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THE IMPACT OF "MISSION INDRADHANUSH" PROGRAMME ON CHILD VACCINATION UTILIZATION IN SELECTIVE STATES IN INDIA: A DIFFERENCE IN DIFFERENCES APPROACH

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Abstract: *Government of India initiated its flagship initiative "Mission Indradhanush (MI)" in December 2014 with the aim of achieving a full immunization coverage of over 90% in the country. Our study aimed to assess the effects of the Mission Indradhanush program on vaccination coverage in the states of Uttar Pradesh and Tamil Nadu. Additionally, we examined whether the program had a similar effect on these two states, despite their differing socioeconomic features. We used the difference-in-differences approach with NFHS-4 and NFHS-5 data. Our study revealed that while vaccination coverage in the treatment district of Uttar Pradesh increased, it declined sharply in the control district. In Tamil Nadu, vaccination coverage in the intervention district has increased slightly, while it has declined considerably in the control district. The outcome indicates that the programme's mission, Indradhanush, had varying effects across these two states. The Mission Indradhanush has significantly improved vaccine coverage in the intervention district of Uttar Pradesh. However, the increase in vaccination coverage in the intervention district of Tamil Nadu cannot be attributed to the program.*

Keywords: *Mission Indradhanush, Vaccination, Difference in Differences*

1. Introduction

Vaccination is a highly effective public health measure for preventing and controlling diseases. Since its inception in 1974 by the World Health Organisation, the Expanded Program on Immunization (EPI) has successfully prevented an estimated 2–3 million potential deaths per year from vaccine-preventable diseases (World Health Organization). Every nation is dedicated to increasing its vaccination coverage, thereby reducing the impact of vaccine-preventable illnesses. Substantial advancements have been made in this regard (UNICEF and WHO, *Progress and Challenges 2020*). Different periodic strategies have been developed at both the global and country levels to increase vaccination coverage and reduce inequality in access to vaccination, such as the Global Vaccine Action Plan 2011–2020. In the last decade, global vaccination coverage has risen by only 5% and has remained steady at approximately 86% since 2016 (UNICEF and WHO, *Progress and Challenges 2019*). Consequently, there are still over 20 million children who have not received adequate vaccination or are under-vaccinated. In 2016, the percentage of children in India who received full immunizations was just 62%. State-level coverage ranged from 35% to 91%, according to the National Family Health Survey (NFHS-4) in 2015 (International Institute for Population Sciences). There is a

scarcity of robust research regarding the most efficient methods to enhance routine immunization coverage. Studies have shown that mass immunization campaigns are successful in achieving high vaccine coverage for a single or small number of vaccines (Shearer et al.). However, there is limited reliable information on the effectiveness of campaign-like tactics in ensuring the full schedule of routine immunizations. Although campaign-like tactics can reach a large number of people, some of those people would have been reached by ordinary services regardless. The claimed delivery quantities from campaigns may thereby overstate the actual increase in coverage.

To enhance the planning and implementation of routine vaccination, the Ministry of Health and Family Welfare, Government of India, launched its flagship initiative "Mission Indradhanush (MI)" in December 2014, aiming to achieve full immunization coverage of over 90% in the country. Mission Indradhanush was one of the largest ever periodic intensification of the routine immunization strategy.

In this study, we conducted a quasi-experimental evaluation of Mission Indradhanush using a difference-in-differences approach across select states in India. Initially, we examined whether vaccine coverage changed following the project's implementation. Subsequently, we analyzed whether the alteration in vaccination coverage varied between the districts where the mission was implemented and other districts.

2. Data and Methodology

2.1 Study design and population

The study employed a difference-in-differences approach using secondary repeated cross-sectional data from the Kids dataset and reports of India's DHS (NFHS) conducted in 2015-16 and 2019-21. For our study, we have chosen two states, Uttar Pradesh and Tamil Nadu, based on two criteria. Firstly, in Mission Indradhanush, 55 districts were selected from Uttar Pradesh, accounting for approximately 38 per cent of the total districts selected in India. In contrast, only one district from Tamil Nadu was chosen for Mission Indradhanush Phase I. Furthermore, we sought to examine the disparate effects of MI on immunization rates in two states with contrasting Human Development Index (HDI) and distinct socioeconomic characteristics. To ensure the study's specificity, we have chosen Meerut and Jhansi as the treatment and control groups, respectively, in the state of Uttar Pradesh. Coimbatore and Kancheepuram were selected as the treatment and control groups, respectively, from Tamil Nadu. The districts selected for the control group do not share borders with any districts where Mission Indradhanush has been implemented. Additionally, both the treatment group and control group districts should have the same level of Human Development Index. A binary variable, MI, was used to distinguish districts where Mission Indradhanush was implemented from those where it was not. MI districts were assigned a code of 1, whereas non-MI districts were assigned a code of 0. Pre and Post MI Intervention periods, v007, were denoted 0 for 2015-16 and 1 for 2019-21. This resulted in four comparison districts: pre-intervention MI districts, pre-intervention non-MI districts, post-intervention MI districts, and post-intervention non-MI districts.

A standardized sampling methodology was implemented throughout all districts. The sample selection process in each district involved two parts. In the first stage, Primary Sampling Units (PSUs), which are villages in rural regions and Census Enumeration Blocks (CEBs) in urban areas, were picked using a method called probability proportional to size (PPS). Next, an equivalent number of families were randomly chosen within each PSU during the second step. PSUs with fewer than 40 households were connected to the geographically closest PSUs. The PSUs were chosen using PPS systematic sampling, while the homes were picked using systematic sampling. Each state had a consistent sample size of 20 households per PSU. The NFHS-5 utilized a stratified sample design. Stratification was achieved by dividing each district into distinct urban and rural regions. Only women aged 15-49 in the selected households were eligible for the interview, while only men aged 15-54 in the selected households for the state module were eligible. For this study, we included all children aged 12-23 months, as they are expected to have received all necessary primary vaccination doses.

2.2 Intervention

To enhance the planning and implementation of routine vaccination, the Ministry of Health and Family Welfare, Government of India, launched its flagship initiative, "Mission Indradhanush," in December 2014, with the aim of achieving full immunization coverage of over 90% in the country. As part of its efforts, the country has implemented two stages of Mission Indradhanush in 2015, covering eight rounds in high-priority areas. The country was classified into high-, medium-, and low-focus districts based on risk prioritization. Phase I of Mission Indradhanush focused on 201 districts that required special attention. It involved four

rounds of activity that took place from April to July 2015. Phase II specifically focused on 352 districts, out of which 73 districts were repeated from phase I. The activities were carried out in four waves, spanning from October 2015 to January 20165.

2.3 Outcome variables

The study included the administration of the Bacillus Calmette-Guérin (BCG) vaccine, three doses of polio vaccine, three doses of a diphtheria, pertussis, and tetanus-containing (DPT) vaccine, one dose of a measles and Hepatitis A vaccine for children.

2.4 Covariates

The covariates were determined based on predetermined criteria and their presence in the DHS data sets. The place of living was documented as both urban and rural. The percentages of individuals identifying as Hindu and Muslim are significantly higher than those for other religions. The gender of the household head is documented as either male or female. The child's birth order was categorized as 1, 2 & 3; 4 & 5; or 6 and above. The mothers' ages were categorized into four groups: 15-24 years, 25-29 years, 30-34 years, and 35-49 years. We reclassified household socioeconomic status quintiles into three categories: wealthy, middle, or poor. This was done by combining the wealthier and richest quintiles into the rich category, and the poorer and poorest quintiles into the poor category. The intermediate category remained untouched. The child's mother's educational level was categorized into four groups: no education, primary education, secondary education, and higher secondary education.

2.5 Data Analysis approach

In the initial analysis, we calculated the vaccination coverage for BCG, Polio, DPT, Measles, and Hepatitis vaccines in rural, urban, and overall areas. This was done for the district where the IM program was implemented, as well as a control district. The study was conducted for the period before (2015-16) and after (2029-21) the implementation of the MI program. Subsequently, we assessed whether vaccination coverage changed between districts that implemented MI and those that did not, utilizing a difference-in-differences (DiD) approach in both unadjusted and adjusted analyses. We calculated and presented both crude and adjusted Prevalence Rate Ratios (PRRs) together with their corresponding 95% confidence intervals (CIs). When reporting p-values, we consider $p < 0.05$ to be statistically significant.

3. Results

3.1 Descriptive analysis

Table 1 shows vaccination coverage in two districts of Uttar Pradesh. The vaccination coverage for BCG, Polio, DPT, Measles, and Hepatitis in the districts of Meerut (treatment) and Jhansi (control) in Uttar Pradesh is being examined. The BCG vaccine uptake remains rather consistent throughout the districts after the intervention period. The rural-urban distinctions remain consistent between the two periods. The polio vaccination coverage in Meerut has increased slightly, but in Jhansi, it has decreased considerably during the same period. The same pattern can be observed in these two districts for DPT and Measles vaccination. However, there has been a notable increase in Hepatitis 0 vaccination rates in both districts from 2015-16 to 2019-21.

Table 1: BCG, Polio, DPT, Measles and Hepatitis Vaccination coverage of Meerut(treatment) and Jhansi(control) districts of UP.

Year		2015-16	2015-16	2019-21	2019-21
Vaccination uptake		Meerut	Jhansi	Meerut	Jhansi
BCG	Total	86.82	94.64	89.91	93.14
BCG	Urban	84.67	95.52	86.48	96.07
BCG	Rural	90.01	94.06	93.42	91.44

Three Doses of Polio	Total	60.88	62.01	63.07	44.94
Three Doses of Polio	Urban	59.97	60.96	61.60	38.19
Three Doses of Polio	Rural	62.25	62.72	64.57	48.87
Three Doses of DPT	Total	51.61	62.79	68.14	52.43
Three Doses of DPT	Urban	47.54	62.07	64.26	47.64
Three Doses of DPT	Rural	57.67	63.27	72.11	55.13
Measles	Total	39.63	51.39	66.36	55.46
Measles	Urban	33.65	49.21	63.99	49.43
Measles	Rural	48.52	52.85	68.78	58.96
Hepatitis 0	Total	36.68	54.41	38.42	58.67
Hepatitis 0	Urban	34.22	55.37	30.88	64.57
Hepatitis 0	Rural	40.35	53.77	46.67	55.24

Source: NFHS

Table 2 displays the rates at which various vaccinations were administered in two districts of Tamil Nadu. The coverage of BCG vaccination was nearly identical for both districts during the pre-intervention period. However, in the post-intervention period, uptake remained the same in Kancheepuram and increased significantly in Coimbatore. The coverage of three doses of polio immunization has decreased in both districts, but the decrease was more significant in Kancheepuram during this time. While DPT vaccine coverage in Coimbatore has marginally increased, Kancheepuram has seen a 5 percentage-point decrease. Similarly, a decline in Measles and Hepatitis B vaccination rates may be observed in both districts from 2015-16 to 2019-21

Table 2: BCG, Polio, DPT, Measles and Hepatitis Vaccination coverage of Coimbatore(treatment) and Kancheepuram(control) district of Tamil Nadu

Year		2015-16	2015-16	2019-21	2019-21
Vaccination Uptake		Coimbatore	Kancheepuram	Coimbatore	Kancheepuram
BCG	Total	96.3	96.33	98.93	96.95
BCG	Urban	94.79	94.29	98.44	95.75
BCG	Rural	100	100	100	100
Three Doses of Polio	Total	72.69	69.81	87.68	64.33
Three Doses of Polio	Urban	70.45	65.58	88.33	63.13
Three Doses of Polio	Rural	78.22	77.49	86.24	67.26
Three Doses of DPT	Total	74.34	75.1	85.84	80.05

Three Doses of DPT	Urban	72.76	70.36	85.66	83.17
Three Doses of DPT	Rural	78.22	83.35	86.24	72.15
Measles	Total	61.07	53.78	87.68	80.93
Measles	Urban	60.15	44.07	88.33	82.51
Measles	Rural	63.33	71.19	86.24	76.93
Hepatitis 0	Total	87.25	71.63	93.77	69.01
Hepatitis 0	Urban	85.08	62.32	90.94	62.47
Hepatitis 0	Rural	92.70	88.83	100	85.56

Source: NFHS

3.2 Differences in vaccination coverage between treatment and control districts of Uttar Pradesh

The overall Difference-in-Differences (DiD) for BCG vaccination before and after the intervention, comparing MI and non-MI districts, was 0.023 (CI: 0.0047-0.041) and was statistically significant. However, after adjusting for covariates, the ratio decreased and became non-significant. The Polio vaccination resulted in a crude DiD ratio of 0.049 (CI: 0.016-0.083), which was statistically significant. After adjusting for covariates, the ratio remained nearly unchanged at 0.041 (CI: 0.0058-0.077), which is similarly statistically significant. The adjusted difference-in-differences (DiD) ratio for DPT vaccination has marginally dropped to 0.059 (CI: 0.024-0.094) from the crude DiD ratio of 0.068 (CI: 0.035-0.10). Both results were statistically significant. The DiD ratio for the measles vaccine is approximately the same for both the crude DiD and the covariate-adjusted DiD. For Hepatitis, the crude DiD analysis did not yield any significant findings. However, when adjusting for variables, a negative impact was observed, although neither result was statistically significant.

3.3 Differences in vaccination coverage between treatment and control districts of Tamil Nadu

In Tamil Nadu, the crude DiD (Difference-in-Differences) ratio for polio vaccine was 0.047 (CI: 0.008-0.086). This result was the only one that was statistically significant, whereas all other crude ratios, as well as those adjusted for covariates, were not.

4. Discussion and Conclusion

Our study aimed to assess the effects of the Mission Indradhanush program on vaccination coverage in the states of Uttar Pradesh and Tamil Nadu. Additionally, we examined whether the program had a similar effect on these two states, despite their differing socioeconomic features. Our study revealed that vaccine coverage did not increase as anticipated during this period. Instead, in the selected districts, there was a decline in coverage for Polio, DPT immunization, and even measles vaccination between 2015-16 and 2019-21. While vaccination coverage in the treatment district of Uttar Pradesh increased, it declined sharply in the control district. In Tamil Nadu, vaccination coverage in the intervention district has increased slightly, while it has declined considerably in the control district. The outcome indicates that the programme's mission, Indradhanush, had varying effects across these two states. The Mission Indradhanush has significantly improved vaccine coverage in the intervention districts of Uttar Pradesh. However, the increase in vaccination coverage in the intervention district of Tamil Nadu cannot be attributed to the program.

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