Maternal Education and Child Vaccination in India: Logistic Regression Estimation of the Effect of Mother's Education on Complete Immunisation

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Abstract

Background: To improve public health and achieve sustainable development goals, child immunisation is important and for improving child immunisation improved maternal education is the key. Maternal education improves the knowledge, attitude and the need for childhood complete immunisation. Improving female education also improves women empowerment and bargaining power within the marital household and the intrafamily resource allocation, especially on the health and education of female children. In India, women and female children are much discriminated against as a result India could not achieve the target and is away from the goal of full immunisation.

Method: This paper estimates the effect of mother's education on the child receiving all vaccinations - a dose of BCG, three doses of DPT and three doses of oral polio vaccine (OPV) - within the age of 12-48 months. As the dependent variable is binary whether the child has received complete immunisation or not - a logistic regression model is used. The nationwide data are derived from the 6th round of the Demographic and Health Survey of India for the year 2015-16 (DHS-VI), consisting of 12817 observations.

Results: The logit estimates show that the effect of maternal education on complete child vaccination is significantly positive. Woman with at least formal education is better placed in seeking child immunization, which is further facilitated by the mother's knowledge and awareness of immunisation programmes. Socioeconomic variables like status, father's education, birth order, urban residence and religion significantly influence child immunisation status, but community and birth intervals are not important for child immunisation. Significantly more boys receive complete immunisation than girls, showing some form of neglect of female children.

Conclusion: An inclusive education, health and family welfare approach that improvesfemale schooling, health knowledge, and positive attitudes toward modern healthcare among mothers and female empowerment are beneficial for complete vaccination of children in India towards improving child health and reducing child mortality in India, a measure that will take India a step closer to achieving the SDG goals.

Keywords: Female education • Empowerment • Intrahousehold allocation • Child immunisation • Logit estimation

Introduction

General education is important because it often enhances not only productivity and output, but also confers many non-market social benefits, especially for women and the marginalised. An added benefit of raising school enrollment and literacy, particularly for girls and females, is the spillover effects on own health and health of the family, especially child health. Many outcomes demonstrate that education improves both health-seeking behaviour and health outcomes [1]. Education is the only tool with which a girl or a woman can empower herself, her family and her child, the next generation. Therefore, by declaring education as a fundamental right, India ensures constitutional provisions for providing free and compulsory education to all children between 6 to 14 years of age and special considerations for educating girl children. There exist in India numerous schemes to bring girl child to school as well as providing incentives to mothers to send children to school. The central and state governments also provide free health services both for mothers in neonatal periods and for the girl child in school, apart from general health services and health insurance.

Among the various schemes aimed at increasing health and reducing mortality, child immunisation has been regarded as the most cost-effective intervention for child health, which is vigorously promoted by the World Health Organisation (WHO). Immunisation at early childhood significantly reduces the costs of treating diseases, thus providing a healthy childhood and reducing poverty and suffering. Immunisation or vaccination is the injection of a small number of viruses/bacteria into the human body to stimulate the immune system to make antibodies against them. Childhood vaccination has saved millions of lives and prevents many more millions suffering from debilitating illness and lifelong disability. Despite the huge success in vaccination across countries, WHO estimates that 1.5 million children under 5 years die from vaccine-preventable diseases annually [2-5].

As a signatory of the Sustainable Development Goals (SDGs) agenda, India is committed to ensure healthy lives and promote well-being for all, at all ages. To foster global efforts, India tries to make rapid headway in achieving universal health coverage, particularly in the provisioning of essential health care services [6]. The Universal Immunisation Programme (UIP), started as early as 1978, is one of the key interventions for the protection of children from preventable life-threatening conditions diseases. It is considered to be one of the largest immunisation programmes around the world and a major public health intervention in the country. Since 2005, the immunisation has been one of the key areas under the National Rural Health Mission (NRHM). Under the Universal Immunisation Programme, the Government of India is providing vaccination to prevent seven vaccine-preventable diseases i.e. Pertussis, Tetanus, Polio, Measles, Childhood Tuberculosis, Hepatitis B, Hemophilus influenza type b (Hib) and Diarrhea [7].

In December 2014, India's Ministry of Health and Family Welfare launched the Mission Indradhanush with an ambitious target to vaccinate at least 90 percent of pregnant women against tetanus and ensure that all children are fully vaccinated against seven vaccine-preventable diseases before they reach an age of two years with a rigorous focus on remote and inaccessible rural areas, urban slums and migrant and mobile communities. Subsequently, General improvements in the delivery of routine immunisation services are also critical in the successful efforts to interrupt polio transmission in India and remain a key component in attempts to eliminate measles from the country by 2020. Different campaigns and awareness programs through anganawadis and panchayats at grass root levels of the society are also vigorously undertaken to spread knowledge of immunisation and health benefits.

Figure 1 presents the trend of child immunisation in India between 1999 and 2013 showing shows a gradual increase in child immunisation over the period. The estimated changes are from 74 percent to 91 percent for BCC (Bacilli Calmette-Guerin) vaccine; from 74 percent to 90 percent and from 59 percent to 83 percent for DTP1 and DTP3, respectively; from 57 percent to 82 percent for the third dose of oral polio vaccine; and from 56 percent to 83 percent for the first dose of vaccine against measles (Figure 1).

Despite the all-round efforts by the governments in India and significant progress, still, India could not achieve the target and is away from the goal of full immunisation. One of the important factors in child immunisation is the

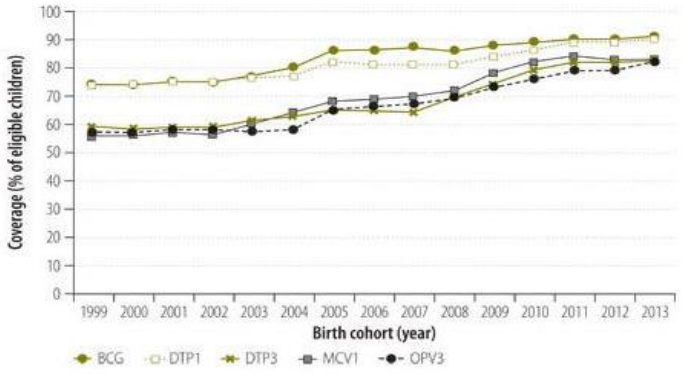

Figure 1: Trends in Child Immunisation in India.

role of the mother's education. Illiteracy among mothers is the primary cause of the poor health of the family. Improving female education is important for increasing childhood vaccination uptake and coverage. Therefore, this paper examines the determinants of child immunisation, focusing the home of the child itself, especially female education. This study also incorporates other mother characteristics, socioeconomic and demographic characteristics that are closely related to child immunisation in a family. The 6th round survey data of DHS (2015-16) is used in this study. The empirical analysis is based on a sample of 12817 observations out of a total sample of 259628 of DHS. This paper analyses the relationship between female education and child immunisation status for children in the ages between 12 to 23 months. The econometric methods followed are univariate and multivariate logistic regression (LOGIT) analysis as the dependent variable child immunisation status is a categorical variable with two possibilities - whether the child is fully vaccinated or not.

Review of Literature

Studies on the relationship between child health and female education go back to early 1970s when Caldwell (1979) demonstrated that "ceteris paribus, children of educated mothers experience lower mortality than do children of uneducated mother". Many studies have established the link between female education and different aspects of child health in every country both developing and developed.

Desai S, Alva S analyse the causal relationship between child health and female education, using a panel of demographic and health data for 22 developing countries. The study uses child mortality, immunisation status and height for age as dependent variables and mother's education, children's age, father's education, area of residence, marital status and some environmental factors as independent variables. Among the 22 countries, in 11 countries mother's primary education and 15 countries mother's secondary education are statistically significant for infant mortality, an indicator of child health. The education variables are jointly significant in 14 countries. When accounting for height for age, female education coefficients are significant as well as positive. Out of 20 countries, in 9 countries female primary education and in 11 countries mother's secondary education has a significant positive effect on children's immunisation status regardless of the community effects and other socioeconomic factors [8].

Basaleem et al. evaluate the Expanded Programme on Immunisation (EPI) in Yemen which vaccinates children in 12-23 months in Aden region of Yemen. In contrast to many studies, the outcome of this study finds that a mother's education has no significant impact on determining the immunisation status of a child in Yemen. On the other hand, father's occupation, birth order of child and place of residence account more for the immunisation status [9].

Forshaw et al. attempt a meta-analysis on 37 studies to examine the correlation between increasing female education and vaccine uptake in an attempt to know whether this relationship varies between continents, setting and time. The analysis shows increasing child vaccination uptake with increasing female education, the odds of full childhood vaccination are 2.3 times greater in children whose mother received secondary or higher education when compared to children whose mother with no education. Vaccination of children is most likely in highly educated women in rural areas, with an odds ratio of 2.17. There is no statistically significant difference in the odds ratios between the rural and urban settings [10].

Though many studies assert the positive relationship between female education and child immunisation, only a few studies explore the pathway through which female education increases child immunisation uptake. Merely having heard the term immunisation does not necessarily imply having accurate knowledge of the functions of specific types of immunisation. While the pattern of knowledge of immunisation in general increases slightly with higher education, the level of correct knowledge about which diseases the immunisation prevents rises with increasing education. Illiteracy, socioeconomic status and empowerment of women are significant factors linked to poor uptake of routine polio vaccination.

Streatfield et al. find in two villages in Indonesia, the levels of knowledge of the function of anti-polio vaccine are much higher than for the BCG and DPT vaccines, probably because the name of the vaccine incorporates the name of the disease. About 51.7 percent of mothers with primary school or more are much more likely to obtain their immunisation knowledge from a medical source (doctor, nurse and vaccinator). Further, the levels of complete coverage do not follow a clear linear pattern according to educational level. The study finds that mother's with primary education are around 7 times less likely to have their children immunised than those having either no formal education or secondary education. While more than half (55 percent) of children of mothers with a secondary school have complete immunisation, illiterate group and the highly educated group have higher coverage levels (45 percent) than some primary (31 percent) or completed primary (34 percent) groups. All education groups have an equally small proportion (1.1-3.5 percent) who never obtained any immunisation for their children. Thus, a mother's education has a nonlinear relationship described earlier [11].

Abuya et al. and Onsomu et al. analyse the effect of female education on immunisation and nutritional status in Kenya, where the child mortality rate is 115/1000 children compared to 88/1000 average for Sub-Saharan African countries. The data from Kenya Demographic Health Survey (KDHS)-2003 shows that 80 percent of children in Kenya are (nutritionally) stunted and only 49 percent are immunised. Children born to mothers with only primary education are 2.17 times more likely to be fully immunised compared to those whose mothers lacked any formal education [12,13].

Kim et al. assess the effects of women and provider characteristics on children's up-to-date status on age-appropriate immunisation. The study observes that vaccination completion rates vary according to mother's socio-demographic characteristics, especially educational attainment. Lower vaccination completion rates are associated with single motherhood. The rate among children of mothers who are never married is 14 percent, whereas the rate among children of mothers in all other marital status categories combined is 17 percent [14].

Babalola S introduces household characteristics in the relationship between child immunisation and female education and finds that motherly elements are underrated as compared to household characteristics such as income, residence area, etc. Further, children whose mothers have primary education are less likely to be immunised than those whose mothers are illiterate. Another finding of the study shows that mother's knowledge, decision making power and ideation plays a crucial role in giving immunisation to their child than the number of years she sat in the classrooms [15].

Khan MT et al. study polio vaccination coverage in Pakistan using DHS data and show that only 56.4 percent of children received complete polio vaccination and it is attributed to female education. Females with no education had significantly higher odds of their children receiving no polio vaccination and incomplete vaccination. Further, un-empowered women also have significantly higher odds of not taking their child for any polio vaccination and incomplete vaccination. The multivariate analysis on the

relationship between mothers' level of education and polio vaccination uptake for their children shows that 74.4 percent of children of mothers with higher education are completely vaccinated compared to 66.9 percent of those with secondary education and 62.3 percent and 47.1 percent of those with primary and with no education respectively [16].

Balogun et al. try to capture the mediating role of female literacy and socioeconomic status on the link between female education and complete immunisation of children under the age of one in Nigeria. The ability to read and write is considered to be female literacy while household expenditure is treated as the measure of socioeconomic status. Using prevalent ratios and regression analysis, the study concludes that the relationship between female education and immunisation uptake is substantially explained by female literacy. Household economic status is another pathway through which female education improves immunisation uptake. The indirect effect of the socioeconomic status is lower compared to female literacy skills [17].

In the Indian context, study immunisation status of children and female education in Madhya Pradesh in the context of Universal Immunisation Programme (UIP). The multivariate analysis shows an increasing full vaccination with an increasing level of female education i.e. significant differences has been observed among the fully immunised children of literate parents especially for literate mother as compared to illiterate parents. Lack of information is the main obstacle of non-immunisation [18].

Phukan et al. take into account the fact that in North-Eastern regions of India immunization coverage is poor. In analysing the factors associated with immunisation coverage of child over the first year of life in Assam, the study observes that only about 62.2 percent of children only are fully immunised. Mother's education level and urban region show significant role in immunisation coverage. Lack of information among the parents is one of the major causes of poor vaccination in North-Eastern India [19].

Patra N analyses the determinants of immunisation coverage in India concluding a strong positive relationship between mother's education and children's immunisation coverage. The study observes that the chance that the child is immunised is almost three times higher for the children of mothers with high school or above education than the children of illiterate mothers. Mother's awareness of immunisation also has a significantly strong positive effect on vaccination. The chance of child immunisation is 58 percent for children of mothers with some awareness of immunisation, whereas it is only 33 percent for children of mothers unaware of vaccination. This study also finds that empowerment of women, exposure of mother towards mass media, mother's employment and her communication skills and fathers education show positive and significant relationship with child vaccination [20].

Sharma B examine the status and performance of child immunisation programmes in Uttar Pradesh and Uttarakhand during the period 1980-2004 and try to identify the factors stimulating immunisation coverage. The study observes a positive relationship between mother's education and children's vaccination coverage. While 74 percent of children are fully vaccinated whose mothers have completed at least high school, 56 for mothers educated below high school level, only 28 percent of children of non-literate mothers are fully vaccinated. Further, the relationship between vaccination coverage and birth order is consistently negative for almost all vaccinations. About 69 percent of children have received polio vaccine at the time of birth in urban areas whereas this proportion is only 33 percent in rural areas. Full vaccination is likely for male children (47 percent) than for female children (45 percent). A large majority of first-order births occur to younger women who are more likely than older women to utilize child healthcare services. The children from Hindu households are much more likely (47 percent) than children from Muslim families (36 percent) to have received each of the recommended vaccinations [21].

In a comparative study of India and Pakistan, [22] figure out the impact of female education on child immunisation. Using the multinomial logistic model on the categorized variable, fully vaccinated, partially vaccinated and non-vaccinated, the study concludes that the uneducated women living in villages immunised their children less than the educated mothers living in cities. Child immunisation is higher in a women-headed family than in a male-headed family. Though both India and Pakistan show the same pattern in odds ratios, there is a significant difference in each estimate between the two countries.

Thus, the relationship between female education and child immunisation, both coverage and full vaccination, has been consistently positive in all studies and immunisation coverage increases with rising female education. Further, the studies also show that lack of information is the main cause of poor vaccination in most studies. Therefore, improvement in female literacy coupled with fostering awareness of immunisation especially among females is suggested as the basic issue in full coverage of child immunisation.

Data and Methodology

The main focus of this study is to understand the impact of female education on child immunisation status. This paper uses the 6th round of the nationally-representative Demographic and Health Survey of India for the year 2015-16 (DHS-VI). The global DHS Program, of which India is a part, collects and disseminates nationally representative data on population, family planning, women and child health, HIV/AIDS, malaria, nutrition, etc. along with household demographic data for most of the countries. The DHS survey covers information on 3540 variables including data on child characteristics, household characteristics, health history, etc. To study child immunisation coverage, children between the ages of 12 to 23 months are considered. The criterion for selecting samples is whether the sample household holds an immunisation card or not. A child is considered to be completely vaccinated if he or she has received a dose of BCG, three doses of DPT and three doses of oral polio vaccine (OPV) within the age of 12-48 months. The data set for this paper consists of 12817 samples out of a total of 259628 in the DHS-IV survey of India.

In the empirical analysis on the effect of female education on child immunisation, this paper takes complete immunisation i.e. if he or she has received a dose of BCG, three doses of DPT and three doses of oral polio vaccine (OPV) within the age of 12-48 months. Therefore, the outcome measure of child immunisation is dichotomous in nature which takes a value of 1 for complete immunization and 0 otherwise. Hence, logistic regression is identified as the appropriate estimating model.

Given the basic regression equation:

$$y_i = \beta_0 + \beta_1 x_i + u_i \quad (1)$$

The logistic regression model is derived as:

$$E(y_i|x_i) = \beta_0 + \beta_1 x_i = p_i \quad (2)$$

$$p_i = E(y_i = 1|x_i) = \beta_0 + \beta_1 x_i \quad (3)$$

$$p_i = E(y_i = 1|x_i) = \frac{1}{1+e^{-\beta_0+\beta_1 x_i}} = \frac{1}{1+e^{-z_i}} = \frac{e^{z_i}}{1+e^{z_i}} \quad (4)$$

Which represents the cumulative logistic distribution. The value of z ranges from -∞ to +∞, p, 0< p <1 is non-linearly related to z. The logistic model cannot be estimated by the OLS method as p is non-linear not only in x but also in β. Therefore,

$$1 - p_i = \frac{1}{1+e^{z_i}} \quad (5)$$

and hence,

$$\frac{p_i}{1-p_i} = \frac{1+e^{z_i}}{1+e^{-z_i}} = e^{z_i} \quad (6)$$

Taking log,

$$L_i = ln\left(\frac{p_i}{1-p_i}\right) = lne^{z_i} = z_i = \beta_0 + \beta_1 x_i \quad (7)$$

That is L, the log of the odds ratio, is not only linear in *x* but also linear in the parameters. The L_i is the logit and a positive logit means that when the value of regressors increases, the odds that the regressand equals 1 (complete immunisation) increases and if L is negative, the odds that the regressand equals 1 decrease as the value of *x* increases. Taking the antilog of L, the odds ratio is obtained and the odds ratio ranges from 0 to ∞. From the odds ratio (OR), estimated through the logistic regression, the probability that a child is fully vaccinated is calculated as:

$$OR = \frac{p}{1-p} \Rightarrow p = OR - (OR)p \Rightarrow OR = p + OR(p) \Rightarrow OR = p(1+OR) \Rightarrow p = \frac{OR}{1+OR} \quad (8)$$

As the logit model is non-linear in parameters and variables, the logistic regression is estimated by the maximum likelihood estimation approach. For a random sample of n observations, let $f_i(y_i)$ denote the probability that $y_i = 1$ or 0, the joint probability of observing the *n*values $f(y_1, y_2, \cdots, y_n)$ is given as:

$$L_i = f(y_1, y_2, \cdots, y_n) = \prod_{i=1}^{n} f_i(y_i) = \prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{(1-y_i)} \quad (9)$$

The joint probability density function is a product of individual density functions because each $y_i$is drawn independently and each $y_i$has the same (logistic) density function, which is the likelihood function. Taking natural logarithm, the log-likelihood function is obtained:

$$\ln(y_1, y_2, \cdots, y_n) = \sum_{i=1}^{n}[y_i lnp_i + (1-y_i)ln(1-p_i)] \quad (10)$$

$$= \sum_{i=1}^{n}[(y_i ln p_i - y_i ln(1-p_i) + ln(1-p_i)] \quad (11)$$

$$= \sum_{i=1}^{n}\left[y_i ln\left(\frac{p_i}{1-p_i}\right)\right] + \sum_{i=1}^{n} \ln(1-p_i) \quad (12)$$

Therefore,

$$(1-p_i) = \frac{1}{1+e^{z_i}} \quad (13)$$

$$ln\left(\frac{p_i}{1-p_i}\right) = ln e^{z_i} = \beta_0 + \beta_1 x_i \quad (14)$$

The log-likelihood function is a function of parameters 0 and β_1, since the x_i are known. Once the numerical values of β_0 and β_1 are obtained by maximising the log-likelihood function, then the probability and odds ratios are obtained.

Empirically, as the measure of a child immunisation is a binary variable that indicates whether a child had all six vaccinations or not, binary logit regression is estimated. The estimated β coefficients for the discrete dependent variable shows how the probability that y_i = 1 is predicted to change from 0 to 1 for a change in a covariate and the marginal effects are calculated using the cumulative logistic distribution function. The estimating logit model is specification as:

Complete Immunisation$_i$= β_0 + β_1Mother education + β_2Father education + β_3Residence + β_4Gender of child + β_5Age of child + β_6Socioeconomic status + β_7Community + β_8Religion + β_9Birth order + β_{10}Age of mother + β_{11}Birth interval + β_{12}Access to information + u_i (15)

Empirical Analysis

Table 1 presents the descriptive statistics of the variables used in the estimation of the effect of female education on child health in India. The descriptive statistics include mean and standard deviations and proportions for the variables with 12817observations. The mean of education of mothers is 6.69 years with a standard deviation of 5.19 years. The mean of father's education is slightly higher, 7.84 years with a dispersed of 4.86 years. The mean age of children is 20.42 months and the standard deviation is 5.17 months.

The proportion of children received all course of immunisation in time is 67 percent, while 32 percent of children failed to receive complete vaccination. Surprisingly, more female children (88 percent) has been immunised compared to male children (68 percent). Newborn babies have higher chances (74 percent) of receiving complete vaccination than older children (60 percent). About 77 percent of children from higher-income class received an immunisation, while only 59 percent of children in poor families have received full immunisation. While child immunisation is almost complete in urban households, only 88 percent of children are vaccinated in rural areas. There is not much difference by community or religion in child immunisation. But, significant differences exist by sources of knowledge as a sizable number of mothers do not read newspapers and watch television which is the main channels of information (Table 1).

Table 2 presents the logistic regression estimates of complete immunization with alternative specifications. The primary interest is to identify the effect of female education on child immunisation. In the first specification where the female education alone is regressed on child immunisation, the estimated coefficient is positive and statistically significant. An increase of a year of mother's education, the probability of the child getting immunised increases by 0.0214. Controlling for confounding effects of socioeconomic and demographic characteristics also, the effect of mother's education is attenuated, in such a way that the probability of child immunisation is almost the same, ranging from 1.3 percent to 1.8 percent. In all specifications,

Table 1: Descriptive statistics of variables in the analysis of child immunisation and female education.

Variable	Description	Mean	
Complete immunisation	If a child is completely vaccinated i.e. if the child has received a dose of BCG, three doses of DPT and three doses of oral polio vaccine (OPV) within the age of 12-48 months = 1, 0 otherwise i.e. if the child missed any of the five vaccines	0.67 (0.32)	
Child's age	Age of the child between 12 and 23 months	20.42 (5.17)	
Birth order of child	Birth parity/order from the first birth to the last birth of children	2.24 (1.45)	
Mother's education	Completed education of mother (years)	6.69 (5.19)	
Age	Age of mother (years)	26.6 (4.94)	
Father's education	Completed years of education of father (years)	7.84 (4.86)	
Proportions		Complete vaccination	No full immunisation
Child's gender	Male child =1 Female child - 2	67.89 88.27	32.05 21.73
Birth interval	≥ 48 months = 1 25–47 months =2 ≤ 24 months = 3	60.24 67.09 73.87	27.72 32.91 38.71
Socioeconomic status	Poor income= 0 Middle income = 1 High income = 2	58.92 70.49 76.78	41.08 29.51 23.22
Community	SC = 1 ST = 2 Other backward class = 3 Others = 4	68.42 60.15 68.86 70.27	31.56 39.85 31.39 29.72
Religion	Hindu = 1 Muslim = 2 Christian = 3 Others = 4	68.56 68.03 59.60 76.39	31.44 40.86 40.40 23.51
Residence	Urban = 1 Rural = 0	99.00 88.12	1.00 11.46
Information source	Mother reads newspaper = 1 Not reading newspaper = 0	63.17 37.55	32.43 68.78
Information source	Mother watches television = 1 Not watching television = 0	78.56 21.78	21.45 77.96
Observations		12817	

Note: Figures in parentheses are standard deviations.

Table 2: Logistic regression estimates of child immunisation.

Variable	Speci.1	Speci.2	Speci.3	Speci.4	Speci.5
Mother's education	0.0214*** (0.0008)	0.0183*** (0.001)	0.0165*** (0.001)	0.0165*** (0.001)	0.0138*** (0.001)
Father's education	-	0.0045*** (0.001)	0.0026** (0.001)	0.002** (0.001)	0.0019** (0.001)
Age of child	-	-0.0003 (0.0008)	0.0003 (0.0008)	-0.0006 (0.0008)	-0.0007 (0.0008)
Male child	-	0.013** (0.084)	0.0163** (0.0084)	0.0162** (0.0084)	0.016** (0.0084)
Urban	-	0.0217** (0.010)	0.0089 (0.011)	0.0078 (0.011)	0.0067 (0.011)
Poor income	-	-	-0.059*** (0.013)	-0.0450*** (0.013)	-0.036* (0.013)
Middle income	-	-	-0.010 (0.013)	-.0048 (0.013)	-0.003 (0.013)
SC	-	-	-0.064 (0.074)	-0.0508 (0.075)	-0.0508 (0.076)
ST	-	-	-0.1006 (0.088)	-0.087 (0.087)	-0.087 (0.087)
OBC	-	-	-0.022 (0.085)	-0.020 (0.085)	-0.019 (0.085)
Hindu	-	-	-0.07* (0.023)	-0.066* (0.023)	-0.066* (0.023)
Muslim	-	-	-0.131*** (0.028)	-0.116*** (0.028)	-0.113*** (0.028)
Christian	-	-	-0.162*** (0.032)	-0.145*** (0.032)	-0.152*** (0.032)
Birth order	-	-	-	-0.029*** (0.004)	-0.029*** (0.004)
Mother's age	-	-	-	0.004*** (0.001)	0.004*** (.001)
Birth interval ≥ 48 months	-	-	-	-0.003 (0.011)	-0.001 (0.011)
Birth interval ≤ 24 months	-	-	-	0.0028 (0.011)	0.0039 (.011)
Mother reads newspaper	-	-	-	-	0.023* (.023)
Mother watches television	-	-	-	-	0.036* (0.11)
Log-likelihood	-7772.74	-7759.67	-7709.92	-7679.22	-7670.91
LR chi2(1)	689.48	715.64	815.13	876.53	893.14
Prob.> chi^2	0.000	0.000	0.000	0.000	0.000
Pseudo R-square	0.045	0.044	0.050	0.054	0.055

Note: Figure in parentheses are standard errors.
*** Significant at 1%level
** Significant at 5% level
* Significant at 10% level

the coefficients are still positive and statistically significant. Thus, female education is important for complete vaccination of children.

The estimated results show that the father's education also plays a positive and statistically significant role in child immunisation, though its effect is somewhat lower than female education. Age of the children has no statistically significant effect on child immunisation, whereas the age of mother influences child immunisation positively and significantly. The birth order effect on the probability of child receiving complete immunisation is significantly negative the birth interval has no significant effect. Older children have about 3 percent fewer chances of completely immunised. The probability of receiving complete immunisation is significantly higher for a male child and urban residence. The probability of the male child getting immunised is higher by 1.6 percent than the female child. Another significant variable in child vaccination is income status. While the probability of child immunisation is significantly negative for poor families, other income groups have a statistical impact on child vaccination. The community background has little effect on complete immunisation of children, whereas the effect of all religion on child immunisation is significantly negative. The effect of knowledge of immunisation helps higher chances of the child getting complete vaccination in time as the positive and significant coefficients of reading a newspaper and watching television reveals.

Thus, the overall estimated logistic regression results show that female education dominates over all other factors in generating a significant impact on child immunisation coverage. The estimates also show a consistent attenuation of positive measure of the probability of getting child immunised as the female education increases in all specifications considered (Table 2).

Conclusion

Education makes a woman empowered and this empowered woman is central for fruitful decisions, especially on health and education of children. Female education builds strong mindsets and is effective in improving communication and maintaining relations with society. The crucial role of female education especially in the Intrahousehold allocation of resources specifically towards girl child is well documented in the literature. The effect of female education on the utilisation of government services especially on healthcare is also well recognized. Female education is the crucial factor in seeking both neonatal and post-natal care of both the mother and the child. The focus of this paper is to understand the effect of female education on child health in India. The paper measures child health in terms of complete immunisation, the child receiving all vaccinations - a dose of BCG, three doses of DPT and three doses of oral polio vaccine (OPV) within the age of 12-48 months. To study the impact of female education on child immunisation status, this paper uses the 6th round of the Demographic and Health Survey of India for the year 2015-16 (DHS-VI), the nationwide survey consisting of 12817 samples out of a total of 259628 in the DHS-IV survey of India. Empirically, as the dependent variable is binary – whether the child received complete immunisation or not, logistic regression is used.

The logit estimates show that the effect of female education on complete child vaccination is significantly positive. Woman with at least formal education is better placed in seeking child healthcare. This positive effect is further facilitated by knowledge and awareness of immunisation programmes. The information on child vaccination is enhanced with female education. Socioeconomic status, father's education, birth order, urban residence and religion also show significant influence on child immunisation status. Significantly, more boys receive complete immunisation than girls, showing some form of neglect of female children. The estimated results also show that community and births are not important for child immunisation in India. Therefore, an integrated approach that improves female schooling, increasing the level of health knowledge, and developing positive attitudes toward modern healthcare among mothers are beneficial for complete vaccination of children in India. This is also a key to improving child health and reducing child mortality in India bringing India a step closer to achieving the SDG goals.

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