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Evaluation of Immunization Coverage and the Determinants Affecting Immunization in the District of Gujarat, India

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Abstract

Background: Immunization remains one of the most cost-effective public health strategies globally, preventing millions of deaths from vaccine-preventable diseases (VPDs). India's Universal Immunization Programme (UIP) aims to provide equitable vaccine access. However, significant disparities persist in immunization coverage. This study was conducted to assess the immunization status of children aged 12–35 months in a district of Gujarat, and to identify the factors influencing coverage.

Objectives: The study aimed to determine the proportions of fully, completely, partially, and unimmunized children; identify determinants influencing immunization coverage; evaluate vaccine utilization and dropout rates.

Methods: A community-based cross-sectional study was carried out from June 2018 to October 2019 using WHO's 30-cluster sampling method, expanded to 40 clusters for better representation. A total of 400 children aged 12–35 months were selected across urban and rural areas of district. Data were collected through structured household interviews with parents/guardians using a pre-tested questionnaire. Variables were analysed using Microsoft Excel 2007, with proportions and chi-square tests applied for statistical analysis.

Results: Out of 400 children studied, 73.04% of children aged 12–23 months were fully immunized, 19.57%

partially immunized, and 7.39% unimmunized. In the 24–35-month group, full immunization slightly declined to 69.41%, and unimmunized cases increased to 12.35%. BCG vaccine coverage was the highest at 99.25%, while measles (1st dose) and Penta-3 vaccines showed lower coverage. Dropout rates were notable: 10.04% between BCG to Measles and 6.25% between Penta-1 to Measles. Vaccination card availability stood at 69.75%. A major reason for partial or non-immunization included lack of awareness (29.1%), and at least one missed outreach session (7.59%).

Keywords: Immunization, Children, Drop Out, Vaccines, Coverage

Introduction

"Immunization has been named one of the Ten Great Public Health Achievements in the 20th Century"[1].

Immunisation is developing an individual's body's protective response to a specific disease by introducing an immunising agent. It is considered one of the most important and cost-effective public health services for children. Significant progress has been made towards the development of effective national immunisation programmes, and the major contributor to this success is the Expanded Programme on Immunization (EPI) of the WHO, UNICEF, and the Global Alliance for Vaccines Initiative (GAVI). [2]

Immunizing children is one of public health's "best buys". Vaccines are relatively easy to deliver and, in most cases, provide lifelong protection. According to the State of the World's Vaccines and Immunization 2009 report, "Immunization - even with the addition of the new, more costly vaccines - remains one of the most cost-effective health interventions"[2]. The Expanded Programme on Immunization (EPI) was initiated by the Government of India in 1978 to reduce morbidity, mortality and disability from seven Vaccine-Preventable Diseases (VPD) by making vaccination services available to all eligible children free of cost through the public health sector, which was re-introduced as the Universal Immunization Programme in India-World`s largest such programme in 1985.[3]

Initially, the target was set to cover at least 85% of all infants. However, national socio-demographic goals in the National Population Policy set a target of achieving 'Universal' immunization of children by 2010.[4] Despite being operational for the past more than 30 years, 65% of children in India receive all vaccines during their first year of life. It is estimated that annually, more than 89 lakh children in the country do not receive all vaccines that are available under the UIP–the highest number compared with any other country in the world.[5][6]

Therefore, this study is justified as it provides insights into immunization coverage, identifying gaps and socio-demographic determinants affecting vaccine uptake, and findings will support the strategies to enhance vaccine accessibility, equity, and overall program effectiveness.

Aims and Objectives

1. To determine the proportion of fully immunized, completely immunized, and partially immunized, and unimmunized children, and identify the factors influencing immunization coverage.
2. To investigate the reasons for partial immunization and complete non-immunization.
3. To evaluate the utilization of immunization services by analysing vaccine drop-out rates.

Methodology

Study Setting: The present study was conducted in urban and rural communities of the district of Gujarat. A prominent state in western India, it is recognised for its progressive development and has a population of 60.3 million, accounting for approximately 5% of India's total population. A significant proportion, 57.4%, resides in rural areas with an urbanisation rate of 84.04% and a rural population of 15.96%.[7] The district comprises 11 sub-districts, one municipal corporation, seven municipalities, and 506 inhabited villages. [8]

Study Design: A community-based cross-sectional study.

Sampling & Sample Size: A multi-stage cluster sampling was adopted, utilizing the WHO 30-cluster sampling technique for immunization coverage assessment.

Cluster Selection: A total of 40 clusters were selected based on probability proportional to population size (PPS). A comprehensive list of all Primary Health Centers (PHCS) and Urban Health Centers (UHCS) was obtained. A class interval (1,80,356) was determined by dividing the total population by 40 (the total number of clusters). A random number less than the class interval was generated using a currency note method. The cluster corresponding to this number was designated as the first cluster, while subsequent clusters were selected by systematically adding the cluster interval.

Sample size: The sample size was estimated based on immunization coverage data from surveys such as NFHS-4, Rapid Survey on Children (RSOC), District Level Household Survey (DLHS), and the Coverage Evaluation Survey.[9] The sample size for a cluster survey of immunization is calculated by the following formula: Sample size ESS * DEFF.

ESS- The Effective Sample Size (ESS) was determined for ±10% precision. Based on previous surveys (NFHS-4, DLHS, RSOC, etc.), full immunization coverage ranged between 50- 70%. For 95% (CI), an ESS of 100 was selected.[10][9][11][12]

Design Effect (DEFF) = 1+ (m-1)*ICC

= 1+ (10-1)* 1/3

= 4

Where m number of samples per cluster, and ICC 1/3 [Intra-cluster Correlation Coefficient (ICC) was taken 1/3 for Routine Immunization (RI) coverage as suggested by the WHO vaccination coverage cluster surveys reference manual, 2015].[10]

Total sample size = ESS * DEFF =100 * 4 =**400**

Therefore, 40 clusters and 10 children from each cluster were selected. (40 * 10 = 400)

Household Selection: Each cluster was arbitrarily divided into four quadrants using the Google Earth application and numbered from west to east. A lottery method was employed to select one quadrant. Households within the selected quadrant were numbered sequentially from west to east. The first household was selected using the currency note method, and a house-to-house survey was conducted until 10 eligible children (aged 12-35 months) were enrolled per cluster.

Study Population

Inclusion Criteria

- Children aged 12– 35 completed months.
- Permanent residents of the district.
- The parent/guardian provided informed consent for participation.

Exclusion Criteria

- Guest children in the eligible age group who were only visiting the area temporarily.

- Children younger than 12 months or older than 36 months.

Study Period: The study was conducted from June 2018 to October 2019.

Ethical Approval: Ethical clearance was obtained from the Institutional Review Board of B. J. Medical College, Ahmedabad.

Data Collection: Data were collected at the household level through structured interviews with informants (parents/guardians) using a pre-tested, pre-designed questionnaire. Before data collection, verbal and written informed consent were obtained from respondents.

Data Triangulation: A cross-verification approach was used to validate immunization status through:

1. Vaccination Cards (primary source)
2. Maternal Recall (secondary source)

The following information was collected at Households: Information was gathered by interviewing the mother, preferably; if not available, then the person knowing about the child's immunisation in the family was approached. Socio-demographic information, occupation and educational status of parents, and availability of vaccination cards were collected.

Data Analysis: Data entry and data analysis were performed using Microsoft Excel 2007, and the χ^2 test was applied to assess statistical significance of associations.

Method to Calculate Coverage Rates: The methodology used for calculating vaccination coverage rates is summarized in the following steps:

Step 1: Child's age (in completed months): A child's exact age in months was computed by subtracting the date of birth (DOB) from the household visit date. If the DOB was unavailable, the mother's reported age of the child was considered.

Step 2: Used a binary variable whether the specific vaccine was received or not:

- Vaccination Card Data: If a valid date (DD/MM/YYYY) was recorded on the vaccination card, the vaccine was considered administered.
- Maternal Recall: If the card was unavailable, the mother's affirmative response was accepted as evidence of vaccination. If the response was "No" or "Don't know", the vaccine was considered not received.

Step 3: Valid dose: If a dose of vaccine is given before the minimum recommended age or interval, then the dose is considered invalid.

Step 4: Immunization coverage: Different age groups were considered to estimate coverage rates for different vaccines. The following Output Indicators were developed and used in study:

Output Indicators

1. % of children are fully immunised (FIC rate)
2. % of children with vaccination cards
3. % of children are completely immunized
4. Proportion of partially immunized and unimmunized children
5. Association of immunization coverage with socio-demographic factors
6. Factors contributing to partial or missed immunization

Limitations of the study

- Cluster homogeneity may lead to overrepresentation or underrepresentation, potentially influencing results.
- A limited number of clusters were surveyed, leaving portions of the population unaccounted for.

- The study focused solely on outcome evaluation without assessing program implementation processes.

Result and discussion

A cross-sectional study was conducted in urban and rural areas of a district in Gujarat, India, among 400 children aged 12–35 months. Of these, 75% (n=300) resided in urban areas and 25% (n=100) in rural areas. Age-wise distribution showed that 57.5% (n=230) were in the 12–23-month group, while 42.5% (n=170) belonged to the 24–35-month group. Chi-square analysis indicated no statistically significant difference ($p>0.05$) in age distribution across residential settings, suggesting that place of residence did not influence immunization status. Of the total participants, 52.75% (n=211) were male and 47.25% (n=189) were female, aligning with findings by Bhatt et al.[13] No significant association was observed between gender and place of residence ($p=0.9539$). The mean age was 21.8 months (SD = 6.68). Among children aged 12–23 months, 53.04% were male and 46.96% female, while in the 24–35-month group, 52.35% were male and 47.65% female. No significant gender difference was observed across age groups ($p=0.8912$).

The majority (88.2%) of children belonged to Hindu families, consistent with findings by Murhekar et al. (86.2%).[14] Religious affiliation was not associated with immunization status. Socioeconomic classification using the modified B.G. Prasad scale revealed that 19% of children were in Class I, 31.75% in Class II, 29.75% in Class III, 15.25% in Class IV, and 4.25% in Class V. Inadequate immunization was more prevalent in lower socioeconomic strata: 10.75% in Class IV and 3.75% in Class V. The association between socioeconomic status and immunization coverage was statistically significant, indicating that higher socioeconomic class was positively associated with appropriate age-specific immunization.

Among the 400 children surveyed, 84.75% had vaccination cards, while 15.25% did not present them during house-to-house visits. Card availability was significantly higher in urban areas (87%) than in rural (78%). These findings align with the RSoC in Gujarat, which reported 84.3% availability and 15.7% lacking documentation. In contrast, earlier surveys such as NFHS-3, DLHS-3, and the 2009 CES reported lower availability, around 53% in urban and 47% in rural areas. Similarly, Bhatt et al. reported even lower card possession in Ahmedabad, with only 45.3% of urban and 32.8% of rural caregivers presenting a Mamata card, and 1.6% of rural parents stating they were never issued one. These disparities highlight persistent gaps in service delivery and documentation, especially in rural regions.[13] [15][11]

Immunization Coverage

Table 1: Immunization Coverage among Children

12-23 months age group	Immunisation status	Number (%)	95% C.I.
	Fully Immunized	168 (73.04)	(67.31% to 78.77%)
	Partially Immunized	45 (19.57)	(14.44% to 24.7%)
	Unimmunized	17 (7.39)	(4.01% to 10.77%)

24-35 months age group	Fully Immunized	118 (69.41)	(62.48% to 76.34%)
	Partially Immunized	31 (18.24)	(12.43% to 24.05%)
	Unimmunized	21 (12.35)	(7.4% to 17.3%)

Table 1 shows that 73.04% of children aged 12–23 months were fully immunized, 19.57% partially immunized, and 7.39% unimmunized. In the 24–35-month group, full immunization slightly declined to 69.41%, and unimmunized cases increased to 12.35%. This indicates a slight drop in coverage with age, highlighting the need for improved follow-up and outreach as children grow older.

Table 2: Availability of Vaccination Cards Among Children in Urban and Rural Areas (N=400)

Vaccination card availability	Urban Number (%)	Rural Number (%)	Total Number (%)
Yes	261 (65.25)	78 (19.5)	339 (84.75)
No	39 (9.75)	22 (5.5)	61 (15.25)
Total Number (%)	300 (75)	100 (25)	400 (100)
χ2 statistic is 4.7004; p-value is 0.030155. The result is statistically significant at $p<0.05$			

Table 2 shows that 84.75% (n=339) of children had vaccination cards, while 15.25% (n=61) did not. Card availability was significantly higher in urban areas (p = 0.0302), indicating better documentation. Availability was greater in the 12–23 months group (50.25%) than in the 24–35 months group (34.5%), though more older children (8%) lacked cards compared to younger ones (7.25%). This age-wise difference was not statistically significant (χ^2 = 2.9212; p = 0.087421). Among 12–23-month-olds, 42% were appropriately immunized, versus 29.5% in the 24–35-month group. Partial or no immunization was seen in 15.5% of the younger and 13% of the older children. However, this difference was not statistically significant (χ^2 = 0.6327; p = 0.426371), indicating no association between age group and immunization status.

Table 3: Association between Immunization status and gender of studied children (N=400)

Gender	Immunization appropriate for age Number (%)	Partial/no immunization Number (%)	Total Number (%)
Male	162 (40.5)	49 (12.25)	211 (52.75)
Female	124 (31)	65 (16.25)	189 (47.25)
Total Number (%)	286 (71.5)	114 (28.5)	400 (100)
χ2 statistic =6.103 ;p-value =0.0134, The result is statistically significant at $p<0.05$			

Table 3 shows that male children were more likely to be appropriately immunized for their age compared to females, with a statistically significant difference. Among the 400 children surveyed, 71.5% (95% CI: 67.07%–75.92%) were fully immunized, 19% (95% CI: 15.16%–22.84%) partially immunized, and 9.5% (95% CI: 6.61%–12.38%) unvaccinated. This contrasts with findings by Kadri AM et al. in Ahmedabad's urban slums, where no significant gender-based difference in immunization coverage was reported.[16]

Age-specific immunization coverage showed that among 230 children aged 12–23 months, 73.04% (95% CI:

67.31%–78.77%) were fully immunized, 19.57% (95% CI: 14.44%–24.7%) partially immunized, and 7.39% (95% CI: 4.01%–10.77%) unimmunized. In the 24–35-month group (n=170), full coverage was 69.41% (95% CI: 62.48%–76.34%), with 18.24% (95% CI: 12.43%–24.05%) partially and 12.35% (95% CI: 7.4%–17.3%) unimmunized. Compared to previous surveys—NFHS-4 (50.4%), CES (56.6%), and DLHS-3 (54.9%)—the current study shows improved coverage by 23%, 17%, and 18%, respectively, likely due to better service delivery and healthcare access. However, Bhatt et al. and Gupta et al. reported even higher FIC rates (84%–93 %).[(13)(17)(9)(18)(11)]

Table 4: Association Between Immunization Status and Education Among Children(N=400)

	Education	Immunization appropriate for age Number (%)	Partial/no immunization Number (%)	Total Number (%)
Mother's	Illiterate	32 (8)	48 (12)	80 (20)
	Primary	48 (12)	39 (9.75)	87 (21.75)
	Secondary	117 (29.25)	24 (6)	141 (35.25)
	Higher secondary and above	89 (22.25)	3 (0.75)	92 (23)
	Total Number (%)	286 (71.5)	114 (28.5)	400 (100)
χ2 statistic =88.2134 ;p-value <0.00001, The result is statistically significant at p<0.05				
Father's	Illiterate	11 (2.75)	11 (2.75)	22 (5.5)
	Primary	37 (9.25)	32 (8)	69 (17.25)
	Secondary	72 (18)	58 (14.5)	130 (32.5)
	Higher secondary and above	166 (41.5)	13 (3.25)	179 (44.75)
	Total Number (%)	286 (71.5)	114 (28.5)	400 (100)
χ2 statistic =71.9992 ;p-value <0.00001, The result is statistically significant at p<0.05				

Table 4 shows a significant positive association between paternal education and immunization coverage. Children whose fathers had higher secondary education or above had the highest age-appropriate immunization coverage (41.5%, n=166), while partial or no immunization was more common among children of fathers with only primary education (8.0%, n=32) or who were illiterate (2.75%, n=11). This suggests that higher paternal education increases the likelihood of appropriate immunization. Similar trends were observed by Nath et al. in Lucknow and secondary analyses of NFHS-4 and DLHS-3. However, MM Angadi et al. in Bijapur reported no significant link between maternal education or child's gender and immunization status.[(9)(11)(19)]

A significant association was found between paternal occupation and immunization status. Children of fathers in business (34.0%) or salaried jobs (27.0%) had the highest rates of appropriate immunization, while lower coverage was seen among children of laborers (1.75%) and farmers (7.0%), with more partial or no immunization in these groups (4.0% and 3.75%, respectively). This aligns with findings by Rahman et al.

in rural Bangladesh.[20] Children of housewife mothers had higher full immunization (60.0%) compared to those of working mothers (11.5%). Partial or no immunization was slightly higher among children of working mothers (7.0%) than housewives (21.5%). However, this association was not statistically significant (χ^2 = 3.3433; p = 0.067479).

Regarding family structure, 67.25% of children belonged to nuclear families and 32.75% to joint families. Appropriately immunized children were slightly more in nuclear (49.25%) than joint families (22.25%). Partial or non-immunization was also marginally higher in nuclear families (18.0%) than in joint families (10.5%), but this difference was not statistically significant (p = 0.270889).

Table 5: Association between Immunization Status and Place of Delivery among Children (N=400)

Place of delivery	Immunisation appropriate for age Number (%)	Partial/no immunisation Number (%)	Total Number (%)
Institutional Delivery	282 (70.5)	101 (25.25)	383 (95.75)
Home Delivery	4 (1)	13 (3.25)	17 (4.25)
Total Number (%)	286 (71.5)	114 (28.5)	400 (100)
$\chi2$ statistic =17.6666 ;p-value = 0.000026, The result is statistically significant at $p<0.05$			

Table 5 shows a significant association between place of delivery and immunization status. Among children born in healthcare institutions, 70.5% were fully immunized, while 25.25% were partially or non-immunized. In contrast, only 1.0% of home-delivered children were fully immunized, and 3.25% were partially or non-immunized, indicating a statistically significant advantage for institutional births. Among institutional deliveries, 56.92% occurred in government and 43.08% in private facilities. Immunization rates were similar: 42.04% (government) and 31.59% (private) were fully immunized, with partial or no immunization at 14.88% and 11.49%, respectively. No significant difference (p = 0.908971) was found between government and private institutions, suggesting the type of facility did not impact immunization coverage.

Table 6: Individual vaccine coverage of children (N=400)

Vaccine	Urban Number (%)	Rural Number (%)	Total Number (%)	95% C.I.
BCG	274 (68.5)	85 (21.25)	359 (89.75)	86.78% to 92.72%
Hep B 0	134 (33.5)	48 (12)	182 (45.5)	40.62% to 50.38%
OPV 0	274 (68.5)	83 (20.75)	357 (89.25)	86.21% to 92.29%
OPV1	275 (68.75)	87 (21.75)	362 (90.5)	87.63% to 93.37%
fIPV1	200 (50)	57 (14.25)	257 (64.25)	59.55% to 68.95%
PENTA 1	264 (66)	81 (20.25)	345 (86.25)	82.88% to 89.62%
OPV2	251 (62.75)	77 (19.25)	328 (82)	78.24% to 85.76%
PENTA 2	241 (60.25)	74 (18.5)	315 (78.75)	74.74% to 82.76%
OPV3	241 (60.25)	74 (18.5)	315 (78.75)	74.74% to 82.76%
fIPV2	179 (44.75)	46 (11.5)	225 (56.25)	51.39% to 61.11%
PENTA3	230 (57.5)	72 (18)	302 (75.5)	71.29% to 79.71%
MR1	228 (57)	69 (17.25)	297 (74.25)	69.96% to 78.54%

The highest vaccine coverage was for OPV1 (90.5%) and BCG (89.75%), while the lowest was for the Hepatitis B birth dose (45.5%). Factors contributing to low coverage include insufficient knowledge among healthcare workers, concerns about Adverse Events Following Immunization (AEFI), lack of awareness among private practitioners, poor coordination between immunization clinics and maternal health departments, and limited public awareness.

Fractional Inactivated Poliovirus Vaccine (fIPV) coverage was 64.25% for fIPV-1 and 56.25% for fIPV-2. BCG coverage was 89.75% (95% CI: 86.78%–92.72%), and Measles-1 coverage was 74.25% (95% CI: 69.96%-78.54%), in line with RSOC, NFHS-4, and DLHS-3. Penta-3 coverage was 75.5% (95% CI: 71.29%-79.71%), comparable to RSOC, NFHS-4, and DLHS-3, with no significant differences. Regarding Vitamin A, 74.25% received one dose and 60.63% received two doses. DPT Booster, OPV Booster, and MR 2 had coverage rates of 61.26%, 62.53%, and 60.63%, respectively, with significant urban-rural disparities. Urban areas had higher vaccination rates (48–49%) compared to rural areas (12–13%).[12][9][11]

Table 7: Dropout rates in children

	Dropout rates	Number (first vaccine –last vaccine)	Rate (%) {(first vaccine –last vaccine/first vaccine)*100}
12-13 months (N=230)	BCG TO PENTA 3	38	18.01
	BCG TO MR1	42	19.90
	PENTA 1 TO PENTA 3	35	16.59
	PENTA 1 TO MR1	39	18.48
24-35 months (N=170)	BCG TO PENTA 3	20	13.5
	BCG TO MR1	21	14.1
	PENTA 1 TO PENTA 3	9	6.5
	PENTA 1 TO MR 1	10	7.2
	PENTA 3 TO DPT Booster	11	8.5
	OPV 3 TO OPV Booster	16	11.9
	MR 1 TO MR 2	10	7.8

Table 7 outlines dropout rates in a vaccination program. The highest dropout is observed from BCG to MR1 (14.1%–19.9%) and BCG to Penta 3 (13.5%), indicating that many children who begin early vaccination do not complete the schedule, highlighting gaps in follow-up and continuity of care. Dropout within the same vaccine series, such as Penta 1 to Penta 3 (6.5%), is lower, suggesting better adherence once a series is initiated. However, a dropout from Penta 3 to DPT Booster (8.5%) and OPV 3 to OPV Booster (11.9%) reflects a decline in follow-up after the primary series, possibly due to reduced urgency or caregiver perception. Similarly, the MR1 to MR2 dropout (7.8%) shows a moderate loss, critical for achieving full measles immunity. Overall, the trend points to the need for improved caregiver awareness, follow-up mechanisms, and accessibility to ensure complete immunization.

Immunization Dropout Rates

Dropout rates serve as indicators of immunization service utilization and healthcare system performance. While national surveys like NFHS-3 and DLHS-3 showed declining DPT1–DPT3 dropout trends in Gujarat, the present study found a Penta-1 to Penta-3 dropout rate of 16.5% among children aged 12–23 months, exceeding the WHO threshold of 10%, suggesting gaps in continuity.(11) The highest dropout was from BCG to MR1 (19.9%), similar to CES Gujarat estimates, and significantly lower than those reported by Desai VK et al. in urban slums of Surat (31.9%, 57.5%, and 60.2%, respectively).(21) Dropout rates were generally lower in children aged 24–35 months, though rates above 10% persisted from BCG to Penta-3, BCG to MR1, and OPV3 to OPV booster, indicating improved but still suboptimal service continuity in older age groups.

Reasons for Partial or Non-Immunization

The primary reasons for immunization default among children in the study were categorized into three major domains: lack of information (37.19%), obstacles in the utilization of services (20.66%), and lack of motivation or counselling of caregivers (42.15%). Within these, the most common individual reasons included fear of multiple injections (19.83%), unawareness of missed doses (16.52%), and concern for loss of wages (9.92%). Other notable factors were family resistance to immunization (9.09%), minor illness following previous vaccination (7.44%), and lack of knowledge about where to go for immunization (4.96%). This highlights that both informational gaps and motivational barriers significantly contribute to immunization defaults, underlining the need for targeted awareness campaigns and improved service accessibility.

Reasons for immunization default in this study highlight that demand-side barriers (79.34%) far outweighed supply-side issues. The leading causes for partial immunization were fear of multiple injections (19.83%) and lack of awareness about missed doses (16.52%), while non-immunization was mainly attributed to family resistance (9.09%) and concerns about wage loss (9.92%). Additional contributing factors included unawareness of the need for immunization (4.96%), lack of knowledge about where to go, fear of adverse events following immunization (AEFI), and absence of support to accompany the child. These findings are in line with national surveys like CES-Gujarat and DLHS-3, and studies by Pratibha Gupta et al. (Lucknow) and Punith et al. (Bangalore), which identified a lack of information and awareness as major determinants of non-acceptance or discontinuation of immunization.[22][23] Overall, the data underscore the importance of strengthening caregiver education, improving counselling, and implementing community-based awareness strategies to bridge the information and motivation gap and thereby enhance immunization coverage.

Conclusion

This study effectively assessed immunization coverage and its influencing factors among children aged 12–35 months in the district. The proportion of fully immunized children was 71.5%, while 28.5% were either partially or non-immunized, with rural areas showing lower coverage than urban areas. Key determinants included paternal occupation and place of delivery, highlighting the role of socioeconomic and institutional factors. The main reasons for partial or non-immunization were demand-side barriers such as fear of multiple injections, lack of awareness about missed doses, and concerns about wage loss. Dropout analysis revealed significant drop rates between key vaccine doses, most notably from BCG to MR1 (19.9%) and Penta-1 to Penta-3 (16.59%)—underscoring service utilization gaps. Overall, targeted community engagement, health education, and system-level interventions are needed to reduce immunization gaps and ensure better vaccine coverage.

Recommendations

- Promote institutional deliveries to improve early vaccination uptake.
- Engage fathers through targeted IEC activities, especially in lower socioeconomic groups.
- Prioritise maternal education to enhance vaccine awareness and compliance.
- Conduct regular community-based awareness campaigns to dispel fears and misconceptions.
- Train health workers in counselling techniques to address caregiver concerns effectively.

- Provide flexible vaccination hours or mobile units to reduce wage loss concerns.
- Institutionalise periodic immunization audits at PHCS/UHCS for early detection of service gaps.
- Strengthen supportive supervision to ensure timely and complete vaccinations.
- Introduce incentive-based recognition for health workers achieving full coverage.
- Integrate routine immunization with Maternal and Child Health (MCH) services to sustain engagement.

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