outcome and predictor variables. The value of spatial-autocorrelation for JSY was 0.71 which depicts high dependence of the outcome variable over districts of India. Additionally, the highest Moran's I value among predictor variables was witnessed by women from the poor wealth quintile (0.75) followed by women from the Hindu religion (0.74) and women who had no mass media exposure (0.72). It was found that the spatial auto-correlation of JSY and women with no schooling was 0.35 and that with women from poor wealth quintile was 0.52. Additionally, the spatial auto-correlation of JSY and women from rural areas was 0.31, and women who had no media exposure were 0.42.

Table 4 provides estimates for spatial regression estimates for JSY and its predictors for 640 districts of India. From the OLS estimates, it was confirmed that women aged less than 25 years (β: -0.614, $p<0.05$), met CHW (β: 0.341, $p<0.05$), no schooling status (β: 0.206, $p<0.05$), poor wealth quintile (β: 0.637, $p<0.05$) and rural place of residence (β: 0.035, $p<0.05$) were found to be significant spatial predictors of JSY in India. The value of adjusted R-square was 0.54 and the value for AIC was found to be 5394.

The value of the lag coefficient was 0.67 ($p<0.01$) from the SLM which signifies that a change in the JSY coverage in a particular district may statistically lag the rate of JSY coverage by 67% in the neighboring districts. In the spatial lag model, it was found that women aged 15-24 years (β:-0.317, $p<0.05$), met CHW (β: 0.248, $p<0.05$), no schooling status (β: 0.56, $p<0.05$) and poor wealth quintile (β: 0.245, $p<0.05$) were significantly associated with JSY coverage in India. The respective model splits the value of adjusted R-square as 0.78 and the value for AIC was found as 5004.

However, as per the theory of spatial regression models, the model with the lowest AIC value and highest R-square value is considered to be the best fit model. Therefore, as per our model estimates the lowest AIC and highest adjusted R-square value was found to be of spatial error model (SEM) which makes it the best fit model among all the three models. The spatial error model was having an AIC value of 4996 and an adjusted R-square value of 0.79. Interestingly the value of Lambda (spatial autoregressive coefficient)/error lag value was 0.80 ($p<0.01$) which signifies that spatial influence on JSY coverage through the omitted variables not present in the SEM.

The model depicts that if in a district the women aged less than 25 years increases by 10% then benefit of JSY get significantly declined by about 2.9%. Interestingly if in a particular district the women who met CHW get significantly increased by 10% then the benefit of JSY gets

348 significantly increased by almost 2.9%. If in a district the women with no schooling status
349 increases by 10% then the benefits of JSY get significantly increased by 2.2%. Similarly, if in
350 a district the women from the poor wealth quintile increases by 10% the benefits of JSY also
351 significantly increased by 4.4%. However, if in a district there is a 10% increase of women
352 who had no mass media exposure then the JSY benefits get declined by 0.4%. Moreover, rural
353 place of residence (β: 0.017, $p>0.05$), Scheduled caste/Scheduled tribe status residence (β:
354 0.028, $p>0.05$) and Hindu religion status residence (β: 0.069, $p<0.05$) were positively
355 associated with JSY estimates, but the results were not significant except for Hindu religion
356 status. The results simply imply that districts with a higher percentage of women having no
357 schooling status and belong to the poor wealth quintile had higher chances to get benefited
358 from the JSY programme.

359 Map-1 shows the coverage and spatial distribution of the JSY scheme across the districts of
360 India. The colour pattern shows the spatial differences in the service utilization of the JSY
361 scheme. Moreover, deeper colour indicates a higher proportion of JSY coverage and light
362 colour indicates lower coverage. More than 50% of the women utilizing JSY services in the
363 districts of Odisha, Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Uttarakhand, Assam, and
364 few districts of Rajasthan, Bihar, Jharkhand, and Meghalaya.

365 Figure-1 represents univariate LISA (cluster and significance) maps for outcome and
366 independent variables for districts of India, 2015-16. A significant high-high clustering of JSY
367 service utilizing found in 162 districts, which belonged to the above-mentioned states. There
368 were 162 cold spots in Gujarat, Maharashtra, Telangana Andhra Pradesh, Punjab, Chandigarh,
369 and Haryana showed lower service utilization of the JSY scheme.

370 The high-high clustering (125 districts) for women aged less than 25 years was found in West
371 Bengal , Jharkhand, Chhattisgarh, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh,

Orrisa and Karnataka. The high-high clustering (106 districts) for women who met CHW was found in West-Bengal, Orrisa, Madhya Pradesh, Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu. On the other hand, no schooling hotspots (132 districts) were found in Rajasthan, Bihar, and few districts of Madhya Pradesh, Uttar Pradesh, and Odisha. While the clustering of poor women were more in (160 districts) the districts of Uttar Pradesh, Bihar, Jharkhand, Chhattisgarh, Odisha, and few parts of Assam. Furthermore, the hotspots (151 districts) of the Hindu religion were found in empowering action group states and the clustering of no mass media was high (123 districts) Uttar Pradesh, Bihar, Jharkhand, and few districts of Maharashtra.

Figure-2 displays the bivariate LISA cluster map which indicated the high-high clustering for JSY and women aged less than 25 years were observed in 50 districts which were from Rajasthan, Madhya Pradesh, Orrisa, West Bengal, Jharkhand and Chhattisgarh. The hotspots (high-high) clustering for JSY and women who met CHW were observed in 63 districts which were from Madhya Pradesh, Orrisa, Andhra Pradesh, West Bengal and Tamil Nadu. About 117 of 640 districts had the highest JSY service utilization and no schooling among women. These districts mostly from Rajasthan, Madhya Pradesh, and some parts of Uttar Pradesh, Bihar, and Odisha. However, cold spots (127 districts) of JSY utilization and no education were found in the southern part of India. Bivariate LISA map suggested that around 142 districts constitute the hot spots of high JSY utilization and high poverty. Majority of these districts from Uttar Pradesh, Bihar, Jharkhand, Chhattisgarh, Odisha, West Bengal, and Assam. Only 85 districts constitute the hot spots of high JSY coverage and rural areas. These districts from Uttar Pradesh, Bihar, and few districts from Chhattisgarh, Odisha, and Assam. About 20% of districts (121 districts) of India were observed as hot spots (high JSY utilization and high Hindu religion population) while 53 districts were found as cold spots (low JSY coverage and low Hindu population). Mostly hot spots districts from Madhya Pradesh, Chhattisgarh, Odisha, and some

397 part of Uttar Pradesh and Uttarakhand. Similarly, around 109 districts were identified as hot
398 spots (high JSY coverage and high no mass media exposure) and 147 districts as cold spots
399 (low JSY coverage and low no mass media coverage). These hot spots district from Uttar
400 Pradesh, Bihar, Jharkhand, and few districts from Madhya Pradesh whereas cold spots were
401 found in the southern part of India and the states of Punjab Chandigarh, Haryana, and Himachal
402 Pradesh.

403 **Discussion**

404 Though this spatial analysis of the JSY coverage is an attempt to find the clustering of exposure
405 to the programme at the district level in India, and the paper is acknowledged with several
406 interesting findings. Firstly, there is a need to improve the policy coverage at the very
407 household level so that, it can make thrive the concept of universal access and enhance the
408 socio-spatial coverage too. Secondly, in receiving the JSY services by the beneficiary groups
409 of people, there are multiple social determinants of health that affect accessing it and therefore
410 need to be prioritized at the individual, household, and community levels. Thirdly, a high health
411 inequity is seen across the spatial-regional distributional patterns of JSY service and it
412 concentrated at one particular geographical region and it also extremely varied within and
413 between regions.

414 In the present study, it was found that regional disparity was visible in the case of JSY coverage
415 across districts of India. For instance, the concentration of JSY coverage among illiterate
416 women was visible in states of Rajasthan, Madhya Pradesh, Uttar Pradesh, Bihar and Orissa
417 which are considered as the empowered action group (EAG) [55] states. Moreover, the spatial
418 auto-correlation of JSY and women from poor wealth status was concentrated in the entire
419 central and eastern part of India which has lower socio-economic development in comparison
420 to other parts of India [5,20,53,58]. The regional disparity also remained the same in the

421 coverage of the programme, although the financial incentives have led to the poor women in
422 more service utilization under the NRHM policy [5,21,24-25], but, there is evidence that shows
423 the targeted groups are lacking in availing the services [11-12] which need to be enhanced with
424 the universalization of the programme to every individual.

425 There is evidence shown in previous studies that accessing maternal and child health-related
426 information in the community as a whole and household particularly depend on several factors.
427 Socially and economically marginalized communities receive fewer services as compared to
428 their counterparts [13,15,55]. At the same time, women belonging to these communities have
429 faced discrimination in availing healthcare services [10,26,33]. In our analysis, it is shown that
430 there are regions and districts which are socio-economically poor, and the proportionality with
431 a high SCs and STs population are shown under-coverage of JSY services. For example, in the
432 states like Jharkhand, Chhattisgarh, Bihar, and Madhya Pradesh, and Uttar Pradesh, the
433 coverage of JSY across socio-economic groups are not up to that mark and it varied
434 significantly across districts and regions too. The factors like governance, CHWs and
435 associated determinants often played a role in the implementation of the programme and the
436 community health workers that are key to make it a success. Previous studies have also
437 supported our findings regarding the under-coverage of JSY scheme in some of the districts is
438 due to unavailability of CHWs, lack of governance, and the interaction between stakeholders
439 and CHWs [34-38,50-51]. Further, the major finding of this study is that the regions which
440 were already facing high inequity in health service coverage yet again spotted with socio-
441 spatial inequality in the JSY coverage. Overall, the high concentration region of JSY coverage
442 is shown in the central region (states included as Madhya Pradesh, Uttar Pradesh, and
443 Chhattisgarh), the eastern region (Bihar, Jharkhand, and Orissa) and the northern region
444 (Uttarakhand and Rajasthan and Jammu & Kashmir). These regions or states are having huge
445 health disparities that can be also seen in the distribution of JSY services [6,32,52,55]. Contrary

446 to that, the southern and western part of India is partially covering the programme, although
447 there are some patches in Tamil Nadu (South Indian state) showed the coverage of the JSY.
448 However, southern states are falling back with the programme coverage. Even though in the
449 southern states, the private institutional deliveries have increased irrespective of the socio-
450 economic conditions in the last decade [23], moreover, some households are eligible to get the
451 JSY services, are still lacking access to the services. The regional inequality in the JSY
452 coverage has also put women's health at risk and therefore the regional planning and policy
453 concern is highly required in India. The lower the coverage lesser the inequality, and higher
454 the coverage the highest inequality is seen in the JSY utilization across India.

455 Regional inequality and high severity in social policies have made profound effects on MCH
456 outcomes in many developing countries, including India [17-19,25,50,58]. Historically, a lack
457 of policy consistency and programme intervention on evidence-based maternal healthcare in
458 India has made a lesser imperative in the development of mother and child health. Further,
459 there has also been little intervention on socio-behavioral change in the community that paved
460 to rural women to deliver their child at health institutions except for JSY that helps financially
461 after the child born at public health institutions [4-6]. Although the programme was to support
462 rural pregnant women to deliver their babies in public health institutions, however, the results
463 show that there is still inequality in the distributional patterns of service utilization among the
464 population who are eligible to adhere to it [57]. The findings of this study clearly show that the
465 service utilization among the poor and disadvantaged groups of women is higher compared to
466 their counterparts, even though the programme was for the targeted groups, however, the
467 results showed that it is still lacking the full coverage of service utilization among them [53-
468 57]. As the previous studies have also provided the evidence and supported the analysis in the
469 context of service coverage where the women deprived of multiple grounds face inequity in
470 the use of JSY service [55,57]. Moreover, previous literature argued that after JSY in 2005-07,

471 the benefit was more weighted towards rural, illiterate and women from lower socio-economic
472 strata [33,37-38]. Additionally, it was too argued that the concentration of JSY coverage was
473 high among women from lower socio-economic strata because of cash incentive system of JSY
474 [5,11,21]. The use of public institutional delivery has increased many folds among the poor
475 socio-economic women after the launch of the National Rural Health Mission (NRHM) in 2005
476 and it turned up as a pro-poor programme [9,12,20,50]. However, the gap remained the same
477 in accessing the JSY service (Under the NRHM) by marginalized and disadvantaged women
478 which are shown in this study as well. The findings are also consistent with previous evidence
479 that the probability of service utilization is more among those who are not deprived of multiple
480 socio-economic and political grounds [7,17,33,35].

481 Although the study had some limitations too. Firstly, recent advancements and
482 implementations under the JSY could not be analyzed as the data source used for 2015-16.
483 Secondly, socio-economic inequality within districts was not assessed which would be
484 interesting to evaluate in further analysis. Thirdly, the reasons why women cannot assess JSY
485 benefits were not covered in the study which can be further investigated through qualitative
486 research. Lastly, more magnification of the districts was not possible due to sample size issues
487 at primary sampling unit's (PSU's) that would be of utmost importance for block level policy
488 implementation.

489 However apart from the above limitations, the analysis provided a broad perspective regarding
490 inequality in JSY coverage across districts of India which can be very important for
491 policymakers to evaluate the scheme at district level.

492 **Conclusion**

493 The overall utilization of JSY services in India after the launch of the programme in 2005 is
494 still 36 percent only. The coverage of JSY highly varied across different regions, districts, and

even socioeconomic groups. It was reflected that the high coverage of JSY was concentrated in EAG states and among poor and illiterate women. Yet, rural and remote areas with geographical barriers across Indian states and districts are shown under-coverage. There is a need to mobilize the resources and implement JSY in every corner of the districts of the country so that every woman should get benefit from JSY and to reduce inequality across districts. Because it has huge implications for mothers and child survival. No doubt, the JSY scheme in India has led to an increase in MCH services among pregnant women but due to unequal utilization of JSY service coverage across the groups made unequal distribution in the districts and states. Though the JSY programme has been less known among families, for example, those who had have no mass media exposure, no education, lower-caste groups, and poorer households. However, the JSY coverage is fair enough comparatively and it needs more attention from the government in response to implementation and governance. Also, to counter social determinants of women's health a need-based policy intervention like this is required to enhance the MCH coverage among the poor and marginalized women. To make an effective such programme like JSY, the CHWs (community health workers) need to be trained and engaged for diffusing the information at the individual and household levels.

Abbreviations:

JSY: Janani Suraksha Yojana

MCH: Mother and Child Health

NRHM: National Rural Health Mission

EAG: Empowered Action Group

CHW: Community Health Worker

BPL: Below Poverty Line

ASHA: Accredited Social Health Activist

NFHS: National Family Health Survey

MoHFW: Ministry of Health and Family Welfare

PPS: Probability Proportional to Size

HH: Household

CEBs: Census enumeration block

LISA: Local indicators of spatial association

OLS: Ordinary Least Square

SLM: Spatial Lag Model

SEM: Spatial Error Model

AIC: Akaike information criterion

Declarations

Ethics approval and consent to participate: The data is freely available in the public domain and survey agencies that conducted the field survey for the data collection have collected prior consent from the respondent. The local ethics committee of the International Institute for Population Sciences [IIPS], Mumbai, ruled that no formal ethics approval was required to carry out research from this data source.

Consent for publication: Not applicable

Availability of data and materials: The study utilizes a secondary source of data that is freely available in the public domain through http://iipsindia.org.

Competing Interests: The authors declare that they have no competing interests.

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Author's Contribution: The concept was drafted by PSM; PK and SS contributed to the analysis design; PSM and SS advised on the paper and assisted in paper conceptualization; PSM, PK and SS contributed to the comprehensive writing of the article. All authors read and approved the final manuscript.

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Table-1. Socio-demographic profile of the study population in India, 2015-16

Variables	N=148,185 (n (weighted %))
Received Janani Suraksha Yojana	
No	84,520 (63.6)
Yes	63,665 (36.4)
Age (in years)	
Less than 25	50,485 (36.1)
25 or more	97,700 (63.9)
Met with CHW	
No	70,723 (48.1)
Yes	77,462 (51.9)
Educational level	
No schooling	33,814 (21.6)
Educated	114,371 (78.4)
Caste	
Scheduled Caste/Scheduled Tribe	51,896 (31.0)
Non-Scheduled Caste/Scheduled Tribe	90,060 (69.0)
Religion	
Hindu	111,810 (80.6)
Non-Hindu	36,375 (19.4)
Wealth quintile	
Poor	59,298 (37.6)
Non-poor	88,887 (62.4)
Mass media exposure	
No exposure	29,725 (19.0)
Some exposure	118,460 (81.0)
Place of residence	
Urban	42,215 (33.1)
Rural	105,970 (66.9)

%: percentage; N: Sample; CHW: Community health worker

Table-2 Results from bivariate and logistic regression analysis for JSY utilization by background factors in India, 2015-16

Variables	JSY (%)	OR (95% C.I.)
Age (in years)		
Less than 25	36.6	Ref.
25 or more	36.3	1.06***(1.03 -1.08)
Met with CHW		
No	29.7	Ref.
Yes	42.6	1.71***(1.67 -1.75)
Educational level		
No schooling	51.4	Ref.
Educated	32.3	0.78***(0.76 -0.81)
Caste		
Scheduled Caste/Scheduled Tribe	44.3	Ref.
Non-Scheduled Caste/Scheduled Tribe	33.0	0.82***(0.80 -0.84)
Religion		
Hindu	37.9	Ref.
Non-Hindu	29.9	0.76***(0.74 -0.79)
Wealth quintile		
Poor	53.2	Ref.
Non-poor	26.2	0.48***(0.47 -0.49)
Mass media exposure		
No exposure	54.4	Ref.
Some exposure	32.12	0.85***(0.83 -0.88)
Place of residence		
Urban	21.4	Ref.
Rural	43.8	1.46***(1.42 -1.50)

*JSY: Janani Suraksha Yojana; OR: Odds Ratio; CI: Confidence Interval; ***if p<0.01; Ref: Reference; %: percentage; CHW: Community health worker*

Table-3 Univariate and Bivariate Moron's I Values for outcome and predictors in India, 2015-16

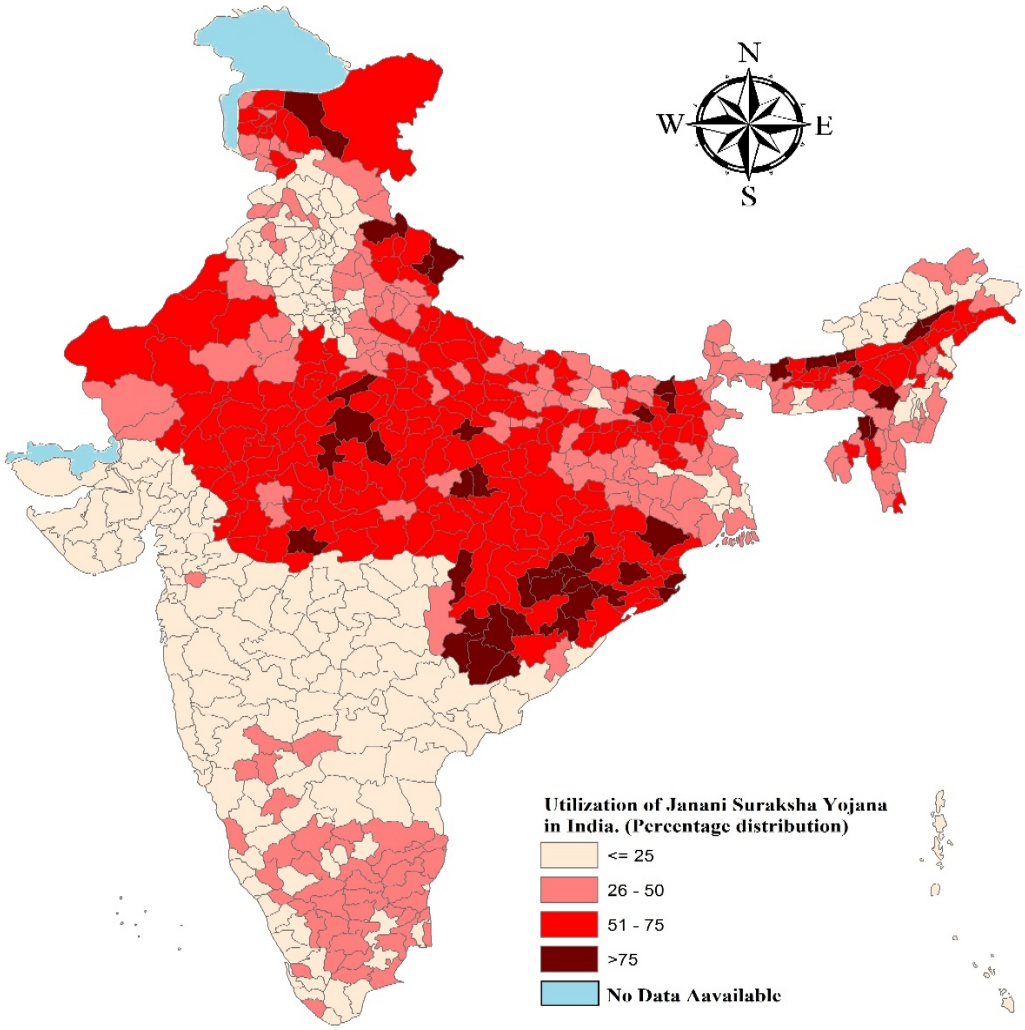
Variables	Univariate	Bivariate
		Janani Suraksha Yojana
Janani Suraksha Yojana (%)	0.71 (0.001)	-
Age (Less than 25 years) (%)	0.61 (0.001)	0.07 (0.001)
Met with CHW (%)	0.55 (0.001)	0.13 (0.001)
No schooling (%)	0.71 (0.001)	0.35 (0.001)
Poor wealth quintile (%)	0.75 (0.001)	0.52 (0.001)
Rural place of residence (%)	0.41 (0.001)	0.31 (0.001)
Scheduled Caste/Scheduled Tribe (%)	0.60 (0.001)	0.06 (0.001)
Hindu (%)	0.74 (0.001)	0.11 (0.001)
No mass media exposure (%)	0.72 (0.001)	0.42 (0.001)

%: Percentage; CHW; Community Health Worker

Table-4 Spatial regression model for estimating spatial association between Janani Suraksha Yojana and background factors in India, 2015-16

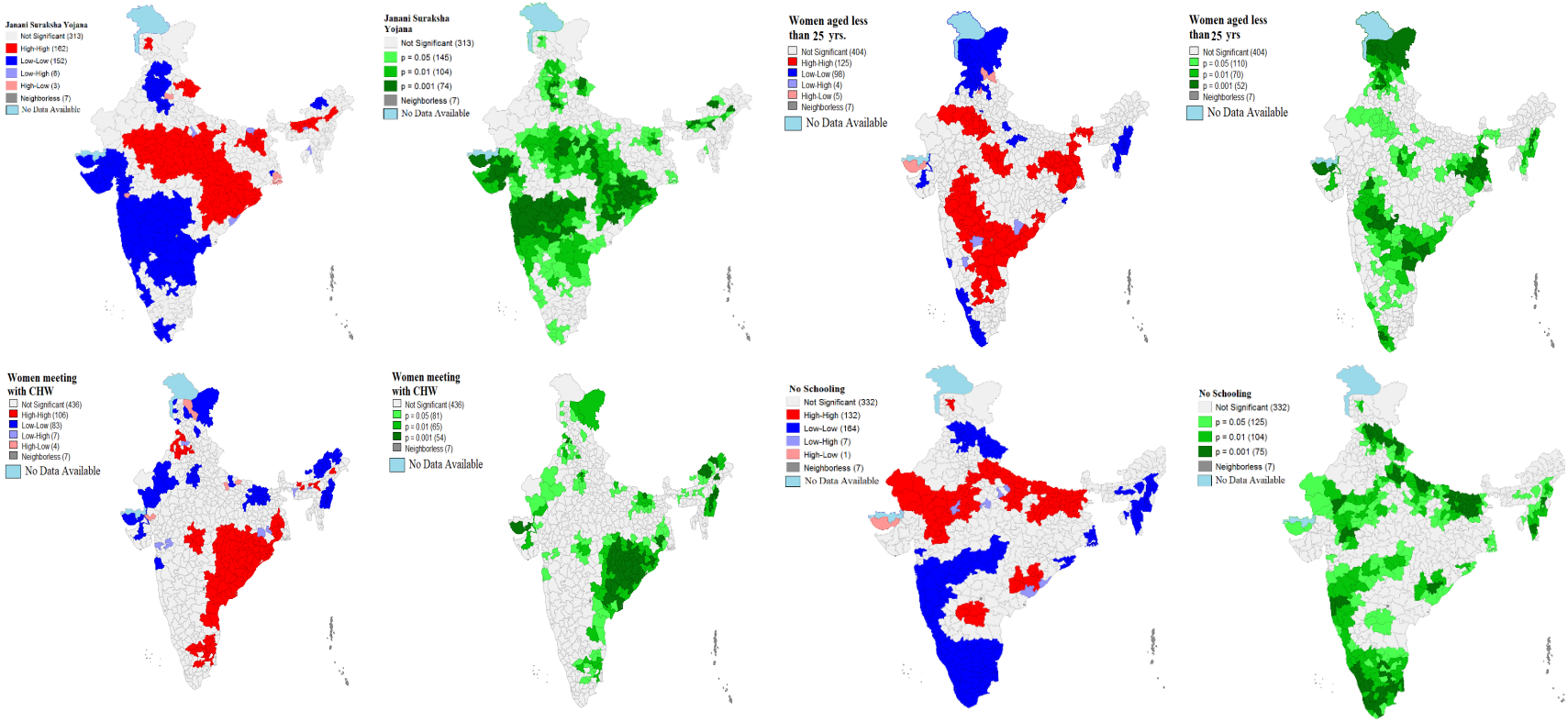
Variables	OLS(p-value)	SLM(p-value)	SEM(p-value)
Age (Less than 25 years) (%)	-0.614 (0.000)	-0.317 (0.000)	-0.293 (0.000)
Met with CHW (%)	0.341 (0.000)	0.248 (0.000)	0.290 (0.000)
No schooling (%)	0.206 (0.004)	0.156 (0.000)	0.216 (0.000)
Poor wealth quintile (%)	0.637 (0.000)	0.245 (0.000)	0.439 (0.000)
Rural place of residence (%)	0.035 (0.350)	0.034 (0.165)	-0.017 (0.601)
Scheduled Caste/Scheduled Tribe (%)	0.008 (0.809)	0.024 (0.306)	0.028 (0.367)
Hindu (%)	0.044 (0.134)	0.027 (0.187)	0.069 (0.032)
No mass media exposure (%)	-0.094 (0.274)	-0.025 (0.670)	-0.037 (0.607)
N (Sample)	640	640	640
Rho		0.67 (0.000)	
Lambda			0.80 (0.000)
AIC	5394.5	5004.2	4996.4
Adjusted R	0.54	0.78	0.79

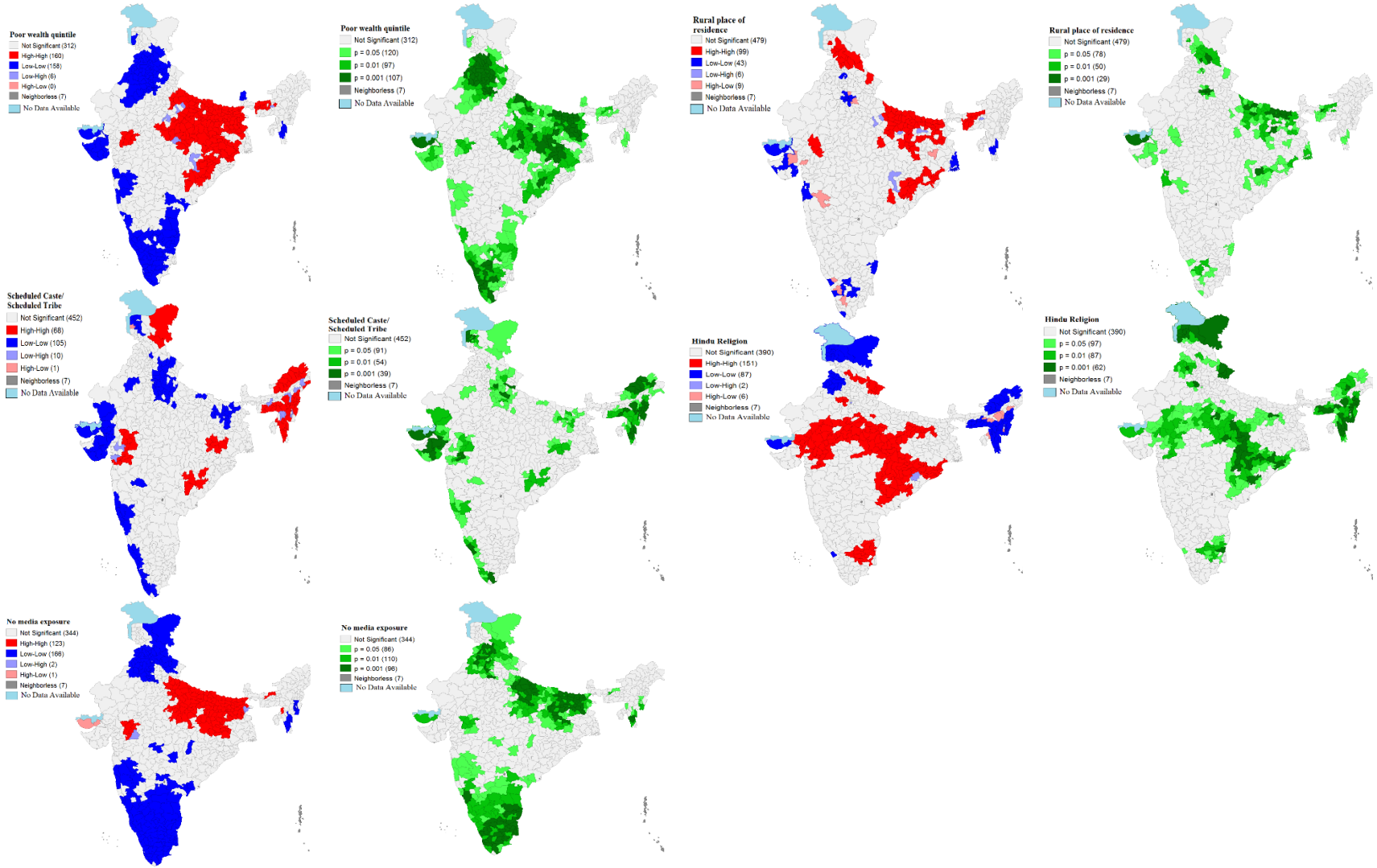
AIC: Akaike information criterion; OLS: Ordinary least square; SLM: Spatial lag model; SEM: Spatial error model



Map-1 Percentage distribution of Janani Suraksha Yojana coverage among women in India.

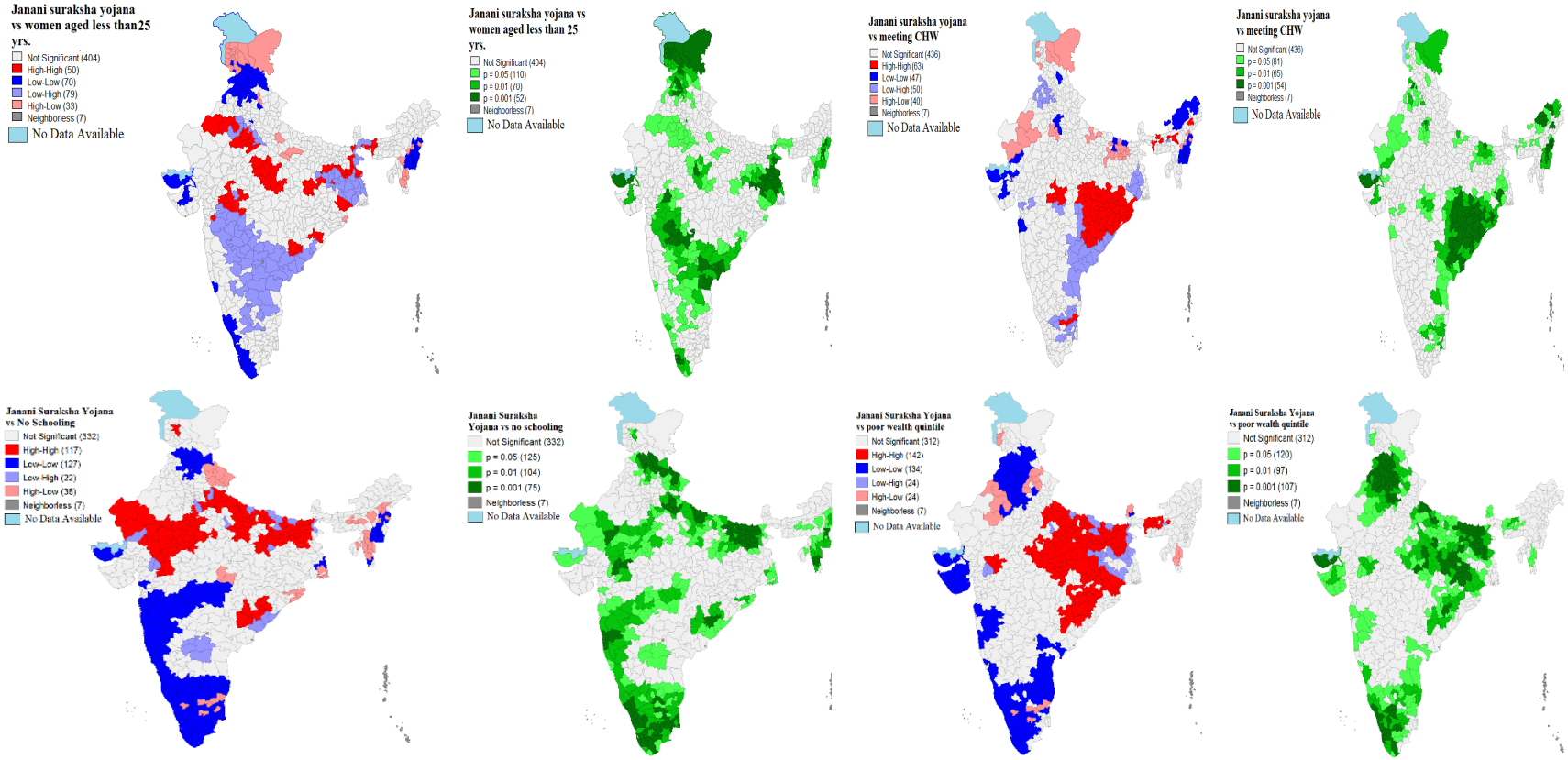
Figure-1 Univariate Local Indicator of Spatial Association (LISA) (cluster and significance) maps for dependent and outcome variables for districts of India, 2015-16

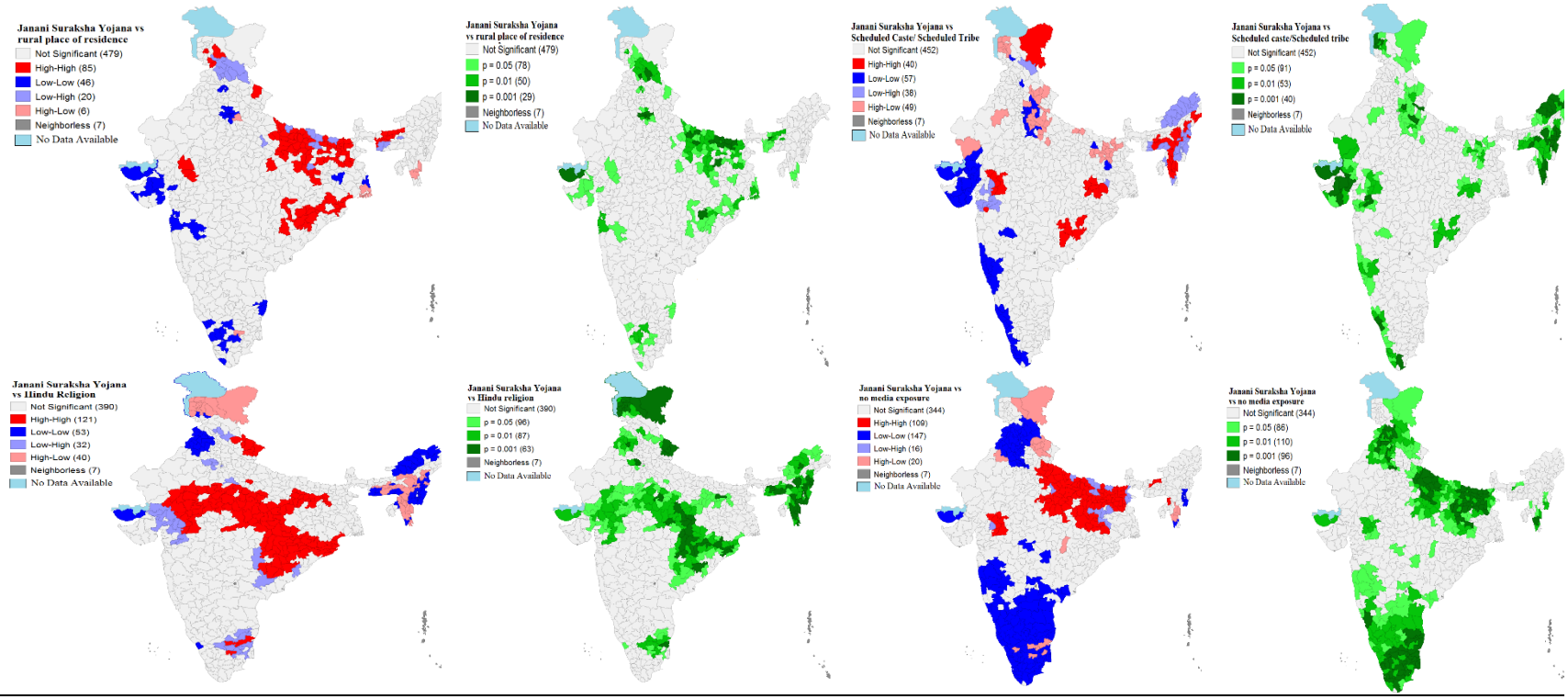




CHW: Community health worker; Yrs.: Years

Figure-2 Bivariate Local Indicator of Spatial Association (BiLISA) (cluster and significance) maps for dependent vs outcome variables for districts of India, 2015-16





CHW: Community health worker; Yrs.: Years