Child Immunization in Selected States of India: Community-level Effect of Education, Religion and Wealth

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Introduction

Childhood immunization has been an outstanding public health success in many developing countries, and for the last three decades the Expanded Programme on Immunization (EPI) has been promoted as one of the most important key elements of child health intervention in developing countries. Immunization is the process of artificially inducing immunity from many diseases. The aim of an immunization program is to reduce the incidence of or to eliminate a particular disease (Rao et al., 2003). The World Health Organization (WHO) launched the EPI in 1974 and GOI launched the same in India in 1978 with a view to provide protection to the children against disease and to reduce infant mortality rate .The main focus of the program is on tackling six major childhood diseases namely measles, tuberculosis, pertussis (whooping-cough), diphtheria, tetanus and poliomyelitis. The programme aims at ensuring universal immunization of children against all the above mentioned diseases.

The Government of India launched Universal Immunization Program in 1985-86 with the main objective of covering at least eighty-five percent of all infants against the six preventable diseases by 1990 and also to achieve production and the manufacture of cold chain equipment. Under the EPI, children should receive one dose of BCG (Bacillus Calmette Gueri) for protection against tuberculosis, three doses of DPT (diphtheria, pertussis and tetanus) three doses of OPV (Oral Polio Vaccine) for poliomyelitis protection and one dose of the measles vaccine by their first birthday. Immunization against poliomyelitis was introduced in 1979-80, tetanus toxoid was added in 1980-81 and immunization against tuberculosis (BCG) was brought under the EPI in 1981-82. The latest addition to the program was vaccination against measles, introduced in 1985-86 (Ministry of Health and Family Welfare, 1991).

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This scheme has been introduced in every district of the country and the target is to achieve 100 percent immunization coverage. To achieve universal immunization coverage of children against all vaccine preventable diseases by 2010 was one of the socio-demographic goals in National Population Policy (NPP) 2000.

It is 2008, two years away from our expected goal period, it is little over two decades since the programme started, but the coverage of children under the complete immunization programme is less than half! According to the National Family Health Survey-III only 44 percent of eligible children are fully vaccinated and five percent have not received any vaccination at the national level. This disappointing performance of the child immunization programme compels us to investigate the determinants of success for such programmes and their correlations. Given the regional as well as cultural diversity of large nation like India socio-economic characteristics like education, religion, wealth, health etc play an important role in issues of accessibility, availability and affordability of immunization services.

In India, these factors have an effect at the individual and community level. Above all, the characteristics of parents in general and mothers in particular are of utmost importance as in India children are mothers' responsibility.

This study too investigates the correlation between three important determinants of education, religion and wealth in the success of the child immunization programme in selected states of India. However, the novelty of this research lies in understanding the dynamics of these influences at a community level.

Review of literature

Education is not only one of the most important socioeconomic factors that is known to significantly influence individual behavior and attitudes, but educational attainment is a fundamental indicator of a country's level of human capital development (Kravdal, et al.,2004). In a study conducted in slums of Ludhiana, it was observed that there is a significant

relationship between education as well as poverty with acceptance of complete immunization (Panda et. al; 1993).

Education is linked to the socioeconomic status of family, which itself is a determinant of child health. Caldwell suggested two potential paths. One that education improves child health solely by enhancing the use of modern health services, and second that education results in a wide range of favorable behaviors, mostly connected with childcare (Caldwell and Caldwell, 1993). Studies have shown a positive correlation between maternal education and child health and use of modern preventive services, even after controlling for the income (Streatfield et al.1990, Matthews and Diamond 1997, Kiros and White 2004).

Although literacy of mother itself is an important factor, the level of education also affects immunization. Children are more likely to receive immunization if the mother is at least a middle-school-education (De and Bhattacharya 2002). Maternal education improves child survival because of greater knowledge of childhood immunizations and better utilization of modern preventive services (Streatfield et al.1990, Matthews and Diamond 1997, Kiros and White 2004).

The community in which a child grows may play a motivating role in seeking full immunization. The social interactions of individual in the community help to share knowledge regarding the advantage of immunization and different immunization programmes run by the Government. Collective notions about child vaccination could emerge when members of social networks, relatives, or neighbors exchange ideas and information about the quality of health services provided in the community (Streefland et al. 1999). Women who live in areas where the average educational level is relatively high may have lower fertility than they would otherwise, for reasons discussed by Kravdal (2002) and Moursund and Kravdal (2003).This may be favourable from the prospective of child health.

One should be concerned about the possibility that an individual-level prospective may fail to reveal the entire impact of education, for there may be beneficial effect of education of other

women in the community. In a society, innovative ideas of an individual or a group of individuals get diffused to other individuals who are living in the society. There is a debate on how these ideas spread from some individuals to others. The processes of social interaction are central here, and important mechanisms emphasized in the literature are social learning and social influence. The former concerns individuals' acquisition of information and knowledge from others, through interpersonal networks and impersonal sources like mass media. The second mechanism- social influence - refers to the ways some individuals exert influence over others' decision making, for example through peer pressure. (Kravdal et al., 2004)

A study by Antai (2008) in Nigeria found that religion plays a role in the risk of non-immunization and also found that religion was significantly associated with the reduced risk of full immunization. A study conducted in Ghana, using bivariate analysis show that children whose mother is as Muslim and traditional were found to have a significantly higher risk of death compared to Christian mothers. (Gyimah so, 2007)

Education is influenced greatly by economic status & religion of an individual along with the overall economic situation of the community to which he/she belongs. Indicators of individual and community wealth are also included in the model it can be a signal of the living standard of her family of origin, which is likely to have been a key determinant. In Niger, household structure does not have a significant effect on children's likelihood of being fully immunized. (Gage et al., 1997). In a study conducted in rural Bangladesh, economic condition of household was found to be significantly related with the acceptance of immunization (Bhuiya, 1995).

Need for the study

Universal immunization of children against the six preventable diseases is crucial in reducing child and infant mortality which is considered to be a good indicator of the health status of the population. Basic childhood immunization services are part of the essential health services in the country and are available at all public health centers and sub centers free of cost. Providing these services has been accorded a top priority in our health delivery system. However, provision of health services varies widely across the states of India, by sex of the child,

economic and social status of household. Understanding these variations at the community as well as at the individual level is important in order to successfully implement any health related policies and programmes. Additionally, information on immunization coverage is important for monitoring and evaluation of programmes on Immunization.

Given the current level of immunization coverage it may not be possible for us to reach our goals of full immunization by 2010. Therefore, an investigation into the factors associated with immunization assumes critical importance. While studies have examined supply side factors such as provision of facilities and services, not much attention has been paid to community level factors. Therefore, the main purpose of this study is to understand whether education, religion and wealth of the community where women live assume substantial importance in influencing individual women's decisions about immunization of their children.

Objectives

To examine the influence of community education, religious concentration of community and community wealth on full immunization of child in selected states of India.

We have framed these three hypotheses on the basis of given objective:

Hypothesis 1: There is an effect of community education on child immunization in selected states of India.

Hypothesis 2: There is an effect of community standard of living index on child immunization in selected states of India.

Hypothesis 3: There is an effect of religious concentration of community population on child immunization in selected states of India.

Data sources

The study utilizes data from third round of the National Family Health Survey (NFHS 2005-06). All the three rounds of NFHS collected data on immunization coverage for the surviving child aged 12-23 months prior to the survey date. Children aged 12-23 months are the unit of analysis. Children's file of NFHS-3 has been used for the analysis. Children who had received BCG, Measles and three doses of DPT and Polio (excluding Polio 0) are considered to be fully vaccinated based on the information obtained from the card. Wherever the cards were not available, information was procured from the mothers.

In India women's education plays an important role in seeking health care facilities, especially reproductive and child health care. In India, women are an important source of information for immunization of their children. Therefore, women's education would give a better estimate of the community level-effect of education on child immunization. In order to find community level-effect of education, we have computed average education of all the women (aged 15-49) in each primary sampling unit (PSU). Therefore, community education has been measured by the average years of schooling of women (aged 15-49) nested in the PSU or in the community, which in the study has been operationalized at the level of primary sampling unit. This average education of women within a PSU will be taken as community education as it is considered to be an indicator of the awareness of a community to provide a favourable supporting environment favouring child immunization.

To understand the effect of community wealth on child immunization a computed standard of living index or wealth score at the community level has been taken into consideration rather than a wealth index. According to Bollen et al. (2002), such a measurement should be good proxy for economic status.

To analyze the effect of religious concentration of community, proportion of Muslims has been computed PSU wise since literature says that Muslims were less inclined to get their children immunized.

Selection of states

For the purpose of analysis, since we have to have a sufficient sample size, the criteria for the selection of states is based on the percent distribution of Muslim population and the percent of fully immunized children in the selected states. Three major states have been chosen on the basis of performance, i.e., low, moderate and high level of full immunization of children. The three major selected states: Uttar Pradesh with 21 percent Muslim population and 23 percent fully immunized children, Andhra Pradesh with 20 percent Muslim population and 46 percent fully immunized children, and Maharashtra with 13 percent Muslim population and 59 percent fully immunized children.

Description of variables

- **Dependent variable**

Dependent variable is the full immunization of the surviving child aged 12-23 month prior to the survey coded in dichotomous categories, 1 fully immunized and 0 otherwise.

- **Independent variables**

Individual level variables

Mother's age at child birth, birth order, sex of child, antenatal care visits, place of delivery, mother's education, religion, caste, husband's education, mother's work status, place of residence, women's autonomy index, standard of living index, household structure.

Community level variable

Average education among women within PSU, Proportion of Muslim, Wealth score/Average SLI

Methodology

Multi-level Analysis

Analysis is based on a two-level logistic model; individual woman (level one) and these women are nested within PSU (level two). Therefore, Community is defined as the group of women nested within PSU. In NFHS-III, PSU are either a village or a part of it in rural area and a census enumeration block (CEB) in urban area.

Multi-level analysis is different from ordinary logistic regression as it provides fixed effect as well as random effect in the model. (Goldstein, 1995) The model specification and other details are given below:

Separate models have been fitted for each of the selected states. To check the influence of community level attributes a two-level binary logistic model has been fitted. A two-level binary logistic model with *n* explanatory variable is as follows:

$$y_{ij} \sim \text{Binomial}(\pi_{ij,}\, n_{ij})$$

$$\text{logit}(\pi_{ij}) = \beta_0 + \Sigma\, \beta_m x_{mij} + u_{0j} + e_{0ij} \quad \ldots\ldots\ldots (1)$$

$$u_{ij} \sim N(0, \sigma^2_u)$$

$$e_{0ij} \sim N(0, \sigma^2_e)$$

In the model y_{ij} is the dichotomized response of the event of i^{th} individual in the j^{th} PSU therefore here, y_{ij} be the binary response for i^{th} child in the j^{th} community, with y_{ij}=1, if the child fully immunized between 12-23 age group and y_{ij}=0 otherwise. Also, π_{ij} has been defined as π_{ij} = P (y_{ij}=1).

The assumption of normality for the within and between subject residuals inherent in most classical approaches to analysis may not be satisfied in practice. So, to overcome such problems

Bayesian approach has been adopted. In Bayesian approach all unknown quantities are treated as random variables and so must be assigned prior probability distributions. To make inferences about an unknown parameter in a multilevel model in a Bayesian framework we first need to find the joint posterior distribution of all the unknown parameters and then integrate over all the other unknowns. In the case of a variance component model the joint posterior is

Posterior distribution α (Prior distribution * Likelihood function)

A Bayesian Markov Chain Monte Carlo (MCMC) estimation procedure is one which efficiently generates the posterior joint density of the parameters. In the MCMC estimation procedure we are interested in generating samples of values from the joint posterior distribution of all the unknown parameters rather than finding the maximum of this distribution. MCMC algorithms produce chains of serially correlated parameter estimates and consequently often have to be run for repeated iterations to get accurate estimates. The chains are started from arbitrary parameter values and so it is common practice to ignore the first *N* iterations (known as a burn-in period) to allow the chains to move away from the starting value and settle at the parameters' equilibrium distribution. The sampling is done using the Metropolis-Hasting (M-H) algorithm. In M-H sampling values are generated from another distribution called a proposal distribution. These values are then either accepted or rejected in favour of the current values by comparing the posterior probabilities of the joint posterior at the current and proposed new values. The acceptance rule is designed so that M-H is effectively sampling from the conditional posterior even though we have used an arbitrary proposal distribution.

To assess the variation explained by the second level (PSU), intra-class correlation has been calculated. The raw intra-class correlation is the proportion of the total variance which is between villages and is given by

$$\rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_e^2} \qquad \text{..... (2)}$$

Where σ_u^2 and σ_e^2 are the residual variations at level two and level one respectively. When the intra-class correlations are small one can expect reasonably good agreement between the multilevel estimates and the simpler ordinary least square ones (Goldstein 1995). The raw intra-class correlation is computed from the empty model. Another intra-class correlation known as residual intra-class correlation is computed from the same formula but this time taking into all the variables into consideration. The amount of reduction in the residual intra-class correlation from the raw intra-class correlation gives an idea of the percentage explained by the community level variable considered in the model.

Community- level effect is captured by taking four models and to arrive at a model which will best fit the present study. In all multilevel logistic regression tables there are five models. Among these five Models, Model IV is the final model. Descriptions of models in each of the selected states are given below:

Model I is an empty model without any control variables but with a random intercept for communities measuring variation in the full immunization of children between communities. In addition to a random intercept, model II considered mother's educational level to signify the importance of maternal education on enhancement of full immunization. Model III which includes maternal education as well as other controlled variables such as husband's education, household standard of living (SLI), women's age at child birth, birth order of child, family structure of household, residence background, place of delivery, women's autonomy index, sex of child, caste and religion of household and ANC visit. Model specification including both maternal education and community education of women i.e., average years of schooling of women in each PSU is represented by Model IV which also includes all the controlled variables of Model III. Model V includes the estimates obtained from MCMC estimation procedure. However, from Model I to Model IV the estimate is obtained from IGLS/RIGLS estimation procedure. A comparison of the estimates of final model (Model IV) obtained from IGLS/RIGLS estimation procedure with the estimates obtained from MCMC estimation procedure (Model V)

shows that the estimates and standard error obtained from two procedures differ to a certain extent.

Table displays the parameter estimates of these models. For each model, parameter estimates (that is, the coefficient of covariates) in the logistic model are provided and corresponding standard error is shown within parentheses. The exponentiation of the estimated parameter of a correlate yields odds of full immunization of children associated with the particular category of the background variables relative to the reference category while the rest of the covariates are controlled. For assessment of the model fit, summary statistics are also included in the form of deviance, which measures the extent to which the fitted model deviates from the saturated model. In the case of individual level binary data the likelihood for the saturated model being 1, the deviance is simply the value of minus twice the natural logarithm of the likelihood. The approach followed for assessing model fit is to find the difference in the deviances from alternative models. The difference in deviance follows an exact Chi-square distribution with degrees of freedom equal to the difference in the number of parameter in the competing models.

Community level-effect of education on full immunization of child

Table 1.1 Effects (with standard errors) of education and other variables for two level models on full immunization of children in Uttar Pradesh, NFHS-3 (2005-06).

Fixed Effect	IGLS/RIGLS				MCMC
	Model I	**Model II**	**Model III**	**Model IV**	**Model V**
Intercept	-1.003**(0.078)	-1.801**(.110)	-2.368**(.305)	-2.575**(.321)	-2.575**(.323)
Individual level variable					
Education of women					
Illiterate ®					
Primary		.849**(.227)	.535**(.247)	.524**(.247)	.520**(.248)
Secondary and above		1.793**(.152)	1.079**(.195)	.994**(.199)	.990**(.200)
Education of husband					
Illiterate ®					
Primary			-.154(.273)	-.098(.274)	-.093(.275)
Secondary and above			-.147(.160)	-.129(.161)	-.129(.162)
Standard of living Index					
Low®					
Medium			.082(.195)	.087(.195)	.087(.196)
High			.098(.221)	.082(.222)	.086(.223)
Women age at child birth					
Less than 25 years®					
25 years and above			.349**(.172)	.314**(.173)	.314**(.174)
Birth Order					
First®					
Second and above			-.496**(.185)	-.473**(.186)	-.477**(.186)
Family Structure					
Nuclear®					
Joint			.073(.172)	.054(.173)	.054(.174)
Place of Residence					
Rural®					
Urban			.139(.191)	-.127(.225)	-.130(.228)
Place of Delivery					
Home®					
Institution			.726**(.172)	.654**(.175)	.651**(.176)

Fixed Effect	IGLS/RIGLS				MCMC
	Model I	**Model V**	**Model III**	**Model IV**	**Model V**
Autonomy Index					
Low®					
High			.092(.159)	.097(.159)	.099(.160)
Sex of child					
Female®					
Male			.079(.149)	.070(.150)	.072(0.151)
ANC visit					
No visit®					
visit in first trimester			.856**(.200)	.839**(.202)	.836**(.202)
visit after first trimester			.636**(.192)	.668**(.194)	.664**(.194)
Caste					
SC/ST®					
OBC			.340*(.199)	.311*(.199)	.314*(.200)
Others			.446**(.226)	.346*(.231)	.348*(.232)
Religion					
Hindu®					
Muslim			-.723**(.206)	-.580**(.214)	-.578**(.216)
Others			.503(.662)	.485(.677)	.483(.679)
Community-level variable					
Average education				.080**(.035)	.081**(0.036)
-2logliklihood	1490.52	1243.95	1070.02	1051.85	1051.69

® Reference category; figure in the parentheses are S.E. of estimates; * *p<0.05.

The estimates of Table 1.1 shows that the significance of the random intercept at p<0.05 in all the models is indicative of the generality that in Uttar Pradesh there exists considerable variation in full immunization of children even after controlling individual and community factors. The result of model II reflects the significance of maternal education as an individual level characteristic accounting for variation in child immunization.

The positive relationship between maternal education and full immunization of children is evident in studies by Parashar (2004); Srivastava and Saxena (1988). These associations are once again confirmed by the present study. The odds of full immunization of children were

found to be 2 times more likely to be in the primary educated mothers and 6 times more likely to be in the secondary and above educated mothers compared to other children of uneducated mothers. This is statistically significant at 5 percent level of significance.

In model III the inclusion of other independent variables at the individual level reduces the effect of mother's own education. An effect for primary educated mothers reduces estimates from 0.849 to 0.535 and it also reduces in case of secondary educated mothers from 1.793 to 1.079. Immunization of children to a large extent depends on mother's age at birth. This is due to the fact that younger women are less exposed to children health care services and their importance to the child survival. Children born to mother's age 25 years and above are 41 percent more likely to be fully immunized compared to the children born to young mothers. Children delivered in an institution are 2 times more likely to be fully immunized than children delivered at home. When the mothers deliver their children in any health institution they are more aware about the advantage of health facility and are probably followed up by health workers. This enhances mother's skill to obtain childhood vaccination for better survival of their children. If the birth order of child is other than first they are 40 percent less likely to be fully immunized. The odds of full immunization of children were found to be 88 percent higher in ANC visit after first trimester and 2.4 times higher in ANC visit in first trimester compared to the no ANC visit of mothers. Muslim children were 52 percent less likely to be fully immunized than the children of other religions. Children belonging to OBC and other castes are nearly 1.4 times more likely to be fully immunized than that of SC/ST children.

In model IV the inclusion of community education of women (aged 15-49) again reduces the effect of mother's own education. Even after controlling for many other independent variables, it is interesting to note that maternal education and community education remain significant in explaining the full immunization of children. The other variables that remain significant after inclusion of community education are birth order other than first order, children of Muslim religion, OBC and other castes children, ANC visit in first and later trimesters and also institutional delivery. Model IV clearly depicts that education of women in the community has a positive impact on full immunization of children.

From Model IV and Model V we can compare estimates obtained from IGLS/RIGLS Approach and Bayesian MCMC Approach. For example the estimates for the category education, place of residence, birth order and sex of the child obtained from model IV and model V differ significantly. Similarly one can notice change in standard error also. This indicates that IGLS/RILGS method of estimation gives a biased result. A clear indication that standard error is underestimated in case of IGLS/ RIGLS procedure can be noted from the comparison of the standard error values obtained from the two procedures. Though it is noticed that the direction has not changed in any of the cases, the magnitude of the variable changed significantly.

The Model IV and Model V reveals that the estimates of women's education obtained from the two methods not differ notably. Figure 1 depicts the MCMC diagnostic of the average years of schooling of women in the community for the state of Uttar Pradesh for full immunization of children. The upper left hand cell shows the whole trace for the parameter. The upper right hand cell gives the kernel density estimate of the posterior distribution. From figure 1 it can be observed that the density looks to have normal distribution. The second row boxes plot the autocorrelation (ACF) and Partial Autocorrelation (PACF) functions. The PACF has a spike at lag one with a very high autocorrelation. The ACF is also consistent result with this. This indicates the chain is not close to independent identically distributed data. The left hand box of the third row plots the estimated Monte Carlo Standard Error (MCSE) of the posterior estimate of the mean against the number of iterations. The Raftery-Lewis diagnostic is a diagnostic based on a particular quintile of the distribution. The Nhat diagnostic is used to estimate the length of markov chain required to estimate a particular quintiles to a given accuracy level. From the above figure the Nhat values are between 61561 and 27319 for 2.5 percent and 97 percent quintiles.

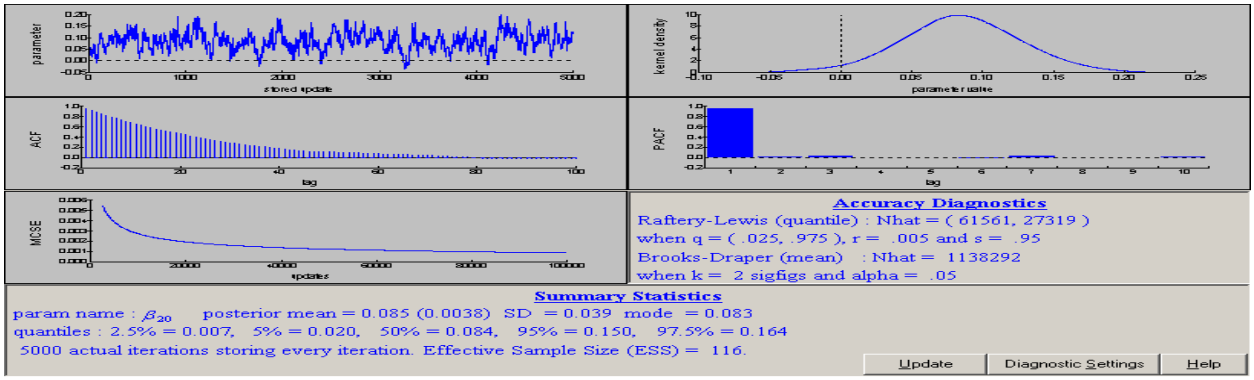

Figure 1 The MCMC diagnostic of the average years of schooling of women in the community for the state of Uttar Pradesh for full immunization of children

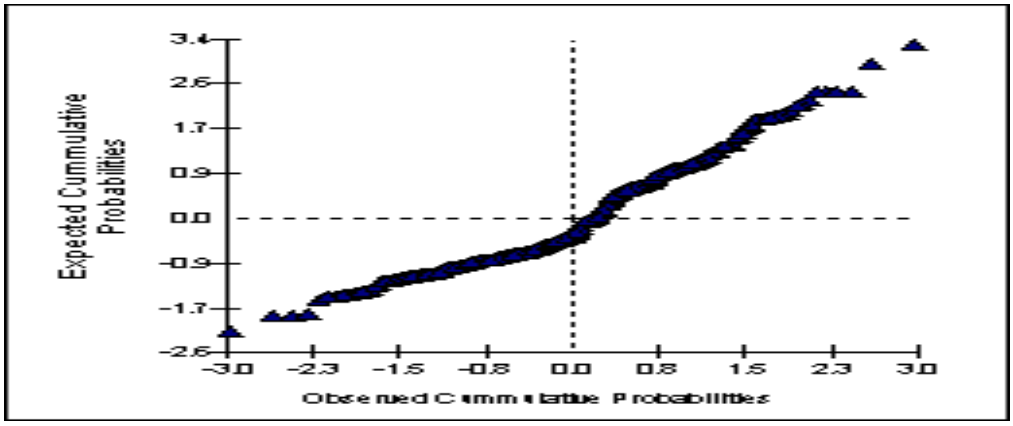

Figure 2 Normal P-P Plots for full immunization of children at PSU level in Uttar Pradesh

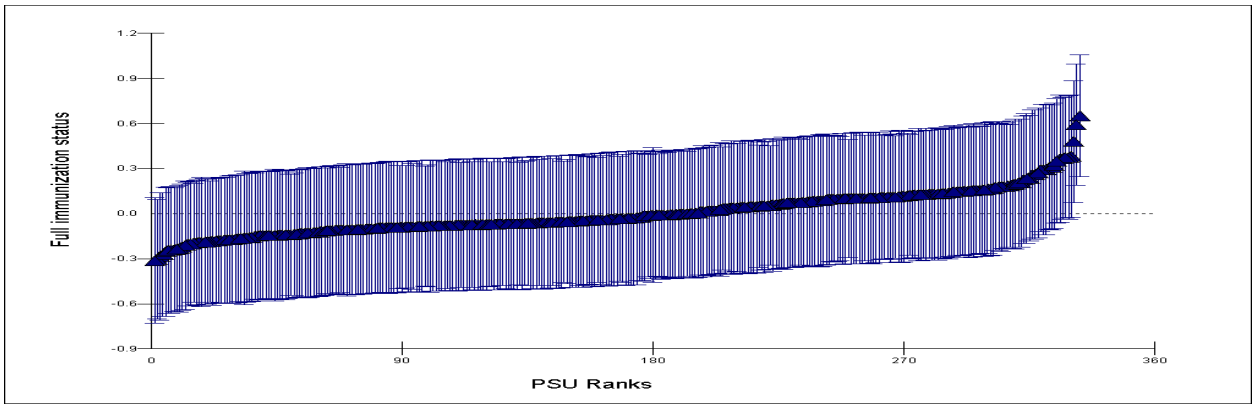

Figure 3 PSU ranking was done on the basis of residual analysis for full immunization of children in Uttar Pradesh.

After controlling the selected variables at the individual, household and PSU level, PSU ranking was done on the basis of residuals analysis for full immunization of children.

Table 1.2 Effects (with standard errors) of education and other variables for two level models on full immunization of children in Maharashtra, NFHS-3 (2005-06)

	IGLS/RIGLS				MCMC
Fixed Effect	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
Intercept	-.508**(0.103)	-0.083(.218)	-0.726(.485)	-1.28**(.534)	-1.269**(.54)
Individual level variable					
Education of women					
Illiterate ®					
Primary		.095(.342)	-.087(.346)	-.173(.379)	-.167(.382)
Secondary and above		.808**(.241)	.227(.293)	.013(.304)	.013(.307)
Education of husband					
Illiterate ®					
Primary			-.451(.334)	-.386(.337)	-.38(.339)
Secondary and above			-.001(.228)	.101(.233)	0.101(.235)
Standard of living Index					
Low®					
Medium			.073(.293)	.064(.294)	.06(.297)
High			.745**(.302)	.666**(.305)	.658**(.307)
Women age at child birth					
Less than 25 years®					
25 years and above			-.007(.220)	-.078(.223)	-.074(.225)
Birth Order					
First®					
Second and above			-.167(.208)	-.136(.209)	-.132(.21)
Family Structure					
Nuclear®					
Joint			-.579**(.221)	-.542**(.222)	-.545**(.224)
Place of Residence					
Rural®					
Urban			.326(.242)	.007(.270)	.003(.277)
Place of Delivery					
Home®					
Institution			.033(.245)	-.080(.249)	-.089(.252)

Fixed Effect	IGLS/RIGLS				MCMC
	Model I	Model II	Model III	Model IV	Model V
Autonomy Index					
Low®					
High			.176(.202)	.175(.203)	.177(.205)
Sex of child					
Female®					
Male			-.021(.188)	.003(.190)	.003(.191)
ANC visit					
No visit®					
visit in first trimester			.864**(.342)	.846**(.346)	.852**(.348)
visit after first trimester			.937**(.355)	.975**(.359)	.977**(.36)
Caste					
SC/ST®					
OBC			.067(.294)	.055(.296)	.059(.3)
Others			.174(.272)	.196(.273)	.191(.276)
Religion					
Hindu®					
Muslim			-.550**(.273)	-.496**(.273)	-.489**(.277)
Others			.414(.379)	.386(.382)	.382(.385)
Community-level variable					
Average education				.134**(.051)	.134**(.052)
-2logliklihood	825.407	806.784	738.85	727.53	728.047

® Reference category; figure in the parentheses are S.E. of estimates; * *p<0.05.

In table 1.2, the significance of the random intercept for full immunization at p<0.05 in first and last two models shows in Maharashtra there exists a variation in full immunization of children even after controlling individual and community factors. The result of model II reflects the significance of maternal education as an individual level characteristic accounting for variation in child immunization.

The odds of full immunization of children were found to be 2.4 times more likely to be in the secondary and above educated mothers compared to children of uneducated mothers. This is statistically significant at 5 percent level of significance.

In model III the inclusion of other independent variables at the individual level reduces the effect of mother's own education. The effect of secondary educated mothers becomes insignificant. The birth orders of child other than first then they are 16 percent less likely to be fully immunized. The standard of living index (SLI) is an indication of the overall material well being of households and it makes sense to take households with high SLI as belonging to a more affluent category. Therefore, it is consistent that the odds ratio of full immunization of children increases with increasing in SLI. For high SLI households the odds-ratio of full immunization of children relative to low SLI household is higher by 2.1 times and it is significant at $p<0.05$. For the joint family the odds for full immunization lower by 44 percent compared to nuclear family. Since there may be reason that in joint family autonomy of mothers is low due to presence of mothers-in-law in the household. Also, they are less likely to be exposed of mass media because of some social factors. The odds of full immunization of children was found to be 2.5 times higher in ANC visit after first trimester and 2.4 times higher in ANC visit in first trimester compared to the no ANC visit of mothers. Muslim children were 43 percent less likely to be fully immunized than children of other religions.

In the model IV the inclusion of community education of women (aged 15-49) depicts the community education of women. Model IV clearly shows that as education of women in the community increases 1.14 times more children were fully immunized. So, it shows the effect of community education. Other independent variables which were significant in Model III remain significant. Through Model V and Model IV we can compare the estimates obtained from IGLS/RIGLS Approach and Bayesian MCMC approach. For example the estimates for the category religion, caste autonomy index of women, place of residence, birth order of child, mother's age at child obtained from model IV and model V differ significantly. Similarly one can notice change in standard error also. This indicates that IGLS/RIGLS method of estimation gives a biased result. A clear indication that standard error is underestimated in case of IGLS/ RIGLS procedure can be noted from the comparison of the standard error values obtained from the two procedures. Though the direction has not changed in any of the cases, the magnitude of the variable changed significantly.

Table 1.3 Effects (with standard errors) of education and other variables for two level models on full immunization of children in Andhra Pradesh, NFHS-3 (2005-06).

	IGLS/RIGLS				MCMC
Fixed Effect	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
Intercept	-.025(0.110)	-0.687**(.208)	-1.111**(.525)	-1.104**(.533)	-1.115**(.542)
Individual level variable					
Education of women					
Illiterate ®					
Primary		.678**(.335)	.484(.367)	.485(.367)	.489(.371)
Secondary and above		1.05**(.246)	.643**(.314)	.651**(.328)	.67**(.333)
Education of husband					
Illiterate ®					
Primary			-.043(.366)	-.047(.369)	-.038(.373)
Secondary and above			-.604**(.242)	-.607**(.245)	-.607**(.248)
Standard of living Index					
Low®					
Medium			.233(.306)	.233(.306)	.230(.309)
High			.251(.326)	.254(.329)	.251(.334)
Women age at child birth					
Less than 25 years®					
25 years and above			.237(.256)	.239(.258)	.233(.26)
Birth Order					
First®					
Second and above			-.500**(.240)	-.501**(.241)	-.501**(.243)
Family Structure					
Nuclear®					
Joint			-.594**(.225)	-.594**(.225)	-.589**(.227)
Place of Residence					
Rural®					
Urban			-.067(.278)	-.054(.322)	-0.043(.335)
Place of Delivery					
Home®					
Institution			.619**(.336)	.623**(.339)	.603**(.343)

Fixed Effect	IGLS/RIGLS				MCMC
	Model I	**Model II**	**Model III**	**Model IV**	**Model V**
Autonomy Index					
Low®					
High			.190(.225)	.192(.226)	.195(.228)
Sex of child					
Female®					
Male			.548**(.218)	.548**(.218)	.554**(.22)
ANC visit					
No visit®					
visit in first trimester			.757**(.384)	.759**(.384)	.748**(.387)
visit after first trimester			.227(.423)	.228(.423)	.241(.426)
Caste					
SC/ST®					
OBC			-.345(.316)	-.346(.317)	-.342(.322)
Others			.298(.381)	.300(.382)	.309(.387)
Religion					
Hindu®					
Muslim			-.040(.341)	-.039(.342)	-.053(.35)
Others			-.349(.567)	-.343(.572)	-.345(.58)
Community-level variable					
Average education				-.004(.058)	-.004(.059)
-2logliklihood	626.571	605.484	551.88	552.001	552.25

® Reference category; figure in the parentheses are S.E. of estimates; * *p<0.05.

In table 1.3 the random intercept for full immunization at p<0.05 is comes out be insignificant in the first model in Andhra Pradesh. The result of model II shows that maternal education plays a significant role to increase level of full immunization of children. The odds of full immunization of children were found to be 1.9 times more likely to be in the primary educated mothers and 2.9 times more likely to be in secondary and above educated mothers compared to other children of uneducated mothers. This is statistically significant at 5 percent level of significance.

In model III the inclusion of other independent variables at the individual level reduces the effect of mother's own education and the effect for primary educated mothers becomes insignificant. The effect for primary educated mothers reduces from 0.678 to .484 and it also reduces in case of secondary educated mothers from 1.050 to 1.643. Here, it also shows that if the husband's education is secondary and above then the odds of full immunized children found to be lower by 46 percent. If the birth order of child is other than first then it is 40 percent less likely to be fully immunized. But in this model for the category of joint family the odds for full immunization is lower by 40 percent compared to nuclear family. If the birth order of child is other than first it is 16 percent less likely to be fully immunized. The odds of full immunization of children were found to be 2.13 times higher in ANC visit in first trimester compared to the no ANC visit of mothers. Male children were 1.72 times more likely to be fully immunized than female children. Thus, the finding shows there is a gender disparity in health. Children of mothers who delivered in the institution are 1.9 times more likely to be fully immunized than those delivered at home. This shows the importance of health worker and health institution. This enhances mother's skill to receive childhood vaccination for better survival of their children. If the birth order of child is other than first it is 40 percent less likely to be fully immunized.

In the model IV the inclusion of community education shows that there is no role of the community education of women in Andhra Pradesh. Other independent variables which were significant in Model III remain significant.

Through Model V and Model IV we can compare the estimates obtained from IGLS/RIGLS Approach and Bayesian MCMC approach. For example the estimates for family structure, place of residence, religion of the household obtained from model IV and model V differ significantly. Similarly, one can notice a change in standard error also. Here, it also indicates that IGLS/RILGS method of estimation gives a biased result. A clear indication that standard error is underestimated in case of IGLS/ RIGLS procedure can be noted from the comparison of the standard error values obtained from the two procedures.

Table 1.4 Effects (with standard errors) of Standard of Living Index and other variables for two level models on full immunization children in Maharashtra, NFHS-3 (2005-06)

	IGLS/RIGLS				MCMC
Fixed effect	**Model I**	**Model II**	**Model III**	**Model IV**	**Model V**
Intercept	-.508**(.103)	-.133(.206)	-.726(.485)	-2.096(.827)**	-2.085(.8412)**
Individual level variable					
Religion					
Hindu®					
Muslim			-.550(.273)**	-.513(.274)**	-.516(.278)**
Others			.414(.379)	.378(.381)	.375(.384)
Standard of living Index					
Low®					
Medium		.310(.226)	.073(.293)	.014(.296)	.011(.298)
High		1.041(.240)**	.745(.302)**	.606(.311)**	.600(.313)**
Women age at child birth					
Less than 25 years®					
25 years and above			-.007(.220)	-.050(.223)	-.048(.224)
Birth Order					
First®					
Second and above			-.167(.208)	-.143(.209)	-.139(.210)
Family Structure					
Nuclear®					
Joint			-.579(.221)**	-.554(.222)**	-.557(.223)**
Place of Residence					
Rural®					
Urban			.326(.242)	.026(.284)	.023(.291)
Place of Delivery					
Home®					
Institution			.033(.245)	-.063(.250)	-.074(.253)

Fixed Effect	IGLS/RIGLS				MCMC
	Model I	**Model II**		**Model IV**	**Model V**
Autonomy Index					
Low®					
High			.176(.202)	.173(.203)	.175(205)
Sex of child					
Female®					
Male			-.021(.188)	-.007(.190)	-.006(.191)
ANC visit					
No visit®					
visit in first trimester			.864(.342)**	.853(.345)**	.858(.347)**
visit after first trimester			.937(.355)**	.953(.357)**	.956(.359)**
Caste					
SC/ST®			.067(.294)	.016(.297)	.022(.300)
OBC			.174(.272)	.157(.274)	.154(.277)
Other					
Education of women					
Illiterate ®					
Primary			-.087(.376)	-.112(.378)	-.108(.381)
Secondary and above			.227(.293)	.124(.298)	.121(.301)
Education of husband					
Illiterate®					
Primary			-.451(.334)	-.402(.336)	-.396(.338)
Secondary and above			-.001(.228)	.083(.233)	.083(.235)
Community Variable					
Mean Standard of living				.031(.015)**	.031(.015)**
-2loglikihood	825.407	795.132	738.185	732.568	733.074

® Reference category; figure in the parentheses are S.E. of estimates; **p<0.05.

Table 1.4 shows the community level effect of SLI on full immunization in Maharashtra. This table shows that there is an effect of SLI at the community level on full immunization of children. The result of model II shows that SLI plays a significant role in increasing the level of full immunization of children. The odds of full immunization of children were found to be 2.82 times more in the high SLI households compared to children of low SLI households. This is statistically significant at 5 percent level of significance.

In model III the inclusion of other independent variables at individual level reduces the effect of effect of SLI at individual level. An effect for high SLI household at individual level reduces by 1.041 to 0.745. Some more variable are comes out to be significant viz., religion, SLI, family structure, ANC visit of women. In this model for the category of joint family the odds for full immunization is lower by 44 percent compared to nuclear family. The odds of full immunization of children were found to be 2.34 times higher in ANC visit in first trimester and 2.59 times higher in ANC visit after first trimester compared to no ANC visit of mothers. Muslim children were 43 percent less likely to be fully immunized than children belonging to other religions.

In model IV the inclusion of mean SLI as a community level variable shows that there is a role of the community SLI in Maharashtra. Community SLI plays an important role in increasing the level of full immunization since it reduces the effect of SLI at individual level. Inclusion of SLI at community level reduces the effect of SLI at individual level and effects are reduces from 2.10 to 1.83.

From model V it can be concluded that the effect of estimates remains the same except in a few cases where negligible change occurs. Through Model V and Model IV we can compare the estimates obtained from IGLS/RIGLS Approach and Bayesian MCMC approach. For example, the estimates for family structure, place of residence, religion of the household obtained from model IV and model V differ significantly. Similarly, one can notice change in standard error is very minute. It indicates that IGLS/RILGS method of estimation and Bayesian MCMC approach give approximately the same result.

Raw and residual intra-class correlation coefficients (Expressed in percent) in case of education, religion and SLI in selected states

The raw intra class correlation is maximum in Maharashtra (39 percent) followed by Uttar Pradesh (39 percent) and then in Andhra Pradesh (24 percent). With the inclusion of community variables i.e., education, religion and SLI the correlation on an average reduces by 20 percent in Uttar Pradesh, 9 to 10 percent in Maharashtra and 6 percent in Andhra Pradesh. The amount of reduction in the residual intra-class correlation from the raw intra-class correlation gives an idea of the percentage explained by the community level variable considered in the model.

Summary and Conclusion

Child health status is one of the most important healthcare aspects of nation. The health of child is an issue which gets influenced by an array of factors such as socio-economic, cultural, demographic, biological and environmental. Thus, the basic component of child health i.e., childhood immunization has been selected for this present study. Childhood immunization reflects the extent to which the children are prevented from six major childhood diseases. It is also important to note that India is a demographically, socio-economically, culturally and geographically diversified country. Because of its huge diversities, it would be worth to study the differentials in immunization of children for selected states viz Uttar Pradesh, Maharashtra and Andhra Pradesh and at the all-India level. Also, this research adds to evidence base about the influence of community level-effect of education, religion and wealth on child Immunization.

Findings

- The multilevel analysis reveals that education of women in the community plays a significant and positive role on the likelihood of full immunization of children in Uttar Pradesh and Maharashtra. Also, community level SLI comes out to be significant for full immunization of children only in the case of Maharashtra. However, there is no role of religion on full immunization of children in any of the selected states.

- Other factors at the individual level which influence the level of full immunization in Uttar Pradesh are mother's education, birth order, religion, caste, ANC visit and institutional delivery. However, higher birth order and Muslim religion are negatively related with full immunization of children and others factors mentioned above are positively related with full immunization of children.
- In the case of Maharashtra, the individual level factors religion, standard of living index, ANC visit and family structure play a significant role in determining full immunization.
- Gender disparities in full immunization were found in the case of Andhra Pradesh where male children are more likely to be fully immunized than female children. Also, in Andhra Pradesh children belonging to joint families are less immunized than children belonging to nuclear families.

Although the study has examined the influences of several individual, household and community level attributes, some amount of variations remain unexplained which implies that other observed and unobserved factors not included in the study could explain this unexplained part. The evidences suggest that community education is one of the most important determinants of full immunization of children. Therefore, plans are to be made in such a way that the interaction among individuals will increase and every individual can benefit from it. Full participation means completion of immunization programme whereas partial immunization means dropping out of a program. Every government policy aims at complete participation of an individual till the objective of the programme is met and therefore understanding the factors that are significant in full immunization is of greater importance. At the state level these factors play in complex fashion wherein an economically advanced state like Maharashtra shows negative full immunization status among working women.

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