

Factors Affecting Timeliness in Vaccination of Under-five Children in India: A Cross-sectional Study using Health Survey during COVID-19

Dr. Mohammed Shoyaib Khazi¹, Dr. Divya Bharathi Gattam², Dr. Nitu Kumari³, Dr. Afraz Jahan⁴

1. Senior Resident, All India Institute of Medical Sciences. 2. Senior Resident, Kempegowda Institute of Medical Sciences.
3. Assistant Professor, World College of Medical Sciences. 4. Assistant Professor, Kasturba Medical College.

Introduction

Immunization is a vital human right and public health tool, **preventing 2–3 million deaths annually**, yet **1.5 million vaccine-preventable deaths still occur**, with untimeliness of vaccination remaining a key challenge in India. This study aims to **assess factors affecting timely immunization in Indian children under five during COVID-19**.

Methods

Study Design & Data Source: Cross-sectional analysis of NFHS-5 (2019–2021) using Kids Recode (KR) dataset with 724,115 entries, restricted to children <5 years with **immunization cards showing exact vaccination dates**.

Dependent Variable (Timeliness): Vaccination on time defined per **National Immunization Schedule** birth doses **within 28 days**, and subsequent doses given **4 days early to 28 days late**. Timeliness was assessed for each vaccine/dose.

Independent Variables: **Child** (birth order, health check-up, size at birth), **Maternal** (age, education, marital status, ANC visits, place of delivery), **Household** (wealth index, religion, sex of household head, distance to facility), and **Community** (zone, urban/rural, survey timing pre/post COVID).

Statistical Analysis: Survey-weighted analysis in STATA v18 with chi-square tests and Poisson regression to calculate unadjusted/adjusted prevalence ratios; robust variance estimators used.

Results

Factors affecting
of

Untimeliness
Childhood Vaccinations

Low Birth Weight

Smaller babies are more likely to be vaccinated late



Household Disadvantage

Poverty and religion influence vaccination timeliness



Rural-Urban Divide

Rural children face delays in initial vaccinations



Maternal Factors

Lack of education and antenatal care impacts vaccination



Community Disparities

Regional inequities affect health infrastructure and access



Cascade Effect

Early delays lead to further vaccination delays



Proportion of Children
with untimeliness of
Vaccines

Measles 2	2.69
Measles 1	8.77
Polio 3	60.16
Rota 3	58.03
Pentavalent 3	35.29
Polio 2	45.8
Rota 2	45.63
Pentavalent 2	46.23
Polio 1	27.54
Rota 1	30.6
Pentavalent 1	28.12
Polio 0	9.08
Hepatitis B	9.26
BCG	14.84

COVID-19 did not worsen timeliness:

Vaccination timeliness was comparable between pre- and post-pandemic periods.

Conclusion

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Timeliness remains a major challenge: Although most children receive vaccines at birth, **delays accumulate with later doses**, reducing protection in the first year of life.

Multiple risk factors contribute: **Low birth weight, low maternal education, fewer antenatal visits, and home or private deliveries** strongly increase untimeliness.

Socioeconomic and regional inequities matter: Children from **poorer households, non-Hindu families, and those living in Central and Northeast zones** face the highest delays.