Section: Paediatrics

Original Research Article

ASSOCIATION BETWEEN ROTAVIRUS IMMUNIZATION COVERAGE AND DIARRHEAL MORBIDITY AMONG UNDER-FIVE CHILDREN IN A TERTIARY CARE SETTING

Shrestha Shee[1], Sushama Sahoo[2], Sarbani Misra[3]

[1]*Post graduate trainee, Department of Paediatrics, Malda Medical College, India.*
[2]*HOD, Department of Paediatrics, Malda Medical College, India.*
[3]*Associate Professor, Department of Paediatrics, Malda Medical College, India.*

Received *: 02/09/2025*
Received in revised form *: 17/10/2025*
Accepted *: 04/11/2025*

Corresponding Author:
Dr. Shrestha Shee,
Junior Resident, Department of Paediatrics, Government Malda Medical College & Hospital, Malda, West Bengal, India.
Email: shrestha96shee@gmail.com

DOI: 10.70034/ijmedph.2025.4.219

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 1221-1225

ABSTRACT

Background: The rotavirus vaccine is new to the Universal Immunization Program in India, and will contribute importantly to the alleviation of childhood diarrhea disease burden. However, immunization coverage remains incomplete (despite the vaccine being included in the program), which may have an influence on morbidity and hospitalization outcomes. **Objective:** To evaluate the association between rotavirus immunization coverage large-scale outcomes of acute diarrheal morbidity and hospitalization among children < 5 years admitted with acute diarrhea at a tertiary care facility.

Materials and Methods: Cross-sectional research was performed in a hospital setting, at Malda Medical College, India. Over the course of one year, 228 children aged 1 month to 5 years were enrolled. The vaccination status for rotavirus was confirmed either by immunization cards or caregiver recall. Diarrheal outcome data (type, severity, complications) and outcome of hospitalization was collected. Chi-square, Kruskal-Wallis and logistic regression analyses were conducted with $p<.05$ defined as significant.

Results: 39% of children in the study were fully vaccinated, 18.4% were partially vaccinated, and 42.6% were unvaccinated. The fully vaccinated children had substantially lower rates of persistent diarrhea (4.5% vs. 14.1%, p=0.014), dysentery (2.2% vs. 17.5%, p=0.023), complications (9% vs. 33%, p=0.003) and shorter median lengths of stay (3 days vs. 7 days, p=0.002) compared with unvaccinated children. The incidence of malnutrition was also substantially lower in fully vaccinated children compared to unvaccinated children. Maternal education and health worker visits were both significant predictors of full vaccination.

Conclusion: Full rotavirus vaccination is linked to a significant reduction in diarrheal disease morbidity and severity of hospitalization among children less than 5 years of age. Infection control strategies that emphasize improving coverage of vaccination programs, especially among vulnerable children, are necessary in the effort to mitigate the disease burden associated with diarrheal diseases.

Keywords: Rotavirus vaccine, Immunization coverage, Diarrhea, Hospitalization, Morbidity, Children under five.

INTRODUCTION

Rotavirus is recognized around the world as the single biggest source of severe acute diarrheal disease among infants and young children. It causes a proportion of excess hospitalizations and mortality in these groups.[1] Prior to the introduction of rotavirus vaccines, virtually every child became infected prior to five years of age, with disease burden being borne most heavily in low- and middle-income countries.[2]

With the introduction of two indigenous rotavirus vaccines (Rotavac and Rotasiil), there is now a unified approach by India in the Universal Immunization Program (UIP), which achieved a national rollout in 2019.[3,4] The introduction of these vaccines has resulted in a predictable decline in rotavirus morbidity, mortality, and hospitalization in some states. However, the burden of rotavirus is variable and influenced by differences in immunization coverage and uptake differences based on socioeconomic status, maternal education level, accessibility to the healthcare system, and awareness levels.[5]

While there have been successes at a national level, some populations continue to suffer from high rates of diarrheal illness from rotavirus-specific illness due to under-immunization or delayed immunization.[6] Thus, it is necessary to evaluate the effect of rotavirus vaccination levels on service coverage in various health contexts to aide in identifying gaps in service coverage and to create opportunities for more effective disease prevention.[7]

The current study seeks to evaluate the relationship between rotavirus immunization coverage and diarrheal morbidity and hospitalizations in children under five years of age at a tertiary hospital. This study will link immunization status to clinical outcomes and provide context-specific evidence to continue to support ongoing efforts for strengthening vaccine coverage and decreasing the burden of diarrheal morbidity preventable in children.

MATERIALS AND METHODS

Study Design

A hospital-based analytical cross-sectional observational study was completed to investigate the association between rotavirus vaccination coverage and diarrheal morbidity among children under the age of five hospitalized with acute diarrhea.

Study Setting and Period

The study was conducted in the isolation wards of Malda Medical College and Hospital in West Bengal, India from June 2023 to May 2024.

Study Population

Inclusion criteria: Children ages 1 month to 5 years of age hospitalized with acute diarrhea based on WHO definition.

Exclusion criteria: Children with known immunodeficiency, congenital gastrointestinal malformations, chronic disabilities, or incomplete clinical/immunization record.

Sample Size and Sampling Method

All consecutive admissions who met eligibility criteria during the study period were included for a total sample size of 228 children.

The minimum sample size needed was calculated assuming a full rotavirus vaccination coverage expected of 40% and a difference of 20% in the prevalence of severe diarrhea between the vaccinated children and children who were not vaccinated (α=0.05, power=80%). Consecutive sampling was conducted until the sample size was achieved.

Data Collection Procedures and Exposure Classification

Data collected through a structured proforma by trained personnel. Rotavirus vaccine status was verified chiefly via immunization cards, and parental recall was obtained when no documentation was available. Data on other routine childhood vaccinations were also recorded for completeness. Clinical and demographic data included age, sex, socioeconomic status, residential status, sanitation status, feeding practices and maternal education. Data on diarrhea was capture by diarrhea type (acute watery, persistent, or dysentery), duration, and severity. Diarrhea was classified by the WHO severity classification based on stool frequency, hydration status, and duration of symptoms. Complications were documented, including dehydration, sepsis, and need for intensive care. Nutritional assessment included weight, height/length, mid-upper arm circumference (MUAC). Nutritional status was classified using the WHO growth standards. Based on the rotavirus vaccination history, participants were classified into three exposure groups: fully immunized (received all three recommended doses of Rotavac/ Rotasiil under the Universal Immunization Programme schedule at 6, 10 and 14 weeks), partially immunized (received one or two doses) and not immunized (no documentation and/or parental recall of receiving the vaccine).

Ethical considerations

The study protocol was approved by the Institutional Ethics Committee of Malda Medical College and Hospital. Written informed consent was obtained from the parents/caregivers of each participant before any data was collected.

Statistical Analysis

Statistical analysis was conducted using SPSS version 21.0 (IBM Corp, Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, and the Chi-square test or Fisher's exact test was used for comparison, as appropriate. Continuous variables were presented as medians with interquartile ranges and were analyzed using the Mann–Whitney U or Kruskal–Wallis test as appropriate. Binary logistic regression was used to determine predictors of full rotavirus immunization coverage, adjusting for potential confounders (maternal education, socioeconomic status, residence, and if a health worker was visited). P-values of <0.05 were considered statistically significant. Data accuracy was ensured through double entry and periodic cross-checking.

RESULTS

Among the 228 children under five years of age admitted with diarrhea, 39.0% received all three doses of the rotavirus vaccine and were classified as

fully immunized, while 18.4% were classified as partially immunized, and 42.6% received no doses at all. These findings suggest very little vaccination coverage, even with rotavirus vaccination being part of the Universal Immunization Programme, a national program.

Table 1: Rotavirus Immunization Status among Admitted Children (n = 228)

Immunization Status	n (%)
Fully immunized (3 doses)	89 (39.0)
Partially immunized (1–2 doses)	42 (18.4)
Not immunized	97 (42.6)

Legend: Descriptive distribution of rotavirus immunization coverage among study participants.

In comparison with children who were unimmunized or only partially immunized, those who received full immunization had much lower rates of acute watery diarrhea, with 70.8% vs 3 frequency p=0.012 not immunized. The heavier rates of persistent diarrhea and dysentery observed for unimmunized children (14.4% vs and 17.5% vs p<0.05). The estimates of complications showed essentially the same trend as for diarrhea, in that complications increased from 9.0% with full immunization to 33.0% with partial or no immunization p=0.003. This data provides strong evidence for the protective effect of immunization against long-lasting and substantial morbidity outcomes for children presenting to our hospital for diarrhea.

Table 2: Diarrheal Morbidity According to Rotavirus Immunization Status

Morbidity Indicator	Fully	Partial	None	p-value
Acute watery diarrhea	70.8%	61.9%	54.6%	0.012
Persistent diarrhea	4.5%	9.5%	14.4%	0.014
Dysentery	2.2%	11.9%	17.5%	0.023
Complications	9.0%	19.0%	33.0%	0.003

Legend: Association analyzed using Chi-square test; $p < 0.05$ considered statistically significant.

The length of hospital stay progressively increased as the vaccination status worsened; fully vaccinated children had a median length of stay of 3 days, while children who were unvaccinated had a median length of stay of 7 days ($p = 0.002$). Fully vaccinated children were less likely to require admission into an ICU (2.2%) in comparison to partially vaccinated (7.1%) and unvaccinated children (10.3%) ((p = 0.008). The median number of complications per group also significantly increased based on vaccination status ($p = 0.006$). Overall, these data demonstrate the substantial benefits of rotavirus vaccination in children, which indicated a strong decrease in the severity of disease and health care costs.

Table 3: Hospitalization Outcomes by Rotavirus Immunization Status

Outcome	Fully	Partial	None	p-value
Median days hospitalized	3	5	7	0.002
ICU admission rate	2.2%	7.1%	10.3%	0.008
Median complication count	0	1	2	0.006

Legend: Comparison across groups using Kruskal–Wallis test for medians and Chi-square for categorical variables.

The nutrition status showed a strong association with immunization status. The prevalence of underweight status and severe acute malnutrition (SAM) was significantly lower among fully immunized children (12.4% and 6.7%, respectively) compared to unvaccinated children (29.9% and 20.6%, respectively) ($p = 0.021$ and $p = 0.010$). Furthermore, only 8.9% of fully vaccinated children had mid-upper arm circumference (MUAC) < 12.5 cm (indicating malnutrition), compared to 31.9% among unvaccinated children ($p = 0.004$). Therefore, the data suggest that children who complete the rotavirus vaccination schedule experience indirect nutrition benefits.

Table 4: Association of Rotavirus Immunization with Nutritional Status

Status	Fully	Partial	None	p-value
Underweight	12.4%	22.6%	29.9%	0.021
Severe Acute Malnutrition	6.7%	14.3%	20.6%	0.010
MUAC < 12.5 cm	8.9%	21.4%	31.9%	0.004

Legend: Association assessed using Chi-square test; significance set at $p < 0.05$.

Severe dehydration, sepsis, and rehospitalization were all inversely associated with vaccination status in a graded manner. Severe dehydration was seen in 1.1% ($p = 0.008$) of fully immunized children and 13.4% of non-immunized children. Sepsis ($p = 0.043$) and rehospitalization ($p = 0.021$) were also significantly more prevalent in children with no vaccinations, thus, suggesting that rotavirus

vaccination offers protection from severe complications.

Table 5: Complications and Rotavirus Immunization

Complication	Fully	Partial	None	p-value
Dehydration (severe)	1.1%	7.1%	13.4%	0.008
Sepsis	0	2.4%	5.2%	0.043
Rehospitalization	2.2%	5.0%	11.3%	0.021

Legend: Chi-square test applied for categorical variables.

Maternal education and health worker visits were identified as significant predictors of full vaccine coverage. The odds of being fully vaccinated were 2.3 times higher among children of an educated mother (OR = 2.3; 95% CI: 1.4 - 3.9; p = 0.002). Likewise, households that had a visit from a health worker were 2.8 times more likely to have full coverage (p = 0.001). Living in an urban area indicated a positive trend but was not statistically significant (p = 0.087)

Table 6: Predictors of Full Rotavirus Immunization Coverage

Variable	Full Coverage (%)	OR (95% CI)	p-value
Maternal education	58.1	2.3 (1.4–3.9)	0.002
Urban residence	43.5	1.4 (0.9–2.4)	0.087
Health worker visit	61.6	2.8 (1.6–4.5)	0.001

Legend: Binary logistic regression model showing predictors of complete immunization coverage; odds ratios (OR) with 95% confidence intervals (CI) reported.

DISCUSSION

This study demonstrates a significant protective association between full rotavirus immunization coverage and reduced diarrheal morbidity and hospitalization severity among under-five children admitted to a tertiary care hospital in Eastern India. Children who received all three doses of the rotavirus vaccine experienced significantly lower rates of persistent diarrhea, dysentery, severe dehydration, and complications such as sepsis compared to partially immunized or unimmunized children. These findings are consistent with prior large-scale studies and systematic reviews showing that rotavirus vaccines reduce the incidence of severe diarrhea and hospital admissions by 40-70% in low- and middle-income countries, including India (Nair NP et al., 2019; Tate et al., 2016).[8-10]

The study also established a graded inverse relationship between vaccine coverage and length of hospitalization, ICU admission and rehospitalization. Fully vaccinated children had a median length of stay of 3 days compared to 7 days for unvaccinated children, further supporting that fully vaccinated children had less severe illness profile and quicker recovery course, as previously described regarding the impact of vaccination on illness severity (Burnett et al., 2017).[11] Furthermore, the proportion of underweight and severe acute malnutrition (SAM) was lower among fully immunized children, reinforcing the indirect nutritional benefits of protection from recurrent diarrheal illness (Black et al., 2013).[12-14]

Factors associated with completed rotavirus immunization included lower maternal education and lack of health worker household visits, consistent with national surveys that broadly measured barriers to immunization uptake in India (Patel et al., 2025).[15] These social determinants of health emphasize the need to create community outreach and educational efforts to improve coverage, for example, rotavirus vaccine, in rural and other economically disadvantaged settings.[16]

Strengths and Limitations: The strengths of this research include the use of actual clinical outcome data connected to validated immunization records in a tertiary care setting with limited resources, which is reflective of real-world vaccine effectiveness. Although, it used a cross-sectional design, the strengths of the sample size and statistical analysis strengthen confidence in reported associations. Limitations of the research rely on vaccine history of rotavirus without laboratory-confirmed diagnosis of rotavirus infection in every instance, which possibly dilutes the exact estimates of vaccine impact. Moreover, this was a single-center hospital-based study and therefore results may not be generalizable to community settings or another region. Caregivers recall bias and potential confounding factors such as concurrent infections were also acknowledged.

CONCLUSION

Full rotavirus immunization is significantly associated with decreased diarrheal morbidity and complications and shorter lengths of hospitalization among children under-five years of age in Eastern India. These findings strongly express the importance of expanding rotavirus vaccine coverage when strategizing parts of national child health interventions. and escalating opportunities to improve maternal education and secure health worker engagement at the household social and health levels to address coverage gaps and facilitate equitable access to vaccination. Such measures have the potential to greatly reduce the preventable burden of

childhood diarrheal morbidity and mortality and improve childhood development and survival.

REFERENCES

1. Hallowell BD, Chavers T, Parashar U, Tate JE. Global estimates of rotavirus hospitalizations among children <5 years in 2019 and current and projected impacts of rotavirus vaccination. J Pediatric Infect Dis Soc. 2022 Apr 30;11(4):149–58.
2. Sadiq A, Khan J. Rotavirus in developing countries: molecular diversity, epidemiological insights, and strategies for effective vaccination. Front Microbiol. 2024 Jan 5; 14:1297269.
3. Malik A, Haldar P, Ray A, Shet A, Kapuria B, Bhadana S, et al. Introducing rotavirus vaccine in the Universal Immunization Programme in India: From evidence to policy to implementation. Vaccine. 2019 Sept 16;37(39):5817–24.
4. Koshal SS, Ray A, Mehra R, Kaur A, Quadri SF, Agarwal P, et al. Partnering for rotavirus vaccine introduction in India: A retrospective analysis. Vaccine. 2021 Oct 22;39(44):6470–6.
5. Bhat N, Vodicka E, Clifford A, Ananth KB, Bavdekar A, Roy AD, et al. The evidence base for rotavirus vaccination in India: Current status, future needs. Vaccine. 2025 Jan 12; 44:126551.
6. Hallowell BD, Tate J, Parashar U. An overview of rotavirus vaccination programs in developing countries. Expert Rev Vaccines. 2020 June;19(6):529–37.
7. Saikia K, Ahmed R, Das B, Paul S, Ray SK, Chandra Deka R, et al. Impact of Rotavac Vaccine on Hospital-Based Disease Prevalence and Strain Diversity in India: A Systematic Review and Meta-Analysis. Reviews in Medical Virology. 2025;35(5):e70066.
8. Nair NP, Reddy N S, Giri S, Mohan VR, Parashar U, Tate J, et al. Rotavirus vaccine impact assessment surveillance in India: protocol and methods. BMJ Open. 2019 Apr 25;9(4):e024840.
9. Tate JE, Burton AH, Boschi-Pinto C, Parashar UD, World Health Organization–Coordinated Global Rotavirus Surveillance Network. Global, Regional, and National Estimates of Rotavirus Mortality in Children <5 Years of Age, 2000-2013. Clin Infect Dis. 2016 May 1;62 Suppl 2(Suppl 2):S96–105.
10. Gleason A, Kumar CK, Klein E, Laxminarayan R, Nandi A. Effect of rotavirus vaccination on the burden of rotavirus disease and associated antibiotic use in India: A dynamic agent-based simulation analysis. Vaccine. 2024 Sept 17;42(22):126211.
11. Burnett E, Parashar U, Tate J. Rotavirus Vaccines: Effectiveness, Safety and Future Directions. Paediatr Drugs. 2018 June;20(3):223–33.
12. Immunization Data [Internet]. [cited 2025 Oct 30]. WHO Immunization Data portal - Detail Page. Available from: https://immunizationdata.who.int/global/wiise-detail-page
13. Dhalaria P, Kapur S, Singh AK, Verma A, Priyadarshini P, Taneja G. Potential impact of rotavirus vaccination on reduction of childhood diarrheal disease in India: An analysis of National Family Health Survey-5. Vaccine X. 2023 May 23; 14:100319.
14. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet. 2008 Jan 19;371(9608):243–60.
15. Patel P, Sadanandam P, Khakharia M. Assessment of Immunization Coverage and Its Determinants Among Under-Five Children in Urban Slums: A Cross-Sectional Analysis. Journal of Heart Valve Disease. 2025 July 26; 30:223–7.
16. Ghosh A, Annigeri S, Hemram SK, Dey PK, Mazumder S, Ghosh P. Demography and determinants of incomplete immunization in children aged 1–5 years and vaccine-hesitancy among caregivers: An Eastern Indian perspective. Clinical Epidemiology and Global Health [Internet]. 2022 Sept 1 [cited 2025 Oct 30];17. Available from: https://www.ceghonline.com/article/S2213-3984(22)00197-X/fulltext.