DETERMINANTS OF CHILD IMMUNIZATION AND MEASURMENT OF GENDER BIAS

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Abstract

This paper attempts to analyse the role of some socio-economic and demographic variables on the likelihood of being fully immunised in Indian scenario . Six childhood vaccinations are being considered for the children of the age between one to two years in India. The data used in this paper are from the India Human Development Survey (IHDS), which was conducted in 2004-05 by the University of Maryland in collaboration with the National Council of Applied Economic Research, New Delhi between November 2004 and October 2005.The nationally representative data covers 1504 villages and 971 urban areas across33 states and union territories of India. The paper also tries to decompose the gender gap in full immunisation among children of age one to two years and tries to quantify the gender discrimination with regard to childhood immunisation.

Keywords: Child Immunisation, UIP, Gender discrimination, Fairlie Decomposition

Introduction

Despite the growing awareness, the childhood immunisation rate in India is not yet satisfactory. Measure of children’s immunizationagainst several childhood diseases gives an indicationof how much priority the children’s health is given in household. It is important to determine the factors which play crucial role in children’s welfare. Though childhood vaccinations are available free of cost in India, but the population of children not fully immunised is worrisome.

Immunisation programme is the essential interventions for protection of children from life threatening diseases.

The immunisation programme in India was launched in 1978 as Expanded Programme on Immunisation (EPI). With Universal Immunisation Programme (UIP), It gained momentum in 1985 and was carried out in phased manner to cover all districts in the country by 1989-90 (MoHFW 2006-07: 58). More than 90 million pregnant women and 83 million infants were targeted to be immunised over a five year period under the UIP. UIP became a part of the *Child Survival and State Motherhood* (CSSM) Programme in 1992 (MoHFW 2002-03: 176). Since 1997, immunisation activities have been an essential part of the *National Reproductive and Child Health* (RCH) Programme (MoHFW 2005-06: 54).

In India, under the UIP, vaccines for six vaccine-preventable diseases (Tuberculosis, Diphtheria, Pertussis (whooping cough), Tetanus, Poliomyelitis, and Measles) are available free of cost to all.

This programme faces many supply side and demand side bottlenecks. In India, healthcare budget is meagre which the fact for many developing countries is. But there are problems in demand side of immunisation. Some socio economic and demographic factors play crucial role in shaping the demand for full vaccination of a child in a household. This paper focuses on demand side problem of immunisation.

Vaccine-preventable diseases have socio-economic outcomes. Children suffering from diseases have poor attendance in school and may even drop out eventually. These diseases have effect on morbidity and mortality. Also, the parents have to bear the cost of children's ill health through hospitalisation, doctor's fees, and medicines etc. These diseases have negative impact on individual as well as society. A sick child can suffer from chronic diseases in his adult life also and may have lesser productivity in professional front. Health status of population determines state's human capital.

Health of population is a product of society and has an indispensable contribution to economic growth and political stability. UIP is often cited as 'the most cost-effective route to child's better health' (WHO 1998). 'Universal immunisation of children … is crucial to reducing infant and child mortality' (IIPS 2007: 227).

Literature Review

There are studies which indicate the gender discrimination against girl children aged between 1 to 2 years compared to the boys of same age group in the area of full immunisation (Borooah, 2004). Other researchers have also noted such discriminating behaviour of families against girl children (Choi et al 2006 (in rural areas only); Das Gupta 1987; Gatchell et al 2008, Islam et al 1996; Lloyd 1993; Rajeshwari 1996). However, Hill et al (1995) showedthat although there are significant variations in immunisation coverage between genders, the median difference across all countries is very close to zero.

Borooah,2004 has also showed that this bias declines with mother's education. Such a positive effect of maternal education is also hypothesised by Akmatov et al 2007, Desai et al 1998, Gage et al 1997, Gatchell et al 2008, Islam et al 1996, Lee 2005.

Higher immunisation coverage in urban areas is confirmed by many researchers (Padhi, 2001; Pebley et al 1996). But, after controlling for other variables, the rural-urban disparity is not statistically significant.

Objective

This paper tries to assess influence of somedemographic and socio-economic variables on full immunisation coverage of children, aged between 1-2 years. The immunisation helps to prevent six vaccine-preventable diseases covered under Universal Immunisation Programme (UIP).

The paper also tries to decompose the gender gap in full immunisation among children of age one to two years. I want to quantify the amount of discriminating behaviour contributing to this gap in immunisation between two genders.

Data

The data used in this paper are from the India Human Development Survey (IHDS), which was conducted in 2004-05 by the University of Maryland in collaboration with the National Council of Applied Economic Research, New Delhi between November 2004 and October 2005. The nationally representative data covers 1504 villages and 971 urban areas across 33 states and union territories of India. The survey covering 41,554 households was carried out through face-to-face interviews by pairs of male and female enumerators in local languages. The respondents included a person who was knowledgeable about the household economic situation (usually the male head of the household) and an ever-married woman aged 15-49.

The 12-23 month age group was taken for analysis because as per international and GoI guidelines children should be fully immunized by one year of birth.

I have used Household file, Birth-history file and Village file to collect the information related to children and their mothers, household etc.

Data on immunisation is based on vaccination card for each living child or on mother's report in case of non availability of the card. According to World Health Organisation guideline, children who received BCG, measles, and three doses each of DPT, and Polio (excluding Polio 0) are considered to be fully vaccinated.

For, explanatory variables, I have three categories – Individual specific, household specific and village specific. Indicators used in my analysis are listed in next table. I have taken mother's membership at Mahila Mandal as proxy for women empowerment.

Variables used in Logistic regression

Indicators	Category
Place of residence	Rural, Urban, Urban slum
Caste	Others, SC, ST, OBC
Religion	Hindu, Muslim, Christian, Sikh, Others
Income of household	Continuous variable
Mother's Education	No education, Primary, Secondary, Higher Secondary
Major occupation of HH	Business, Salaried & others
Member of Mahila Mandal	No, Yes
Birthorder	Continuous variable
Mother's age	Continuous variable
Mass media exposure	Radio, News paper, TV watching
Place of delivery	Home, Govt, clinic, Pvt. Nursing home, other
No. of Anganwadi or other childcare centre in village	Continuous variable
Antenatal checkup	No, Yes
Postnatal checkup	No check up, Only mother, only baby, both
No. of health subcentres	Continuous variable
No. of immunisation camp	Continuous variable

The dependent variable is full immunisation that says whether a particular child is fully immunised or not.

Methodology

I have used logistic regression to determine significant variables for childhood immunisation.

The binary variable R_i is defined as: $R_i = 1$ if the child was fully immunised, in the sense he/ she has received the all the eight vaccination doses , otherwise $R_i = 0$.

The probabilities of a child being fully immunised is estimated separately for boys and for girls, as logit models:

$$\frac{\Pr(R_i = 1)}{1 - \Pr(R_i = 1)} = e^{\sum_{k=1}^{K} \beta_k x_{ik}};$$

where: x_{ik} is the values of the *kth* determinant forthe *ith* child

I have estimated logistic regression equations for pooled as well as for boys and girls separately.

In Table 4, I have reported the results for all three equations.

To analyse gender discrimination I have used Fairlie Decomposition. This is extension of popular Blinder-Oaxaca decomposition analysis.

Fairlie Decomposition: Fairlie decomposition computes the nonlinear decomposition of binary outcome differentials proposed by Fairlie (1999, 2003, 2005). That is, fairlie computes the difference in Pr(Y # 0) between the two groups and quantifies the contribution of group differences in the independent variables to the outcome differential. Furthermore, fairlie estimates the separate contributions of the individual independent variables (or groups of independent variables).

Perhaps the most common approach used in the past few decades to identify underlying causes of racial/gender differences and quantify these causes is the technique of decomposing inter-group differences in mean levels of an outcome into those due to different observable characteristics or "endowments" across groups and those due to different effects of characteristics or "coefficients" of groups. The technique is commonly attributed to Blinder and Oaxaca.

This paper aims to study the contribution of gender in the immunization gap. The Blinder Oaxaca decomposition technique is useful in quantifying the separate contribution of the factors and also how behavioural differences or discrimination contribute to the gap. This technique only requires coefficient estimates from linear regressions for the outcome of interest and sample means of the independent variables used in the regressions. However, the standard Oaxaca decomposition technique cannot be used when dependent variable is binary. In this study, the dependent variable, immunization, is binary. There are several studies which use Fairlie decomposition technique for the binary dependent variable (Fairlie, 1999, 2005; Yun, 2004; Jan, 2008;).

Here I will use an extension of Blinder- Oaxaca decomposition to non linear regression developed by Fairlie (1999, 2005).

For a linear regression, the standard Blinder-Oaxaca decomposition of the white/black gap (male/female, North//South, etc. . .) in the average value of the dependent variable, Y , can be expressed as:

$$\overline{Y}^W - \overline{Y}^B = \left[(\overline{X}^W - \overline{X}^B)\hat{\beta}^W\right] + \left[\overline{X}^B(\hat{\beta}^W - \hat{\beta}^B)\right], \quad (1)$$

where $^{-}X\ j$ is a row vector of average values of the independent variables and $\hat{}\ \beta j$ is avector of coefficient estimates for race *j*. Following Fairlie , the decompositionfor a nonlinear equation, $Y = F(X\ \hat{}\ \beta)$, can be written as:

$$\overline{Y}^W - \overline{Y}^B = \left[\sum_{i=1}^{N^W} \frac{F(X_i^W \hat{\beta}^W)}{N^W} - \sum_{i=1}^{N^B} \frac{F(X_i^B \hat{\beta}^W)}{N^B}\right] + \left[\sum_{i=1}^{N^B} \frac{F(X_i^B \hat{\beta}^W)}{N^B} - \sum_{i=1}^{N^B} \frac{F(X_i^B \hat{\beta}^B)}{N^B}\right], \quad (2)$$

where Nj is the sample size for race j. Here we define $\overline{Y}^j$ as the average probability of the binary outcome of the group j and F is the cumulative distribution function from the logistic distribution.

In both Equations (1) and (2), the first term in brackets represents the part of the racial/ gender gap that is **due to group differences in distributions of X**, and the second term represents the part **due to differences in the group processes determining levels of Y**. The second term also captures the unexplained portion of the racial/gender gap which is caused by differences in unobserved endowments.

The coefficient part or 'unexplained' part is a measure of discrimination.

The contribution of each variable to the gap is thus equal to the change in the average predicted probability from replacing boys' immunisation distribution with girls' immunisationl distribution while holding the distributions of the other variable constant.

Using coefficient estimates from a logit regression for a sample, the independent contribution of X1 (an independent variable) to the gender gap, in our case, can then be expressed as:

$$\frac{1}{N^B}\sum_{i=1}^{N^B} F(\hat{\alpha}^* + X_{1i}^W\hat{\beta}_1^* + X_{2i}^W\hat{\beta}_2^*) - F(\hat{\alpha}^* + X_{1i}^B\hat{\beta}_1^* + X_{2i}^W\hat{\beta}_2^*)$$

While keeping distribution of other variable constant. A useful property of this technique is that the sum of the contributions from individual variables will be equal to the total contribution from all of the variables evaluated with the full sample.

Tthe positive contribution of a covariate indicates that particular covariate contributed to widening the gender gap in immunisation, the negative contribution of a covariate indicates diminishing the gap

Result and Analysis

Table 1 and 2 in Appendix shows the distribution of some of the covariates across the children aged between 1 to 2 years. Of the total boys around 59% has full vaccination coverage while among girls around 57% is fully immunised. In the context of Caste and religion, Muslims have least immunisation and ST has lowest immunisation coverage.

Table 3 portrays the immunisation scenario across the states North Eastern states have very low immunisation rate. Bihar, UP, Rajasthan, MP, Jharkhand have lower coverage than country average. Southern states, Punjab, Himachal have higher immunisation rate than all India average.

From descriptive statistics in Table1 and 2 we can see that there is immunisation gap between boys and girls children of the age 1 to 2 years. Interestingly this gap persists even if vaccines are freely available in India.

Other researchers have also noted such behaviour of families in neglecting and discriminating against girl children (Choi et al 2006 (in rural areas only); Das Gupta 1987; Gatchell et al 2008, Islam et al 1996; Lloyd 1993; Rajeshwari 1996).

The chance of immunisation is significantly low in Muslim household.

There is consistently positive relationship between immunisation and mother's education. It is also clear from the regression coefficient that impact of mother's education on full vaccination is almost same for girl and boy child. So, the education narrows down gender gap in immunisation.

Higher immunisation coverage is found with lower birth order in several studies. Butafter controlling for other variables this factor is not showing statistically significance.

Media exposure has a significantly positive effect on immunisation. The chance of full immunisation is higher when mothers' have regular media exposure compared to children whose mothers are not. The likelihood of vaccination increases with regular exposure to mass media, specially TV.

Antenatal care during pregnancy is positively associated with childhood immunisation. Such a positive relationship is also found by Choi et al 2006 (in rural areas only), Gatchell et al 2008, and Islam et al 1996. This shows the possibility of positive *information spillover* or *learning-by-doing* (Lee et al 2005) from antenatal care during pregnancy on childhood immunisation. ICDS centres and health sub centres counsel the pregnant women about the need for child immunisation.

Decomposition Result

The decomposition result shows that there is difference in likelihood of fully vaccinated among boy and girl child. But only 17% of this gap is explained by independent variables. Rest 83% difference remains unexplained. Although the decomposition technique distinguishes between explained and unexplained portions of the total gender difference, it does not give any signal as to what might clarify the unexplained gap.Usually, we can consider unexplained part as a measure of discrimination.

This result indicates towards the discrimination against girl child. Unexplained part is simply the difference between average probability of the girls being fully immunised, had they been treated as boys and sample proportion of fully immunised girls. While doing decomposition I have used Boys as reference and have used the coefficient of boy's regression equation as weight.

Results of the paper are listed down in brief

- Mother's education level increases the probability of child being fully immunised.
- Only 13% of the immunisation gap between boys and girls could be explained by the fact that girls are born in the families with different familial circumstances (endowment factor). Rest 87% of the immunisation gap is accounted for different treatment for girls which is unexplained/ unmeasured. The underlying cause may be the discrimination against girl child.
- Among the religious groups, Muslim children are least likely to be Immunized
- Some antenatal care during pregnancy raises immunization chances significantly. This increases possibility to meet health personnel who help mothers to raise awareness by disseminating information regarding immunization.
- The persistence of considerable gender differentials suggest the failure of social and health policies to ensure equitable health progress for all population groups .
- The results suggest that in addition to strengthening MCH programmes in rural areas, substantial efforts must also be made to improve women empowerment and female education

Conclusion

While the state is committed to well-being of children, it seems that some social factors have retarding effect which limit some children's access to health services.

The presence of inequities among genders,religions, caste,poor strategies for the targeting of basic needs by the state,inadequate information systems have created scenarios thathave potentially negative implications for children's health care.

Though state's interventionis essential for improving the welfare of children, the ultimateresponsibility for accessing such services lies with the households.

Policies and programmes in other sectors such aseducation, welfare, industry, labour, information, environment, etc. shouldalso take the public health into considerations(Gopalan, 1994).

To achieve the goal of UIP in India, the policy makersshould also give more importance in female education through Education for All.

Also building better infrastructure to provide antenatal care, increasingmass awareness regarding vaccinationthrough electronic mass media will be also effective for improving immunisation coverage

Appendix

Table1: Descriptive statistics of the some variables of the sample (children aged 1-2 years)

Variables	Percentage
Full Immunization (Yes)	58.8
Sex of child (Boy)	54.5
Boy children- fully immunised	59.57
Girl children- fully immunised	56.52
Religion	
Hindu	78.42
Muslim	13.45
Christian	3.31
Sikh	2.28
Others	2.54
Caste	
Others	30.53
SC	20.87
ST	8.82
OBC	39.78
Residence -Rural	65
Urban	33.25
Urban slum	1.74
Antenatal checkup	
No	17.69
Yes	82.31
Place of delivery	
Govt. clinic	27.73
Pvt. Nursing home	25.33
Home	45.95
Other	0.99
Women empowered- No	93.32

Table 2: Proportion of fully immunized children (1-2 years)

Variables	***Full Immunization (in %)***
Boy	59.57
Girl	56.52
Others caste	61.23
OBC	57.19
SC	56.98
ST	54.95
Hindu	60.18
Muslim	43.7
Christian	62.4
Sikh	65.12
Others caste	61.46
Empowered mother	75.79
Non-empowered mother	56.96

Table 3: Child Immunization(aged within 1 to 2 year) by states, IHDS (2004-05)

State	Fully immunised (%)
Bihar	15.77
Arunachal Pradesh	16.67
Manipur	33.33
Uttar Pradesh	37.4
Meghalaya	38.46
Jammu & Kashmir	41.82
Rajasthan	44.2
Delhi	44.83
Madhya Pradesh	47.21
Tripura	47.83
Jharkhand	51.56
Andhra Pradesh	57.52
Haryana	57.66
Uttaranchal	60.38
Punjab	65.54
Gujarat	66.19
Karnataka	66.27
Orissa	69.14
Kerala	69.75
West Bengal	72.35
Mizoram	72.73
Maharashtra	73.6
Tamil Nadu	81.29
Chhatishgarh	81.69
Himachal Pradesh	89.21
All India	58.18

*Have not included Nagaland and Assam due to inadequate data regarding immunisation

Table 4: Result of Logistic Regression

Variables	***Pooled sample***			***Boy child***			***Girl child***		
Factor	**Odds ratio**	**Robust S.E**	**Signif.**	**Odds ratio**	**Robust S.E**	**Signif.**	**Odds ratio**	**Robust S.E**	**Signif.**
INCOME	1.000	1E-06		1	1.17E-06		1.000	0.000	
Caste_HH- others ref									
SC	1.000	2E-01		1.069	0.263		0.959	0.234	
ST	1.237	3E-01		1.171	0.352		1.435	0.428	
OBC	1.675	5E-01		2.549	1.004	**	1.127	0.483	
Religion – Hindu ref									
Muslim	0.487	1E-01	***	0.514	0.144	**	0.454	0.129	***
Christian	1.072	4E-01		0.842	0.418		1.426	0.866	
Sikh	0.515	2E-01		0.271	0.141	**	4.257	2.559	**
Others	0.773	3E-01		0.487	0.283		1.360	0.864	
Occupation- cultivator & allied ref									
Ag & non-ag labour	1.219	2E-01		0.920	0.203		1.711	0.421	**
Business	1.076	2E-01		0.894	0.258		1.292	0.421	
Salaried & others	0.717	2E-01		0.435	0.140	***	1.182	0.351	
Radio exposure- Never ref									
sometime	1.098	2E-01		1.207	0.262		0.980	0.211	
regular	0.962	2E-01		0.842	0.253		1.064	0.360	
News paper exposure- Never ref									
sometime	0.714	2E-01		0.745	0.225		0.711	0.208	

regular	0.532	2E-01	**	0.842	0.394		0.324	0.140	
TV exposure- Never [ref]									
sometime	1.691	3E-01	***	1.707	0.389	**	1.644	0.390	
regular	1.938	4E-01	***	1.569	0.464		2.545	0.691	***
Mahilamandal member- yes	1.326	4E-01		1.299	0.487		1.392	0.572	
Mother's age	0.997	2E-02		0.965	0.020	*	1.033	0.024	
Mother's education	1.135	2E-02	***	1.131	0.032	***	1.133	0.032	***
No. of children	0.944	6E-02		1.020	0.083		0.861	0.079	
Antenatal checkup- No [ref]	4.386	8E-01	***	4.229	1.005	***	4.885	1.392	***
Place of delivery- Govt. clinic [ref]									
Pvt. Nursing home	0.931	2E-01		0.978	0.302		0.811	0.260	
Variables	***Pooled sample***			***Boy child***			***Girl child***		
Factor	**Odds ratio**	**Robust S.E**	**Signif.**	**Odds ratio**	**Robust S.E**	**Signif.**	**Odds ratio**	**Robust S.E**	**Signif.**
Home	1.080	2E-01		0.978	0.240		1.046	0.260	
Others	1.413	7E-01		0.911	0.604		2.252	1.535	
Post natal checkup- never [ref]									
For mother	1.424	5E-01		1.753	0.779		1.112	0.589	
for baby	0.988	2E-01		0.789	0.248		1.284	0.394	
for both	1.435	3E-01		1.482	0.392		1.266	0.415	
Anganwadi centre #	0.978	2E-02		1.000	0.025		0.955	0.023	*
Immunisation camp #	1.003	4E-02		1.016	0.051		0.977	0.048	

Note: *** p< 0.01, ** p< 0.05

Table 5: Decomposition of gender gap in child immunisation

Covariates	***Coefficient***	***Significance***
Income of Household	0.001	
Caste	0.000	
Religion	0.001	
Occupation of HH	0.004	**
Exposure to Radio	0.001	
News paper reading	0.000	
Watching TV	-0.001	
Mahilamandal member- yes	0.003	**
Mother's age	-0.001	
Mother's education	-0.004	***
No. of children	-0.002	
Postnatal checkup	0.002	**
No. ofAnganwadi centre	0.000	
No. of immunisation camp	0.000	

Table 6: Aggregate Fairlie decomposition result[Y refers to full immunization]

Terms of decomposition	P(Y=1|Boy) - P(Y=1|Girl)	Percentage
Total gap	0.00931	
Explained	0.00159	17.10 (%)
Unexplained	0.00772	82.90(%)

References:

Bose, Ashish (2001): "Health for All by 2000: Broken Promises", Economic and Political Weekly, Mar 17, pp-905-7.

Desai, S. and Alva, S. (1998): "Maternal Education and Child Health: Is There a Strong Causal
Relationship?", Demography, Vol-35, No.-1, pp-71-81.

Fairlie, Robert W. (2005):"An extension of the Blinder-Oaxaca decomposition technique to logit and probit models", Journal of Economic and Social Measurement 30: 305-316.

Gage, A.J., Sommerfelt, E. and Piani, A. (1997): "Household Structure and Childhood Immunization in
Niger and Nigeria", Demography, Vol-34, No.-2, pp-295-309.

Islam, S.M.S. and Islam, M.M. (1996): "Influences of Selected Socio-economic and Demographic Factors on Child Immunization in a Rural Area of Bangladesh", Demography India, Vol-25, No.-2.

Lee (2004): "Demand for Immunization, Parental Selection, and Child Survival", Working paper

Pande, Rohini P. and Yazbeck, A.S. (2003): 'What's in a Country Average? Wealth, Gender, and Regional Inequalities in Immunisation in India', Social Science and Medicine, Vol.-57, pp-2075-88.

Patra, Nilanjan (2008a): 'A Probe into the Ways to Stimulate Childhood Immunisation in India: Findings from NFHS-III'. Available at SSRN: http://ssrn.com/abstract=1117614

Pebley, A.R., Goldman, N. and Rodriguez, G. (1996): "Prenatal and Delivery Care and Childhood
Immunization in Guatemala: Do Family and Community Matter?", Demography, Vol-33, No.-2

Rajeshwari (1996): "Gender Bias in Utilization of Health Care Facilities in Rural Haryana", Economic and Political Weekly, Feb 24.

R.W. Fairlie(1999):"The Absence of the African-American Owned Business: An Analysis of the Dynamics of Self-Employment", Journal of Labor Economics 17(1).

Sokhey, Jotna (1988): National Immunisation Programme (National Health Programme Series 1), MoHFW, National Institute of Health and Family Welfare, New Delhi.

Steele, F., Diamod, I. and Amin, S. (1996): 'Immunisation Uptake in Rural Bangladesh: A Multilevel Analysis', Journal of Royal Statistical Society, Vol-159, Part-2, pp-289-99.