

District Level Analysis of Routine Immunization in Haryana State: Implications for Mission Indradhanush under Universal Immunization Programme

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Abstract

Background: The immunization coverage in India is far away from satisfactory with full immunization coverage being only 62% at national level. Targeting the intensive efforts to poor performing areas and addressing the determinants of nonimmunization and dropouts offers a quick solution. In this paper, we assess the inter-district variations in Haryana state, and the association of social determinants with partial and no immunization. **Methodology:** This analysis is based on data collected as part of a large household survey undertaken in the state of Haryana to measure the extent of Universal Health Coverage. A multistage stratified random sampling design was used to select primary sampling units (i.e., subcenters), villages, and households. A total of 11,594 mothers with a child between 12 and 23 months were interviewed on receipt of immunization services. Determinants of nonimmunization and partial immunization were assessed using multiple logistic regression. **Results:** About 21% of children aged 12–23 months were partially immunized, while 4.3% children aged 12–23 months had received “no immunization.” While the coverage of full immunization was 74.7% at the state level, it varied from 95% in best performing district to 38% in poorest performing district. Odds of a partially immunized child were significantly higher in urban area (odds ratio [OR] = 1.23; 95% confidence interval [CI] = 1.1–1.38), among Muslim household (OR = 3.52; 95% CI = 3.03–4.11), children of illiterate parents (OR = 1.58; 95% CI = 1.22–2.05), and poorest quintile (OR = 1.61; 95% CI = 1.36–1.89). **Conclusions:** Wide interdistrict variations call for a need to consider changes in resource allocation and strengthening of the government initiatives to improve routine immunization in these districts.

Keywords: Immunization, India, social determinants, vaccination

INTRODUCTION

Vaccination is one of the most cost-effective child survival intervention.^[1] This also has the current policy impetus in the country, as the Government has aggressively launched Mission Indradhanush to target vaccination dropouts. Successful implementation of this requires district level information, as in a decentralized health system, districts prepare program implementation plan on which budgets are released. Data on vaccine coverage at this level, however, remains scarce. Most of the national surveys such as the National Family Health Survey (NFHS) or Coverage Evaluation Survey (CES) provide estimates at the state level.^[2,3] District Level Household Survey (DLHS) although provides district-level coverage has a long recall period which may lead to bias.^[4] Public health system's records and reports have been repeatedly reported

to be inaccurate and incomplete by various researchers.^[5] Therefore, there is an urgent need to generate concurrent data for immunization coverage at the district level, which may better contribute to policy planning. To bridge this gap, we undertook the current study in Haryana state, with an aim to assess district level immunization coverage and identify interdistrict inequalities, along with determinants of partial and nonimmunization.

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METHODOLOGY

Study setting and sampling

This present analysis is based on data collected as part of a large household survey undertaken in the state of Haryana to measure the extent of Universal Health Coverage.^[6] Haryana state in north India has 95 Community Health Centres, 440 Primary Health Centres (PHCs), and 2630 Subcentres (SCs) for the provision of primary healthcare services.^[7] As part of this survey, 30 graduate-level field investigators collected household-level information from a randomly selected sample of SCs in all 21 districts of the state. A multistage stratified random sampling design was used in the selection of primary sampling units (PSUs), i.e., SCs in rural areas and polio post in the urban area, villages, and households.

Using the list of SCs and urban polio posts obtained from the National Health Mission (NHM), PSUs were selected randomly. The data regarding population and villages under each SC was obtained from SC and Anganwadi center records. These data were then used by the investigators for subdivision of SC level targets into village level. The 1st household in each village was selected randomly followed by consecutive sampling till deserved sample size was completed. The detailed methodology regarding procedure of data collection is mentioned elsewhere.^[6,8]

Sample size determination

With an average population of 906 of children aged 12–23 months at PHC level in Haryana state, assuming full immunization coverage as 71.7% and absolute error to be 11%, 95% confidence interval (CI), and an effect size of 1.5, a sample size of 70 was considered appropriate at PHC level. Since there were 4 SCs in each PHC, a sample size of 19 children aged 12–23 months per SC was estimated.

Data collection procedure and quality management

The data were collected from October 2012 to April 2014. A total of 79,742 households were enrolled in the study. A pretested, semistructured questionnaire, translated into Hindi language was used to collect the data. Data regarding immunization card and receipt of different vaccines were collected besides general demographic information of households and other social determinants. The data were collected through face-to-face interview with the mothers/caregivers.

Immunization cards were first checked manually to validate information and confirm the correct date of vaccination. Where immunization card was not available for verification, responses based on mother's recall were recorded. Completeness and consistency of the collected data were checked each day by the senior investigators followed by senior staff at the regional office. At regional office, if any error was found by research officer after validating the data, the copy of the data was then forwarded to investigators, so that these errors were corrected at investigator end by visiting households again.

The study was approved by the Institute Ethics Committee of the Post Graduate Institute of Medical Education and Research, Chandigarh. A written informed consent was taken from the

mothers (or caregiver) of all the study children. Administrative approval of the NHM, Government of Haryana was obtained.

Data analysis

Measure of the study

On the basis of the information on vaccination, we categorized the child as fully immunized, partially immunized, or not immunized at all based on the following standard definitions:^[4]

Full immunization

Defined as a child, who has received one dose of Bacillus Calmette–Guérin (BCG), 3 doses of Diphtheria, Pertussis, Tetanus (DPT)/Pentavalent vaccine and oral polio vaccine and one dose of measles vaccine within the age of 1 year. Either DPT or pentavalent was considered since there was a switch between from DPT to pentavalent vaccine in the state immunization policy during data collection. Hence, while the earlier cohort of children was eligible for DPT, the subsequent cohort was provided with the pentavalent vaccine.

Partial immunization

A child who has received at least one vaccine but has not completed the entire set of vaccines. This is similar to drop out.

Nonimmunization

A child who has not received any vaccine as per Universal Immunization Programme schedule.

District wise and state level weighted coverage of immunization was calculated. Appropriate sampling weight is applied at district level as well as state level as discussed in supplement material.^[6] A bivariate analysis was conducted to examine the association of vaccination status with each of the potential predictor variables. Further, we employed multiple logistic regression to see the association of no-immunization and partial immunization with their social determinants. The dependent variables were status of immunization, i.e., partial immunization and no immunization; while independent variables were gender of child (boy and girl), area of residence (rural and urban), religion, caste (SC and ST, other backward class/general), education of head of household occupation of head of household, and wealth quintile of the household. Wealth status was assessed using household assets by applying principal component analysis.^[9] The adjusted odds ratio (OR) is reported as a measure of association along with the 95% confidence limits and P. Data analysis was done using SPSS version 21.0 (Armonk, NY: IBM Corp) statistical software.

RESULTS

Sample characteristics

The overall sample included 11,594 children aged 12–23 months belonging to 446 rural and 124 urban PSUs across all 21 districts of Haryana state. Out of all these children, 56% were male, 77.6% were from rural areas, 80.9% were Hindus, and 40.1% belonged to SC category [Table 1].

Interdistrict variations in immunization coverage

Full immunization coverage in Haryana was found to

Table 1: Sociodemographic characteristics of study population, partial, and no immunization rates and its association with social determinants

Categories	Social demographic characteristics Frequency (n=11,594), n (%)	No immunisation		Partial immunisation	
		Mean 95% CI (LL-UU)	OR 95% CI (LL-UU)	Mean 95% CI (LL-UU)	OR 95% CI (LL-UU)
Area					
Rural	9000 (77.6)	4.3 (3.9-4.7)	-	20 (19.1-20.8)	-
Urban	2594 (22.4)	3.8 (3-4.5)	-	21.8 (20.2-23.4)	1.23** (1.10-1.38)
Gender					
Male	6469 (55.8)	4 (3.5-4.5)	-	20 (19-21)	-
Female	5124 (44.2)	4.4 (3.8-4.9)	-	20.8 (19.7-21.9)	-
Religion					
Hindu (reference)	9152 (80.9)	3.4 (3.1-3.8)	-	17 (16.3-17.8)	-
Muslim	1185 (10.5)	11.1 (9.3-12.8)	3.13** (2.39-4.1)	47.5 (44.7-50.4)	3.52** (3.03-4.11)
Christian/Sikh	974 (8.6)	2 (1.1-2.8)	0.6* (0.37-0.97)	20.4 (17.9-23)	1.28** (1.07-1.52)
Social group					
SC/ST	4501 (40.1)	3.7 (3.2-4.3)	-	18.6 (17.4-19.7)	-
OBC	3799 (33.9)	5.4 (4.7-6.1)	1.03 (0.8-1.33)	24.9 (23.5-26.3)	1.04 (0.92-1.18)
Other/general	2922 (26.0)	3.1 (2.5-3.8)	0.88 (0.66-1.17)	16.7 (15.4-18.1)	0.93 (0.81-1.07)
Occupation of head of the household					
Self employed	7423 (66.0)	4.6 (4.1-5)	-	22.4 (21.5-23.4)	-
Wages	589 (5.2)	3.9 (2.3-5.5)	0.84 (0.54-1.32)	18.9 (15.7-22)	0.86 (0.69-1.08)
Unemployed	1716 (15.2)	2.4 (1.7-3.1)	0.58** (0.41-0.81)	15.6 (13.9-17.3)	0.77** (0.67-0.9)
Regular salaried	1527 (13.6)	3.9 (2.9-4.8)	1.1 (0.82-1.48)	17.8 (15.8-19.7)	0.96 (0.83-1.12)
Education of head of the household					
Illiterate	3871 (33.5)	5.2 (4.5-5.9)	1.51 (0.88-2.58)	22.4 (21.1-23.7)	1.58** (1.22-2.05)
Primary and below primary	2304 (19.9)	4.9 (4-5.7)	1.41 (0.82-2.44)	24.6 (22.9-26.4)	1.71** (1.31-2.23)
Matric and below	3744 (32.4)	3.3 (2.7-3.9)	1.08 (0.64-1.83)	18.3 (17.1-19.6)	1.44** (1.12-1.86)
High secondary and other	975 (8.4)	2.7 (1.7-3.7)	0.93 (0.5-1.75)	15.1 (12.8-17.3)	1.19 (0.88-1.6)
Postgraduate and below	668 (5.8)	2.5 (1.4-3.7)	-	12.4 (9.9-14.9)	-
Wealth quintile					
Poorest	2461 (21.7)	6.3 (5.3-7.3)	1.32 (0.96-1.83)	28.9 (27.1-30.7)	1.61** (1.36-1.89)
Poor	2192 (19.3)	3.6 (2.8-4.4)	0.87 (0.61-1.25)	21 (19.3-22.7)	1.26** (1.06-1.5)
Medium	2252 (19.8)	3.6 (2.9-4.4)	1 (0.71-1.4)	16.1 (14.6-17.6)	1.01 (0.86-1.2)
Rich	2201 (19.4)	3.8 (3-4.6)	0.95 (0.67-1.33)	20.6 (18.9-22.3)	1.18 (1.0-1.39)
Richest	2252 (19.8)	3 (2.3-3.7)	-	15.1 (13.6-16.6)	-

** $P < 0.01$; and * $P < 0.05$. -: reference category, CI: Confidence interval, LL: Lower limit, UL: Upper limit, OR: Odds ratio

be 74.7%. While 20% were partially immunized and 4% children had received no immunization. Among the children with immunization card, coverage rate is even higher (81.8%). Kurukshetra district had highest full immunization coverage (95%) followed by Panchkula (91%) whereas Mewat, one of the backward districts of Haryana, had the lowest immunization coverage (38%). All other districts in Haryana had coverage in excess of 60%. Partial immunization coverage and no immunization were again highest in Mewat (46% and 16%, respectively) and lowest in Kurukshetra (4% and 1%, respectively) [Table 2].

Social determinants

Odds of partial immunization is significantly more in urban as compared to rural area (OR = 1.23; 95% CI = 1.1-1.38), among Muslims (OR = 3.52; 95% CI = 3.03-4.11), among children whose parents were self-employed (cultivator, own account worker, self-employed, and employer) (OR = 0.77;

95% CI = 0.67-0.9), and those with illiterate head of the family (OR = 1.58; 95% CI = 1.22-2.05). The odds of partial immunization are also strongly associated with wealth status with higher odds in the poorest (OR = 1.61; 95% CI = 1.36-1.89). Similarly, odds of no immunization is significantly more in Muslims (OR = 3.13; 95% CI = 2.39-4.1), parents who are self-employed (OR = 0.58; 95% CI = 0.41-0.81), and among the poorest wealth quintile (OR = 1.32; 95% CI = 0.96-1.83) [Table 1].

DISCUSSION

Overall, we found that almost one-fourth of the children in Haryana aged 12-23 months were "partially immunized" or had "no immunization." The interdistrict variations were quite wide with Kurukshetra district having lowest percentage and Mewat district having the highest percentage of "partially immunized" or "no immunized" children. The partial

Table 2: District wise full immunization coverage rates in Haryana state, India (2012-2014)

	BCG	OPV1	OPV2	OPV3	DPT1/LPV1	DPT2/LPV2	DPT3/LPV3	Hepatitis B1	Hepatitis B2	Hepatitis B3	Measles 1	Vitamin A	Full immunisation	No immunization	Partial immunization
Ambala	95	95	95	94	96	96	95	77	76	72	89	81	85	3	11
Bhiwani	96	96	95	94	95	96	95	74	73	71	88	77	87	3	10
Faridabad	95	93	92	89	94	94	90	41	38	35	83	74	76	4	20
Fatehabad	93	91	89	86	93	89	86	47	43	41	85	83	78	4	18
Gurgaon	93	90	89	87	91	90	89	80	79	77	74	67	70	5	25
Hisar	97	93	91	90	92	91	89	73	72	70	80	74	74	2	24
Jhajjar	94	88	88	85	92	91	89	67	63	61	84	72	77	5	18
Jind	94	93	93	92	94	93	92	67	66	66	90	86	88	6	6
Kaithal	94	91	89	89	92	90	87	62	60	56	78	78	73	5	23
Karnal	98	98	96	95	99	97	96	70	62	58	82	61	80	0	20
Kurukshetra	99	99	99	98	99	99	98	83	81	80	96	95	95	1	4
Mahendergarh	96	95	94	92	96	94	91	64	57	52	88	80	83	3	14
Mewat	77	82	77	73	68	60	51	39	34	28	43	42	38	16	46
Palwal	96	97	97	96	92	92	92	73	67	65	79	64	74	3	23
Panchkula	98	96	96	95	98	97	97	91	91	90	94	93	91	2	8
Panipat	99	86	85	82	96	97	95	66	63	58	84	79	69	1	30
Rewari	96	95	95	94	96	95	93	82	80	77	88	85	85	2	13
Rohtak	97	97	98	96	97	97	95	83	83	81	94	88	91	2	7
Sirsa	92	89	90	87	90	90	87	74	71	69	84	69	77	7	16
Sonapat	95	95	93	92	94	92	90	58	54	50	79	62	75	3	22
Yamunanagar	97	97	95	94	96	97	93	52	49	44	87	85	79	2	20
Haryana	94	92	91	89	92	90	88	66	63	60	81	74	74.7	4.3	21

OPV: Oral polio vaccine, BCG: Bacillus calmette-guérin, DPT: Diphtheria, Pertussis, Tetanus, L.PV: Liquid Pentavalent vaccine

immunization was significantly more among urban, Muslim, illiterate and in the poorest quintile and no immunization was significantly more among Muslims.

The findings of our study show an encouraging trend of reduced dropouts with 21% partially immunized children as compared to 25% and 42% in CES 2009 and DLHS 4 (2012–2013), respectively.^[3,10] Dropouts have also declined as compared to what others have reported in studies from specific districts.^[11] Furthermore, among those children with immunization card, the rates of partial (17.5%) and no immunization (0.7%) coverage were further low. We found a higher full immunization coverage in Haryana than NFHS 4 (62%).^[2] Our study ($n = 79,742$ households) has a much larger sample size than NFHS. Second, we draw the sample from a representative set of state population covering all districts and have recorded information from immunization cards in the majority of cases. Finally, while NFHS uses a much longer recall period, we have used a shorter recall period. Hence, we believe that our estimates are more accurate.

Determinants of immunization coverage

Despite an increase in routine vaccination coverage of the state during the past decade, the percentage of children completing the recommended vaccination schedule remains below expected targets. The challenge of decreasing dropouts and enrolling the ones with no immunization at all becomes ever more daunting as the country adds a pool of 12.5 million partially immunized children each year.^[12] Therefore, it is important to assess the determinants of partial and no immunization so that attention can be paid to overcome the factors or barriers impeding the compliance for full immunization. Moreover, it is well documented that the epidemiology of nonimmunization may differ substantially from the epidemiology of partial immunization.^[13]

A number of studies have focused on individual predictive factors for vaccination including gender, age, and birth order, and others on household factors such as family size, number of children below the age 3 of years, household wealth, caste, and maternal education, but most of these studies categorize vaccination status into complete (i.e., full) versus incomplete (i.e., under- or non-vaccinated).^[13] Only few studies^[11,14] had used three distinct vaccination categories (i.e., full-, partial, and non-vaccination) to investigate determinants of childhood vaccination in India but was limited by small sample sizes drawn from narrowly defined geographic areas potentially impacting the generalizability to the national population.

Vaccination coverage in children from urban areas has been reported to be better than the ones in rural areas.^[15,16] However, our study findings indicated significantly more number of partial immunized children in urban as compared to rural. The higher proportion of the partially immunized might be attributed to the migratory population of urban slums. Migration is an important determinant of child immunization and various studies have supported the fact of increase dropouts in the urban migrant

population.^[17-19] Moreover, there is an extensive network of health-care centers and health workforce (Accredited Social Health Activists) in rural areas of India to mobilize children and pregnant women to provide health-care services; however, a comparable network does not exist in urban areas.^[13] Thus, these findings could partially account for lower chances of urban children to be fully vaccinated and thus lay, significant implications for targeted immunization intervention programs such as Mission Indradhanush and related policies.

Researchers have noted that lack of attention to social determinants of health, including gender, education, employment, and the failure of the health-care system to deliver to those in need lead to existing health inequities in India.^[8] The odds of partial or no immunization is significantly lower as we move to the higher level of wealth quintile, in children with more educated parents and lower in male child, thus in concordance with the findings in the previous literature.^[11,15,20-22] Profound visible inequity in the utilization of services among religious groups has been reported in India.^[13] More unimmunized children and partially immunized children are found among Muslim families. The finding was concordant with other previous surveys in India.^[23,24] Religious disparities affecting immunization coverage is seen in low-income, middle-income countries, as well as in high-income countries.^[25] This finding also explains higher rate of under-vaccination (46%) in Mewat district of Haryana as the almost three-fourth population in Mewat belongs to Muslim religion.^[26]

Implications for mission Indradhanush Programme

Mission Indradhanush Programme launched by Central Government targeted the five high priority districts in Haryana (Faridabad, Gurgaon, Mewat, Palwal, and Panipat) but, the state had launched this targeted program in all 21 districts. This has led to wastage of resources in those districts where the partially immunized and no immunized children were very low. In addition, this also led to gap in paying attention on the focused interventions for addressing the social determinants in high priority districts of Haryana. Resources should be allocated equitably so that the high priority districts get benefits. Thus, the program should specifically target children in lower wealth quintiles pockets, slum populations, Muslim dominated areas, as these are more vulnerable to partial immunization.

CONCLUSIONS

Our findings suggest that there is considerable interdistrict variations in routine vaccination coverage in Haryana state. Immunization program should prioritize efforts to address the determinants of dropout and no immunization at the community level. More formative research could be done at the subdistrict level and thoughts should be put on to tackle the barriers to achieve high coverage before implementing the policies and targeted programs. Equitable resource allocation should be ensured in the state to tackle the supply side gaps in providing immunization services.

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Conflicts of interest

There are no conflicts of interest.

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