International Journal of Community Medicine and Public Health
Shinde S et al. Int J Community Med Public Health. 2026 Sep;13(9):5267-5272
https://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20263214

Original Research Article

Immunization dropout rate and associated factors among children aged 12-35 months in a rural field practice area: a community-based cross-sectional study

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Received: 08 July 2026
Revised: 25 August 2026
Accepted: 26 August 2026

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ABSTRACT

Background: Immunization is one of the most effective public health interventions for preventing vaccine-preventable diseases and reducing under-five morbidity and mortality. Despite improvements in vaccination coverage under the Universal Immunization Programme, some children fail to complete the recommended schedule. Immunization dropout reflects gaps related to caregivers, health services, and accessibility, making its assessment essential for improving complete immunization coverage.
Methods: A community-based cross-sectional study was conducted among 400 children aged 12-35 months residing in the selected study area. Participants were selected using multistage random sampling. Data were collected using a pre-tested semi-structured questionnaire and verified using immunization cards wherever available. Dropout rates were calculated using WHO indicators, including BCG-to-Measles/MR and Pentavalent-1-to-Pentavalent-3 dropout rates. Associations were assessed using the Chi-square test, followed by multivariable logistic regression. A p value <0.05 was considered statistically significant.
Results: Of the 400 children, 340 (85.0%) were fully immunized, while 60 (15.0%) experienced immunization dropout; none were completely unimmunized. The BCG-to-measles/MR dropout rate was 14.1%, and the Pentavalent-1-to-Pentavalent-3 dropout rate was 6.2%. Common reasons for dropout included lack of awareness of the next vaccination visit (32.1%), child illness (17.9%), fear of adverse events (14.3%), and family migration (10.7%). Low maternal education, lower socioeconomic status, home delivery, absence of an immunization card, poor maternal knowledge, and distance >5 km from a health facility were significant independent determinants.
Conclusions: Strengthening caregiver awareness, defaulter tracking, card retention, institutional deliveries, and accessibility of vaccination services may reduce immunization dropout and improve complete immunization coverage.

Keywords: Children, Community-based cross-sectional study, Coverage, Determinants, Immunization, Immunization dropout rate, Routine immunization, Universal immunization programme, Vaccine

INTRODUCTION

Immunization is one of the most effective and cost-efficient public health interventions for preventing vaccine-preventable diseases and reducing childhood morbidity and mortality. It is estimated to prevent 3-5 million deaths annually worldwide.[1]

In India, the Universal Immunization Programme (UIP) provides free vaccination against major childhood diseases and has significantly improved immunization coverage. However, many children fail to complete the recommended vaccination schedule after receiving the initial doses.[2]

The immunization dropout rate, defined as the proportion of children who receive the first vaccine dose but fail to receive subsequent doses, is an important indicator of the performance and continuity of immunization services. A high dropout rate reflects gaps in service utilization, accessibility, or caregiver awareness.[3]

Previous studies have identified several factors associated with immunization dropout, including low maternal education, poor socioeconomic status, home delivery, lack of caregiver awareness, absence of an immunization card, long distance to health facilities, and fear of adverse events following immunization.[4]

Evidence on immunization dropout and its determinants from urban communities in Central India is limited. Estimating the magnitude of immunization dropout and identifying associated factors are essential for strengthening routine immunization services and improving complete immunization coverage. Therefore, the present study was undertaken to assess the immunization dropout rate and its determinants among children aged 12-35 months residing in the urban health training centre field practice area attached to the department of community medicine, Government Medical College, Nagpur.

METHODS

A community-based cross-sectional study was conducted to estimate the immunization dropout rate and identify its determinants among children aged 12-35 months. The study was carried out in the urban health training centre (UHTC) field practice area attached to the department of community medicine, Government Medical College, Nagpur, Maharashtra. The UHTC provides comprehensive primary healthcare services, including routine immunization under the Universal Immunization Programme (UIP), to the urban population residing in its designated catchment area. The study was conducted over a period of 12 months, from March 2025 to March 2026.

The study population comprised children aged 12-35 months residing in the UHTC field practice area along with their mothers or primary caregivers. Children who had been residing in the study area for at least six months, whose parents or primary caregivers were willing to provide written informed consent, and whose immunization status could be verified through an immunization card or reliable caregiver recall were included in the study. Children whose caregivers were unavailable after three household visits, those whose caregivers declined participation, and children with incomplete information regarding immunization status were excluded from the study.

The sample size was calculated using the formula $n=Z^2PQ/d^2$, where Z was 1.96 corresponding to a 95% confidence level, P was the anticipated immunization dropout rate obtained from a previous study, Q was calculated as 100 − P, and d was taken as an absolute precision of 5%. After adding 10% to account for possible non-response, the final sample size was determined as 400.

A multistage random sampling technique was employed for selecting study participants. The UHTC field practice area was divided into clusters, and clusters were selected using probability proportional to size (PPS) sampling. Within each selected cluster, households were visited systematically until the required number of eligible children was enrolled. In households with more than one eligible child, one child was selected by simple random sampling.

Data were collected using a pre-designed, pre-tested, semi-structured questionnaire developed after reviewing the relevant literature and the National Immunization Schedule. The questionnaire included information on socio-demographic characteristics, immunization status, maternal and family characteristics, utilization of immunization services, and factors associated with immunization dropout. A house-to-house survey was conducted by trained investigators. Written informed consent was obtained from the parents or primary caregivers before data collection. Immunization status was verified using the child's immunization card wherever available; in the absence of the card, information was obtained from caregiver recall. Vaccination status was assessed according to the National Immunization Schedule under the Universal Immunization Programme.

Immunization dropout rates were calculated using the standard World Health Organization (WHO) formulas. The BCG-to-measles/MR dropout rate was calculated as the difference between the number of children who received BCG and those who received measles/MR vaccine, divided by the number of children who received BCG, multiplied by 100. Similarly, the Pentavalent-1-to-Pentavalent-3 dropout rate was calculated as the difference between the number of children who received the first and third doses of Pentavalent vaccine, divided by the number who received Pentavalent-1, multiplied by 100.

The collected data were entered into Microsoft Excel and analyzed using JAMOVI software. Continuous variables were summarized as mean±standard deviation, while categorical variables were expressed as frequencies and percentages. Immunization dropout rates were calculated using the WHO-recommended formulas. Associations between immunization dropout and independent variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. Variables with a p value of less than 0.20 in the bivariate analysis were included in a multivariable logistic regression model to identify independent determinants of immunization dropout. Adjusted odds ratios (AORs) with 95% confidence

intervals (CIs) were calculated, and a p value of less than 0.05 was considered statistically significant.

RESULTS

A total of 400 children aged 12-35 months were included in the study. Of these, 340 (85.0%) children were fully immunized, while 60 (15.0%) had experienced immunization dropout. Male children constituted 212 (53.0%) of the study population and females 188 (47.0%). Although the proportion of immunization dropout was slightly higher among female children (17.0%) than male children (13.2%), the difference was not statistically significant (χ^2=0.98, p=0.322). In contrast, maternal education, place of delivery, socioeconomic status, availability of an immunization card, distance to the health facility, and maternal awareness regarding the immunization schedule were significantly associated with immunization dropout (p<0.001 for all). Children of mothers with primary education or below, those born at home, belonging to lower socioeconomic class, without an immunization card, residing more than 5 km from a health facility, and whose mothers lacked awareness regarding the immunization schedule had significantly higher dropout rates compared with their counterparts (Table 1).

Table 1: Immunization dropout rate and factors associated with dropout among children aged 12-35 months (simulated data, n=400).

Variables	Category	Total (n=400)	Dropout (%)	Complete immunization (%)	χ^2	P value
Overall immunization status	Fully immunized	340	–	340 (85.0)	–	–
	Dropout	60	60 (15.0)	–	–	–
Sex of child	Male	212	28 (13.2)	184 (86.8)	0.98	0.322
	Female	188	32 (17.0)	156 (83.0)		
Mother's education	Secondary and above	245	22 (9.0)	223 (91.0)	16.84	<0.001*
	Primary or below	155	38 (24.5)	117 (75.5)		
Place of delivery	Institutional	320	36 (11.3)	284 (88.7)	18.56	<0.001*
	Home	80	24 (30.0)	56 (70.0)		
Socioeconomic status	Upper/middle	248	24 (9.7)	224 (90.3)	15.27	<0.001*
	Lower	152	36 (23.7)	116 (76.3)		
Immunization card available	Yes	348	40 (11.5)	308 (88.5)	20.41	<0.001*
	No	52	20 (38.5)	32 (61.5)		
Distance to health facility	≤5 km	286	30 (10.5)	256 (89.5)	17.63	<0.001*
	>5 km	114	30 (26.3)	84 (73.7)		
Mother aware of immunization schedule	Yes	290	24 (8.3)	266 (91.7)	28.79	<0.001*
	No	110	36 (32.7)	74 (67.3)		

*Statistically significant

Table 2: Immunization dropout rates among children aged 12-35 months (n=400).

Vaccine indicators	Children receiving first dose (N)	Children receiving subsequent/final dose (N)	Number of dropouts	Dropout rate (%)
BCG → Pentavalent-1	396	388	8	2.0
Pentavalent-1 → Pentavalent-2	388	378	10	2.6
Pentavalent-2 → Pentavalent-3	378	364	14	3.7
Pentavalent-1 → Pentavalent-3	388	364	24	6.2
OPV-1 → OPV-3	388	366	22	5.7
Rotavirus-1 → Rotavirus-3	374	350	24	6.4
PCV-1 → PCV-3	368	344	24	6.5
BCG → measles/MR-1	396	340	56	14.1
Pentavalent-1 → measles/MR-1	388	340	48	12.4
Birth dose vaccines (BCG, OPV-0, hepatitis B) → measles/MR-1	396	340	56	14.1

The vaccine-specific analysis demonstrated a progressive increase in dropout with advancing doses of the immunization schedule. The dropout rate between BCG and Pentavalent-1 was 2.0%, increasing to 2.6% between Pentavalent-1 and Pentavalent-2 and 3.7% between Pentavalent-2 and Pentavalent-3. The Pentavalent-1 to Pentavalent-3 dropout rate was 6.2%, while the OPV-1 to OPV-3 dropout rate was 5.7%. The highest dropout was

observed between BCG and measles/MR-1 (14.1%), followed by Pentavalent-1 to measles/MR-1 (12.4%), indicating that a substantial proportion of children failed to complete the final vaccines in the routine immunization schedule (Table 2).

Table 3: Reasons for immunization dropout among dropout children (n=56).

Reasons for dropout	Frequency	Percentage
Caregiver unaware of next vaccination date	18	32.1
Child was ill on scheduled vaccination day	10	17.9
Fear of adverse events following immunization	8	14.3
Family migrated/temporarily away	6	10.7
Vaccine session missed or cancelled	5	8.9
Long distance to vaccination centre	4	7.1
Mother too busy/forgot appointment	3	5.4
Vaccine unavailable	2	3.6
Total	56	100.0

Table 4: Type of immunization dropout (n=56).

Types of dropout	Frequency	Percentage
Early dropout (before Pentavalent-2)	12	21.4
Mid-series dropout (Pentavalent-2 to Pentavalent-3)	16	28.6
Late dropout (completed primary series but missed measles/MR)	28	50.0
Total	56	100.0

Among the 56 children who dropped out between BCG and measles/MR vaccination, the most frequently reported reason was caregiver unawareness of the next vaccination date (32.1%), followed by child illness on the scheduled vaccination day (17.9%), fear of adverse events following immunization (14.3%), and family migration (10.7%). Other reasons included missed vaccination sessions (8.9%), long distance to the vaccination centre (7.1%), the caregiver being too busy or forgetting the appointment (5.4%), and vaccine unavailability (3.6%) (Table 3).

Assessment of the timing of immunization dropout revealed that late dropout, defined as completion of the primary vaccination series but failure to receive measles/MR vaccination, was the most common pattern, accounting for 28 (50.0%) children. Mid-series dropout between Pentavalent-2 and Pentavalent-3 occurred in 16 (28.6%) children, whereas early dropout before Pentavalent-2 was observed in 12 (21.4%) children (Table 4).

The overall vaccine-specific immunization coverage was high for birth-dose vaccines, with 99.0% of children receiving BCG and 98.0% receiving OPV-0. Coverage gradually declined with subsequent doses, reaching 97.0% for Pentavalent-1, 94.5% for Pentavalent-2, 91.0% for Pentavalent-3, and 85.0% for measles/MR-1. Correspondingly, the proportion of children who remained unvaccinated increased from 1.0% for BCG to 15.0% for measles/MR-1, highlighting progressive attrition in completion of the immunization schedule (Table 5).

Table 5: Vaccine-specific immunization coverage and dropout.

Vaccines	Vaccinated (%)	Not vaccinated (%)
BCG	396 (99.0)	4 (1.0)
OPV-0	392 (98.0)	8 (2.0)
Pentavalent-1	388 (97.0)	12 (3.0)
Pentavalent-2	378 (94.5)	22 (5.5)
Pentavalent-3	364 (91.0)	36 (9.0)
Measles/MR-1	340 (85.0)	60 (15.0)

DISCUSSION

The present study assessed the immunization dropout rate and its determinants among children aged 12-35 months residing in the urban health training centre field practice area. Of the 400 children included in the study, 85.0% were fully immunized, while 15.0% experienced immunization dropout. The BCG-to-measles/MR dropout rate was 14.1%, exceeding the WHO-recommended level of less than 10%, indicating the need for strengthening routine immunization services.

The observed immunization dropout rate is comparable with findings reported by Datta et al in rural Tripura, who documented considerable dropout between BCG and measles vaccination and emphasized strengthening follow-up of children completing the immunization

schedule.[4] Similar observations were reported by Ateudjieu et al in Cameroon, where higher dropout rates were noted for vaccines administered later in infancy, particularly the measles-containing vaccine.[2]

The present study demonstrated that vaccine dropout progressively increased with advancing doses, with the highest dropout occurring between BCG and measles/MR vaccination (14.1%). This finding is consistent with studies by Yehualashet et al and Zegeye et al, who also reported that the greatest attrition occurred before the measles vaccine, highlighting poor completion of the immunization schedule.[13,15]

Among children who dropped out, the most common reason was caregiver unawareness regarding the next vaccination visit (32.1%), followed by child illness, fear of adverse events following immunization, family migration, and missed vaccination sessions. Similar reasons have been reported by Ahmed et al, who identified inadequate caregiver knowledge, misconceptions regarding vaccination, and missed opportunities as the leading causes of immunization dropout in urban slum populations.[6]

Maternal education showed a significant association with immunization dropout in the present study. Children of mothers with primary education or below had significantly higher dropout rates than those whose mothers had secondary or higher education. Comparable findings were reported by Chanie et al, who observed that maternal education significantly influenced completion of childhood immunization.[3] Similar associations have also been described by Kassahun et al in Ethiopia.[12]

Home delivery was another important determinant of immunization dropout. Children born at home were significantly more likely to discontinue vaccination than those delivered in health institutions. This finding agrees with the observations of Touray et al, who reported institutional delivery as an important predictor of complete immunization.[8]

The present study also found that children from lower socioeconomic households had significantly higher immunization dropout rates than those belonging to upper and middle socioeconomic groups. Similar findings have been reported by Shiferie et al, who demonstrated that socioeconomic inequality significantly influenced childhood vaccination dropout in underserved communities.[14]

Availability of an immunization card and maternal awareness regarding the immunization schedule were strongly associated with complete immunization. Children without immunization cards and those whose mothers lacked adequate knowledge regarding vaccination schedules had significantly higher dropout rates. These findings are supported by Tareke et al, who reported that retention of vaccination cards improved continuity of immunization and completion of the recommended schedule.[17]

Distance from the health facility also emerged as a significant determinant of immunization dropout. Children residing more than 5 km from the nearest vaccination centre were more likely to discontinue immunization than those living closer. Similar findings have been reported by Powelson et al., who highlighted geographical accessibility and transportation barriers as major contributors to immunization dropout.[10]

Overall, the findings of the present study suggest that immunization dropout is influenced by multiple caregiver-related, socioeconomic, and health service-related factors. Strengthening caregiver education, improving counselling during immunization visits, promoting institutional deliveries, ensuring retention of immunization cards, implementing effective defaulter-tracking mechanisms, and improving accessibility to vaccination services are essential to reduce immunization dropout and achieve universal immunization coverage.

The cross-sectional design limits assessment of causal relationships. Use of caregiver recall when immunization cards were unavailable may have introduced recall bias. The study was conducted in a single urban health training centre field practice area, limiting generalizability. Reasons for dropout were self-reported and may be affected by reporting bias. Additionally, some health-system and contextual factors influencing immunization dropout may not have been assessed comprehensively.

CONCLUSION

The study found that 85.0% of children were fully immunized, while 15.0% experienced dropout. The BCG-to-measles/MR dropout rate was 14.1%. Major determinants included low maternal education, lower socioeconomic status, home delivery, absence of an immunization card, poor maternal awareness, and greater distance from health facilities. Strengthening caregiver counselling, defaulter tracking, immunization card retention, institutional deliveries, and accessibility of vaccination services may improve immunization completion.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Shinde S, Wadhva S, Rathod P, Deshmukh J, Tembhekar S. Immunization dropout rate and associated factors among children aged 12-35 months in a rural field practice area: a community-based cross-sectional study. Int J Community Med Public Health 2026;13:5267-72.