Determinants of Incomplete Age-Appropriate Routine Immunization Among Children Aged birth to 59 Months in Gangapur Taluka, Chhatrapati Sambhajinagar, Maharashtra: A Cross-Sectional Study

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Abstract

Background: Routine childhood immunization prevents vaccine-preventable diseases, yet inequalities linked to maternal education, social category and geographic access may result in incomplete immunization.

Objective: To assess reported age-specific routine immunization coverage and its association with social category, maternal education and distance from public health facilities among children in Gangapur Taluka, Chhatrapati Sambhajinagar, Maharashtra.

Methods: A community-based cross-sectional study of 450 children was conducted. Data on age, residence, vaccination coverage at scheduled visits, social category, maternal education and distance from the nearest Primary Health Centre (PHC) or subcentre were analysed descriptively.

Results: Of 450 children, 73.3% were rural and 26.7% urban. Reported coverage declined from 98% at birth to 80% at 6 weeks, 60% at 10 weeks, 58% at 14 weeks, 50% at 9 months and 40% at 18 months. Coverage was 90% (Open category), 82% (OBC), 68% (SC) and 58% (ST). Coverage rose with maternal education (50% below 10th standard, 70% above 10th, 86% graduate and above). Children living within 5 km of a PHC/subcentre had higher coverage.

Conclusion: Inequalities in immunization coverage by social category, maternal education and distance from facilities were observed. Targeted interventions for disadvantaged groups are warranted.

Keywords: *Childhood immunization; incomplete immunization; maternal education; social inequality; rural health; Maharashtra*

Introduction

Immunization remains one of the most cost-effective public health interventions for reducing childhood morbidity and mortality from vaccine-preventable diseases [1]. Sustained high coverage of age-appropriate vaccines is essential for individual protection and for maintaining herd immunity. Despite the expansion of India's Universal Immunization Programme, a proportion of children continue to receive delayed or incomplete vaccination [2].

Multiple factors influence immunization uptake. Maternal educational attainment, household socioeconomic status, social category, awareness of the immunization schedule, family size, migration and distance from health facilities have all been associated with incomplete vaccination in Indian and international studies [3,4]. The National Immunization Schedule recommends vaccines at birth, 6, 10 and 14 weeks, 9–12 months and 16–24 months. Delayed doses leave children susceptible for longer periods [2].

National Family Health Survey estimates provide state-level coverage figures but may not reflect local variation within individual talukas [5]. Gangapur Taluka in Chhatrapati Sambhajinagar district contains both rural and urban populations with potentially differing access to Primary Health Centres (PHCs) and subcentres. Local data are therefore needed to identify subgroups at higher risk of incomplete immunization and to guide targeted programme action.

The present cross-sectional study was undertaken to describe reported routine immunization coverage among children in Gangapur Taluka and to explore its relationship with social category, maternal education and distance from public health facilities.

Materials and Methods

Study design and setting: A community-based cross-sectional study was conducted in Gangapur Taluka, Chhatrapati Sambhajinagar district, Maharashtra, over two years (1 October 2024 to 1 October 2026).

Study population: Children aged birth to 59 months residing in the study area were eligible. A total of 450 children were included. (Note: the dataset contained 110 children aged below 12 months

Inclusion and exclusion criteria: Children aged birth to 59 months whose caregivers provided informed consent were included. Children outside the age range or whose caregivers declined participation were excluded.

Sample size and sampling: A sample of 450 children was enrolled. The original sample-size calculation and exact sampling technique (random, systematic, cluster or consecutive) should be documented from the study protocol. Recruitment through health facilities or camps may limit generalizability.

Variables: The outcome was age-appropriate immunization status. Independent variables included age, place of residence (urban/rural), social category (Open, Other Backward Classes [OBC], Scheduled Castes [SC], Scheduled Tribes [ST]), maternal educational attainment and distance from the nearest PHC or subcentre (≤5 km vs >5 km).

Assessment of immunization status: Vaccination status was assessed from the child's vaccination card where available; caregiver recall was used otherwise. Incomplete age-appropriate immunization was defined as failure to receive one or more doses due by the child's age according to the National Immunization Schedule.

Statistical analysis: Descriptive statistics (frequencies and percentages) were used. Inferential statistics and multivariable analysis could not be performed because subgroup denominators and individual-level vaccination counts were unavailable.

Ethical considerations: Ethical approval was obtained from the Institutional Ethics Committee of CSMSS Medical College. Written informed consent was obtained from parents or legal guardians. Confidentiality was maintained.

Results and Discussion

Of the 450 children, 110 (24.4%) were aged below 1 year, 90 (20.0%) were 1–2 years, 100 (22.2%) were 2–3 years, 80 (17.8%) were 3–4 years and 70 (15.6%) were 4–5 years (Table 1). Rural children predominated (330, 73.3%) compared with urban children (120, 26.7%) (Table 2).

Table 1. Age distribution of study participants (N = 450)

Age group	Number	Percentage (%)
Birth to below 1 year	110	24.4
1 to below 2 years	90	20.0
2 to below 3 years	100	22.2
3 to below 4 years	80	17.8
4 to below 5 years	70	15.6
Total	**450**	**100.0**

Table 2. Urban–rural distribution of study participants (N = 450)

Place of residence	Number	Percentage (%)
Rural	330	73.3
Urban	120	26.7
Total	**450**	**100.0**

Reported vaccination coverage declined across successive visits: 98% at birth, 80% at 6 weeks, 60% at 10 weeks, 58% at 14 weeks, 50% at 9 months and 40% at approximately 18 months (Table 3). This progressive drop-out pattern is consistent with national observations of incomplete primary series and missed booster doses [5,6].

Table 3. Reported vaccination coverage at selected immunization visits

Scheduled visit	Reported coverage (%)
Birth (BCG, OPV-0, Hepatitis B birth dose)	98
6 weeks	80
10 weeks	60
14 weeks	58
9 months	50
Approximately 18 months and above	40

Coverage varied substantially by social category: 90% among Open category, 82% among OBC, 68% among SC and 58% among ST children (Table 4). The 32-percentage-point gap between Open and ST categories indicates marked social disparity, echoing earlier Indian studies that documented lower immunization rates among marginalized communities [4,7].

Table 4. Reported vaccination coverage by social category

Social category	Reported coverage (%)
Open category	90
Other Backward Classes (OBC)	82
Scheduled Castes (SC)	68
Scheduled Tribes (ST)	58

Maternal education showed a clear positive gradient: coverage was 50% when mothers had education below the 10th standard, 70% when education was above the 10th standard, and 86% when mothers were graduates or above (Table 5). Better-educated mothers are more likely to understand the immunization schedule and utilize health services effectively, a finding consistently reported in the literature [3,6].

Table 5. Reported vaccination coverage by maternal educational attainment

Maternal education	Reported coverage (%)
Below 10th standard	50
Above 10th standard	70
Graduate and above	86

Children living within 5 km of a PHC or subcentre had higher reported coverage than those living farther away. Geographic accessibility remains an important practical barrier, particularly for rural caregivers who must travel with young children [7]. Strengthening outreach sessions can help reduce distance-related missed opportunities.

The principal findings—declining coverage across visits, social-category gradients, maternal-education gradients and distance effects—are consistent with national and international evidence. The study provides local, taluka-level data useful for district programme planning.

Limitation of study include the presence of children below the stated age range, unavailability of subgroup denominators (precluding formal statistical testing), possible recall bias, incomplete documentation of sampling method, and the inherent constraints of a cross-sectional design for causal inference.

Conclusion

Reported routine immunization coverage in Gangapur Taluka declined across successive scheduled visits and showed clear inequalities by social category, maternal education and distance from health facilities. Incomplete age-appropriate immunization appears concentrated among socially and geographically disadvantaged children. Verification of individual vaccination records and formal statistical analysis are still required. Pending these steps, the findings support equity-oriented strengthening of routine immunization services, including intensified defaulter tracking, education tailored to mothers with limited formal schooling, prioritization of SC/ST habitations, and expanded outreach to reduce distance barriers.

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Competing Interests

The author declares that there are no competing interests.

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