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Socioeconomic Correlates of Child Immunization among Scheduled Tribes in India, 1990-2006

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Abstract:
Background: Immunization is a way of protecting the human body against infectious diseases through vaccination. Immunization coverage has been accorded high priority on international and national agendas as the vaccine-preventable diseases have been a major cause of child mortality and morbidity. In India, the basic childhood immunization services have been part of essential health services and accorded top priority in its health delivery system. As per NFHS-3 estimates, the under-five mortality rate and the child Mortality rate are much higher for Scheduled Tribes than any other social group/ castes at all childhood ages (95.7 and 35.8 respectively). Only 31.3 percent of Scheduled tribe's children were found to be fully vaccinated as compared to 53.8 percent belonging to Others.
Aim: The main aim of this study is to provide socioeconomic correlates of child immunization among Scheduled Tribes in India, during last one and half decade. Further, this study traces the changes in child immunization patterns that occurred along with the development of the socioeconomic and health sectors from 1990-20006.
Methodology: Data from three round of the Demographic and Health Survey (DHS), known as the National Family Health Survey (NFHS) in India were analyzed. Bivariate and multivariate-pooled logistic regression model were applied to examine the socioeconomic correlates of child immunization among Scheduled Tribes in India, during last one and half decade 1990-2006.
Key finding: The results from analysis indicate that the coverage of child immunization has increased from 24.8 percent to 32.0 percent during the last one and half decade, 1990-2006. Overall, it can be said that, there was an improvement in the level of child immunization over the period of time. There are considerable differentials in child immunization by various individual (education, gender and birth order), household (wealth) and community (place of residence, region of residence) characteristics. Along with the mother's education, father's education, ANC status, delivery status, economic status, mass media exposure and region of residence is a significant predictor in explaining the child immunization irrespective of time over last one and half decade.
Conclusion: The study concludes that much of these inequalities are social constructs that can be reduced by prioritizing the needs of the disadvantaged and adopting appropriate policy change options. The vaccination rates are lower among infants with mothers having no or low literacy, and families with insufficient empowerment of women. Paternal literacy and awareness has an inconsistent positive relationship with child vaccination. The study also recommends that the targeted intervention among the marginalized sections of society and addressing obstacles in the way of utilizing health services and effort should be made through Information, Education and Communication (IEC) activities targeted to educate, especially rural tribes and counseling them about adverse effect of child immunization.

Keywords: NFHS, Full ANC, pooled data, MDG, SBA, child immunization and Scheduled tribes.

1. Introduction and Reviews of Literature

Universal immunization of children against the six vaccine-preventable diseases (namely, tuberculosis, diphtheria, whooping cough, tetanus, polio, and measles) is crucial for reducing infant and child mortality. Immunization is a way of protecting the human body against infectious diseases through vaccination. Immunization prepares human bodies to fight against diseases which can come into contact with them in the future. Immunization is one of the most successful public health interventions of the past century responsible for averting 3 million deaths globally each year and protecting millions more from illness and permanent disability [1]. Globally, vaccine preventable diseases account for nearly 20% of all deaths occurring annually among children under five years of age, and immunization has a vital role to play in achieving the goals specified in the Millennium Declaration [2]. In 2005, WHO and United Nations Children's Fund (UNICEF) developed the Global Immunization Vision and Strategy (GIVS), with the aim of reducing vaccine-preventable disease related morbidity and mortality by improving national immunization programs [3]. However, according to the Global Routine Vaccination Coverage (GAVI)–2010, about 19.3 million children were not fully vaccinated and remained at risk for diphtheria, tetanus, and pertussis and other vaccine-preventable causes of morbidity and mortality, and about 50% of these children are from India, Nigeria, and Congo [4]. Even though the immunization services in India are being offered free of cost in public health

facilities, about 45% of Indian children are deprived of the recommended vaccinations [5]. After independence in 1947, it took three decades for India to articulate its first official policy for childhood vaccination; nevertheless, childhood immunization has been an important part of the Reproductive and Child Health (RCH) services [6-7]. There is a considerable evidence of marked regional and socioeconomic inequities in child health and mortality [8-9].

As per NFHS-3 estimates, the under-five mortality rate and the child mortality rate are much higher for Scheduled Tribes than any other social group/castes at all childhood ages (95.7 and 35.8 respectively). Based on information obtained from a vaccination card or reported by the mother ('either source'), only 31.3 percent of ST children were found to be fully vaccinated as compared to 53.8 percent belonging to 'Others'. 11.5% of Scheduled Tribes children have no vaccinations at all [10].

A few attempts have been made to understand the trends in full immunization among Scheduled tribe's children over time period, to feel the gap, present study going to investigate the differentials in child immunization among Scheduled Tribes in India (1990-2006) and further, this study also traces the changes in patterns of child immunization by socioeconomic and demographic background of Scheduled tribe's women during last one and half decade, 1990-2006.

1.1. Study Setting, Data and Method

This study is based on three round of the Demographic and Health Survey (DHS), known as the National Family Health Survey (NFHS) data, which were canvassed during 1992–93 (NFHS-1), 1998–99 (NFHS-2), and 2005–06 (NFHS-3) in India [11–13]. These surveys used a multistage stratified sampling design. The NFHS is a standard large-scale survey in India, which provides nationally representative estimates on issues related to family welfare, maternal and child healthcare, and nutrition. In NFHS-1 (1992–93), information was collected for the last three births to women in the four years preceding the date of survey. Similarly, in NFHS-2 (1998–99), information was collected for the last two births in the three years preceding the date of survey. However, in NFHS-3 (2005–06), was collected for the last three births in the five years preceding the date of survey. Considering these inconsistencies across the three surveys, the sample for this study was limited to the information for the last birth in the three years preceding the date of survey. Required information/data in states of Sikkim was missing in NFHS-1. Therefore, in order to retain consistency, samples for Sikkim was excluded from the final analytic samples. The details of the sampling weights as well as extensive information on survey design, data collection, and management procedures are described in the NFHS reports of the respective rounds [11-13].

1.2. Outcome Measurements

According to the guidelines developed by WHO [14], children aged 12–23 months who received one dose each of BCG and measles, and three doses each of DPT and polio vaccine, were defined as being fully immunized.

1.3. Defining Predictor Variables

Important socioeconomic and demographic predictors included in the analysis are based on their theoretical and observed importance applied in the literature. The study considered a number of potential individual factors, included in the analysis were age of women at the time of birth (Younger age 15-24, Middle 25-34 and Older 35-49), women's education and husband's education (illiterate, literate but below primary, primary but below middle school, middle but below high school, and high school and above), women's and husband work status (not working, agricultural work, skilled/unskilled work, professional work), birth order and interval (first birth order, birth order 2/3 and interval ,<= 24, birth order 2/3 and interval >24, birth order-4+ and interval<=24 and birth order-4+ and interval>24), status of the child (wanted and unwanted), mass media exposure (no exposure, any exposure). Household characteristics included in the analysis were the religion of the mother (Hindu, Muslim, and others), social group (Scheduled Castes, Scheduled Tribes and Other than SC/ST) wealth quintile (poorest, poorer, middle, richer and richest), while the community characteristics included in analysis were place of residence (urban and rural), city-wise residence (capital, large city, small city, town, countryside). Several previous studies reveal the regional variation in the utilization of maternal and child health care services. [14-15], therefore adjust the estimates for region of residence, India was divided into six regions based on geographical location and cultural settings. The six regions consist of North (Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Rajasthan, Delhi and Uttaranchal), Central (Uttar Pradesh, Madhya Pradesh and Chhattisgarh), East (Bihar, Jharkhand, West Bengal and Orissa), North-East (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura), West (Gujarat, Maharashtra and Goa), and South (Andhra Pradesh, Karnataka, Kerala and Tamil Nadu).

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1.4. Analytical Approach

To identify the trends of child immunization among Scheduled tribe's children, bi-variate and multivariate analyses were performed. In order to trace the trend in child immunization, this study try to assessed whether the association between the predictor of interest and the outcome variable varied during the last one and half decade. This required the data from all three rounds to be pooled and tested for the trend using linear or nonlinear trend analysis. As the sampling design of the NFHS offers an opportunity to make all the three rounds of data comparable [17], several earlier studies have pooled the different rounds of DHS/NFHS datasets to observe changes over time [18-20]. To take into account the survey design (i.e. sampling weights with clustering and strata) while estimating bivariate and multivariate statistics, the SVY command [21] in STATA [22] was used. Since the outcome indicator used in this study were measured with binary responses in all three round of surveys, I used pooled multivariate logistic regression models to assess the effect or the strength of selected key individual, household and community characteristics predictors in explaining the child immunization.

1.5. Ethical Consideration
The study is based on data available in public domain, therefore no ethical issue is involved. I wish to thank the DHS (NFHS) for making this data available for this study.

2. Results

2.1. Differentials in Full Immunization
Table 1 shows the weighted percentage of Scheduled Tribes children who have received full immunization by socioeconomic and demographic background characteristics in India. Results shows that full immunization received by Scheduled Tribes children in India, increased by nearly seven percentage points from a level of 24.8% during 1990–93 to 32.0% during 2003-06. A considerable growth in the level of full immunization was observed in the children whose mothers was from older age cohort (35-49 years) during 1990–2006. The prevalence (%) of full immunization among children whose mothers was from older age cohort (35-49 years) grew by 297.8%, compared to an increase of only 0.9% among children whose mothers was youth (15-24 years) during 1990–99 while the prevalence (%) of full immunization among children whose mothers was from older age cohort (35-49 years) grew by 194.3%, compared to an increase of about 16% among children whose mothers was youth (15-24 years) during 1990–2006. A considerable increase was observed in the proportion of full immunization by children whose mother were completed their education high school and above. The prevalence (%) of full immunization among children whose mother were completed their education high school and above grew by 198.3%, compared to an increase of about 15.1 among children whose mother were illiterate. As for the observed across geographical regions, analysis indicated that a considerable increase was observed in the proportion of full immunization by children who born in Northeast and East regions as compared to others regions during 1990–2006.

Background characteristics	Full Immunization								
	NFHS-1 (1990–93)		NFHS-2 (1996–99)		NFHS-3 (2003–06)		Relative Change (%)		
	%	95% CI	%	95% CI	%	95% CI	a	b	c
Individual characteristics									
Mother's age at time of birth	χ2=12.442**		χ2=10.237**		χ2=1.260				
Youth (15-24)	27.8	[23.3,32.7]	31.7	[26.7,37.1]	32.5	[27.1,38.4]	14.0	02.5	16.9
Middle (25-34)	22.3	[16.7,29.1]	28.5	[22.1,35.9]	31.5	[25.5,38.2]	27.8	10.5	41.3
Older (35-49)	8.8	[4.0,18.4]	13.0	[5.9,26.1]	25.9	[15.2,40.7]	47.7	99.2	194.3
Sex of child	χ2=0.052		χ2=12.274**		χ2=0.001				
Male	24.5	[20.0,29.7]	34.1	[28.9,39.7]	31.9	[26.5,37.8]	39.2	-06.5	30.2
Female	25.0	[20.2,30.7]	25.2	[19.3,32.1]	31.8	[26.3,37.9]	0.8	26.2	27.2
Women's education	χ2=58.672***		χ2=124.642***		χ2=86.090***				
Illiterate	21.2	[17.0,26.1]	21.4	[16.9,26.8]	24.4	[19.8,29.7]	0.9	14.0	15.1
Literate but below primary	42.2	[28.8,56.9]	37.2	[26.9,48.8]	36.7	[22.9,53.1]	-11.8	-01.3	-13.0
Primary but below middle	33.4	[12.8,63.1]	51.7	[31.4,71.6]	32.7	[17.9,51.9]	54.8	-36.8	-02.1
Middle but below high school	49.6	[37.2,62.0]	51.8	[39.8,63.6]	52.1	[43.4,60.8]	04.4	00.6	05.0
High school and above	18.0	[3.0,61.1]	71.6	[54.8,84.0]	53.7	[32.9,73.2]	297.8	-25.0	198.3
Husband's education	χ2=46.542***		χ2=79.746***		χ2=35.409***				
Illiterate	18.1	[14.0,23.1]	18.6	[13.3,25.5]	27.0	[21.3,33.6]	2.8	45.2	49.2
Literate but below primary	27.9	[17.8,40.9]	27.4	[19.4,37.0]	26.5	[16.5,39.6]	-01.8	-03.3	-05.0
Primary but below middle	33.0	[23.9,43.5]	37.3	[29.0,46.6]	29.6	[20.8,40.3]	13.0	-20.6	-10.3
Middle but below high school	35.6	[23.7,49.6]	40.6	[28.5,53.9]	38.1	[27.7,49.7]	14.0	-06.2	07.0
High school and above	36.9	[27.1,47.9]	47.8	[37.6,58.2]	47.1	[36.7,57.8]	29.5	-01.5	27.6
Women's occupation	χ2=6.191		χ2=3.419		χ2=32.727***				
Not working	25.7	[20.9,31.1]	29.9	[23.4,37.3]	39.9	[32.9,47.4]	16.3	33.4	55.3
Agricultural work	26.3	[19.2,35.0]	28.4	[23.3,34.2]	27.3	[21.6,33.9]	08.0	-03.9	03.8
Skilled/Unskilled work	17.7	[11.1,27.1]	41.3	[18.2,69.1]	22.0	[13.5,33.7]	133.3	-46.7	24.3
Professional work	26.0	[12.3,46.7]	34.6	[20.4,52.2]	46.5	[27.4,66.7]	33.1	34.4	78.8
Husband's occupation	χ2=12.314		χ2=10.830		χ2=20.560**				
Not working	42.3	[20.4,67.7]	26.0	[9.9,53.0]	57.0	[19.8,87.6]	-38.5	119.2	34.8
Agricultural work	24.1	[19.2,29.8]	27.9	[23.2,33.1]	29.5	[23.8,36.1]	15.8	05.7	22.4
Skilled/Unskilled work	22.0	[16.3,28.9]	28.5	[20.9,37.5]	30.1	[23.2,38.0]	29.5	05.6	36.8
Professional work	32.6	[24.4,42.1]	40.6	[29.6,52.6]	45.3	[35.2,55.7]	24.5	11.6	39.0
ANC visit first trimester	χ2=0.060		χ2=8.548**		χ2=6.245				
No	39.0	[32.3,46.2]	37.2	[30.5,44.4]	38.7	[31.1,46.9]	-04.6	04.0	-0.8
Yes	39.9	[31.5,49.0]	47.9	[38.5,57.5]	43.8	[36.5,51.3]	20.1	-08.6	09.8
ANC Status	χ2=203.952***		χ2=190.209***		χ2=181.328***				
No ANC	10.0	[6.9,14.3]	10.1	[6.9,14.6]	7.0	[3.3,14.0]	01.0	-30.7	-30.0

	Period 1 %	CI	Period 2 %	CI	Period 3 %	CI	a	b	c
Partial	50.5	[41.3,59.8]	56.8	[47.4,65.7]	52.6	[45.4,59.8]	12.5	-07.4	04.2
Full ANC	32.2	[25.9,39.2]	35.4	[28.6,42.7]	28.5	[23.0,34.8]	09.9	-19.5	-11.5
Delivery status	χ2=68.742***		χ2=79.469***		χ2=49.415***				
Home Delivery by NSBA	20.5	[16.5,25.2]	23.5	[19.1,28.7]	26.6	[22.1,31.6]	14.6	13.2	29.8
Institutional Delivery	45.7	[33.5,58.4]	52.4	[42.5,62.1]	48.0	[37.9,58.3]	14.7	-08.4	05.0
Home Delivery by SBA	46.6	[31.3,62.6]	43.9	[31.0,57.7]	39.8	[28.2,52.7]	-05.8	-09.3	-14.6
Birth order and interval	χ2=25.443***		χ2=29.903***		χ2=32.235***				
Birth order 1	32.5	[25.6,40.4]	34.7	[26.7,43.7]	37.3	[29.9,45.4]	06.8	07.5	14.8
Birth order-2/3 and interval<=24	30.8	[22.2,40.9]	30.5	[20.3,43.0]	27.7	[17.8,40.5]	-01.0	-09.2	-10.1
Birth order-2/3 and interval>24	24.0	[17.8,31.4]	36.1	[28.3,44.7]	37.6	[30.1,45.8]	50.4	04.2	56.7
Birth order-4+ and interval<=24	20.5	[11.7,33.2]	23.1	[13.4,36.9]	16.7	[9.0,28.9]	12.7	-27.7	-18.5
Birth order-4+ and interval>24	17.6	[12.2,24.9]	20.0	[14.1,27.5]	26.1	[19.8,33.6]	13.6	30.5	48.3
Status of the child	χ2=0.488		χ2=5.056		χ2=1.161				
Wanted	24.4	[20.0,29.4]	30.8	[26.4,35.7]	32.4	[27.8,37.4]	26.2	05.2	32.8
Unwanted	26.6	[19.0,35.8]	23.1	[14.8,34.3]	28.7	[21.2,37.7]	-13.2	24.2	07.9
Mass media exposure	χ2=33.100***		χ2=84.160***		χ2=104.922***				
No exposure	20.5	[16.0,25.9]	21.3	[16.9,26.5]	19.2	[14.8,24.4]	03.9	-09.9	-06.3
Any exposure	35.1	[28.6,42.2]	46.1	[38.7,53.7]	44.4	[38.4,50.5]	31.3	-03.7	26.5
Household characteristics									
Religion	χ2=5.139*		χ2=7.936*		χ2=0.586				
Hindu	25.4	[21.0,30.4]	28.2	[23.5,33.4]	32.4	[27.4,37.7]	11.0	14.9	27.6
Non_Hindu	20.3	[13.6,29.3]	38.4	[27.7,50.3]	29.8	[22.6,38.1]	89.2	-22.4	46.8
Wealth quintile	χ2=59.711***		χ2=68.245***		χ2=88.973***				
Poorest	20.8	[15.7,27.2]	20.4	[15.7,26.1]	24.3	[19.5,29.8]	-01.9	19.1	16.8
Poorer	19.9	[14.3,27.0]	32.9	[25.1,41.7]	30.5	[22.5,39.9]	65.3	-07.3	53.3
Middle	38.3	[29.7,47.5]	38.7	[28.8,49.6]	47.3	[35.5,59.5]	01.0	22.2	23.5
Richer	39.0	[25.3,54.7]	50.3	[34.6,65.9]	54.3	[39.9,68.0]	29.0	08.0	39.2
Richest	61.6	[37.1,81.4]	67.1	[42.0,85.1]	61.7	[43.3,77.3]	08.9	-08.0	0.2
Community characteristics									
Type of residence	χ2=12.174***		χ2=23.308***		χ2=19.032***				
Urban	38.7	[26.7,52.3]	47.3	[34.9,60.1]	48.9	[35.7,62.3]	22.2	03.4	26.4
Rural	23.6	[19.4,28.4]	27.4	[22.8,32.6]	30.2	[25.7,35.1]	16.1	10.2	28.0
City-wise residence	χ2=15.214*		χ2=24.008***		χ2=27.256***				
Capital, large city	50.4	[23.5,77.0]	48.0	[20.2,77.1]	48.1	[22.9,74.3]	-04.8	0.2	-04.6
Small city	42.0	[20.6,66.9]	42.5	[21.6,66.4]	69.4	[39.8,88.6]	01.2	63.3	65.2
Town	32.0	[17.2,51.8]	49.8	[33.7,66.0]	40.8	[26.0,57.4]	55.6	-18.1	27.5
Countryside	23.6	[19.4,28.4]	27.4	[22.8,32.6]	30.2	[25.7,35.1]	16.1	10.2	28.0
Region	χ2=174.332***		χ2=146.463***		χ2=55.950***				
North	14.7	[9.2,22.6]	14.6	[9.2,22.5]	10.2	[4.8,20.4]	-00.7	-30.1	-30.6
Central	17.5	[12.5,23.9]	14.2	[9.2,21.4]	26.3	[19.6,34.3]	-18.9	85.2	50.3
East	15.8	[10.3,23.5]	30.4	[21.1,41.7]	38.5	[29.0,48.9]	92.4	26.6	143.7
Northeast	12.8	[9.3,17.4]	23.5	[18.8,28.9]	33.0	[25.6,41.3]	83.6	40.4	157.8
West	51.5	[40.0,62.8]	55.0	[43.8,65.8]	39.3	[27.0,53.1]	06.8	-28.5	-23.7
South	47.5	[34.7,60.6]	43.7	[28.3,60.4]	39.2	[28.0,51.5]	-08.0	-10.3	-17.5
Total	**24.8**	**[20.8,29.3]**	**29.6**	**[25.1,34.5]**	**32.0**	**[27.5,36.5]**	**19.4**	**08.1**	**29.0**

aCalculated as relative change = [(period 2 %-period 1%)/period 1%*100].
bCalculated as relative change = [(period 3 %-period 2%)/period 2%*100].
cCalculated as relative change = [(period 3 %-period 1%)/period 1%*100].

Table 1: Percentages and trends of Scheduled Tribes children (aged 12–23 months) who had received full immunization by selected background characteristics in India, 1990–2006.

2.2. Determinants of Full Immunization

Table 3 presents the results of the logistic regression models to examine the effect of individuals, household and community characteristics on receiving full immunization among children aged 12–23 months during 1990-2006. The results show that women's education, husband's education, ANC status, safe delivery status, birth order and interval, economic status and region of residence are statistical significant determinants of full immunization. The odds of receiving full immunization among children of mothers with High school and above (OR=2.04; 95% CI=0.59-2.46) during 1990-93 and (OR=3.30; 95% CI=1.07-10.19) during 1996-98 were more likely to receive full immunization compared with children of uneducated mothers. However same trends showing during 2003-2006 but it is not statistically significant. Although father's education appeared to be a significant factor for receiving full

immunization among children. The likelihood of receiving full immunization was low among children whose fathers were uneducated. The probability of receiving full immunization was found to be higher among children whose mothers were reprieved antenatal care (partial immunization or full immunization) during her pregnancy compared with children whose mother were not relieving antenatal care during her pregnancy, irrespective of time period. Children whose mothers utilized safe delivery i.e. Institutional delivery and home delivery assist by trained skilled birth attendant were higher chance to utilized full immunization compared with children whose mother, were not utilized safe delivery care service during her child birth irrespective the time period. The odds of receiving full immunization increased significantly with increasing household economic status. Compared to children belong from North region, others region children have higher probability to received full immunization expect Northeast region.

Background characteristics	Full Immunization					
	NFHS-1 (1990–93)		NFHS-2 (1996–99)		NFHS-3 (2003–06)	
	OR	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*
Individual characteristics						
Mother's age at birth of child						
Youth (15-24)						
Middle (25-34)	1.49	[0.90-2.46]	1.46	[0.83-2.60]	1.10	[0.66-1.82]
Older (35-49)	0.74	[0.25-2.22]	0.70	[0.23-2.07]	1.04	[0.43-2.51]
Mother's education						
Illiterate						
Literate but below primary	1.35	[0.59-3.09]	1.28	[0.66-2.48]	1.28	[0.67-2.42]
Primary but below middle	1.32	[0.41-4.31]	2.28	[0.75-6.92]	1.06	[0.43-2.60]
Middle but below high school	1.69	[0.73-3.90]	1.70	[0.82-3.52]	1.22	[0.68-2.16]
High school and above	2.04***	[0.59-2.46]	3.30**	[1.07-10.19]	1.32	[0.35-5.01]
Father's education						
Illiterate						
Literate but below primary	1.35	[0.75-2.45]	1.21	[0.62-2.34]	0.70	[0.33-1.47]
Primary but below middle	1.78**	[1.04-3.05]	1.71*	[0.91-3.21]	0.62	[0.32-1.19]
Middle but below high school	1.84**	[0.94-3.60]	2.09*	[0.94-4.68]	0.95	[0.49-1.84]
High school and above	1.20	[0.56-2.59]	1.44	[0.69-3.02]	0.56	[0.25-1.25]
ANC Status						
No ANC						
Partial	2.91***	[1.78-4.75]	3.47***	[1.94-6.21]	4.54***	[2.06-10.02]
Full ANC	4.81***	[2.65-8.74]	5.24***	[2.72-10.12]	10.31***	[4.56-23.30]
Delivery status						
Home Delivery by NSBA						
Institutional Delivery	1.70***	[1.47-1.72]	1.70**	[0.96-3.01]	1.41	[0.76-2.62]
Home Delivery by SBA	2.93***	[1.28-6.74]	1.85**	[0.96-3.58]	1.27	[0.68-2.36]
Birth order and interval						
Birth order 1						
Birth order-2/3 and interval<=24	0.68	[0.37-1.25]	0.99	[0.47-2.08]	0.81	[0.38-1.72]
Birth order-2/3 and interval>24	0.55**	[0.32-0.96]	1.18	[0.68-2.05]	1.08	[0.65-1.80]
Birth order-4+ and interval<=24	0.37**	[0.14-0.95]	1.07	[0.43-2.67]	0.54	[0.22-1.31]
Birth order-4+ and interval>24	0.45**	[0.23-0.89]	0.82	[0.39-1.72]	0.84	[0.40-1.77]
Mass media exposure						
No exposure						
Any exposure	0.98	[0.51-1.87]	1.48	[0.93-2.37]	1.97***	[1.28-3.04]
Household characteristics						
Religion						
Hindu						
Non_Hindu	0.69	[0.31-1.51]	2.09*	[0.93-4.72]	0.81	[0.40-1.62]
Wealth quintile						
Poorest						
Poorer	0.83	[0.47-1.44]	1.14	[0.70-1.85]	1.08	[0.64-1.83]
Middle	2.15**	[1.06-4.33]	0.77	[0.36-1.65]	1.70	[0.85-3.42]
Richer	1.27	[0.50-3.20]	0.61	[0.19-1.96]	2.48***	[0.98-6.28]
Richest	8.67***	[2.05-36.66]	0.97	[0.20-4.62]	2.75	[0.72-10.47]
Community characteristics						

Type of residence						
Urban						
Rural	1.12	[0.58-2.17]	1.17	[0.55-2.46]	1.48	[0.67-3.28]
Region						
North						
Central	1.28	[0.60-2.75]	0.90	[0.44-1.84]	4.80***	[2.08-11.10]
East	1.26	[0.52-3.10]	2.32***	[1.16-4.64]	7.98***	[3.37-18.92]
Northeast	0.62	[0.24-1.57]	0.59	[0.25-1.38]	3.94***	[1.46-10.63]
West	4.84***	[2.09-11.21]	5.69***	[2.74-11.83]	4.95***	[1.86-13.22]
South	3.21***	[1.29-7.98]	2.89***	[1.21-6.89]	3.93***	[1.62-9.50]
Levels of significance: *p<0.10; **p<0.05; ***p<0.01; OR=Odds ratio City wise residence was excluded from the multivariate analysis after examining high collinearity between type of residence and city wise residence.						

Table 2: Socioeconomic and demographic predictors for Scheduled tribe's children (aged 12–23 months) who had received full immunization in India, 1990–2006.

2.3. Multivariate-Pooled Logistic Regression Results for Receiving Full Immunization

Table 3 presents the results of the pooled logistic regression models to examine the effect of individuals, household and community characteristics on receiving full immunization among children aged 12–23 months during 1990-2006. Along with the adjusted odds ratios, the table provides observed (or unadjusted) odds ratios for each correlate, which permit direct comparison of observed and adjusted effects. The study estimated the baseline effect of each variable on receiving full immunization in the unadjusted model, and then controlled for other variables in the adjusted one. The result from the both model unadjusted and adjusted shows that the time period, mother's education, father's education, birth order and birth interval of child, wealth status and region of residence emerged as significant factors affecting the utilization of full immunization. The result from the unadjusted model shows that children born during 2003-06 were 42% more likely, to receive full immunization compared with children born during 1990-93. When all other potential individual, household and community variables were controlled in the adjusted model, the direction remained the same. The likelihood of full immunization was 79% more among children born during 2003-06, as compared to children born during 1990-93.

The odds of receiving full immunization among children of mothers who were middle but below high school (AOR=1.47, 95% CI=0.98-2.20), and with high school and above (AOR=1.48; 95% CI=0.70-3.16) were more likely to receive full immunization compared with children of uneducated mothers. The likelihood of full immunization was higher among those children whose mother had any exposure to mass media (AOR=1.53; 95% CI=1.14-2.04) compared with children whose mother had no mass media exposure. The probability of receiving full immunization was found to be higher among children whose mothers were reprieved antenatal care (partial immunization or full immunization) during her pregnancy compared with children whose mother were not relieving antenatal care during her pregnancy in both unadjusted and adjusted model. Both model shows that the children whose mothers utilized safe delivery i.e. institutional delivery and home delivery assist by trained skilled birth attendant were higher chance to utilized full immunization compared with children whose mother, were not utilized safe delivery care service during her child birth. Compared with the children of North region, others region children have higher chances to received full immunization.

Background characteristics	Full Immunization			
	Unadjusted		Adjusted	
	Odds ratio	95% CI	Odds ratio	95% CI
Period				
1990–93 *(ref)*	1.00		1.00	
1996–99	1.27	0.94-1.72	1.08	[0.79-1.48]
2003–06	1.42**	1.04- 1.93	1.79**	[0.86-2.10]
Individual characteristics				
Mother's age at birth of child				
Youth (15-24) *(ref)*	1.00		1.00	
Middle (25-34)	0.85	0.69- 1.05	1.27	[0.94-1.71]
Older (35-49)	0.41***	0.26- 0.64	0.86	[0.49-1.49]
Mother's education				
Illiterate *(ref)*	1.00		1.00	
Literate but below primary	2.20***	1.55- 3.11	1.25	[0.84-1.87]
Primary but below middle	2.18***	1.24- 3.84	1.38	[0.73-2.61]
Middle but below high school	3.72***	2.79- 4.95	1.47**	[0.98-2.20]
High school and above	5.03***	2.90- 8.72	1.48**	[0.70-3.16]
Father's education				
Illiterate *(ref)*	1.00		1.00	
Literate but below primary	1.42**	1.01- 2.00	1.06	[0.73-1.53]

Primary but below middle	1.88***	1.42- 2.48	1.18	[0.85-1.64]
Middle but below high school	2.34***	1.63- 3.37	1.33	[0.87-2.05]
High school and above	2.97***	2.22- 3.97	0.97	[0.62-1.52]
ANC status				
No ANC *(ref)*	1.00		1.00	
Partial	10.72***	7.69-14.95	3.39***	[4.16-8.80]
Full ANC	4.43***	3.18- 6.19	6.05***	[2.39-4.80]
Delivery status				
Home Delivery by NSBA *(ref)*	1.00		1.00	
Institutional Delivery	3.17***	2.41- 4.17	1.31	[0.91-1.86]
Home Delivery by SBA	2.50***	1.71- 3.65	1.81***	[1.17-2.80]
Birth order and interval				
Birth order 1 *(ref)*	1.00		1.00	
Birth order-2/3 and interval<=24	0.79	0.55- 1.12	0.77	[0.52-1.16]
Birth order-2/3 and interval>24	0.88	0.67- 1.16	0.89	[0.64-1.23]
Birth order-4+ and interval<=24	0.46***	0.30- 0.71	0.58**	[0.35-0.98]
Birth order-4+ and interval>24	0.49***	0.37- 0.66	0.71*	[0.47-1.07]
Mass media exposure				
No exposure *(ref)*	1.00		1.00	
Any exposure	2.84***	2.26- 3.57	1.53***	[1.14-2.04]
Household characteristics				
Religion				
Hindu *(ref)*	1.00		1.00	
Non_Hindu	1.04	0.78-1.40	1.14	[0.75-1.73]
Wealth quintile				
Poorest *(ref)*	1.00		1.00	
Poorer	1.35**	1.01- 1.80	0.93	[0.67-1.28]
Middle	2.45***	1.84- 3.25	1.33	[0.89-1.99]
Richer	3.34***	2.23- 5.00	1.22	[0.71-2.08]
Richest	6.01***	3.49- 10.35	1.79	[0.82-3.91]
Community characteristics				
Type of residence				
Urban *(ref)*	1.00		1.00	
Rural	0.45***	0.32- 0.63	1.24	[0.81-1.88]
Region				
North *(ref)*	1.00		1.00	
Central	1.57**	1.03- 2.39	1.92***	[1.23-2.98]
East	2.58***	1.64- 4.06	2.88***	[1.79-4.64]
Northeast	1.93***	1.28- 2.90	1.25	[0.75-2.08]
West	6.27***	3.95- 9.96	4.86***	[2.93-8.06]
South	5.08***	3.12- 8.26	3.26***	[1.95-5.46]
Levels of significance: *p<0.10; **p<0.05; ***p<0.01; OR= Odds ratio City wise residence was excluded from the multivariate analysis after examining high collinearity between type of residence and city wise residence.				

Table 3: Binary logistic regression model showing odds ratio (OR) and confidence intervals (95% CI) for receiving full immunization among Scheduled tribe's children age 12-23 month in India, 1990–2006. (pooled data)

3. Discussion

The present study examines the utilization of full immunization by Scheduled tribe's children, in India 1990-2006. The results from both bivariate and multivariate analyses confirmed the importance of mother's education for the utilization of child immunization which indicated in several other studies in developing countries [23-28]. After education of mothers and fathers, the wealth quintile of the household was found to be another significant factor affecting the full immunization Previous studies also indicated that the poor–rich gap in the utilization of maternal and child health care services [29-30]. Most of the studies indicated that women are significantly more likely to use maternal and child health care services for their first child [31-34]. The findings of this study also highlighted that the child immunization were less for the second and higher births order children compared with the first birth order children which evident from several others studies that higher birth order suggests a greater family size and hence lower resources (both time and money) available to seek formal health care [35-37]. The variations in the receiving of full immunization by children in different

regions in India may be partly linked with the diversity and availability of resources and the state of socioeconomic and demographic progress.

4. Conclusion

This paper has provided insights into the trends, changes patterns over time and also factors associated with full childhood immunization among Scheduled tribe's children in India. This study concludes that the full immunization receiving by Scheduled tribe's children in India over the last one and a half decades, increases but it is far from satisfactory. Moreover, the adverse effect of the low coverage of child immunization could lead to high child morbidity and mortality. It is well documented in previous study and this study also that education is most important factor influencing of child immunization. The information, education and communication should be improving specially for poor and uneducated women and awareness about the adverse effects of child immunization. Since scheduled tribes were Scheduled tribes, which are considered a socially and geographically disadvantaged group, have a higher probability of living under adverse conditions. Higher birth order children have lower child immunization the precise reasons for this have not been elucidated. Efforts are needed to create a comprehensive immunization plan labelled on an immunization card in a way that can easily be understood by the less educated. The future studies should find out which doses for an individual vaccine. This may help in the better understanding of the factors influencing full immunization among Scheduled tribe's children in India.

5. Limitation of the study

The strength of my study is its use of data from a nationally-representative survey (Demographic and Health Survey (DHS), known as the National Family Health Survey (NFHS) in India), which enhances generalization of results for the entire country. However, the primary source of limitation is retrospective nature of the survey, which may be associated with recall bias. Data were collected retrospectively for the past three years and, hence, family member and mothers may not be in a position to recall very well all the events that took place during child immunization, especially where the card was missing. Some others predictors variables such as type of family, presence of ASHA, visited health provider during pregnancy and women autonomy, which were not collected in NFHS-1 and NFHS-2, could not be used for this study to maintain consistency across the three round of NFHS survey.

6. Funding

7. Competing interests

The authors declare that they have no competing interests.

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