DOI: https://doi.org/10.53350/pjmhs20231711286

ORIGINAL ARTICLE

Effectiveness of Rotavirus Vaccine in Reducing Hospital Admissions for Acute Diarrhea in Children Under 5 years of Age

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ABSTRACT

Background: Rotavirus is a leading cause of acute diarrhea among children under five, often resulting in hospital admissions and increased healthcare burden.

Objective: To evaluate the effectiveness of the rotavirus vaccine in reducing hospital admissions, disease severity, and clinical complications associated with acute diarrhea in children under five years of age.

Methods: This comparative observational study was conducted at The Children's Hospital Lahore from March 2023 to August 2023. A total of 95 pediatric patients under the age of five were included in this study. Patients with acute diarrhea defined as the sudden onset of three or more loose or watery stools within 24 hours, lasting less than 14 days were included in the study. The sample included both male and female children across various age groups within the under-five population.

Results: Vaccinated children exhibited significantly lower rates of severe dehydration (21.2%) compared to unvaccinated children (44.2%). The average duration of hospital stay was shorter in the vaccinated group (2.3 ± 1.1 days vs. 3.8 ± 1.5 days). Complete recovery within 48 hours was higher among vaccinated children (88.5% vs. 60.5%). The unvaccinated group had a higher need for IV rehydration and accounted for all tertiary care referrals. The relative risk of severe outcomes in unvaccinated children ranged from 1.65 to 3.36 depending on the outcome measured.

Conclusion: It is concluded that the rotavirus vaccine is effective in significantly reducing the severity and hospital burden of acute diarrhea in children under five. These findings support the continued inclusion and timely administration of rotavirus vaccines in national immunization programs.

Keywords: Rotavirus, Acute Diarrhea, Vaccination, Hospitalization, Vaccine Effectiveness

INTRODUCTION

Acute diarrhea continues to be a major contributor to childhood morbidity and mortality worldwide, particularly in children under five years of age. Among the infectious agents responsible, rotavirus has been identified as the leading cause of severe gastroenteritis in this age group. Before the introduction of rotavirus vaccines, the virus was responsible for an estimated 215,000 deaths annually in children under five, predominantly in low-income and middle-income countries[1]. Rotavirus infections frequently necessitated medical attention, resulting in millions of outpatient visits and hundreds of thousands of hospital admissions each year. The burden on public health systems and the economic strain on families and governments highlighted the urgent need for effective preventive measures[2].

In 2006, two live, oral rotavirus vaccines Rotarix (monovalent) and RotaTeq (pentavalent) were introduced and later recommended by the World Health Organization (WHO) for inclusion in national immunization schedules worldwide, particularly in regions with high disease burden[3]. These vaccines are designed to protect infants during the period of highest risk and have been shown in clinical trials to significantly reduce both the incidence and severity of rotavirus gastroenteritis. Since their widespread introduction into national immunization programs, numerous countries have observed measurable improvements in pediatric health outcomes[4]. Reductions in diarrhea-related hospitalizations, all-cause gastroenteritis, and even mortality have been reported, indicating broad benefits beyond the specific prevention of rotavirus[5].

The primary objective of introducing the rotavirus vaccine was to minimize severe disease and its consequences, particularly hospital admissions which place substantial demand on health systems. Evaluating the effectiveness of the vaccine in achieving this goal involves not only assessing changes in rotavirus-confirmed cases but also monitoring trends in all-cause acute diarrhea admissions, which serve as a reliable proxy indicator for public health impact[6]. Multiple observational studies and systematic reviews conducted across different regions including Africa, Asia, Latin America, and Europe have consistently demonstrated that rotavirus vaccination leads to significant declines in diarrhea-related hospitalizations among children under five. In some countries, reductions of 40–70% in hospital admissions for acute gastroenteritis have been documented within a few years of vaccine implementation[7].

Nevertheless, the degree of vaccine effectiveness varies across settings, influenced by factors such as vaccine coverage rates, nutritional status of children, prevalence of other enteric pathogens, and healthcare infrastructure[8]. For instance, studies have shown that while the vaccine is highly effective in high-income countries, slightly lower effectiveness rates have been reported in resource-limited settings. This discrepancy has prompted additional investigations into strategies to optimize vaccine performance, including the timing of doses, booster administration, and the role of maternal immunity and gut microbiota[9].

Objectives: This study aims to provide a comprehensive analysis of the effectiveness of the rotavirus vaccine in reducing hospital admissions for acute diarrhea in children under five years of age.

METHODOLOGY

This comparative observational study was conducted at The Children's Hospital Lahore from March 2023 to August 2023. A total of 95 pediatric patients under the age of five were included in this study. Patients with acute diarrhea defined as the sudden onset of three or more loose or watery stools within 24 hours, lasting less than 14 days were included in the study. The sample included both male and female children across various age groups within the under-five population. To ensure consistency and minimize confounding factors, specific inclusion and exclusion criteria were applied. Children were eligible if they were aged 0 to 59 months, had been hospitalized due to acute diarrhea, and had complete hospital records and a verifiable immunization history. Children were excluded if they were older than five years, had chronic or persistent diarrhea lasting more than 14 days, were diagnosed with immunodeficiency disorders or congenital gastrointestinal anomalies, or had incomplete medical or immunization records.

Received on 03-09-2023
Accepted on 26-10-2023

Data Collection: Data were extracted from a systematically designed questionnaire and medical records, including demographic details (age and sex), vaccination history, duration of hospitalization, clinical severity (notably dehydration status), nutritional status, and patient outcomes. Vaccination status was verified using immunization cards or official hospital immunization registries. Based on their vaccination status, patients were categorized into two groups: the vaccinated group included children who had received at least two doses of the rotavirus vaccine under the national immunization schedule. In contrast, the unvaccinated group included children who had received no doses of the vaccine. The primary outcome of interest was the rate of hospital admissions due to acute diarrhea in vaccinated compared to unvaccinated children. These outcomes provided insights into not only the protective effect of the vaccine but also its potential role in reducing disease severity and associated healthcare burdens.

Statistical Analysis: Statistical analysis was conducted using SPSS v17. Descriptive statistics such as mean, median, and frequency were used to summarize patient demographics and clinical characteristics. Categorical variables, including vaccination status and gender, were analyzed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

Data were collected from 95 patients, 52 (54.7%) were vaccinated with at least two doses of the rotavirus vaccine, while 43 (45.3%) were unvaccinated. The mean age of the children was 24.8 months (±13.2), with no statistically significant difference in age distribution between the two groups. Males accounted for 51.6% (n=49) of the total sample, and gender distribution was comparable between the vaccinated and unvaccinated groups.

Table 1: Demographic and Clinical Characteristics

Variable	Value
Total number of patients	95
Vaccinated (≥2 doses)	52 (54.7%)
Unvaccinated	43 (45.3%)
Mean age (months)	24.8 ± 13.2
Male (%)	49 (51.6%)
Severe dehydration (Vaccinated)	11 (21.2%)
Severe dehydration (Unvaccinated)	19 (44.2%)

Table 2: Clinical Outcomes by Vaccination Status

Outcome	Vaccinated	Unvaccinated
Average hospital stay (days)	2.3 ± 1.1	3.8 ± 1.5
Complete recovery within 48 hrs	46 (88.5%)	26 (60.5%)
IV rehydration required	9 (17.3%)	25 (58.1%)
Referral to tertiary care	0	2 (4.7%)
Mortality	0	0

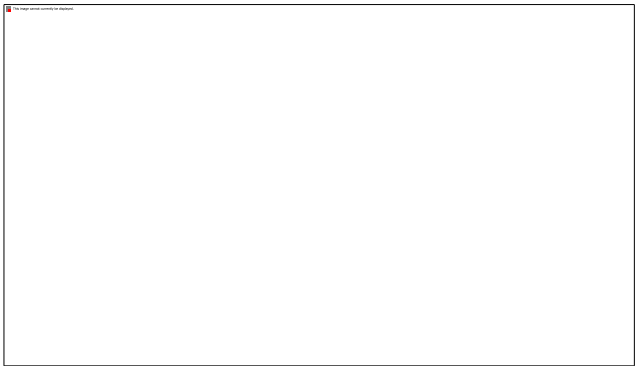

Figure 1: Clinical Outcomes by Vaccination Status

Only 21.2% of vaccinated children presented with severe dehydration on admission, compared to 44.2% in the unvaccinated group. The average duration of hospitalization was also notably shorter in vaccinated children (2.3 ± 1.1 days) than in unvaccinated children (3.8 ± 1.5 days), with the difference being statistically significant ($p < 0.01$). Further analysis of clinical outcomes showed that vaccinated children required fewer interventions such as intravenous rehydration and were more likely to recover without complications. Among the vaccinated group, 88.5% showed complete recovery within 48 hours of admission, compared to 60.5% of unvaccinated children. No deaths were recorded in either group; however, two cases in the unvaccinated group required referral to tertiary care due to severe electrolyte imbalance and prolonged diarrhea.

The majority of cases occurred in the 12–23 month age group across both vaccinated and unvaccinated children. However, a larger proportion of unvaccinated cases fell into the youngest age group (0–11 months), which may reflect delayed or missed vaccinations. Vaccinated children were more evenly distributed across age categories, possibly due to better adherence to the immunization schedule.

Table 3: Age-wise Distribution of Cases

Age Group (months)	Vaccinated (n=52)	Unvaccinated (n=43)	Total (n=95)
0–11	10 (19.2%)	14 (32.6%)	24 (25.3%)
12–23	17 (32.7%)	13 (30.2%)	30 (31.6%)
24–35	13 (25.0%)	9 (20.9%)	22 (23.2%)
36–59	12 (23.1%)	7 (16.3%)	19 (20.0%)

The severity of diarrhea was markedly different between the two groups. Most vaccinated children presented with mild symptoms (53.8%), whereas a significant number of unvaccinated children experienced severe dehydration (44.2%). Only 25.6% of unvaccinated children had mild cases, indicating a strong association between vaccination and reduced clinical severity.

Table 4: Severity of Illness by Vaccination Status

Severity Category	Vaccinated (n=52)	Unvaccinated (n=43)
Mild diarrhea	28 (53.8%)	11 (25.6%)
Moderate dehydration	13 (25.0%)	13 (30.2%)
Severe dehydration	11 (21.2%)	19 (44.2%)

Figure 2: Severity of Dehydration by Vaccination Status

The relative risk analysis revealed that unvaccinated children were 1.78 times more likely to be hospitalized with severe diarrhea and 3.36 times more likely to require IV rehydration compared to vaccinated children. They also had a 1.65 times higher risk of prolonged hospital stays exceeding three days.

Table 5: Relative Risk of Key Outcomes (Unvaccinated vs. Vaccinated)

Outcome	Relative Risk (RR)	95% Confidence Interval
Hospitalization for severe diarrhea	1.78	1.13 – 2.82
IV rehydration requirement	3.36	1.84 – 6.15
Prolonged hospital stay (>3 days)	1.65	1.05 – 2.57

DISCUSSION

This study demonstrates a significant reduction in the severity and duration of acute diarrhea among vaccinated children under five years of age, reaffirming the effectiveness of the rotavirus vaccine in a real-world hospital setting. Among the 95 children evaluated, vaccinated individuals exhibited substantially lower rates of severe dehydration, shorter hospital stays, and quicker recovery times compared to their unvaccinated counterparts. These findings are consistent with global and regional evidence on the protective effect of rotavirus vaccination in reducing the clinical burden of gastroenteritis in young children. The observed reduction in severe dehydration (21.2% in vaccinated vs. 44.2% in unvaccinated) is particularly important, as it highlights the vaccine's role in preventing complications that often lead to prolonged hospital stays or referral to tertiary care[10]. Furthermore, vaccinated children had an 88.5% rate of recovery within 48 hours, while only 60.5% of unvaccinated children showed similar recovery, underlining how the vaccine not only prevents disease onset but also mitigates its severity when breakthrough infections occur. These outcomes translate into reduced strain on healthcare systems and lower out-of-pocket costs for families[11].

Age-wise distribution patterns suggest that younger, unvaccinated children (especially under 12 months) are at higher risk of severe diarrhea-related hospitalizations. This may reflect delays in initiating or completing the rotavirus vaccination schedule, emphasizing the need for timely immunization[12]. The findings also indicate that while some degree of illness occurred in vaccinated individuals, the severity was markedly attenuated, reinforcing the importance of achieving high vaccine coverage rather than relying solely on herd immunity. Statistical analysis further supports these observations[13]. The calculated relative risk (RR) values showed that unvaccinated children were significantly more likely to experience severe outcomes, including a 3.36-fold higher likelihood of requiring intravenous rehydration. These metrics provide robust quantitative evidence for policymakers and health professionals advocating for sustained vaccination programs. Even though mortality was not observed in either group, the need for referral to advanced care in the unvaccinated group suggests the potential for more serious consequences in the absence of immunization[14].

Our findings align closely with prior studies conducted in other settings, such as in Latin America, sub-Saharan Africa, and South Asia, where post-introduction surveillance data consistently show declines in rotavirus-related hospitalizations and deaths[15-17]. While the vaccine's effectiveness may vary across regions due to factors like nutritional status, breastfeeding practices, and co-infections, the overall trend is consistently in favor of vaccination. This underscores the global relevance of rotavirus immunization and its adaptability across different healthcare environments. However, some limitations must be acknowledged. The sample size, though sufficient for preliminary conclusions, may limit the generalizability of findings.

CONCLUSION

It is concluded that the rotavirus vaccine is highly effective in reducing the severity and frequency of hospital admissions due to acute diarrhea among children under five years of age. The findings from this study demonstrate that vaccinated children experienced fewer cases of severe dehydration, shorter hospital stays, and better clinical outcomes compared to their unvaccinated peers. The protective effect of the vaccine was also reflected in the significantly lower need for intravenous rehydration and the absence of referrals to tertiary care in the vaccinated group.

REFERENCES

1. Kilgore A, Donauer S, Edwards KM, Weinberg GA, Payne DC, Szilagyi PG, et al. Rotavirus-associated hospitalization and emergency department costs and rotavirus vaccine program impact. Vaccine. 2013;31:4164–71. doi:10.1016/j.vaccine.2013.06.085. PMID:23845802.
2. Morton VK, Thomas MK, McEwen SA. Estimated hospitalizations attributed to norovirus and rotavirus infection in Canada, 2006–2010. Epidemiol Infect. 2015;143(16):3528–37.
3. Bernard S, Valiquette L, De Wals P, Nault V, Babakissa C, Cyr C, et al. Burden of rotavirus disease: A population-based study in Eastern Townships, Quebec. Can J Infect Dis Med Microbiol. 2013;24:138–42. PMID:24421824.
4. Vesikari T, Matson DO, Dennehy P, Van Damme P, Santosham M, Rodriguez Z, et al. Safety and efficacy of a pentavalent human-bovine (WC3) reassortant rotavirus vaccine. N Engl J Med. 2006;354:23–33. doi:10.1056/NEJMoa052664. PMID:16394299.
5. Ruiz-Palacios GM, Pérez-Schael I, Velázquez FR, Abate H, Breuer T, Clemens SC, et al. Safety and efficacy of an attenuated vaccine against severe rotavirus gastroenteritis. N Engl J Med. 2006;354:11–22. doi:10.1056/NEJMoa052434. PMID:16394298.
6. Vesikari T, Karvonen A, Prymula R, Schuster V, Tejedor J, Cohen R, et al. Efficacy of human rotavirus vaccine against rotavirus gastroenteritis during the first 2 years of life in European infants: randomised, double-blind controlled study. Lancet. 2007;370:1757–63. doi:10.1016/S0140-6736(07)61744-9. PMID:18037080.
7. Boulianne N, Bradet R, Audet D, Ouakki M, De Serres G, Guay M. Enquête sur la couverture vaccinale des enfants de 1 an et 2 ans au Québec en 2012. Institut national de santé publique du Québec. 2013.
8. Gosselin V, Petit G, Généreux M. Trends in severe gastroenteritis in young children according to socio-economic characteristics before and after implementation of a rotavirus vaccination program in Quebec. Can J Public Health. 2016;107(2).
9. Wang FT, Mast TC, Glass RJ, Loughlin J, Seeger JD. Effectiveness of the Pentavalent Rotavirus Vaccine in Preventing Gastroenteritis in the United States. Pediatrics. 2010;125:e208–13. doi:10.1542/peds.2009-1246. PMID:20100757.
10. Leshem E, Moritz RE, Curns AT, Zhou F, Tate JE, Lopman BA, et al. Rotavirus vaccines and health care utilization for diarrhea in the United States (2007–2011). Pediatrics. 2014;134:15–23. doi:10.1542/peds.2013-3849. PMID:24913793.
11. Boom JA, Tate JE, Sahni LC, Rench MA, Hull JJ, Gentsch JR, et al. Effectiveness of pentavalent rotavirus vaccine in a large urban population in the United States. Pediatrics. 2010;125:e199–207. doi:10.1542/peds.2009-1021. PMID:20083525.
12. Desai SN, Esposito DB, Shapiro ED, Dennehy PH, Vázquez M. Effectiveness of rotavirus vaccine in preventing hospitalization due to rotavirus gastroenteritis in young children in Connecticut, USA. Vaccine. 2010;28:7501–6. doi:10.1016/j.vaccine.2010.09.013. PMID:20851087.
13. Cortese MM, Immergluck LC, Held M, Jain S, Chan T, Grizas AP, et al. Effectiveness of monovalent and pentavalent rotavirus vaccine. Pediatrics. 2013;132:e25–33. doi:10.1542/peds.2012-3804. PMID:23776114.
14. Field EJ, Vally H, Grimwood K, Lambert SB. Pentavalent rotavirus vaccine and prevention of gastroenteritis hospitalizations in Australia. Pediatrics. 2010;126:e506–12. doi:10.1542/peds.2010-0443. PMID:20732946.
15. Gagneur A, Nowak E, Lemaitre T, Segura J-F, Delaperrière N, Abalea L, et al. Impact of rotavirus vaccination on hospitalizations for rotavirus diarrhea: the IVANHOE study. Vaccine. 2011;29:3753–9. doi:10.1016/j.vaccine.2011.03.035. PMID:21443962.
16. Vesikari T, Uhari M, Renko M, Hemming M, Salminen M, Torcel-Pagnon L, et al. Impact and effectiveness of RotaTeq vaccine based on 3 years of surveillance following introduction of a rotavirus immunization program in Finland. Pediatr Infect Dis J. 2013;32:1365–73. doi:10.1097/INF.0000000000000086. PMID:24051998.
17. Braeckman T, Van Herck K, Meyer N, Pircon J-Y, Soriano-Gabarro M, Heylen E, et al. Effectiveness of rotavirus vaccination in prevention of hospital admissions for rotavirus gastroenteritis among young children in Belgium: case-control study. BMJ. 2012;345:e4752. doi:10.1136/bmj.e4752. PMID:22875947.

This article may be cited as: Ansari S, Anwar S, Yar A, Jamil S, Sohail A, Sajjad A: Effectiveness of Rotavirus Vaccine in Reducing Hospital Admissions for Acute Diarrhea in Children Under 5 years of Age. Pak J Med Health Sci, 2023;17(11):286-288.