DETERMINANTS OF CHILDHOOD IMMUNIZATION IN BIMARU STATES OF INDIA

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ABSTRACT

The present study aims to empirically examine the factors influencing the status of childhood immunization across BIMARU states of North India namely – Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. The study has been conducted for 2015-16 and has used NFHS-4 (2015-16) data. The econometric model has been estimated with the help of bivariate, multivariate and, ordered logistic regression. The study found that children of educated and affluent families are more likely to be fully immunized than children who belong to underprivileged, or economically disadvantaged communities. The likelihood of immunization increases with the mother's awareness, the level of the mother's education, and with an increase in the age of the mother. The status of immunization improves as one moves the ladder in terms of standard of living however it decreases with an increase in the order of birth. The immunization status of a child also gets influenced by demographic factors such as religion and caste of the family. The study also provides that exposure to media does not have a significant impact on the status of childhood immunization in BIMARU states of India.

Key Words: Childhood Immunization, NFHS-4, Logistic Regression, BIMARU states, and India

INTRODUCTION

Childhood immunization is the major aspect of primary healthcare and an indispensable right of the human. Poor health status can be considered as a major barrier towards achieving higher levels of education and creates a negative feedback loop sometimes referred to as a health-poverty trap as has been put forward by many scholars. Any investment towards improving health outcomes has a long-term impact in terms of increased productivity and better returns in the labor market through improved health and education. In the context of India, Universal Immunization Programme (UIP), was launched in 1985 to achieve fuller immunization status by 1990 by providing vaccines free of cost for six diseases namely tuberculosis, whooping cough, diphtheria, tetanus measles and, polio. Considerable investments have been made on the UIP but a glance at the survey results highlight that the achieved results are far from the target.

Childhood immunization coverage in India has shown an increasing trend wherein the proportion of fully vaccinated children have increased from 43.5 percent in NFHS-3 (2005-06) to 62.0 percent in NFHS-4 (2015-16). However, there seems to be a marginal difference in the urban-rural immunization coverage with a marginal difference of 2.3%. Nearly 64% of children are fully vaccinated in urban India and 61% in rural India. The status of full antenatal care taken by Indian women has been quite low and has increased marginally from 11.6 percent to 21.0 percent in ten years (NFHS, 2015-16). This marginal improvement is likely to commemorate the higher levels of maternal mortality rate (MMR). Also, it is quite evident that majority of the children have received vaccinations under the public health facilities (nearly 90.7%) and a meagre percentage of 7.2% get it from private health institutions. A glance at the data shows that the under-five deaths have come down from 74 per thousand live births to 50 per thousand live births in NFHS-4 survey. However this increase has been marginal and indicates that there is a dire need to strengthen the immunization process which is lagging behind and is insufficient to achieve the Sustainable Development Goals ((WHO), 2011).

To proceed further, it is imperative to highlight the constraints or factors influencing child immunization. These constraints can broadly be classified into two: the external and internal constraints. The former covers the economic constraints that thwart the underprivileged, or economically disadvantaged communities to gain from available health facilities. These include information asymmetry, lack of availability, and access to immunization and healthcare resources. These constraint not only has a direct impact on the

health of women but also has an indirect impact on the overall well-being of the family and development of children. All these factors restrain a poor or relatively disadvantaged individual from making considerable investments in improving its present health status (Bernard & T, 2006). (Patra, 2008) has argued that childhood immunization is the best way towards the sustainable future which not only provide a safe cushion to present generation but also generations to come. This is particularly true in the context of Ethiopia, India, Southern Ghana and other countries where the ratio of poverty stricken people is considerably high.

The internal constraints, on the other hand, cover the social/behavioral constraints faced by the family members or mothers in general. These may cover the factors that may influence the mind set of decision makers, such as, identity constraints: caste, class, ethnicity and rural/urban residence, beliefs and perceptions, preferences or endowment effects. (Bernard & T, 2006) sums these factors as the 'mental model' of individuals regarding their physical and social environment. In the context of Ethiopia, the low investments on the part of Ethiopians towards childhood immunization programme despite the returns to investment being high confirms that such behavior is most common among the poor, depicting a rather restricted mental model that they have about their physical and social environment (Bernard & T, 2006). These two constraints together highlight: one, the significance of an interdisciplinary study on factors influencing childhood immunization, covering economic, social and psychological dimensions and two, the study of immunization holds incomplete if any of these dimensions are excluded or examined separately without accounting for the other two dimensions.

Therefore it is quintessential to take a broader view and empirically examine the factors influencing the status of childhood immunization. Childhood immunization could be influenced by both demand as well as supply side constraints but this paper has only taken demand side constraints into consideration. The present paper has analysed the same in context of BIMARU states of North India namely- Bihar, Madhya Pradesh (MP), Rajasthan and Uttar Pradesh (UP). The remaining of the term paper is organized as follows. Following the introduction, Section II reviews the available literature. Section III elaborates the data structure and methodology explaining the source of data, dependent as well as independent variables and the model used for conducting analysis. Data analysis and interpretation has been done in Section IV of this paper followed by conclusion.

SECTION II: REVIEW OF THE AVAILABLE LITERATURE

A considerable number of scholarly studies have associated poverty as the causal factor of low immunizations among children. Poverty arises as a result of a dearth of economic resources such as income, wealth, credit availability, awareness, education, investable resources, and opportunities. These economic constraints associated with poverty have a positive relation with the immunization levels of children: the higher the level of income and education status, the more likely a child is fully immunized. Similarly, when a poor are exposed to be informed about the benefits of immunization, it will enable him to improve his well-being; and they may be willing to participate in the immunization process but lack of knowledge prohibits them to get fully vaccinated. This could perhaps be due to lack of resources such as TV, radio, not accessing newspapers or magazines and the use of the internet because (Aggarwal, Kapur, & Tognatta, 2012) has proved that exposure to media was one of the major factor contributing to childhood immunization. On the economic grounds, (Dhruv Khullar, 2018) in the context of the United States have argued that income is closely correlated with infant and maternal mortality rates across levels of income distribution and considerable investment in health outcomes provide the vulnerable sections of the society to break free from poverty and participate in the growth process.

The factors influencing childhood immunization can be categorized into four broad categories. Concerning the child-level characteristics, the sex of the child could influence immunization status because of the preferences towards the male child which can result in biased treatment towards them. (Patra, 2008) has highlighted that boys are more likely to get fully immunized and the chances are 4 percent higher for them in comparison to girl children. The same result has been provided by (Dhruv Khullar, 2018) arguing that the behaviour of the families with their daughters-in-law and the pressure upon them for a girl child significantly influences the immunization process. It can also be hypothesized that there exists an inverse relationship between the status of childhood immunization and the birth order of a child. Birth order is important as a higher number of births take place in those subjects which already have a good number of young children competing for limited resources, care, and support by their parents (Pandey, 1998).

Concerning mother-level characteristics, the residence of the mother has been considered because of its impact on accessibility to healthcare services. Children who stay in urban households have better chances to be fully vaccinated than the ones staying in rural household.

This result has been supported by many studies. In the study conducted by (Panda, 1997) and (Patra, 2008), children of urban households are more likely to be fully immunized (62% and 58% respectively) than children staying in rural areas. It can be hypothesized that there exists a positive correlation between the education of a mother and the immunization status of a child. This positive effect has been concluded by several studies (Bhatia, 1991), (Patra, 2008). There are two linkages through which maternal education influences childhood immunization as shown by (Vikram, 2012). It has been provided that the requirement for capital varies according to the level of education with human capital as essential factor for mothers with primary education and cultural capital for females with higher education and beyond.

Demography-level characteristics such as religion and caste also has a significant impact on childhood immunization. These factors represent the perceptions and beliefs of the individuals towards their physical and social environment. (Md Illias Kanchan Sk, 2018) in context of three South Asian countries have argued that with reference to Islam, the odds are higher for Hindus in context of Nepal and India but did not differ among Hindu and Muslim children in context of Bangladesh. However while doing the state level analysis, (Patra, 2008) has argued that caste or religion does not affect the chances of immunization in context of Bihar and Tamil Nadu.

Other important characteristics such as wealth index can be considered to influence childhood immunization because of its ancillary impact on vaccination. Although it can be hypothesized that as the standard of living improves, the chances of getting fully immunized increase. But the results vary across national and state levels. Patra (2008) noted a positive relationship at the national level but income as a determinant of childhood immunization is almost insignificant when the state-level analysis was conducted in the context of Bihar and Tamil Nadu. This could be because of the collinearity that exists between income and other variables. The sex of the household head can also be hypothesized to have a positive relationship with fuller immunization. But the results are quite mixed. According to Patra (2008), the likelihood of receiving all vaccinations are 6 percent higher for children with female leadership than households with a male as the head. However, in context of Orissa, Panda (1997) has shown that the converse is true. Exposure to media such as TV, radio, newspaper, etc. also has a direct bearing on child immunization by increasing the level of mother's awareness about vaccination and also about family planning programs. Electricity on the other hand provide access to media to some extent.

SECTION III: METHODOLOGY

Data Source and Structure

The study has been conducted by using National Family Health Survey (NFHS)-4 2015-16 data for BIMARU states of North India namely- Bihar, Madhya Pradesh (MP), Rajasthan and Uttar Pradesh (UP). NFHS is a large-scale, stratified, cluster survey which account for nearly 99% population of the country. The NFHS-4 covers a representative sample of 601,509 households, with 699,686 women, and 112,122 men and provides data on socio-economic characteristics of the households with 4 main schedules namely – man, woman, biomarker, and household characteristics. It is most often regarded as a "storehouse of socioeconomic and health data in India" (Bhattacharjee, 2017).

The status of full immunization across all these four states have been quite low with around 61.7% of fully vaccinated children in Bihar, 54.8% in Rajasthan, 53.6% in Madhya Pradesh and 51.1% in Uttar Pradesh. The MMR for these states ranges from 149 to 197 per 100,000 live births (MHFW, 2021). These four states also account for having the highest fertility rates in the country which range from 2.3 to 3.4 children per woman. Apart from that, infant mortality rates in these states range from 42 to 64 per thousand live births which are higher than the national average of 41 per thousand live births. Also, female literacy rate rates in each of these states are quite low despite their share in the total population of the country. Together they account for nearly 40.3 percent population of the country (Census, 2011). Therefore it is quintessential to improve the status of maternal health in these states to improve maternal health and childhood immunization in India.

Construction of Dependant Variable

Immunization status was defined based on either vaccination card shown by the household or based on information gathered from the mother of a child. The immunization status of a child which is the dependent variable in our study is a categorical variable with three main categories namely fully immunized, partially immunized and unimmunized.

- **Fully immunized:** A full immunized child has received three doses each of DPT and polio vaccine and one dose each of BCG and measles vaccine.
- **Partially immunized (Dropouts):** A partially immunized child is one who started the vaccination process but did not complete the schedule and hence remained partially immunized.

- **Unimmunized (Left outs):** Unimmunized are those children who have never been vaccinated or reached and thus remained unimmunized.

The total number of vaccinations that have been received by a child of age 12 to 23 months have been taken into consideration because as per international and GoI recommendations a child should get fully immunized before the completion of their first zone in life (Panda, 1997).

- DPT vaccine protects against diphtheria, pertussis (whooping cough), and tetanus. Three doses are recommended.
- Three doses of polio vaccine which protects against poliomyelitis
- BCG which protects against tuberculosis. One dose is recommended.
- One dose of measles which protect against measles, mumps, and rubella

Determinants of Childhood Immunization

The explanatory variables have been selected on the basis of literature review that has been conducted and on the basis of their relative importance. The independent variables have been classified into four broad categories namely child, mother, community, and other level characteristics.

- **Child Level Characteristics** which include the sex of the child (male, female), and order of birth (1, 2, 3, 4 and above).
- **Mother Level Characteristics** which includes the place of residence (urban, rural), age of the mother (15-19, 20-24, 25-29, 30+), mother's education (no education or illiterate, primary, secondary and higher), and mother's awareness (yes, no).
- **Demography Level Characteristics** which include religion (Muslim, Hindu, Christian, and other minorities), and caste/tribe (general, other backward castes, scheduled tribe, scheduled caste).
- **Other characteristics** which include wealth index (low, medium and high), exposure to media (yes, no) and presence of electricity (yes, no).

Media exposure has been captured by taking into account newspapers and magazines, or watching TV or listening to radios. A mother has exposure to media if she does atleast one of these- read newspaper or magazine once in a week, or listen to the radio or watches TV once in a week. Mother's awareness has been captured again in the similar way. If a mother has heard about family planning either on TV or radio or newspaper, she is considered to have

awareness about the benefits of immunization. Mean value of all the independent variables (in percentages) are shown in Table 1.

Table 1: Mean value of the explanatory variables (in percentage)

		India	MP	UP	Rajasthan	Bihar	Urban	Rural
	Full Immunisation (yes)	60.8	51.9	52.5	55.9	63.5	64.61	59.65
Child level	Sex of Child (male)	51.9	52.6	52.5	53.3	51.4	51.3	52.7
	Birth Order							
	1	36.9	37.2	31.7	36.1	27.7	38.5	31.2
	2	31.8	33.6	26.9	31.6	28.3	31.3	29.0
	3	15.9	15.2	18.1	15.7	20.1	15.7	18
	4+	15.4	13.9	23.2	16.7	23.9	14.5	21.7
Mother level	Residence (urban)	23.9	25.0	22.6	22.1	9.6	-	-
	Mother's Education							
	No Education	28.6	31.7	39.1	39.8	53.6	25.5	45.0
	Primary	14.1	18.5	14.3	18.2	12.6	14.1	15.7
	Secondary	46.7	43.2	34.5	31.8	29.5	42.0	32.9
	Higher	10.4	6.6	11.9	10.1	4.6	18.4	6.3
	Mother's Age							
	15-19	3.7	0.9	4.2	2.9	14.0	1.8	6.6
	20-24	45.6	46.8	43.8	42.0	34.4	43.6	41.5
	25-29	8.5	6.3	9.9	7.7	11.1	9.2	8.9
	30+	37.8	40.8	37.3	42.2	36.6	40.8	38.2
	Mother’s Awareness							
	Yes	56.04	58.81	50.90	57.66	36.73	74.66	50.19
Demography level	Religion							
	Hindu	71.9	91.0	77.9	87.2	82.9	68.4	87.3
	Muslim	15.9	8.4	21.8	11.3	17.0	30.6	12.4
	Christian	8.3	0.1	0.04	0.03	0	0.07	0.03
	Others	3.9	0.5	0.2	1.5	0.04	0.9	0.3
	Caste/Tribe							
	General	18.8	12.1	18.4	15.9	14.3	24.2	13.5
	ST	20.8	26.2	1.55	17.2	3.21	3.4	11.5
	SC	19.6	17.3	24.6	19.9	23.04	17.8	22.9
	OBC	40.8	44.4	55.4	46.9	59.5	54.6	52.1
Others	Wealth Index							
	Low	48.7	58.6	53.6	45.3	79.6	18.4	69.9
	Medium	20.3	15.8	18.6	20.6	11.9	17.8	16.4
	High	31.0	25.7	27.8	34.6	8.5	63.7	13.7
	Electricity							
	Yes	80.72	85.1	66.5	82.1	55.7	91.87	77.22
	Media Exposure							
	Yes	63.34	62.13	50.01	62.03	30.09	86.24	56.17
Total	Number of Children	48,928	4545	7692	3139	4852	11700	37228

Source: Computed by the Author using NFHS-4 (2015-16) data

The analysis has been conducted with the help of bivariate, multivariate and ordered logistic regression. Logistic regression follows logistic distribution function and is used when the dependent variable is binary in nature. This method applies Maximum Likelihood Method (MLE) technique after transforming the target variable into a logit variable. A basic logistic equation can be specified as:

$$L_i = ln\frac{Pi}{1-Pi} = \beta_1 + \beta_2 X_i + u_i$$

In this case, Pi which is the probability of success, and RHS is interpreted as natural log of the odds of success. However for the purpose of analysis, marginal effects have been reported.

The basic multinomial logistic regression equation can be specified as:

$$p_{ij} = \frac{e^{x_{i\beta_j}^i}}{[\,1 + \sum_{j=1}^{J} e^{x_{i\beta_j}^i}]} \qquad j = 1,2,3 - - - J$$

which is the probability of $individual_i$ making j^{th} choice. In mlogit model, each category is compared with its base category and interpreted accordingly.

The ordered logit model can be considered as an extension of univariate logit model and is constructed around a latent regression. We begin with

$$y^* = x'\beta + \varepsilon$$

Where y^* is unobserved. We only observe

y = 0 if $y^* \leq 0$

= 1 if $0 \leq y^* \leq \mu_1$

= 2 if $\mu_1 \leq y^* \leq \mu_2$

.

= J if $\mu_{J-1} \leq y^*$, which is a form of censoring wherein we have to estimate μ'_s with the help of $\beta' s$. Assuming ε follows a normal distribution with mean zero and variance equals to one, the probabilities can be computed as:

$$\text{Prob. (y = J)} = 1 - \frac{e^{\mu_{J-1} - x_i'\beta}}{1+e^{\mu_{J-1} - x_i'\beta}}$$

As a preliminary analysis and to explore the data and the relationship between the variables, two ratios have been computed to highlight the urban-rural gap and gender gap in the status of childhood immunization.

SECTION IV: EMPIRICAL ANALYSIS, RESULTS AND INTERPRETATION

Preliminary Analysis

One of the challenges in capturing the determinants of childhood immunization across all four states is that there exists a possibility of collinearity among the explanatory variables and it is quintessential to look at the correlation matrix to account for multicollinearity. However, in real life and in social science research studies, explanatory variables are directly or indirectly correlated with each other. In the context of present study, for example, mother's awareness is closely associated with media exposure. Similarly, age of the mother and birth order of the child are correlated with each other. However if the explanatory variables are correlated but none can be excluded from theoretical point of view, removing an explanatory variable to solve the problem of multicollinearity is not often recommended unless the correlation coefficient is greater than 0.8 (Patra, 2008). The constructed correlation matrix among the explanatory variables shows that the correlated values are less than threshold value and can be retained (Appendix 1). Also, there is considerable degrees of freedom due to large dataset (close to 20,000 observations).

The following ratios have been computed by using data for fully immunized children. A value equal to 100 implies no inequality in terms of vaccination across gender and urban-rural differences, whereas value greater than 100 would mean inequality in full immunization.

Urban-Rural Inequality Immunization Ratio (URIIR)

$$= \frac{\%\ urban\ children\ fully\ immunized}{\%\ rural\ children\ fully\ immunized} \times 100$$

Gender Inequality Immunization Ratio (GIIR)

$$= \frac{\%\ male\ children\ fully\ immunized}{\%\ female\ children\ fully\ immunized} \times 100$$

The calculated ratios are presented in Table 2. A glance at the table shows that the urban-rural inequality immunization ratio (URIIR) has declined in the context of India and so does for all the North Indian states for the study under consideration. It has declined from 149 to 104 at the national level during ten years. In the year 2015-16, Bihar has a ratio of less than 100 which implies more children are fully vaccinated in rural areas than urban areas. On the other hand, the gender inequality immunization ratio (GIIR) has declined at the national level and in the context of all four North Indian states. It is pertinent to note here that GIIR has remained the highest for Uttar Pradesh both during NFHS-3 and NFHS-4 surveys.

Table 2: Child Immunization trends by Urban-Rural and Gender Differences

Year	Region	Urban	Rural	URIIR	Male	Female	GIIR
2015-16	India	63.9	61.3	104.2	50.3	47.2	106.6
	Bihar	59.7	61.9	96.5	51.2	48.8	104.9
	Rajasthan	60.9	53.1	114.7	49.3	46.2	106.7
	Madhya Pradesh	63.0	50.2	125.5	51.2	47.4	107.3
	Uttar Pradesh	53.6	50.4	106.3	48.2	44.2	109.1
2005-06	India	57.6	38.6	149.2	45.4	41.6	109.1
	Bihar	45.6	31.1	146.6	46.6	43.0	108.4
	Rajasthan	44.3	22.1	200.4	45.1	40.2	112.2
	Madhya Pradesh	68.7	31.5	218.1	49.2	41.2	119.4
	Uttar Pradesh	33.0	20.5	161.1	28.1	20.0	140.5

Source: Ratios have been computed by using NFHS-3 and NFHS-4 factsheets of India and given four states

Analysis and Interpretation

Bivariate, multivariate and ordered logistic regression has been estimated and coefficients are presented in Table 3. There seems to be an inverse relationship between birth order and immunization coverage. The likelihood for fuller immunization decreases by 5 percent for the fourth child compared to the first child according to the multinomial logit model and by 4.5 percentage as per the ordered logit model. Patra (2008) has provided two offsetting impacts to argue for higher birth order on the probability of immunization. The first one is positive (learning effect), which argues that with every birth order, knowledge about the benefits of immunization improves marginally and significantly. The second one is negative (negligence effect) which increases with an increase in the order of birth. The negative effect dominates the positive one for higher birth order. However, there does not seem to have much difference in the status of immunization across genders. This result is however not in alignment with the GIIR computed in Table 2, which argued that boys are more likely to be fully vaccinated than girls in the BIMARU states except Bihar.

Regression analysis approbated that children of educated and affluent families are more likely to be fully immunized than children who belong to underprivileged, or economically disadvantaged communities. Based on the multinomial logit model, the likelihood of being fully immunized is 13 percent higher for children of mothers with a higher level of education than the children of illiterate mothers. On a similar note, immunization status also improves as one moves ahead of the ladder in terms of the wealth index of the children's households. The probability is 8 percent higher for children who belong to high-income category in comparison to children whose families belong to the lower stratum of the society. These results are congruent with the previous studies as shown by (Mathew, 2012) in the context of BIMARU

states and (Patra, 2008) in context of India. Similar arguments can be made as per the ordered logit model.

Children staying in urban areas are more likely to be partially vaccinated than the ones staying in rural areas. The likelihood of partial immunization decreases by nearly 2 percentage for children staying in rural areas compared to the ones staying in urban area. According to logistic regression, children staying in rural areas have 3 percent less chances to be fully immunized than children staying in urban areas. However as far as full immunization status is concerned, children staying in rural areas have higher chances (3.2 percent according to multinomial logit and 2.4 percent according to ordered logit) than ones staying in urban areas. This in turn however is in contrast to the computed URIIR which was in favor of rural areas only in the state of Bihar. This could be because the computed regression coefficient for residence could be correlated with other explanatory variables.

The chances of full immunization also increase with the age of the mother but this increase is only up to the age limit of 25-29 and then it decreases. It can be argued that there exists an inverted U-shaped relationship between the age of the mother and the chances of full immunization. This result is in congruence with other studies as highlighted by (Mathew, 2012) and (Patra, 2008). The level of mother's awareness about family planning and immunization also has a positive relationship with vaccination. The likelihood of full immunization is 3 percent higher (according to mlogit) and 2.4 percent higher (according to ologit) for children of mothers who have some sort of awareness in comparison to children with unaware mothers.

The likelihood of receiving vaccinations also varies concerning religion and caste. For children belonging to Muslim families, the likelihood of getting fully immunized is 6.8 percent lower (according to mlogit) than Hindus, however, for Christian and other religions, the likelihood is high with reference to the Hindus. It can also be seen that Muslim household have lower level of full immunization and high levels of no immunization status. However, according to ordered logit results, Muslim children have 4.9 percent lower chances to get fully vaccinated with reference to children belonging to Hindu families. But for children belonging to OBC category, the coefficients are insignificant. Similar relationship has been identified by both (Patra, 2008) and (Mathew, 2012). Caste also has a significant impact on the status of immunization. With reference to children belonging to scheduled caste, the likelihood for full immunization is 2.3 percent lower for General category and 9.6 lower for children belonging to scheduled tribes according to multinomial logistic results.

Table 3: Regression results on immunization coverage

	Logistic Results	Mlogit Regression Results			Ologit Regression Regression		
Variables	Fully Immunized	Fully Immunized	Partially Immunized	Unimmunized	Fully Immunized	Partially Immunized	Unimmunized
Sex of Child (Female)	0 (0.007)	0 (0.007)	-0.001 (0.004)	0.001 (0.007)	0.00 (0.007)	0.00 (0.00)	0.033 (0.008)
Birth Order							
2	0.036 (0.009)	-0.036 (0.009)	0.005 (0.005)	0.031 (0.009)	-0.035 (0.009)	0.002 (0.001)	0.033 (0.008)
3	0.057 (0.011)	-0.057 (0.011)	0.01 (0.006)	0.047 (0.011)	-0.054 (0.011)	0.003 (0.001)	0.051 (0.011)
4+	0.052 (0.015)	-0.051 (0.015)	0.016 (0.008)	0.035 (0.014)	-0.045 (0.014)	0.003 (0.001)	0.042 (0.013)
Residence(rural)	-0.03 (0.01)	0.032 (0.01)	-0.019 (0.006)	-0.013 (0.01)	0.024 (0.01)	-0.001 (0.00)	-0.023 (0.01)
Mothers Education							
Primary	-0.058 (0.011)	0.056 (0.011)	-0.028 (0.005)	-0.029 (0.01)	0.0042 (0.01)	-0.002 (0.001)	-0.04 (0.01)
Secondary	-0.08 (0.009)	0.079 (0.009)	-0.031 (0.005)	-0.048 (0.009)	0.066 (0.009)	-0.033 (0.00)	-0.063 (0.009)
Higher	-0.123 (0.015)	0.127 (0.015)	-0.053 (0.007)	-0.074 (0.015)	0.11 (0.015)	-0.007 (0.001)	0.042 (0.013)
Mother's Age							
20-24	-0.067 (0.021)	0.068 (0.021)	-0.041 (0.014)	-0.027 (0.022)	0.05 (0.021)	-0.002 (0.00)	-0.048 (0.02)
25-29	-0.093 (0.022)	0.094 (0.022)	-0.044 (0.015)	-0.05 (0.022)	0.075 (0.021)	-0.003 (0.001)	-0.072 (0.021)
30+	-0.085 (0.023)	0.086 (0.023)	-0.039 (0.015)	-0.047 (0.024)	0.069 (0.023)	-0.003 (0.001)	-0.066 (0.022)
Mother's Awareness							
Yes	-0.03 (0.009)	0.03 (0.009)	-0.003 (0.005)	-0.007 (0.009)	0.024 (0.008)	-0.001 (0.00)	-0.023 (0.008)
Religion							
Muslim	0.068 (0.01)	-0.068 (0.01)	0.046 (0.006)	0.022 (0.01)	-0.049 (0.01)	0.002 (0.00)	0.047 (0.01)
Christian	-0.268 (0.145)	0.274 (0.142)	-0.063 (0.002)	-0.211 (0.142)	0.268 (0.146)	-0.033 (0.027)	-0.235 (0.119)
Others	-0.093 (0.053)	0.1 (0.053)	-0.04 (0.022)	-0.059 (0.053)	0.092 (0.054)	-0.007 (0.006)	-0.085 (0.048)
Caste/Tribe							
General	0.024 (0.012)	-0.023 (0.012)	0.014 (0.007)	0.009 (0.012)	-0.015 (0.012)	0.001 (0.001)	0.014 (0.011)
ST	0.096 (0.014)	-0.096 (0.014)	0.029 (0.008)	0.067 (0.014)	-0.078 (0.014)	0.003 (0.00)	0.075 (0.013)
OBC	-0.003 (0.009)	0.004 (0.009)	0.002 (0.004)	-0.005 (0.009)	0.006 (0.009)	0.00 (0.00)	-0.006 (0.008)
Wealth Index							
Medium	-0.046 (0.011)	0.046 (0.011)	-0.016 (0.006)	-0.03 (0.011)	0.041 (0.011)	-0.002 (0.001)	-0.039 (0.01)
High	-0.076 (0.012)	0.078 (0.012)	-0.038 (0.005)	-0.04 (0.012)	0.066 (0.012)	-0.004 (0.001)	-0.062 (0.011)
Electricity (Yes)	-0.068 (0.01)	0.066 (0.01)	-0.031 (0.005)	-0.034 (0.009)	0.049 (0.009)	-0.003 (0.00)	-0.047 (0.009)
Media Exposure (Yes)	-0.011 (0.009)	0.011 (0.009)	-0.003 (0.005)	-0.007 (0.009)	0.009 (0.009)	0.00 (0.00)	-0.008 (0.009)

Note: Values in parentheses are standard errors.

The presence of electricity also has a positive impact on the immunization status of a child. There are 7% more chances for children to be fully vaccinated (as per the multinomial logistic model) whose households have access to electricity than ones with no access to electricity. Such positive relation has also been highlighted by (Patra, 2008) and (Panda, 1997). The chances of immunization are however invariant to media exposure by the mothers (in terms of reading newspapers, watching TV, and listening to radios) as the coefficients are insignificant as confirmed by logistic, multinomial logit, and ordered logit regression results.

CONCLUSION

The study was conducted in the context of BIMARU states of north India and analyzes the impact of some selected variables on the status of childhood immunization. The study has provided that although UIP aimed to achieve the status of fuller immunization by 1990 however the achieved results are far from reality. Only 60 percent of the people are fully immunized in India and for BIMARU states it ranges from 51-63 percent. To account for regional and gender inequality, two ratios were computed which showed that it is more probable for children staying in urban areas to be fully immunized than those of rural areas however the difference is marginal. Gender inequality however has declined. While analyzing the impact of demographic and socioeconomic variables, it showed that the likelihood of immunization increases with the mother's awareness, the level of the mother's education, age of the mother and, the standard of living. The immunization status of a child is also influenced by community-level factors such as religion and caste of the family. The study also provides that exposure to media does not have a significant impact on the status of childhood immunization. The study is useful for policymakers trying to understand the status of health and factors influencing childhood immunization across BIMARU states of India. However, the study has been conducted by taking only demand-side variables and the scope of the study can be extended further by considering supply-side variables.

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Appendix 1

Pairwise Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) State	1.00											
(2) Place of Residence	-0.12	1.00										
(3) Age	0.05	-0.04	1.00									
(4) Highest Education	0.11	-0.20	-0.20	1.00								
(5) Electricity Availability	0.09	-0.06	-0.10	0.14	1.00							
(6) Religion	0.05	-0.19	0.07	-0.09	0.01	1.00						
(7) Wealth Index	0.22	-0.48	-0.03	0.47	0.12	0.13	1.00					
(8) Birth Order	-0.01	0.08	0.61	-0.37	-0.15	0.10	-0.23	1.00				
(9) Sex of Child	-0.01	-0.01	0.01	-0.01	0.00	0.01	-0.02	0.04	1.00			
(10) Caste	0.01	-0.12	0.03	0.15	0.04	0.24	0.25	-0.06	-0.09	1.00		
(11) Media Exposure	0.15	-0.29	-0.09	0.41	0.16	-0.01	0.54	-0.22	-0.01	0.12	1.00	
(12) Mother's Awareness	0.12	-0.27	-0.08	0.40	0.13	0.01	0.45	-0.22	-0.01	0.11	0.57	1.00