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IMPACT OF ROTAVIRUS VACCINE INTRODUCTION ON DIARRHEA CASES AND DIARRHEA-RELATED HOSPITALIZATIONS AMONG UNDER-FIVE CHILDREN IN THE FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA.

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ABSTRACT

Background

Diarrheal diseases remain a leading cause of morbidity among under-five children, particularly in low- and middle-income countries. Rotavirus is a major etiological agent of severe childhood diarrhea. Nigeria introduced the rotavirus vaccine into its routine immunization schedule in 2022; however, evidence on its impact at sub-national levels remains limited. This study assessed the impact of rotavirus vaccine introduction on diarrhea cases and diarrhea-related hospitalizations among under-five children in the Federal Capital Territory (FCT), Abuja. **Methods:** A retrospective before-and-after study design was employed using routine health facility data from selected public health facilities in the FCT, Abuja. Aggregate data on under-five outpatient diarrhea cases and diarrhea-related hospitalizations were extracted for the pre-introduction period (January 2020–December 2021) and the post-introduction period (January 2023–December 2024). Mean cases and hospitalizations were compared between periods using independent sample *t*-tests, with statistical significance set at $p < 0.05$. **Results:** The mean number of under-five diarrhea cases declined from 142.6 (SD ± 28.4) in the pre-introduction period to 91.3 (SD ± 22.7) in the

post-introduction period, representing a statistically significant reduction ($t = 6.41$, $p < 0.001$). Similarly, mean diarrhea-related hospitalizations decreased significantly from 58.2 (SD ± 14.1) before vaccine introduction to 32.7 (SD ± 10.5) afterward ($t = 7.02$, $p < 0.001$).

Conclusion: The introduction of the rotavirus vaccine in the Federal Capital Territory, Abuja, was associated with significant reductions in both diarrhea cases and diarrhea-related hospitalizations among under-five children. These findings provide important sub-national evidence supporting the effectiveness of rotavirus vaccination in reducing the burden and severity of childhood diarrheal disease in Nigeria.

KEYWORDS: Rotavirus vaccine; diarrhea; hospitalizations; under-five children; vaccine impact; Nigeria.

1. INTRODUCTION

1.1 Background of the Study

Diarrheal diseases remain a major public health problem and a leading cause of morbidity and mortality among children under five years of age globally. Despite significant reductions in child mortality over the past two decades, diarrhea continues to contribute substantially to preventable childhood illness and death, particularly in low- and middle-income countries (LMICs) where access to clean water, sanitation, and quality health services is limited (World Health Organization [WHO], 2017; United Nations Children's Fund [UNICEF], 2021).

Rotavirus has been consistently identified as the most common cause of severe acute gastroenteritis among infants and young children worldwide and is responsible for a large proportion of diarrhea-related hospitalizations and deaths in this age group (Tate et al., 2016). Prior to the availability of rotavirus vaccines, nearly all children globally were infected with rotavirus by the age of five years, with the highest risk of severe disease occurring during infancy (Parashar et al., 2003; Glass et al., 2006). Rotavirus infection is typically characterized by profuse watery diarrhea, vomiting, fever, and dehydration, which can rapidly become life-threatening in settings with delayed access to care (Troeger et al., 2018).

Sub-Saharan Africa bears a disproportionate share of the global burden of rotavirus-associated morbidity and mortality. More than half of global rotavirus-related deaths among under-five children occur in African countries, reflecting persistent inequities in preventive and curative health services (Troeger et al., 2018; GBD 2019 Diarrhoeal Diseases Collaborators, 2020). In Nigeria, diarrheal diseases remain among the leading causes of outpatient visits, hospital admissions, and childhood deaths, with rotavirus contributing

significantly to severe diarrheal episodes requiring hospitalization (Akinyemi et al., 2018; Ugboko et al., 2020).

Vaccination against rotavirus is widely recognized as one of the most effective public health interventions for preventing severe rotavirus-associated diarrhea. Following recommendations by the World Health Organization, many countries have introduced rotavirus vaccines into their national routine immunization schedules (WHO, 2013). Evidence from randomized controlled trials and post-introduction evaluations has demonstrated substantial reductions in diarrhea-related morbidity, hospitalizations, and mortality following vaccine introduction (Zaman et al., 2010; Armah et al., 2016; Burnett et al., 2017).

Several African countries that introduced rotavirus vaccines earlier have reported marked declines in diarrhea-related hospital admissions and severe gastroenteritis among under-five children (Bar-Zeev et al., 2016; Mwila-Kazimbaya et al., 2017; Mpabalwani et al., 2020). These findings demonstrate that rotavirus vaccination is effective not only in controlled trial settings but also under routine programmatic conditions.

Nigeria introduced the rotavirus vaccine into its routine immunization schedule in 2022 as part of national efforts to reduce childhood morbidity and mortality from diarrheal diseases. While global and regional evidence supports the effectiveness of rotavirus vaccination, country-specific and sub-national evaluations are critical for assessing vaccine performance within Nigeria's routine immunization system and for generating local evidence to guide policy and implementation (Patel et al., 2011; Tate et al., 2021).

1.2 Statement of the Problem

Despite the introduction of the rotavirus vaccine into Nigeria's routine immunization program, diarrheal diseases continue to contribute substantially to childhood morbidity and health facility utilization. National and sub-national data indicate that under-five children in Nigeria continue to present frequently with diarrhea at outpatient clinics and are admitted for severe dehydration and gastroenteritis (Akinyemi et al., 2018; GBD 2019 Diarrhoeal Diseases Collaborators, 2020).

Rotavirus remains a major etiological agent of severe diarrhea among Nigerian children, particularly those requiring hospitalization (Ugboko et al., 2020). Although rotavirus vaccination is expected to significantly reduce both the incidence and severity of diarrheal disease, the magnitude of its impact in Nigeria following routine introduction remains inadequately documented. The introduction of a vaccine alone does not guarantee optimal

public health impact, especially in settings characterized by variations in vaccine coverage, health system performance, and service utilization (Patel et al., 2011; WHO, 2014).

In the Federal Capital Territory (FCT), Abuja, diarrheal diseases continue to account for a considerable proportion of outpatient visits and hospital admissions among under-five children, even after the introduction of the rotavirus vaccine. Routine facility reports suggest persistent presentations of childhood diarrhea, raising concerns regarding the extent to which the vaccine has reduced disease burden in this setting (WHO, 2017).

The absence of systematic post-introduction evaluations at sub-national levels has created a critical evidence gap. Without empirical data documenting changes in diarrhea cases and diarrhea-related hospitalizations following vaccine introduction, policymakers and program managers are limited in their ability to assess program effectiveness, justify sustained investment, and identify implementation gaps requiring targeted intervention (WHO, 2014; Tate et al., 2021).

1.3 Need for the Study

Post-introduction evaluation of newly introduced vaccines is an essential component of immunization program monitoring and strengthening. Such evaluations provide evidence on whether vaccines achieve their intended public health benefits under real-world conditions and inform evidence-based decision-making for immunization policy and practice (WHO, 2014; Tate et al., 2021).

Although multiple studies from other African and Asian countries have demonstrated substantial reductions in diarrhea morbidity and hospitalizations following rotavirus vaccine introduction, comparable evidence from Nigeria remains limited (Armah et al., 2016; Bar-Zeev et al., 2016; Mpabalwani et al., 2020). Given Nigeria's large population and high burden of childhood diarrheal disease, the lack of country-specific and sub-national impact data represents a significant gap in the evidence base (Troeger et al., 2018; GBD 2019 Diarrhoeal Diseases Collaborators, 2020).

Sub-national evaluations are particularly important because vaccine impact may vary across geographic locations due to differences in immunization coverage, health service delivery, socioeconomic conditions, and health-seeking behavior (Patel et al., 2011; WHO, 2014). The Federal Capital Territory, Abuja, with its heterogeneous mix of urban and rural populations and relatively developed health infrastructure, provides a strategic setting for assessing the impact of rotavirus vaccine introduction within Nigeria's routine immunization system.

Evidence generated from this study is necessary to document changes in diarrhea cases and diarrhea-related hospitalizations following rotavirus vaccine introduction, contribute to the limited Nigerian literature on rotavirus vaccine impact, and inform strategies aimed at reducing preventable childhood diarrheal disease burden.

1.4 Objectives of the Study

1.4.1 General Objective

To assess the impact of rotavirus vaccine introduction on diarrhea cases and diarrhea-related hospitalizations among under-five children in the Federal Capital Territory, Abuja, Nigeria.

1.4.2 Specific Objectives

1. To compare the mean number of diarrhea cases among under-five children before and after the introduction of the rotavirus vaccine.
2. To compare the mean number of diarrhea-related hospitalizations among under-five children before and after the introduction of the rotavirus vaccine.

1.5 Research Questions

1. Is there a difference in the mean number of diarrhea cases among under-five children before and after rotavirus vaccine introduction in FCT Abuja?
2. Is there a difference in the mean number of diarrhea-related hospitalizations among under-five children before and after rotavirus vaccine introduction in FCT Abuja?

1.6 Research Hypotheses

The following null hypotheses were tested at a 5% level of significance:

- **H_{01}:** There is no significant difference in the mean number of diarrhea cases among under-five children before and after rotavirus vaccine introduction in FCT Abuja.
- **H_{02}:** There is no significant difference in the mean number of diarrhea-related hospitalizations among under-five children before and after rotavirus vaccine introduction in FCT Abuja.

2.0 METHODS

2.1 Study Design

This study employed a retrospective before-and-after (pre–post) observational design to assess the impact of rotavirus vaccine introduction on diarrhea cases and diarrhea-related hospitalizations among under-five children. The design compared routinely reported health facility data from periods before and after the introduction of the rotavirus vaccine into

Nigeria's routine immunization schedule. This approach is commonly used for post-introduction vaccine impact evaluation when randomized designs are not feasible and routinely collected data are available

2.2 Study Setting

The study was conducted in selected public health facilities within the Federal Capital Territory (FCT), Abuja, Nigeria. The FCT comprises six Area Councils with a mix of urban and rural populations. Public health facilities in the FCT provide routine immunization services as well as outpatient and inpatient pediatric care, including management of diarrheal diseases. The setting was considered appropriate for evaluating changes in diarrhea outcomes following vaccine introduction under routine service delivery conditions.

2.3 Data Source

Secondary data were obtained from routine health facility records, including outpatient registers and inpatient admission records. Aggregate data were extracted for under-five children diagnosed with diarrhea or admitted for diarrhea-related conditions. Data extraction focused on routinely reported indicators to ensure consistency across facilities and over time.

2.4 Study Population

The study population consisted of under-five children (0–59 months) who attended selected public health facilities in the FCT for outpatient care or inpatient admission due to diarrhea during the study period. Individual-level identifiers were not collected, as the analysis was based on aggregated counts.

2.5 Study Period and Classification

The study covered a four-year period, 2020, 2021, 2023 and 2024, which was divided into two comparison periods:

- Pre-vaccine introduction period: 2020 and 2021 from January to December for each.
- Post-vaccine introduction period: 2023 and 2024 from January to December for each.

The classification of periods was based on the timing of rotavirus vaccine introduction into Nigeria's routine immunization schedule in 2022. Therefore, 2022 was excluded in the study.

2.6 Outcome Measures

The primary outcome measures were:

1. Number of diarrhea cases among under-five children attending outpatient departments.

2. Number of diarrhea-related hospitalizations among under-five children admitted to inpatient wards.

These outcomes were selected because they reflect both the incidence of diarrheal illness and the occurrence of severe disease requiring hospitalization.

2.7 Data Collection Procedure

A structured data abstraction form was used to collect counts of diarrhea cases and diarrhea-related hospitalizations from facility registers. Data were abstracted by trained personnel and cross-checked with source documents to ensure completeness and accuracy. Only records with complete reporting were included in the analysis.

2.8 Data Analysis

Data were entered into a spreadsheet and analyzed using statistical software. Counts of diarrhea cases and hospitalizations were summarized using means and standard deviations for the pre- and post-introduction periods.

To assess differences between periods, independent sample t-tests were used to compare the mean number of diarrhea cases and the mean number of diarrhea-related hospitalizations before and after rotavirus vaccine introduction. A significance level of $p < 0.05$ was applied to determine statistical significance.

The analysis focused on identifying overall changes in disease burden following vaccine introduction rather than attributing causality at the individual level.

2.9 Ethical Considerations

Ethical approval for the study was obtained as part of the original PhD research protocol. Administrative permission was granted by the relevant health authorities to access routine facility records. The study used anonymized, aggregated secondary data, and no personal identifiers were collected, ensuring confidentiality and compliance with ethical standards for research involving human data (WHO, 2014).

3. RESULTS

3.1 Overview of the Results

This section presents the findings on the impact of rotavirus vaccine introduction on diarrhea cases and diarrhea-related hospitalizations among under-five children in the Federal Capital Territory (FCT), Abuja. The results compare outcomes during the pre-introduction period

(January 2020–December 2021) and the post-introduction period (January 2023–December 2024) using routine health facility data.

3.2 Comparison of Diarrhea Cases before and After Rotavirus Vaccine Introduction

To assess changes in the burden of diarrheal illness among under-five children following the introduction of the rotavirus vaccine, the mean number of outpatient diarrhea cases was compared between the pre- and post-introduction periods.

Table 1: Mean Number of Under-Five Diarrhea Cases before and After Rotavirus Vaccine Introduction.

Period	Mean Cases	Standard Deviation (SD)	t-value	p-value
Pre-introduction (2020–2021)	142.6	± 28.4		
Post-introduction (2023–2024)	91.3	± 22.7	6.41	< 0.001

Table 1 shows a marked reduction in the mean number of diarrhea cases among under-five children following rotavirus vaccine introduction. The mean cases declined from 142.6 in the pre-introduction period to 91.3 in the post-introduction period. This reduction was statistically significant ($t = 6.41$, $p < 0.001$), indicating a substantial decrease in diarrhea burden after vaccine introduction.

3.3 Comparison of Diarrhea-Related Hospitalizations before and After Rotavirus Vaccine Introduction

To evaluate changes in severe diarrheal disease following rotavirus vaccine introduction, the mean number of diarrhea-related hospital admissions among under-five children was compared between the pre- and post-introduction periods.

Table 2: Mean Number of Diarrhea-Related Hospitalizations among Under-Five Children before and After Rotavirus Vaccine Introduction.

Period	Mean Number of Hospitalizations	Standard Deviation (SD)	t-value	p-value
Pre-introduction (2020–2021)	58.2	± 14.1		
Post-introduction (2023–2024)	32.7	± 10.5	7.02	< 0.001

As shown in Table 2, the mean number of diarrhea-related hospitalizations among under-five children decreased substantially following the introduction of the rotavirus vaccine. Hospital

admissions declined from a mean of 58.2 per month in the pre-introduction period to 32.7 per month in the post-introduction period. The observed reduction was statistically significant ($t = 7.02$, $p < 0.001$), indicating a significant decline in severe diarrhea cases requiring hospitalization.

4.3.3 Statistical Comparison of Pre- and Post-Introduction Periods

To formally assess whether observed differences were statistically significant, inferential analysis was conducted.

Table 3: Comparison of Diarrhea Outcomes before and After Vaccine Introduction.

Outcome	Test Statistic	p-value
Diarrhea cases	$t = 6.41$	< 0.001
Diarrhea-related hospitalizations	$t = 7.02$	< 0.001

The results in Table 3, demonstrate that reductions in both diarrhea cases and hospitalizations were statistically significant. This provides strong evidence to reject the null hypothesis and supports the conclusion that rotavirus vaccine introduction was associated with a significant reduction in diarrheal disease burden among under-five children in FCT Abuja. The analysis demonstrated statistically significant reductions in both the mean number of diarrhea cases and diarrhea-related hospitalizations among under-five children in the post-introduction period compared with the pre-introduction period. These findings indicate a clear decline in both the occurrence and severity of diarrheal disease following the introduction of the rotavirus vaccine in the Federal Capital Territory, Abuja.

4. DISCUSSION

This study assessed the impact of rotavirus vaccine introduction on diarrhea cases and diarrhea-related hospitalizations among under-five children in the Federal Capital Territory (FCT), Abuja, and using routine health facility data. The findings demonstrated statistically significant reductions in both the mean number of diarrhea cases and diarrhea-related hospitalizations following vaccine introduction, indicating a meaningful decline in both the occurrence and severity of diarrheal disease in the post-introduction period.

The observed reduction in outpatient diarrhea cases suggests a decrease in overall diarrheal disease burden among under-five children following rotavirus vaccine introduction. This finding is consistent with evidence from post-introduction evaluations in other low- and middle-income countries, where rotavirus vaccination has been associated with declines in diarrhea incidence at the population level (Burnett et al., 2017; Tate et al., 2021). Although

diarrhea has multiple etiologies, the magnitude of reduction observed in this study supports the role of rotavirus vaccination in reducing a substantial proportion of diarrheal illness presenting to health facilities.

More pronounced reductions were observed in diarrhea-related hospitalizations, reflecting a decline in severe diarrheal disease requiring inpatient care. This finding is particularly important from a public health perspective, as severe diarrhea contributes disproportionately to childhood mortality, healthcare costs, and health system strain. Similar reductions in diarrhea-related hospital admissions following rotavirus vaccine introduction have been reported in several African countries, including Malawi, Zambia, and Rwanda, demonstrating the effectiveness of rotavirus vaccination in preventing severe disease under routine programmatic conditions (Bar-Zeev et al., 2016; Mwila-Kazimbaya et al., 2017; Mpabalwani et al., 2020).

The greater relative reduction in hospitalizations compared with outpatient cases observed in this study aligns with existing evidence that rotavirus vaccines are particularly effective in preventing severe rotavirus gastroenteritis rather than mild disease (Armah et al., 2016; Zaman et al., 2010). This pattern reinforces the value of rotavirus vaccination as a strategy for reducing severe morbidity and preventing complications that necessitate hospitalization.

Despite the significant reductions observed, diarrhea cases and hospitalizations were not completely eliminated in the post-introduction period. This finding was expected, given that diarrheal disease among under-five children is caused by a wide range of bacterial, viral, and parasitic pathogens beyond rotavirus (Troeger et al., 2018). Additionally, variations in vaccine coverage, timeliness of vaccination, and health-seeking behavior may influence the magnitude of observed impact. Nonetheless, the consistent and statistically significant declines across both outcome measures provide strong evidence of vaccine impact in the study setting.

This study contributes important sub-national evidence on rotavirus vaccine impact in Nigeria, where published post-introduction evaluations remain limited. By using routine health facility data, the findings reflect real-world programmatic performance and complement evidence from clinical trials and controlled studies. Such locally generated evidence is critical for monitoring immunization program effectiveness, sustaining political and financial commitment, and guiding strategies to further reduce preventable childhood diarrheal disease burden (Patel et al., 2011; World Health Organization [WHO], 2014).

5. Summary of Findings

This study evaluated the impact of rotavirus vaccine introduction on diarrhea cases and diarrhea-related hospitalizations among under-five children in the Federal Capital Territory (FCT), Abuja, and using routine health facility data.

The findings demonstrated a statistically significant reduction in the mean number of diarrhea cases among under-five children following the introduction of the rotavirus vaccine. Additionally, there was a significant decline in diarrhea-related hospitalizations in the post-introduction period compared with the pre-introduction period, indicating a reduction in severe diarrheal disease requiring inpatient care.

Overall, the results showed consistent reductions in both outpatient diarrhea cases and hospital admissions, suggesting that rotavirus vaccine introduction was associated with a meaningful decline in the burden and severity of diarrheal disease among under-five children in the study setting.

6. CONCLUSION

The introduction of the rotavirus vaccine into Nigeria's routine immunization program was associated with significant reductions in diarrhea cases and diarrhea-related hospitalizations among under-five children in the Federal Capital Territory, Abuja. The findings indicate that rotavirus vaccination has had a positive impact on both the occurrence and severity of childhood diarrheal disease under routine programmatic conditions.

Although diarrheal illness was not completely eliminated, the observed declines provide strong evidence that rotavirus vaccination contributes substantially to reducing preventable childhood morbidity. These results support the continued implementation and strengthening of rotavirus vaccination as a key public health intervention for improving child health outcomes in Nigeria.

7. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. Strengthening Rotavirus Vaccine Coverage: Efforts should be intensified to sustain and improve rotavirus vaccine coverage within routine immunization services to maximize population-level impact.
2. Routine Post-Introduction Monitoring: Regular sub-national evaluations using routine health facility data should be institutionalized to monitor trends in diarrheal disease and assess ongoing vaccine impact.

3. Health System Support: Health facilities should be supported to ensure consistent vaccine availability and accurate documentation of diarrhea cases and hospitalizations to improve disease surveillance and program monitoring.
4. Policy and Programmatic Use of Evidence: Evidence generated from post-introduction evaluations should be integrated into immunization planning and decision-making to guide resource allocation and child health strategies.

8. Source of Funding

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9. Conflict of Interest

The authors declare **no conflict of interest**.

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