**OCCURRENCE OF ROTAVIRUS INFECTION AND ASSOCIATED SOCIO-DEMOGRAPHIC RISK FACTORS AMONG CHILDREN UNDER FIVE WITH DIARRHOEA IN ABUJA, NIGERIA**

**ABSTRACT**

**Background:** Rotavirus remains a leading etiological agent of acute gastroenteritis and severe diarrhoea in young children globally. Despite the availability of effective vaccines, the burden of disease remains substantial in low-resource settings due to poor vaccine uptake, poor sanitation, and limited surveillance.

**Objective:** This study aimed to investigate the occurrence of rotavirus infection and to establish associations between socio-demographic risk factors and rotavirus diarrhoea among children under five attending hospitals in Abuja Municipal Area Council (AMAC), Nigeria.

**Methods:** A total of 200 stool samples were collected from children under five years presenting with diarrhoea across selected hospitals in AMAC. Rotavirus antigens were detected using Enzyme-Linked Immunosorbent Assay (ELISA). Structured questionnaires captured socio-demographic and clinical data. Chi-square tests and logistic regression were used to determine associations between rotavirus occurrence and risk factors.

**Results:** Rotavirus antigen was detected in 20 out of 200 children (10.0%). Infants aged 0–11 months exhibited the highest prevalence (40%, p < 0.05). Significant associations were observed between rotavirus infection and feeding method, handwashing after defecation, maternal age, maternal education level, source of drinking water, and sanitation practices (p < 0.05). Children of mothers aged 20–29 years accounted for 55% of rotavirus-positive cases. Mixed-fed children showed a significantly higher infection rate (45%) compared to exclusively breastfed children (15%).

**Conclusion:** The study highlights rotavirus as a notable cause of paediatric diarrhoea in AMAC. Socio-demographic factors, especially related to feeding practices play a significant role in the transmission of infection. Promoting exclusive breastfeeding, and improving hygiene education among caregivers are recommended.

***Keywords:*** *Rotavirus, Socio-demographic risk factors, Diarrhoea, Children under five, Abuja, ELISA, Feeding practices*

**1. INTRODUCTION**

Diarrhoeal diseases remain a major public health challenge globally, particularly among children under the age of five in developing countries. The World Health Organization (WHO, 2017) estimates that diarrhoea is responsible for approximately 480,000 deaths annually among children under five, making it the second leading cause of death in this age group after pneumonia. These deaths are largely preventable through cost-effective interventions, including improved hygiene, access to clean water, and vaccination.

Among the numerous causative agents of paediatric diarrhoea, rotavirus is widely recognized as the leading cause of severe and acute gastroenteritis in infants and young children (Tate et al., 2016). Rotavirus accounts for nearly 40% of hospitalizations for acute gastroenteritis in children below five years, especially in low- and middle-income countries (Dennehy, 2012; Parashar et al., 2013). The virus is a non-enveloped, double-stranded RNA virus belonging to the family *Reoviridae* and comprises several species, with Group A being the most common and clinically significant in humans (Crawford et al., 2017).

Rotavirus is primarily transmitted via the faecal-oral route, through contaminated food, water, surfaces, or direct person-to-person contact. Following ingestion, the virus infects the enterocytes lining the small intestine, resulting in malabsorption, disruption of tight junctions, and secretory diarrhoea. The characteristic triad of symptoms—watery diarrhoea, vomiting, and fever—often leads to rapid dehydration, necessitating hospital admission, especially in infants.

Despite the ubiquity of infection—nearly all children are infected with rotavirus by the age of five—subsequent infections are typically less severe due to the development of mucosal immunity (Suleiman & Usman, 2020; Dennehy, 2012). However, in many developing countries, repeated exposures, malnutrition, and limited access to timely healthcare contribute to sustained high morbidity and mortality from the virus (Walker et al., 2013).

Nigeria introduced the rotavirus vaccine into its national immunization programme only recently, and vaccine coverage remains inconsistent across regions. A combination of challenges, including vaccine hesitancy, poor infrastructure, and limited public awareness, has hindered the attainment of optimal coverage levels (Amos et al., 2024). As a result, the burden of rotavirus remains substantial. Local studies have highlighted persistently high infection rates, particularly in densely populated urban settings with poor sanitation and inadequate water supply (Digwo et al., 2023). For instance, Suleiman and Dutsinma (2020) reported a 28% prevalence of rotavirus infection among children presenting with diarrhoea at Hasiya Bayero Pediatric Hospital in Kano, Northern Nigeria.

Understanding the socio-demographic and environmental factors influencing rotavirus transmission is essential for tailoring public health interventions. In urban centres such as Abuja Municipal Area Council (AMAC), where varying socio-economic conditions exist side by side, the interplay of maternal education, hygiene practices, water quality, and feeding behaviours may significantly influence infection dynamics.

This study was therefore designed to assess the occurrence of rotavirus infection and to explore the association between socio-demographic risk factors and rotavirus diarrhoea in children under five years presenting with acute diarrhoea in AMAC, Federal Capital Territory (FCT), Nigeria. Findings from this study are expected to inform local policies on child health, vaccine delivery, and community-based hygiene promotion.

**2. MATERIALS AND METHODS**

## **2.1 Study Area**

The study was conducted in Abuja Municipal Area Council (AMAC). Abuja, the capital territory of the Federal Republic of Nigeria, is located within 9.07oN and 7.6oE occupying 1769sqkm (Orisakwe et al., 2017). One of the six administrative area councils in Nigeria’s Federal Capital Territory (FCT). AMAC encompasses the city of Abuja and surrounding suburbs, with a population estimated at over 1.4 million people. It is characterized by a heterogeneous population with varied socio-economic backgrounds, which include civil servants, artisans, traders, and rural settlers. The hospitals that were be used in this study includes; National Hospital, Garki General Hospital and Federal Medical Centre, Abuja.

## **2.2 Study Design and Population**

This was a cross-sectional, hospital-based study targeting children aged 0–59 months who presented with acute diarrhoea at selected public and private hospitals within AMAC. Acute diarrhoea was defined, based on WHO guidelines, as the passage of three or more loose or watery stools within a 24-hour period lasting for less than 14 days (WHO, 2017). Inclusion criteria were children presenting with acute diarrhoea whose parents or guardians gave informed consent. Exclusion criteria included children who had taken antibiotics or probiotics in the past seven days, and those with chronic diarrhoeal conditions or other underlying severe illnesses.

## **2.3 Sample Size Determination**

The occurrence of Rotavirus among children 5 years and below with diarrheoa in Gwagwalada, Abuja has been hypothesized to be approximately 15% (Adebola et al., 2014). To obtain the same prevalence with an error of 5% and 955 confidence level, the minimum estimated sample size was 196 using Open EPI V. 23, although 200 samples were collected.

## **2.4 Sample Collection and Laboratory Analysis**

Fresh stool samples were collected from eligible children using sterile wide-mouthed, leak-proof containers and immediately labeled with unique identifiers. The samples were transported on ice (2–8°C) to the Microbiology Laboratory of IBB University within 6 hours of collection. Detection of Group A rotavirus antigens was conducted using a commercial Enzyme-Linked Immunosorbent Assay (ELISA) kit (Generic Assay, Germany), following the manufacturer’s protocol. The ELISA method is highly sensitive and specific for rotavirus detection, with a reported sensitivity of 93.4% and specificity of 98.1% (Patel et al., 2013). Positive and negative controls were included in each assay run.

## **2.5 Socio-demographic Data Collection**

Caregivers were interviewed using a structured, pre-tested questionnaire to obtain data on the child’s demographic characteristics (age, sex, feeding history), maternal factors (age, education level, occupation), environmental and hygiene-related variables (source of drinking water, water storage practices, handwashing behavior), and sanitation practices. The questionnaire was administered in English or Hausa, depending on caregiver preference, by trained field assistants.

## **2.6 Data Analysis**

All collected data were entered into SPSS version 25.0 (IBM Corp, Armonk, NY, USA) for statistical analysis. Descriptive statistics (means, frequencies, and percentages) were computed to summarize baseline characteristics. Chi-square tests (χ²) were used to evaluate associations between categorical socio-demographic variables and rotavirus positivity. To adjust for potential confounding, binary logistic regression was conducted to identify independent predictors of rotavirus infection. A p-value < 0.05 was considered statistically significant for all inferential analyses.

**3. RESULTS AND DISCUSSION**

## **3.1 Prevalence of Rotavirus Infection**

Out of the 200 children aged 0–59 months enrolled in the study, rotavirus antigen was detected in 20 cases, indicating a prevalence rate of 10.0%. The distribution of cases by age revealed that infection was most prevalent in infants aged 0–11 months, who accounted for 40% (8/20) of positive cases. This was followed by children aged 12–23 months (30%, 6/20), 24–35 months (15%, 3/20), 36–47 months (10%, 2/20), and 48–59 months (5%, 1/20). The age-related differences in prevalence were statistically significant (*P*< 0.05), suggesting that younger age is a key risk factor for rotavirus infection.

**Table 1: Age Distribution of Rotavirus-Positive Children**

| **Age Group (Months)** | **Number Positive** | **Percentage (%)** |
| --- | --- | --- |
| 0–11 | 8 | 40.0 |
| 12–23 | 6 | 30.0 |
| 24–35 | 3 | 15.0 |
| 36–47 | 2 | 10.0 |
| 48–59 | 1 | 5.0 |

In terms of gender, 11 of the rotavirus-positive cases were male (55%), while 9 were female (45%). Although a slightly higher number of males were infected, this difference was not statistically significant (*P* > .05), indicating no clear gender-based susceptibility.

**3.2 Child-Related Factors and Rotavirus Infection**

Feeding practices were significantly associated with rotavirus infection (*P* < .05). The highest proportion of infected children (45%) were those who received mixed feeding (both breast milk and formula), followed by those who were exclusively breastfed (15%) and those fed with bottle/formula only (10%). These findings suggest that mixed feeding may compromise protective immunity from breast milk while introducing possible contamination risks associated with improper bottle hygiene or water quality.

**Table 2: Feeding Practices and Rotavirus Positivity**

| **Feeding Method** | **Rotavirus Positive (%)** | ***P*-value** |
| --- | --- | --- |
| Exclusive Breastfeeding | 15.0 | <.05 |
| Mixed Feeding | 45.0 |  |
| Bottle Feeding Only | 10.0 |  |

**NS – Not Significant**

Hand hygiene practices were also significantly associated with infection. Children whose caregivers reported not washing hands after defecation or cleaning the child had a significantly higher rate of rotavirus positivity (*P* = 0.01). These findings underline the role of poor hygiene in the faeco-oral transmission of rotavirus in domestic settings.

**3.3 Maternal and Household Factors**

Maternal age and education level were found to influence rotavirus infection rates. The highest proportion of infected children (55%) were born to mothers aged 20–29 years, followed by those aged 30–39 years (30%), ≥40 years (10%), and <20 years (5%). The association between maternal age and infection was statistically significant (*P* < .05), suggesting possible links with reproductive experience, health-seeking behaviour, or childcare practices.

Maternal education level also demonstrated a strong association with infection risk. Children of mothers with tertiary education accounted for the majority of rotavirus cases (60%), followed by those with secondary education (30%) and primary education (10%). The correlation was statistically significant (*P* < .05), though counterintuitive, as higher education would be expected to confer better health practices. This finding may reflect lifestyle factors such as earlier childcare outsourcing or reliance on formula feeding in educated, working-class mothers.

**Table 3: Maternal Age and Education**

| **Maternal Age Group** | **No. Positive** | **% Positive** | **p-value** |
| --- | --- | --- | --- |
| <20 | 1 | 5.0 | <.05 |
| 20–29 | 11 | 55.0 |  |
| 30–39 | 6 | 30.0 |  |
| ≥40 | 2 | 10.0 |  |
| **Maternal Education** |  |  |  |
| Primary | 2 | 10.0 |  |
| Secondary | 6 | 30.0 | <.05 |
| Tertiary | 12 | 60.0 |  |

**NS – Not Significant**

**3.4 Discussion**

This study sought to determine the occurrence of rotavirus infection and its associated socio-demographic and environmental risk factors among children under five years of age presenting with diarrhoea in Abuja Municipal Area Council (AMAC), Nigeria. The findings revealed a rotavirus prevalence rate of 10.0%, highlighting an ongoing public health concern within the region. While this prevalence falls within the range of moderate endemicity, it remains consistent with the urban rotavirus burden previously documented in parts of Nigeria and sub-Saharan Africa (Digwo et al., 2023; Muenchhoff & Goulder, 2014).

Compared to studies conducted in Northern Nigeria, such as Suleiman and Dutsinma (2020) who reported a 28% prevalence in Kano, and Garba et al. (2019) who observed 18% in Yobe State, the lower prevalence in AMAC may reflect a relatively better access to healthcare services, water supply, and hygiene facilities in the Federal Capital Territory. Nonetheless, the continued detection of rotavirus cases, despite improvements in infrastructure, suggests gaps in prevention strategies such as vaccination uptake, public awareness, and hygiene education.

**Age-related Vulnerability**

The highest burden of infection was recorded among infants aged 0–11 months, accounting for 40% of rotavirus-positive cases. This age-related susceptibility is well documented in global literature (Tate et al., 2016; Walker et al., 2013). Infants are at elevated risk due to immature immune systems, early weaning, and increased hand-to-mouth behaviour, all of which facilitate faeco-oral transmission of pathogens like rotavirus. Moreover, in resource-limited settings, early exposure to unsafe water and contaminated feeding utensils exacerbates infection risks. These findings reinforce the importance of introducing the rotavirus vaccine early in infancy, ideally before the age of 6 months as recommended by WHO (2021).

**Feeding Practices**

Feeding practices were a significant determinant of infection. Children on mixed feeding (i.e., receiving both breast milk and formula or other liquids) had the highest rate of rotavirus positivity (45%). In contrast, those who were exclusively breastfed had significantly lower rates (15%). This supports evidence from Nwachukwu et al. (2023) and other studies, indicating that exclusive breastfeeding provides immunological protection, particularly through the transfer of maternal antibodies such as IgA, which can neutralize enteric pathogens in the gut.

Mixed feeding often involves the use of feeding bottles, which, if inadequately sterilized, become vectors for pathogen transmission (Onanuga et al., 2017). Additionally, formula is typically prepared with water, and if the water source is contaminated or improperly stored, it may serve as a medium for introducing rotavirus. These insights underscore the World Health Organization’s guidance advocating for exclusive breastfeeding for the first six months of life (WHO, 2021).

**Hygiene and Behavioural Practices**

Poor hygiene practices, particularly the failure to wash hands after defecation or after cleaning a child, were strongly associated with rotavirus infection in this study. This finding aligns with earlier reports from both Nigerian and regional studies, which emphasized that hand hygiene plays a pivotal role in interrupting the transmission of enteric viruses (Garba et al., 2019; Adamu et al., 2022). Handwashing with soap and water is recognized as a low-cost but highly effective intervention that can reduce diarrhoea incidence by up to 40% (Curtis & Cairncross, 2003).

Unfortunately, hand hygiene compliance remains suboptimal in many parts of sub-Saharan Africa, largely due to lack of awareness, inconsistent water supply, and cultural practices. These challenges highlight the need for community-based health education programs tailored to local beliefs and practices.

**Maternal Characteristics**

One of the more unexpected findings was the higher prevalence of rotavirus infection among children of mothers with tertiary education. While it is generally assumed that educated mothers practice better hygiene and feeding habits, studies have shown that higher education is sometimes associated with early return to work, use of daycare centres, and dependence on alternate caregivers, which may reduce the exclusivity of breastfeeding and increase exposure to pathogens (Mwenda et al., 2018; Amos et al., 2024).

Additionally, caregivers from higher socio-economic classes may rely on commercial infant formulas, which are not always prepared under hygienic conditions. In contrast, mothers with lower education levels may breastfeed for longer due to limited access to alternatives. These dynamics reflect the complex interplay between socio-economic status, maternal behaviour, and child health outcomes, and underscore the importance of targeting all education levels with tailored public health messaging.

**Gender Distribution**

Although there was no statistically significant difference between male and female children in terms of rotavirus infection, a slightly higher number of cases occurred in males (55%). This gender pattern is consistent with findings from Kaduna and other studies across Nigeria, though the biological rationale remains unclear (Mohammed et al., 2016). Some researchers hypothesize that male children may receive more health-seeking attention, leading to a higher likelihood of diagnosis and hospital presentation (Piccini et al., 2018). However, gender-based differences in rotavirus susceptibility remain inconclusive and merit further exploration.

**Environmental and Sanitation Factors**

Water source and storage practices emerged as significant risk factors in the transmission of rotavirus. Children from households using tap water and storing it in covered drums had higher infection rates. Although tap water is generally assumed to be safe, intermittent supply, unhygienic storage, and infrequent pipe flushing can result in microbial contamination (Adamu et al., 2022). Moreover, even treated water can be re-contaminated during storage, especially when stored in wide-mouthed or uncovered containers.

Studies have shown that rotavirus can persist on surfaces for several days and survive in water sources despite standard chlorination levels (Awere-Duodu et al., 2024). This raises concerns about current domestic water handling practices and emphasizes the need for both infrastructural improvement and behavioural change communication.

Furthermore, poor waste disposal and open defecation, still common in many peri-urban Nigerian communities, create fertile grounds for the environmental spread of rotavirus and other enteric pathogens. Integrated Water, Sanitation, and Hygiene (WASH) interventions remain central to reducing this risk (UNICEF, 2020).

**Implications for Public Health**

The findings from this study have important implications for public health policy and practice. First, they underscore the continued relevance of rotavirus vaccination in Nigeria’s immunization strategy.   Despite the vaccine’s inclusion in the national schedule, coverage and awareness remain low in many communities. Local and national infrastructure are inadequate for basic surveillance of diarrhoeal disease, and this will have to be improved, together with access to virological stool testing, to monitor the planned vaccine program (Balarabe-Musa, 2023). Second, the results highlight the need for multi-level interventions, combining vaccination with education on infant feeding, maternal hygiene, and household sanitation.

Targeted health education programs for mothers, regardless of their educational status, are crucial. These programs should emphasize the risks of mixed feeding, the importance of safe water handling, and consistent hand hygiene. Policymakers must also prioritize the expansion of clean water infrastructure and support behaviour change initiatives at the community level.

**4. CONCLUSION**

This study has demonstrated that rotavirus infection remains a significant cause of diarrhoeal illness among children under five years of age in Abuja Municipal Area Council (AMAC), Nigeria. Although the overall prevalence of 10% may appear modest compared to figures from other parts of the country, it nonetheless reflects an ongoing burden that demands continued public health attention. The highest incidence was observed among infants aged 0–11 months, highlighting the critical vulnerability of this age group due to immature immune systems and increased exposure to contaminated environments.

Several socio-demographic and behavioural factors were significantly associated with rotavirus infection. These included feeding practices particularly mixed feeding as well as poor hand hygiene, young maternal age, higher maternal education, and inadequate water and sanitation infrastructure. The paradoxical association of infection with tertiary maternal education suggests the need for broader awareness campaigns that transcend educational status and address behavioural and environmental risks.

In light of these findings, targeted interventions are recommended to reduce the incidence of rotavirus infection. These should include increased coverage and awareness of rotavirus vaccination, promotion of exclusive breastfeeding, hygiene education for caregivers, and improved access to clean water and sanitation. Multisectoral approaches involving health, education, and water authorities are essential to addressing this complex public health challenge effectively.

**4.1 RECOMMENDATIONS**

1. Promote exclusive breastfeeding during the first six months of life to enhance infant immunity against enteric infections.
2. Intensify hygiene education and awareness campaigns for mothers and caregivers, especially during antenatal and postnatal care.
3. Strengthen rotavirus prevention efforts by scaling up vaccination coverage and improving access to clean water and sanitation facilities to reduce environmental transmission.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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**ETHICAL APPROVAL AND Consent**

Ethical approval for the study was obtained from the Health Research Ethical Committee (HREC) at the Federal Ministry of Health, Abuja with approval number – FHREC/2023/01/221/01/221/01-11-23. Additionally, administrative permission was secured from the management of each participating health facility. Written informed consent was obtained from caregivers before the commencement of data and sample collection. Participants' confidentiality and the anonymity of their data were ensured throughout the research process.

**COMPETING INTERESTS**

THE AUTHORS DECLARE NO COMPETING INTERESTS.

**AUTHORS' CONTRIBUTIONS**

SULEIMAN, K.O. CONCEIVED AND DESIGNED THE STUDY, CONDUCTED THE LABORATORY ANALYSES, COLLECTED AND ANALYZED THE DATA, AND DRAFTED THE INITIAL MANUSCRIPT. KOLO, I. AND BABA, J. SERVED AS ACADEMIC SUPERVISORS; THEY PROVIDED CRITICAL GUIDANCE THROUGHOUT THE RESEARCH PROCESS AND THOROUGHLY REVIEWED AND EDITED THE MANUSCRIPT FOR INTELLECTUAL CONTENT. ALL AUTHORS READ AND APPROVED THE FINAL VERSION OF THE MANUSCRIPT.

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