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Mapping the Socio-Economic Inequalities among Children Aged 0-5 Years in India: A Benefit Incidence Analysis of Universal Immunization Programme

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Abstract Despite government efforts to achieve Universal Immunization Programme (UIP) targets in India, there is a significant disparity between targets and actual results for immunization coverage. Over two-fifths of children receive all recommended vaccinations, and the rate of complete immunization coverage remains constant. However, partial immunization has increased, reflecting wide regional and socio-economic variations in fully immunized children. The present study investigates socio-economic inequality in the UIP for children aged 0-5 years across India. The study analyzed 75th round of the NSS data conducted from July 2017 to June 2018. Expenditure incurred by households on the immunization of children was considered a dependent variable and analyzed by government and private health facilities. To investigate the extent of inequality among socio-economic groups in the distribution of government subsidies and type of government health centers, we used a Benefit Incidence Analysis (BIA) approach. Also, concentration curves (CC) and concentration indices (CI) were further calculated to disclose inequalities. The study's findings show the variation in the utilization rates for healthcare facilities based on quintile class, urban and rural areas. The poorest section of households utilizes government health centers more than the richer section of households. Gender inequality was seen in terms of the utilization of private and government health centers. The mean expenditure on immunization of children aged 0-5 years in government and private health centers varies across quintile class, rural and urban areas. The CC and CI disclose inequalities in the utilization of healthcare facilities and expenditure incurred by households for immunization of children aged 0-5 years across India. The overall benefit incidence was the highest among the richer section of households in urban areas compared to the poorer section in rural areas. Inequalities in benefit incidence and subsidy impact exist due to the distribution of benefits among the richer sections of households. As a result, the government needs to launch awareness campaigns, improve rural health infrastructure, reduce financial burden through insurance coverage and subsidies and focus on states with high socio-economic inequalities. It will ensure equitable distribution of benefits among poorer socio-economic groups in both rural and urban areas.

Keywords Universal Immunization Programme, Socio-Economic Inequality, Equity, Benefit Incidence Analysis, India

1. Introduction

Over the past 50 years, vaccinations have significantly contributed to the decline in child mortality in India, which has decreased from about 233 to 63 deaths per 1000 births.

Vaccination is a proven and economical means of ensuring the survival of children. Even with this improvement, vaccine-preventable diseases still account for over five lakh deaths yearly in India, highlighting the need for more progress. India also faces challenges in achieving appropriate coverage of routine immunization (RI) [1,2]. India, in 1978, was among the first countries to take action against vaccine-preventable diseases which were preventable by giving vaccination to children and launching the "Expanded Programme on Immunization" (EPI). India has made significant progress in child immunization over the years [3]. However, the nation still needs to meet the SDG-3 objective. As of now, 62% of children aged 12-23 months have received all the recommended vaccinations, including three doses of the DPT vaccine, BCG, measles, and polio. Therefore, in Sustainable Development Goal 3, the universal coverage is far from reaching. However, increasing vaccination coverage has long been India's critical public health goal [4]. The government of India in 1985 launched the UIP to decrease infant and child mortality caused by six diseases, i.e., tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis, and measles. By 12 months, children were supposed to have had three doses of DPT, three doses of oral polio vaccine (OPV), one dose of measles-containing vaccine (MCV), and one dose of bacillus Calmette-Guérin (BCG) under the UIP. Under the UIP, these vaccinations were provided free of cost to all infants against these six diseases [4,5].

India continues to contribute to the high prevalence of underweight children and child mortality under five years. Between 2004 and 2008, vaccine-preventable diseases in India were linked to various diseases, including diphtheria, tetanus, pertussis, measles, hepatitis B, rotavirus, and pneumonia, resulting in a significant loss of life [6]. India's sluggish progress toward attaining the goals of universal immunization for all children is due to its large population, geographical and cultural diversity, and inadequate healthcare spending [7]. Prior studies conducted in India have provided insights into a range of socio-demographic factors that impact the uptake of vaccinations. These factors include but are not limited to the gender of the child, birth order, place of delivery, mother's age at childbirth, parental education, caste, religious, household wealth, and residing in urban or rural areas. Research suggests that there are persisting differences in vaccination coverage in India, even though children's immunization has been a part of maternity and child health services since the 1940s [8]. Attaining universal vaccination coverage is hampered by various factors such as ingrained cultural attitudes, poverty, restricted access to healthcare services, and inadequate parental education [9].

Significant gaps in health outcomes occur between richer and poorer sections of society in developing countries. These differences limit the economic contributions of the poor section of society. Addressing socio-economic gaps in child health is a significant challenge in developing countries. However, there may have been a key vacuum in identifying and understanding the patterns behind these gaps, particularly in less developing nations like India, which has hampered the progress towards these goals, particularly in eliminating socio-economic inequalities in child health [10].

Many researchers have examined immunization rate differences among developing countries such as India based on household economic status [3,5]; [10–16]. Several research used methods such as concentration indices and concentration curves to assess the extent of socio-economic differences in health [10]. Also, till date there is no study that attempted the Benefit Incidence Analysis of Universal immunization Programme in India using NSS 75th round data. Therefore, by exploring the factors impacting the socio-economic inequality in immunization coverage among children aged 0-5 years, the present study strives to address these socio-economic factors by comprehensively analyzing India's Universal Immunization Programme through the Benefit Incidence Analysis approach.

2. Materials and Methods

The present study considered the 75th round of the National Sample Survey (NSS) on household social consumption on health, conducted by the National Statistical Office from July 2017 to June 2018. The data collected through NSS Schedule 25.0 spread over the entire Indian Union, except for the villages in the Andaman Nicobar Islands, which were difficult to reach. This survey used a stratified multi-stage sampling method. Census Villages (rural regions) and Urban Blocks (urban regions) were referred to as "First Stage Units" (FSUs), while households were called "Ultimate Stage Units" (USUs). Using Probability Proportional to Size with Replacement (PPSWR) and the 2011 Census Population, sample villages were selected to establish FSUs. A number of households in the Urban Frame Survey (UFS) blocks were used to build FSUs for the urban region using the PPSWR method. In rural India, the proportion of children aged 0–5 years was 8.6%, whereas in urban India, the corresponding percentage was 7.0%. The total number of children aged 0–5 years amounted to 70,257 individuals, with 43,225 residing in rural India and 27,032 in urban India [17,18].

2.1. Variables

A set of variables including household usual consumption expenditure (as per the survey report, the quintile class of household consumer expenditure was based on information collected on households' usual monthly consumption expenditures, consumption from home produce, wages in kind and free collection, expenditure on durables in a year and household size), place of residence (rural/urban), gender (male/female),

source of immunization i.e., immunization from HSC/ Anganwadi centres; PHC/ dispensary/ CHC/ mobile medical units; government/ public hospital; charitable/ trust/ NGO run hospital; and private hospital/ private doctor/ clinic. Expenditure was incurred by households on HSC/ Anganwadi centres, PHC/ dispensary/ CHC/ mobile medical unit, Government/ Public hospital, Charitable/ trust/ NGO run hospital and Private hospital/ Private doctor/ clinic, to get immunized their children aged 0-5 years.

The expenditure incurred by households on the immunization of children aged 0-5 years was considered a dependent variable and analyzed by government and private health facilities.

2.2. Benefit Incidence Analysis

BIA has been used to assess how government expenditure on healthcare affects the distribution of benefits across various socio-economic categories, particularly regarding government subsidies. The essential premise behind these assessments is that government funds and associated services should disproportionately assist individuals in the lowest socio-economic categories. BIA examines whether government expenditure is truly "pro-poor" or not. This presumption entails that public expenditure should improve efficiency, correct market failures, and advance equity by redistributing economic benefits more evenly. The World Bank has undertaken chiefly BIA research in low- and middle-income countries, focusing on distributing benefits or subsidies from publicly financed education and health services [19].

The below-outlined steps were used to calculate the benefit incidence to know the pro-richness and pro-poorness of the Universal Immunisation Programme:

1. Firstly, quintile class was computed as a measure of socio-economic status (the population was ranked by household usual consumption expenditure).
2. Secondly, the utilization rate for children 0-5 years who got immunized in government health centers was estimated for each quintile class.
3. Thirdly, the net subsidy was estimated for government health centers for each quintile class.
4. Fourthly, individual subsidy for each quintile class was estimated by multiplying the net subsidy with the utilization rate.
5. Lastly, Benefit Incidence was calculated for each quintile class by taking a percentage share of the individual subsidy.

The benefit incidence of a particular group j was estimated by utilizing services i (immunization of children aged 0-5 years) in government health centers. The cost of services in private health centers is the expenditure incurred on immunization by households on private health centers.

Mathematically, the benefit incidence analysis can be computed as below:

$$\mu_j = \sum \alpha_{ij} \frac{\beta_i}{\alpha_i} = \sum \gamma_{ij} \beta_i$$

Where, μ_j = benefits of public subsidies enjoyed by group i

α_i = utilization of health centers by (i) group j

Υ_{ij} = share of group j on utilization of government health centers (i)

α_{ij} = utilization of health centers by (i) all groups

β_i = net expenditure incurred on immunization of children aged 0-5 years (i)

2.3. Statistical Analysis

Using STATA software, descriptive statistics, CI, CC, and BIA were computed in the present study.

2.4. Concentration Index and Concentration Curves

Researchers used CC and CI to investigate inequalities among socio-economic groups in utilizing government and private health centers to immunize their children aged 0-5 years. On the x-axis, the cumulative proportion of households using government and private health facilities to immunise their children aged 0-5 years was plotted against the cumulative proportion of households ranked by household usual consumption expenditure quintile on the y-axis. In case the CC overlaps the line of equality, the extent to which households utilizing government and private health centers for immunizing their children aged 0-5 years are distributed evenly across the consumption expenditure quintile group. CC denotes a pro-poor concentration in utilizing government and private health centers if it is above the line of equality. However, if the CC lies below the line of equality, it implies pro-richness in the utilization of government and private health centers for immunizing their children aged 0-5 years. The twice the area between the CC and the line of equality is known as CI. The CI varies from -1 to + 1, with 0 indicating an equal distribution of service utilized throughout the household's usual consumption expenditure quintile group. A negative number denotes a pro-poor distribution of utilizing health centers service consumption, whereas a positive value denotes a pro-rich distribution [20,21].

3. Results

Table 1 and Table 3 provide an in-depth analysis of the gender-wise and region-wise distribution of utilizing health centers by the households for getting their children aged 0-5 years immunized, classified by consumption expenditure quintiles. Within the "Poorest" quintile, a significant percentage of male children accounting for 5.88%, utilized private health centers, while 5.07% of female children opted for the same. In comparison, 19.21% of male

children and 18.81% of female children got immunized from government health centers. It indicates a greater usage rate among male children for getting immunized in private and government health centers. This pattern holds for all household consumption expenditure quintiles. Male children had a slightly higher rate of utilizing both private and government health centers than female children in the "Poorer," "Middle," "Richer," and "Richest" consumption expenditure quintiles. It indicates a slightly higher utilization rate among male children in private and government health centers within the consumption expenditure quintile.

Conversely, in the rural areas within the "Richer" quintile, a significant percentage of children aged 0-5 years, accounting for 27.90%, utilized private health centers. In contrast, 13.34% of children in the "Poorest" quintile opted for the same. On the other hand, in the "Poorest" quintile, a significant percentage of children aged 0-5 years, accounting for 25.15%, utilized government health centers, while 13.21% of children in the "Richest" quintile opted for the same in the rural areas. In comparison, 67% of children aged 0-5 years in the "Richest" quintile class and 2.67% of children in the "Poorest" quintile used private health centers in rural areas. This pattern holds for household consumption expenditure quintiles in urban areas utilizing government health centers.

Table 2 and Table 4 provide insights into the gender-wise and region-wise distribution of households who paid and did not pay for immunization in private and government health centers by consumption expenditure quintiles. Within the “Poorest” quintile, majority of the male (96.73%) and female (94.12%) children paid for their immunization at private health centers. On the contrary, 38.03% of male and 36.22% of female paid at government health centers for getting immunized. As we move from the “Poorest” to “Richest” consumption expenditure quintile, a significant share of households used government health centers for getting their children aged 0-5 years immunized. With the highest male children i.e., 37.78% & 95.92% respectively paid for immunization at the government health centers and private health centers. On the other hand, female children i.e., 37.44% & 95.86% respectively paid for immunization at the government health centers and private health centers.

In comparison, within the “Poorest” and the “Poorer” quintile, majority of the children aged 0-5 years residing in the rural (97.14%) and urban (96.90%) paid for their immunization at private health centers. On the contrary, 38.19% and 38.86% of children aged 0-5 years residing in the “Richest” quintile in the rural and urban areas paid at government health centers for getting immunized. As we move from the “Richest” to the “Poorest” consumption expenditure quintile, a significant share of households used government health centers for getting their children aged 0-5 years immunized. With the highest children aged 0-5 years i.e., 37.34% & 96.04% respectively residing in rural areas paid for immunization at the government health centers and private health centers. Whereas, 38.10% & 95.84% respectively residing in urban areas paid for immunization at the government health centers and private health centers.

Table 1. Gender-wise distribution of households by Consumption Expenditure Quintiles and Usage of Health Center

Quintile	Private Health Centers				Government Health Centers			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
Poorest	153	5.88	119	5.07	6,379	19.21	5,881	18.81
Poorer	158	6.08	157	6.70	5,588	16.82	5,326	17.03
Middle	272	10.46	266	11.34	5,751	17.31	5,354	17.12
Richer	574	22.08	494	21.07	7,991	24.06	7,587	24.26
Richest	1,443	55.50	1,309	55.82	7,506	22.60	7,125	22.78
Total	2,600	100.00	2,345	100.00	33,215	100.00	31,273	100.00

Source: Author’s calculation from NSS 75th Round

Table 2. Gender-wise distribution of households who paid and did not pay for immunization by consumption expenditure quintile and type of health centers in India, 2017-18

Quintile	Private Health Centers						Government Health Centers					
	Male			Female			Male			Female		
	Paid	Not Paid	Total	Paid	Not Paid	Total	Paid	Not Paid	Total	Paid	Not Paid	Total
Poorest	148 (96.73)	5 (3.27)	153 (100)	112 (94.12)	7 (5.88)	119 (100)	2,426 (38.03)	3,953 (61.97)	6,379 (100)	2,130 (36.22)	3,751 (63.78)	5,881 (100)
Poorer	157 (99.37)	1 (0.63)	158 (100)	150 (95.54)	7 (4.46)	157 (100)	2,013 (36.02)	3,575 (63.98)	5,588 (100)	1,939 (36.41)	3,387 (63.59)	5,326 (100)
Middle	260 (95.59)	12 (4.41)	272 (100)	260 (97.74)	6 (2.26)	266 (100)	2,227 (38.72)	3,524 (61.28)	5,751 (100)	2,005 (37.45)	3,349 (62.55)	5,354 (100)
Richer	537 (93.55)	37 (6.45)	574 (100)	468 (94.74)	26 (5.26)	494 (100)	2,998 (37.52)	4,993 (62.48)	7,991 (100)	2,870 (37.83)	4,717 (62.17)	7,587 (100)
Richest	1,392 (96.47)	51 (3.53)	1443 (100)	1,258 (96.10)	51 (3.90)	1309 (100)	2,886 (38.45)	4,620 (61.55)	7,506 (100)	2,764 (38.79)	4,361 (61.21)	7,125 (100)
Total	2,494 (95.92)	106 (4.08)	2600 (100)	2,248 (95.86)	97 (4.14)	2345 (100)	12,550 (37.78)	20,665 (62.22)	33,215 (100)	11,708 (37.44)	19,565 (62.56)	31,273 (100)

Source: Author's calculation from NSS 75th Round

Note: Parenthesis shows percentage

Table 3. Sector-wise Distribution of Households by Consumption Expenditure Quintiles and Usage of Health Center

Quintile	Private Health Centers				Government Health Centers			
	Rural		Urban		Rural		Urban	
	N	%	N	%	N	%	N	%
Poorest	175	13.34	97	2.67	10,397	25.15	1,866	8.06
Poorer	186	14.18	129	3.55	8,443	20.42	2,472	10.67
Middle	267	20.35	271	7.46	7,739	18.72	3,370	14.55
Richer	366	27.90	702	19.32	9,302	22.50	6,277	27.10
Richest	318	24.24	2,434	67.00	5,459	13.21	9,175	39.62
Total	1321	100.00	3,633	100.00	41,340	100.00	23,160	100.00

Source: Author's calculation from NSS 75th Round

Table 4. Sector-wise Distribution of households who paid and did not pay for immunization by consumption expenditure quintile and type of health centers in India, 2017-18

Quintile	Private Health Centers						Government Health Centers					
	Rural			Urban			Rural			Urban		
	Paid	Not Paid	Total	Paid	Not Paid	Total	Paid	Not Paid	Total	Paid	Not Paid	Total
Poorest	170 (97.14)	5 (2.86)	175 (100)	90 (92.78)	7 (7.22)	97 (100)	3,895 (37.46)	6,502 (62.54)	10,397 (100)	661 (35.42)	1,205 (64.58)	1,866 (100)
Poorer	182 (97.85)	4 (2.15)	186 (100)	125 (96.90)	4 (3.10)	129 (100)	3,009 (35.64)	5,434 (64.36)	8,443 (100)	943 (38.15)	1,529 (61.85)	2,472 (100)
Middle	259 (97.00)	8 (3.00)	267 (100)	261 (96.31)	10 (3.69)	271 (100)	2,927 (37.82)	4,812 (62.18)	7,739 (100)	1,306 (38.75)	2,064 (61.25)	3,370 (100)
Richer	344 (93.99)	22 (6.01)	366 (100)	661 (94.16)	41 (5.84)	702 (100)	3,519 (37.83)	5,783 (62.17)	9,302 (100)	2,349 (37.42)	3,928 (62.58)	6,277 (100)
Richest	305 (95.91)	13 (4.09)	318 (100)	2,345 (96.34)	89 (3.66)	2434 (100)	2,085 (38.19)	3,374 (61.81)	5,459 (100)	3,565 (38.86)	5,610 (61.14)	9,175 (100)
Total	1,260 (96.04)	52 (3.96)	1,312 (100)	3,482 (95.84)	151 (4.16)	3,633 (100)	15,435 (37.34)	25,905 (62.66)	41,340 (100)	8,824 (38.10)	14,336 (61.90)	23,160 (100)

Source: Author's calculation from NSS 75th Round

Note: Parenthesis shows percentage

Table 5. Utilization rate, out-of-pocket payment (OOP), and benefit incidence by place of residence and gender-wise on spending on immunization of children aged 0-5 years across India under Universal Immunization Programme by consumption expenditure quintile and usage of government health centers in India, 2017-18

Government health centers	Quintile	Number of households utilizing public health center (1)	Utilization Rate (2)	Mean Out of Pocket expenditure in government health centers (3)	Mean Cost of service in private health centers (4)	Net subsidy at government health centers (5 = 4-3)	Individual subsidy Benefit (6 = 5*2)	Benefit Incidence (7)
Rural	Poorest	10,397	0.2515	16.988	1032.964	1015.976	255.518	19.761
	Poorer	8,443	0.2042	13.174	1069.116	1055.942	215.623	16.676
	Middle	7,739	0.1872	18.527	1436.843	1418.316	265.509	20.534
	Richer	9,302	0.2250	18.399	1336.343	1317.944	296.537	22.933
	Richest	5,459	0.1321	18.228	1985.256	1967.028	259.844	20.096
	Total	41,340					1293.031	
Urban	Poorest	1,866	0.0806	19.573	1970.375	1950.802	157.235	6.471
	Poorer	2,472	0.1067	17.251	1545.472	1528.221	163.061	6.711
	Middle	3,370	0.1455	21.676	1938.068	1916.392	278.835	11.476
	Richer	6,277	0.2710	23.698	2180.829	2157.131	584.582	24.059
	Richest	9,175	0.3962	28.200	3173.253	3145.053	1246.070	51.283
	Total	23,160					2429.783	
Male	Poorest	6,379	0.1921	18.556	1232.945	1214.389	233.284	12.766
	Poorer	5,588	0.1682	15.521	1309.123	1293.602	217.583	11.907
	Middle	5,751	0.1731	19.197	1676.111	1656.914	286.812	15.695
	Richer	7,991	0.2406	19.378	1763.815	1744.437	419.712	22.968
	Richest	7,506	0.2260	25.800	2990.312	2964.512	669.980	36.664
	Total	33,215					1827.371	
Female	Poorest	5,881	0.1881	16.117	1548.169	1532.052	288.179	14.612
	Poorer	5,326	0.1703	12.606	1221.948	1209.342	205.951	10.443
	Middle	5,354	0.1712	19.803	1708.69	1688.887	289.137	14.661
	Richer	7,587	0.2426	21.755	2041.887	2020.132	490.084	24.850
	Richest	7,125	0.2278	23.099	3090.805	3067.706	698.823	35.434
	Total	31,273					1972.174	

Source: Author's calculation from NSS 75th Round

Table 5 represents the results of benefit incidence analysis by place of residence and gender-wise on spending on immunization of children aged 0-5 years across India, by consumption expenditure quintile and usage of government health centers in India. The utilization rate was highest for the "Poorest" quintile class (0.2515) in rural areas, while it was highest for the "Richest" quintile class (0.3962) in urban areas. The mean out-of-pocket expenditure in government health centers was incurred highest by the "Middle" quintile class (18.527). In contrast, the lowest out-of-pocket expenditure was incurred by the "Poorer" quintile class (16.988) in rural areas. On the contrary, the mean out-of-pocket expenditure in government health centers was incurred highest by the "Richest" quintile class (28.200), followed by the "Poorer" quintile class (17.251) in the urban areas. Overall, the highest share of benefits was received by the "Richer" section of the society (22.93). In contrast, the lowest benefit was received by the "Poorer" section of the society (16.68) in the rural areas. On the other hand, the highest share of benefit was received by the "Richest" section of the society (51.28). In contrast, in urban areas, the lowest benefit was received by the "Poorest" and "Poorer" sections, i.e., 6.47 and 6.71.

Table 6. Concentration Index for consumption expenditure quintile for male children aged 0-5 years getting immunized in Indian states

States	No. of observations	Index Value	Std. error	P-value
Jammu & Kashmir	1104	.34985873	.15292156	0.0223
Himachal Pradesh	648	.30412108	.24231668	0.2099
Punjab	1055	.42527571	.09923166	0.0000
Chandigarh	97	.84582782	.35525023	0.0193
Uttarakhand	568	.60085378	.21659607	0.0057
Haryana	1116	.60531026	.08253922	0.0000
Delhi	386	.60923402	.17547506	0.0006
Rajasthan	1984	.45706123	.12976828	0.0004
Uttar Pradesh	4146	.20514284	.07431635	0.0058
Bihar	2128	.51323277	.0999432	0.0000
Sikkim	140	.11585964	.28297897	0.6829
Arunachal Pradesh	531	.03585085	.08894823	0.6871
Nagaland	384	.12402961	.14080219	0.3789
Manipur	823	-.13239829	.17100918	0.4390
Mizoram	443	.67472889	.26453733	0.0111
Tripura	492	-.0166912	.17108807	0.9223
Meghalaya	446	.24027488	.08495083	0.0049
Assam	1223	.50093376	.10389985	0.0000
West Bengal	1838	.78753075	.11046229	0.0000
Jharkhand	1259	.6800717	.12456314	0.0000
Odisha	1136	-.01740135	.10876933	0.8729
Chhattisgarh	1027	.62669793	.22004157	0.0045
Madhya Pradesh	1993	.44454656	.11863042	0.0002
Gujarat	1332	.2467976	.07571684	0.0011
Daman & Diu	36	.4108644	.36326451	0.2660
Dadra & Nagar Haveli	72	.80152295	.32208762	0.0152
Maharashtra	2745	.5016077	.05964415	0.0000
Andhra Pradesh	1144	.58433023	.23437272	0.0128
Karnataka	1357	.28365651	.06218061	0.0000
Goa	89	.49688244	.46720064	0.2905
Lakshadweep	69	-.01902861	1.1077408	0.9863
Kerala	1242	.10188724	.07647349	0.1830
Tamil Nadu	1754	.50174284	.06844704	0.0000
Puducherry	129	.20374559	.76581578	0.7906
Andaman & Nicobar Islands	131	.53527761	.21156033	0.0126
Telangana	942	.37151333	.10810486	0.0006

Source: Author's calculation from NSS 75th Round

Conversely, for the gender-wise spending on immunization of children aged 0-5 years, the utilization rate was highest for the "Richer" quintile class, i.e., 0.2406 and 0.2426 for both male and female children. The mean out-of-pocket expenditure in government health centers was incurred highest by the "Richest" quintile class (25.800 and 23.099, respectively) and the lowest mean out-of-pocket expenditure on government health centers was incurred by the "Poorer" quintile class (15.521 and 12.606 respectively) by both male and female children aged 0-5 years. Overall, the highest share of benefits was received by the "Richest" section of the male and female children aged 0-5 years (36.66 and 35.43 respectively), and the lowest benefit was received by the "Poorer" section of (11.92 and 10.44 respectively) male and female children aged 0-5 years.

Table 6 and Table 7 provide the concentration index for male and female children aged 0-5 years separately. For the

male children aged 0-5 years, the concentration index varies from -0.132 in Manipur to 0.846 in Chandigarh, i.e., showing pro-poor distribution in Manipur state, while pro-rich distribution in Chandigarh state. The states showing significant pro-rich distribution among male children aged 0-5 years are Mizoram (0.675), followed by Haryana (0.605), Punjab (0.425) and Rajasthan (0.457). On the contrary, the concentration index shows a distinct inequality trend for female children aged 0-5 years. The range of concentration index is narrow, with the Dadra & Nagar Haveli having the highest value of 0.0908 followed by Goa (0.892), Madhya Pradesh (0.764), Chhattisgarh (0.712), and Rajasthan (0.715) showing pro-richness. Whereas, the states showing pro-poorness among female children aged 0-5 years were Manipur (-0.711), followed by Daman Diu (-0.366), Lakshadweep (-0.144), and Tripura (-0.136).

Table 7. Concentration Index for consumption expenditure quintile for female children aged 0-5 years getting immunized in Indian states

States	No. of observations	Index Value	Std. error	P-value
Jammu & Kashmir	1028	.06661055	.10728413	0.5348
Himachal Pradesh	651	.2208601	.15987347	0.1676
Punjab	864	.42649803	.12176543	0.0005
Chandigarh	79	.43668511	.45137313	0.3363
Uttarakhand	601	.37355682	.17717341	0.0354
Haryana	980	.60797653	.07273497	0.0000
Delhi	330	.52907671	.20019734	0.0086
Rajasthan	1827	.71579754	.15328026	0.0000
Uttar Pradesh	3871	.46827959	.07251413	0.0000
Bihar	1945	.60717182	.1273657	0.0000
Sikkim	141	.70151414	.26416725	0.0088
Arunachal Pradesh	462	-.01484715	.10298351	0.8854
Nagaland	314	.11014788	.12510131	0.3793
Manipur	842	-.71111	.10788093	0.0000
Mizoram	522	.48222942	.20163889	0.0171
Tripura	411	-.1363102	.14529847	0.3487
Meghalaya	499	.32909969	.11227181	0.0035
Assam	1052	.28123962	.13619927	0.0392
West Bengal	1765	.62429536	.1756138	0.0004
Jharkhand	1146	.04306199	.27051503	0.8736
Odisha	1123	.25439615	.18231246	0.1632
Chhattisgarh	974	.71288755	.15457514	0.0000
Madhya Pradesh	1921	.76434078	.16159776	0.0000
Gujarat	1200	.24527465	.08814625	0.0055
Daman & Diu	57	-.36651794	.4954208	0.4626
Dadra & Nagar Haveli	70	.9085323	.70643528	0.2028
Maharashtra	2570	.51680278	.05653014	0.0000
Andhra Pradesh	1060	.67340198	.14052816	0.0000
Karnataka	1247	.51352616	.06576858	0.0000
Goa	118	.89227307	.64126795	0.1668
Lakshadweep	68	-.14430228	1.0419471	0.8903
Kerala	1236	.23130169	.10553438	0.0286
Tamil Nadu	1663	.50706795	.0766908	0.0000
Puducherry	136	.21856003	.62980352	0.7291
Andaman & Nicobar Islands	127	-.05302209	.53247574	0.9208
Telangana	890	.53917087	.10770004	0.0000

Source: Author's calculation from NSS 75th Round

Table 8 and Table 9 provide the concentration index for children aged 0-5 years residing in rural and urban regions separately. In the rural areas, Daman Diu (0.981), followed by Mizoram (0.760), West Bengal (0.606), and Chhattisgarh (0.517) shows a pro-rich contribution, reflecting that the Richer quintile class spends more on the immunization of their children aged 0-5 years. There were only few states that show a pro-poor contribution like Goa (-0.781), Manipur (-0.632), Chandigarh (-0.410), and Odisha (-0.196). On the contrary, in the urban areas, Dadra & Nagar Haveli (0.818), followed by Sikkim (0.791), Madhya Pradesh (0.742), Chandigarh (0.704) show a more pro-rich contribution in comparison to other states, reflecting that the Richer quintile class spends more on the immunization of their children aged 0-5 years.

Table 8. Concentration Index for consumption expenditure quintile for children aged 0-5 years getting immunized in rural areas in Indian states

States	No. of observations	Index Value	Std. error	P-value
Jammu & Kashmir	1330	-.05098781	.054546	0.3501
Himachal Pradesh	1079	.12330094	.11767503	0.2950
Punjab	971	.36729972	.12329755	0.0030
Chandigarh	44	-.40982346	.42317699	0.3384
Uttarakhand	741	.48891274	.15307425	0.0015
Haryana	1196	.58349735	.07300135	0.0000
Delhi	39	.33777179	.25044911	0.1856
Rajasthan	2554	-.04956332	.17952585	0.7825
Uttar Pradesh	4984	.11230469	.07610867	0.1401
Bihar	2844	.22308674	.0783837	0.0045
Sikkim	215	.25501074	.23396936	0.2770
Arunachal Pradesh	693	-.07504014	.07817649	0.3375
Nagaland	481	.02432263	.11903131	0.8382
Manipur	936	-.63250171	.11631679	0.0000
Mizoram	480	.76031159	.25164424	0.0027
Tripura	667	-.10474451	.12247162	0.3927
Meghalaya	691	.31711149	.07009194	0.0000
Assam	1781	.25324878	.07895676	0.0014
West Bengal	2354	.60635307	.1421738	0.0000
Jharkhand	1786	-.04388775	.08449738	0.6035
Odisha	1739	-.19615705	.10926396	0.0728
Chhattisgarh	1304	.51719135	.36644951	0.1584
Madhya Pradesh	2427	-.01781183	.09445114	0.8504
Gujarat	1273	.40062071	.0981542	0.0000
Daman & Diu	51	.98066126	.81319311	0.2336
Dadra & Nagar Haveli	79	-.6871884	.46677615	0.1450
Maharashtra	2709	.21559463	.06651428	0.0012
Andhra Pradesh	1423	.41325141	.17160389	0.0162
Karnataka	1467	.11977187	.1080859	0.2680
Goa	77	-.78087155	1.8903035	0.6807
Lakshadweep	50	.59503312	.74029509	0.4255
Kerala	1366	-.05710728	.09616492	0.5527
Tamil Nadu	1938	.29898443	.10299064	0.0037
Puducherry	63	.21165045	1.2308326	0.8640
Andaman & Nicobar Islands	135	.7435953	2.0630905	0.7191
Telangana	981	.2258939	.10388776	0.0299

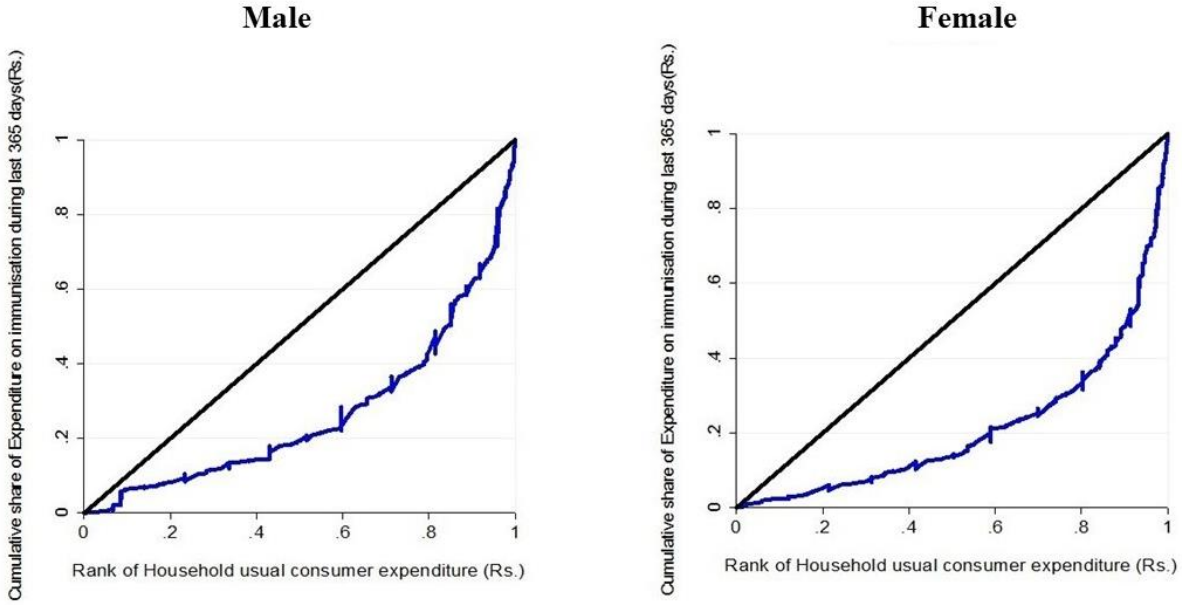
Source: Author's calculation from NSS 75th Round

Table 9. Concentration Index for consumption expenditure quintile for children aged 0-5 years getting immunized in urban areas in Indian states

States	No. of observations	Index Value	Std. error	P-value
Jammu & Kashmir	802	.32894486	.14784267	0.0264
Himachal Pradesh	221	.30015578	.31248459	0.3378
Punjab	949	.34116105	.09179639	0.0002
Chandigarh	132	.70380525	.32648641	0.0329
Uttarakhand	428	.42065844	.22368673	0.0607
Haryana	901	.4023298	.06519403	0.0000
Delhi	677	.58647669	.13767885	0.0000
Rajasthan	1257	.53731823	.09655158	0.0000
Uttar Pradesh	3035	.23661385	.05151114	0.0000
Bihar	1229	.67128459	.06767258	0.0000
Sikkim	66	.7910747	.32955695	0.0193
Arunachal Pradesh	300	.23177851	.11852984	0.0515
Nagaland	218	-.17860433	.11656134	0.1269
Manipur	729	-.28645479	.17883842	0.1096
Mizoram	485	.2480597	.16836586	0.1413
Tripura	236	.36067158	.32535248	0.2688
Meghalaya	254	.15331997	.1625644	0.3465
Assam	495	.28542144	.1076077	0.0082
West Bengal	1250	.62102467	.09717962	0.0000
Jharkhand	619	.47133114	.09607055	0.0000
Odisha	521	.29910322	.15707536	0.0574
Chhattisgarh	697	.22571642	.09828878	0.0219
Madhya Pradesh	1490	.74188126	.10250664	0.0000
Gujarat	1259	-.01544995	.06735028	0.8186
Daman & Diu	42	-.03518514	.41724338	0.9332
Dadra & Nagar Haveli	63	.81786245	.31791644	0.0125
Maharashtra	2606	.36981347	.0451583	0.0000
Andhra Pradesh	781	.56778286	.12920545	0.0000
Karnataka	1137	.26513571	.04460001	0.0000
Goa	130	.61915826	.34854237	0.0780
Lakshadweep	87	.32846762	1.6607611	0.8437
Kerala	1112	.35893211	.08011514	0.0000
Tamil Nadu	1479	.45595574	.05700984	0.0000
Puducherry	202	.1559717	.43815876	0.7222
Andaman & Nicobar Islands	123	.25098785	.17711348	0.1590
Telangana	851	.29835007	.08967994	0.0009

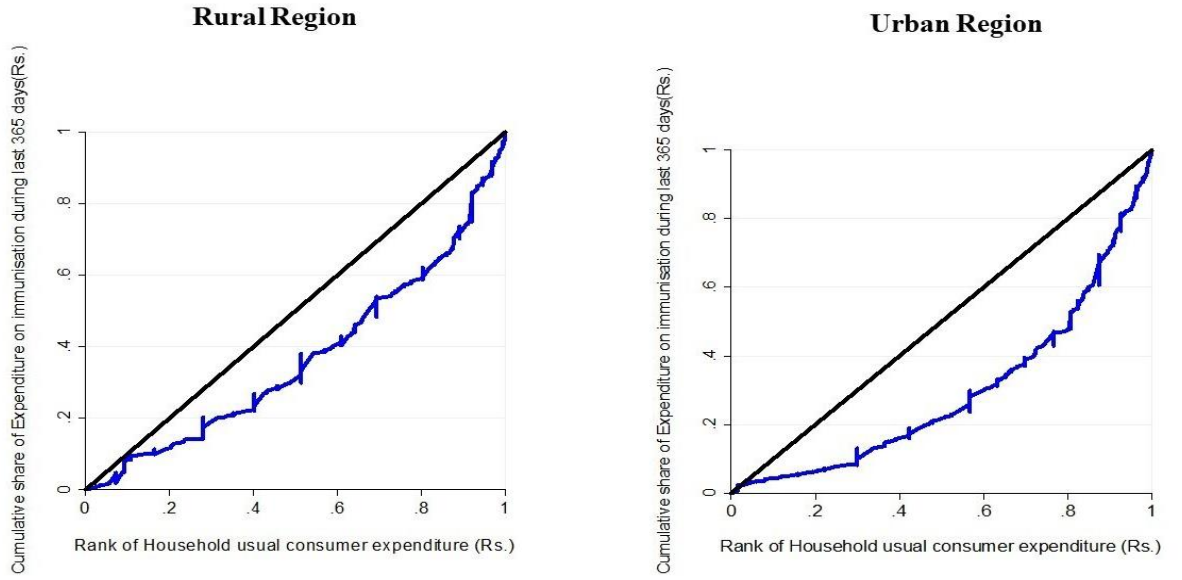
Source: Author's calculation from NSS 75th Round

Figure 1 and Figure 2 represent the gender-wise and region-wise concentration curves of children aged 0-5 years by their cumulative share of expenditure by consumption expenditure quintile class in India. The gender-wise concentration curve for children aged 0-5 years who incurred expenditure on immunization is below the line of equality reflecting pro-rich concentration, i.e., the richer section of the society incurred more expenditure on getting their children aged 0-5 years immunized both gender-wise and region-wise.



Source: Author's calculation from NSS 75th Round

Figure 1. Gender-wise concentration curve by consumption expenditure quintile for children aged 0-5 years in Indian



Source: Author's calculation from NSS 75th Round

Figure 2. Region-wise concentration curve by consumption expenditure quintile for children aged 0-5 years in Indian

4. Discussion

Addressing health inequalities has become increasingly important in the context of global health policy in recent years. This change is the consequence of experts' increasing realization that a nation's overall health performance cannot be accurately measured by depending just on its average health status. Another aspect of socio-economic inequality within the UIP is the region-wide differences in immunization coverage. While rural regions sometimes face significant problems like remote healthcare institutions and restricted accessibility, urban areas typically benefit from more significant infrastructure and healthcare services. Rural areas often have lower socio-economic status so this urban-rural divide can exacerbate existing socio-economic gaps [22]. Although, government initiatives have been instituted in the past to augment the accessibility of essential healthcare services, which included the National Health Policy (NHP) from 2002, the Child Survival and Safe Motherhood Program (CSSMP) from 1992, the UIP from 1985, and the National Rural Health Mission (NRHM) from 2005. After all these efforts by the government, gender-wise and region-wise inequalities in immunization coverage have decreased, although children who are females and residing in rural areas continue to experience inequality. Given the continuation of these inequalities, it is possible that universal and equitable access to immunization services cannot be ensured by merely raising the immunization rate overall, especially for underprivileged or economically disadvantaged sections of society. The population reside in urban areas relative to rural areas. The ease of accessing healthcare services in urban areas relative to the population residing in rural areas has been highlighted continuously, regardless of geographic location [8,23,24].

Some research points to gender-wise differences in immunization. It shows that male children are more likely to complete the immunization than female children, especially in the northern regions. All states except Goa and Karnataka had higher immunization rates for male children than for female children under five years. However, the differences varied somewhat between the two [8].

The above findings thoroughly examine the use of health centers for immunizing children aged 0 to 5 years in India, considering both gender and consumer expenditure quintiles. It was further found that male children aged 0-5 years generally use both government and private health facilities at a higher rate than female children aged 0-5 years across all quintiles to get immunized. This pattern remains consistent in the "Poorest," "Poorer," "Middle," "Richer," and "Richest" consumption expenditure quintiles, that male children aged 0-5 years utilize immunization services more frequently than female children aged 0-5 years, regardless of quintile class. Conversely, the differences can be seen region-wise, i.e., the children aged 0-5 years falling under the "Richest" quintile class residing in rural areas frequently use private health centers for getting immunized. On the contrary, children residing in urban areas frequently use government health centers to get immunized.

Furthermore, the results also reveal that a significant share of male and female children aged 0-5 years in the "Poorest" quintile class paid for their immunization at private health centers. Conversely, a significant share of male and female children aged 0-5 years in the "Richer" quintile class utilized government health centers to get immunized. It implies that children aged 0-5 years falling in the "Richer" and "Richest" consumption expenditure quintile class utilize government health centers to get immunized. A similar trend can be seen among children aged 0-5 years residing in rural and urban areas. These trends indicate that household consumption expenditure significantly impacts where they choose to receive their immunizations.

In terms of most benefits received, the "Richest" quintile class and the "Middle" quintile class in the rural areas exhibit the highest utilization rate and out-of-pocket expenditure. The lowest out-of-pocket expenditure was for the "Poorer" quintile class in rural areas. The "Richest" quintile class had the highest out-of-pocket expenditure in government health centers, followed by the "Poorer" quintile class in urban areas. The "Richest" section received the highest share of benefits, while the "Poorest" and "Poorer" sections received the lowest. For gender-wise spending on immunization for children aged 0-5 years, the utilization rate was highest for the "Richer" quintile class. The mean out-of-pocket expenditure was highest for the "Richest" quintile class, while the lowest was for the "Poorer" quintile class. Overall, the "Richest" section received the highest share of benefits for both male and female children aged 0-5 years.

The study reveals a pro-poor distribution of immunization expenditure among children aged 0-5 years in India. The concentration index for male children varies from -0.132 in Manipur to 0.846 in Chandigarh, with states like Mizoram, Haryana, Punjab, and Rajasthan showing a pro-rich distribution. However, there is a distinct inequality trend for female children aged 0-5 years, with states like Dadra & Nagar Haveli showing pro-richness. In rural areas, the richer quintile class spends more on immunization, while the richer class spends more in urban areas. The gender-wise concentration curve for children aged 0-5 years who incurred expenditure on immunization is below the line of equality, indicating a pro-rich concentration, suggesting that the richer section of society incurred more expenditure on immunization, gender-wise and region-wise. The study highlights the need for more effective immunization policies and strategies for children in India.

5. Conclusions

The findings from the above study reflect that

government health centers are the most preferred source for getting children immunized aged 0-5 years across various socio-economic groups, with higher utilization rates observed in rural areas. Although, inequalities emerge in the benefit incidence and subsidy impact. Since government health centers provide subsidized services, the richer section of households and urban areas tends to get more benefits from these subsidies than the poorer section of households. Therefore, there is a need for targeted interventions to ensure equitable distribution of benefits among poorer socio-economic groups of households both in rural and urban areas. Therefore, to address the above inequalities the government should launch an awareness campaign in the targeted states, improve rural health infrastructure, reduce financial burden through expanding insurance coverage and subsidies to the poorer section of households, and focus on states with high socio-economic inequalities.

The government should focus on integrating new antigens into the UIP and enhancing its elements, including immunization schedule and delivery system oversight. Further recommendations include targeted interventions, educational campaigns, infrastructure improvements, incentives, monitoring, policy flexibility, community engagement, capacity building, research, innovation, and a phased implementation plan to ensure equitable access to immunization services.

Limitations

Since the present study is specifically limited to gender and region, further socio-economic factors like religion and social group can be considered for future study. Also, this study has considered the NSS 75th round; other rounds, i.e., NFHS and DLFH data, can be considered for future studies.

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Not applicable

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