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Prevalence of Rotavirus antigen in children with gastroenteritis in Auchi Etsako West Local Government Area, Edo State, Nigeria

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SUMMARY

Introduction: This study aimed to determine the prevalence of rotavirus infection among children in Auchi, Edo State, Nigeria, and its association with selected demographic factors. Rotavirus infections are a major cause of viral gastroenteritis in children globally, and despite the availability of vaccines, they continue to pose a significant health burden.
Methods: The study population consisted of 200 children aged 2-15 years, with data collected through a questionnaire and stool samples analysed using Enzyme Linked Immunosorbent Assay (ELISA) kits (Abbexa, UK) following the manufacturer's instructions.
Results: The overall prevalence of rotavirus infection was found to be 6%, which was relatively low compared to previous studies in Nigeria and other countries. The study revealed that children in the age group of 6-10 years had the highest prevalence of rotavirus infection, while the prevalence was lower among nursery and secondary school children. There was no significant association between any of the participant's demographic factors and rotavirus infection. However, living in rural areas was associated with a higher risk of rotavirus infection compared to semi-urban and urban areas.
Conclusions: The study emphasizes the importance of rotavirus vaccination, promoting good hygiene practices, and raising awareness among parents, caregivers, and healthcare professionals. Further investigation is needed to explore additional risk factors and improve understanding of rotavirus infection in this population.

Keywords: Prevalence, Rotavirus, children, gastroenteritis, Auchi.

INTRODUCTION

Acute gastroenteritis is a major cause of morbidity and mortality in children aged less than 5 years in low and middle-income countries where limited access to potable water, poor sanitation, deficient hygiene, and food product contamination are prevalent [1, 2]. Gastroenteritis is defined as inflammation of the stomach and intestines that may result in a wide range of symptoms, from asymptomatic infections through mild complaints to life-threatening conditions that lead to death [3]. The risk of an individual developing gastroenteritis is determined by both epidemiologic factors influencing exposure to causative organisms and underlying host factors affecting susceptibility to infection [4]. Relevant exposure

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includes day-care attendance, ingestion of potentially contaminated food or water, travel, and contact with animals [5]. The two host factors most strongly influencing the development of gastroenteritis are the presence of a compromised immune system and recent exposure to antibiotics [6, 7]. Gastroenteritis can be spread by contact with someone who has the virus, contaminated food or water, unwashed hands after going to the bathroom, or changing a diaper [8, 9]

Rotavirus infections are a leading cause of severe, dehydrating gastroenteritis in children <5 years of age [10]. Despite the global introduction of vaccinations for rotavirus over a decade ago, rotavirus infections still result in >200,000 deaths annually, mostly in low-income countries [11]. Rotavirus mainly infects cells in the intestinal lining called enterocytes, causing diarrhoea by damaging these cells responsible for absorption. This damage leads to malabsorption and triggers the release of a specific protein (rotavirus non-structural protein 4) that stimulates intestinal secretion. The enteric nervous system is also activated during rotavirus infection, contributing to diarrhoea. Additionally, rotavirus infections can result in the presence of viral antigens in the bloodstream (known as antigenemia), which is associated with more severe symptoms of acute gastroenteritis. In some cases, the virus can also replicate in other parts of the body (viremia), although this occurrence is limited [12].

Recurring infections with rotavirus are frequent throughout life, but the severity of the disease tends to decrease with subsequent infections. The immune factors that provide protection against reinfection and aid in recovery from rotavirus infection are not well understood. However, it is known that rotavirus-specific immunoglobulin A (IgA) plays a role in both aspects, although the precise mechanisms are not fully elucidated [13]. Rotavirus infection poses a significant public health concern in Nigeria. Despite its high prevalence and impact on child health, the diagnosis and management of rotavirus infection in Nigerian hospitals are limited. The lack of routine diagnosis, coupled with the similarity of symptoms to other forms of gastroenteritis, hinders timely and accurate identification of rotavirus cases. This leads to a lack of targeted interventions and appropriate treatment, exacerbating the burden of the disease. Furthermore, certain environmental, climatic, sanitary, and behavioural factors contribute to the spread of rotavirus, further compounding the problem. Therefore, there is an urgent need to address the challenges associated with rotavirus infection in Nigeria, including improving diagnosis, implementing preventive measures, and enhancing public awareness to reduce the impact of this disease on child health. This study aimed to determine the prevalence of rotavirus infection among children aged 2-15 years between June and September 2023 in Etsako West LGA of Auchi, Edo State, Nigeria.

PATIENTS AND METHODS

A cross sectional and epidemiological survey was conducted to determine the prevalence of rotavirus gastroenteritis among children aged 2 and 15 years in Etsako West LGA of Auchi, Edo State, Nigeria. A consecutive sampling method was employed in selecting the participants as they became available until the required sample size was reached. The sample size of 224 was calculated with a 95% confidence level, a 5% margin of error, and a prevalence of rotavirus in Jos, Nigeria (18%) [14]. A total of two hundred (200) children were recruited for the study due to the constraints of getting consent from parents. The study participants consisted of consecutive male and female children between the ages of 2-15 years affected by diarrhoea attending the in-and-out patients' clinic in various healthcare facilities, including hospitals, clinics and the Primary Health Centre in Etsako West LGA of Auchi, Edo State, Nigeria. The participant selection process for this study was a collaborative effort involving a research assistant who visits each facility every day and healthcare professionals, including doctors and nurses on duty daily, to assist in identifying eligible consecutive diarrheal children from various healthcare facilities whose parents or guardians provided explicit consent for their participation in the study. These professionals, along with their different experiences, contributed to the careful identification of a broad representation of the target group and increased the study's external validity. Etsako West is a local government area of Edo State, Nigeria, made up of six clans: Uzairue, Auchi, South Ibie, Anwain, Jagbe and Aviele.

Data and stool sample collection
Data for the study were collected through a self-administering semi-structured questionnaire. The questionnaires were given to their parents by the selected participants to help fill out the form. Demographic variables were recorded. A trained field epidemiologist who had received a relevant data collection training program on data collection was employed to check the completeness and quality of the data.
Each participant was given a wide mouth screw-capped sterile container. The parents and the children were asked to collect the participant's stool samples, void of urine, water and other impurities, under sterile conditions. The stool samples were labelled appropriately with each participant's identifying code and the date and time of collection. The faecal samples were all taken to the laboratory in leak-proof bags to be stored in fridges at 2-8°C for further processing. Each participant's stool sample was duplicated into three aliquots (1 mL) in a cryovial with the addition of 2 drops of glycerol and kept at -20°C until they were analysed for the presence of rotavirus antigen using Enzyme Linked Immunosorbent Assay kits (Abbexa, UK) following the manufacturer's instructions.

Data analysis
All the data gathered were encoded into MS Excel spreadsheets, and the data were analysed using IBM-Statistical Package for Social Sciences (SPSS) version 25.0, and descriptive statistics (frequencies, percentage) was used to describe the data. The chi-square was used to test for the hypotheses, and a p-value <0.05 was considered statistically significant.

Ethical considerations
Informed consent was obtained from each of the participants before sample collection. Respondents received a detailed description of the study, confidentiality provisions and the fact that their participation is voluntary and they could withdraw at any point if they wished. The principles of privacy and confidentiality were upheld. Before the commencement of the study, permission was also obtained from the medical directors of those hospitals, respectively. Ethical approval was obtained from Edo state University Ethics committee, Nigeria, with the reference number EDSU/AHS/ERC/VOL. 1/38/2022

Table 1 - Socio-demographic characteristic of study participants.

Factors	*Frequency*	*Percentage*
Age		
0-5	38	19.00%
6-10	88	44.00%
11-15	74	37.00%
Gender		
Male	54	27.00%
Female	146	73.00%
Residence		
Urban	14	7.00%
Semi Urban	52	26.00%
Rural	134	67.00%
Educational status		
Nursery	68	34.00%
Primary	100	50.00%
Secondary	32	16.00%

RESULTS

Demographic data
A total of 200 children aged 2-15 years were enrolled in this study. Of the 200 participants, most of them 88 (44.0%) were within the age group 6-10 years, with the majority of them being female 146 (73.0%) and 54 (27.0%) males. Most of the children, 100 (50.0%) were in primary class, 68 (34.0%) nursery, and 32 (16.0%) secondary class. The descriptive statistics of the study population are shown in Table 1. The total prevalence of rotavirus among the study population was 6% (12/200) (Table 2 and Figure 1). Age range 6-10 years had the highest prevalence of rotavirus infection, with 8(67%). The age range (0-5) years had the lowest prevalence with a zero percentage. The age range (11-15 years) had a prevalence percentage of 4 (33%). There was no statistically significant relationship between age groups and the prevalence of rotavirus at p=0.056 as reported in Table 3. The gender distribution of rotavirus infection among the study population reveals that female children had the highest prevalence of rotavirus infection 8 (67%) and males 4 (33%). There was no statistically significant association between gender distribution and rotavirus prevalence at (p=0.587) as seen in Table 4. In Table

Table 2 - Prevalence of Rotavirus among children in Auchi Edo State, Nigeria.

ELISA Result	*Frequency (200)*	*Percentage (100%)*
Positive	*12*	*6*
Negative	*188*	*94*
Total	*200*	*100*

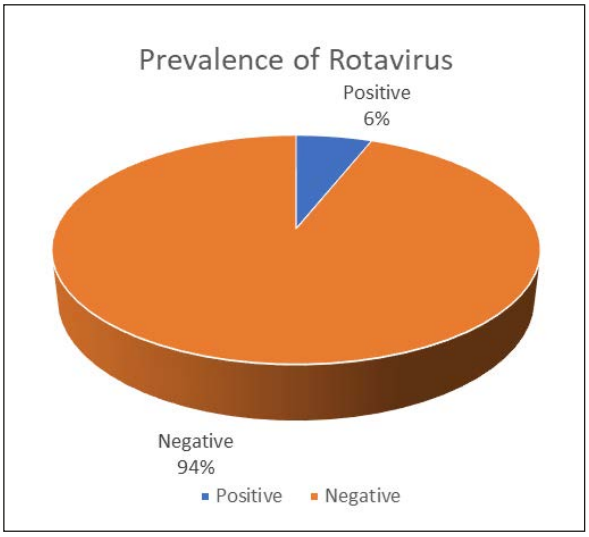

Figure 1 - Prevalence of Rotavirus among Children in Auchi Edo State, Nigeria.

Table 3 - Age Distribution of Rotavirus infection among children in Auchi Edo State, Nigeria.

Age (years)	*Frequency (N=12)*	*(%)*	*p-value*	*Remarks*
0-5	0	0	0.056	*NS*
6-10	8	67.0		
11-15	4	33.0		
Total	12	100.0		

Notes: NS = Not Significant.

Table 4 - Gender distribution of Rotavirus infection among children in Auchi Edo State, Nigeria.

Gender (Years)	*Frequency (N=12)*	*(%)*	*p-value*	*Remarks*
Male	4	33.0	0.587	*NS*
Female	8	67.0		
Total	12	100		

Notes: NS = Not Significant.

Table 5 - Distribution of Rotavirus among children in Auchi Based on location of residence.

Location of Resident	*Frequency (N=12)*	*(%)*	*p-value*	*Remarks*
Rural	8	67.0	0.725	*NS*
Semi-urban	4	33.0		
Urban	0	0		
Total	12	100		

Notes: NS = Not Significant.

Table 6 - Distribution of Rotavirus infection among children in Auchi based on educational level.

Educational level	*Frequency (N=12)*	*(%)*	*p-value*	*Remarks*
Nursery	4	34.0	0.401	*NS*
Primary	6	50.0		
Secondary	2	16.0		
Total	12	100		

Notes: NS = Not Significant.

5, our study shows that rotavirus infection was more prevalent in rural settlements than urban areas in Auchi, Edo State, as the prevalence of rotavirus in rural areas was 8 (67%), semi urban areas 4 (33%) and urban areas 0 (0%). There is no statistically significant association between the prevalence of rotavirus and site of residence (p=0.725). Table 6 shows that there was a higher prevalence of rotavirus among children in primary school 6(50%) and a lower prevalence among children in secondary school. However, there was no statistically significant association between rotavirus prevalence and educational level at (p=0.401).

DISCUSSION

Acute gastroenteritis is the most common infectious disease that causes morbidity after infection of the upper respiratory tract. The aetiology is influenced by age, socio-demographic information, and season [9]. This study reports the prevalence of rotaviruses and their association with socioeconomic factors in Auchi, Edo State, Nigeria. The overall prevalence of rotavirus infection among the study population was found to be 6%. This is in agreement with studies from Northwest Nigeria (9%) [15]. However, this finding is slightly lower than the report from Jos University Teach-

ing Hospital, Nigeria (13.8%), North West Nigeria (18%), (19.2%) among children in Benin City, Nigeria [14, 16, 17]. A higher prevalence (18.5%) was reported in Ibadan, (25%) in Sokoto, Northern Nigeria, among under five years children, (32%) among children in Kaduna, Nigeria, 28%, 25% among children less than 5 years from a teaching hospital in Istanbul, Turkey, and 92.4% among children in Nepal, India [9, 18-22]. The low prevalence rate in our study could be a result of the rotavirus vaccination incorporated into the immunization plan in Nigeria, which is administered at 6, 10, and 14 weeks together with other routine vaccines and is expected to reduce 45-57% cases [2]. The difference in prevalence rates may as well be due to sample size, study population, participants' age, geographical location, climatic factors, vaccination status, and different diagnostic methods used in various studies.

From this study, the rate of infection with rotavirus in primary school children was higher (50%) than in nursery school children (34%) and secondary school children (16%). The reason for this may be due to poor hygiene among primary and nursery school children [23]. There is no significant association between the educational level of children in Auchi and their likelihood of being infected with rotavirus. The rate of rotavirus infection was comparably high in the rural area. The reason for this may be attributed to poor hygienic practices coupled with poor water quality occurring in rural settlements [24]. The prevalence of rotavirus among male children 4 (33%) was lower compared to their female 8 (67%) counterparts. Though there was no statistical difference between genders in the study ($p=0.587$). It is essential to note that in reality, rotavirus affects children of all genders equally, and any perceived gender-related differences in prevalence are likely due to factors unrelated to gender itself [25]. Also, rotavirus was higher in the age group 6-10 years than others. Reasons could be as a result of other factors such as regional epidemiology, vaccination coverage, and socioeconomic conditions which influence the patterns of rotavirus infection within specific age groups [26].

Associated risk factors indicating the prevalence of rotavirus infection in this study are age groups. This suggests that children in the age range 6-10 years may have a higher risk of rotavirus infection compared to younger or older age groups compared to a study by Ece et al. (2012) where all age groups affected were 0-6 years [10, 27]. Being a female may be associated with a higher risk of rotavirus infection in our study population. However, it is important to note that this association does not imply causation and could be influenced by other factors [25]. Living in a rural area may also be associated with a higher risk of rotavirus infection compared to living in semi-urban or urban areas. This could be as a result of limited access to clean water and sanitation facilities, poor hygiene practices, contaminated food and water sources, close-knit communities facilitating transmission, and limited healthcare access and awareness [28]. Children in nursery and primary education may have a higher risk of rotavirus infection compared to those in secondary education due to factors such as their developing immune systems, increased exposure and close contact in school settings, lower vaccine coverage, less developed hygiene practices, and potential exposure to new rotavirus strains. These factors contribute to a greater susceptibility to rotavirus among younger children [29]. However, it is important to note that these associations may indicate correlations but do not establish causation. Other predisposing factors not included in the table, such as hygiene practices, vaccination status, and access to healthcare, could also influence the risk of rotavirus infection. Further analysis and investigation are necessary to understand the specific risk factors associated with rotavirus infection in this study population [23, 24, 30].

LIMITATIONS

The study has some limitations that should be considered. Firstly, the calculated sample size for the study was 224, however, the actual sample recruited was 200, due to difficulties associated with gaining parental consent. This discrepancy may have an impact on the findings' generalizability and statistical power, perhaps reducing the study's capacity to discover more subtle relationships or variations in rotavirus prevalence within the targeted group. In addition, the study used Enzyme Linked Immunosorbent Assay (ELISA) kits to detect the rotavirus antigen. While ELISA is a popular and cost-effective approach, it has inherent limitations, particularly in the diagnosis of infectious diseases, which could lead to cross reactions with other infectious agents like noroviruses. ELISA may be less sensitive than molecular techniques, leading to an

underestimation of rotavirus prevalence. Furthermore, ELISA may not detect specific strains or variants of the virus, limiting the study's findings. Future studies should carefully analyse the diagnostic approach used to achieve a more accurate representation of rotavirus prevalence. Another major shortcoming of the study is the lack of data on the children's rotavirus vaccination status. The absence of information on whether the enrolled children had received Rotavirus vaccinations impedes a thorough understanding of potential preventative factors and vaccine efficacy in the study population. Future studies should strive to incorporate this critical aspect in order to provide a more comprehensive examination of the relationship between vaccination status and rotavirus prevalence. Lastly, further research should look into the broader issue of antibiotic abuse in gastrointestinal cases, promoting a more prudent and tailored approach to antibiotic therapy based on an accurate etiological diagnosis. This might have a substantial impact on global efforts to control antibiotic resistance and provide appropriate patient care.

CONCLUSIONS

Rotaviruses pose a major health risk and are the leading cause of viral gastroenteritis in children. Their global impact on society and the economy remains significant. Prompt and accurate diagnosis and treatment of childhood gastroenteritis are essential for speedy recovery and cost reduction. This study specifically investigated the association between rotavirus and selected demographic data in children residing in Auchi, Edo State. The prevalence of rotavirus in the study population was relatively low compared to previous studies. To prevent and manage rotavirus infection in the study population and Nigeria, it is recommended to ensure that all children receive rotavirus vaccinations according to the immunization schedule. Promote good hand hygiene practices, maintain a clean environment, provide safe food and water, and teach children proper personal hygiene habits. It is expedient to also educate parents, caregivers, and healthcare professionals about rotavirus infection, its symptoms, and the importance of seeking medical care. Consulting with healthcare professionals for personalized guidance is crucial, as recommendations may vary based on individual circumstances.

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Competing interest
The authors declare no conflict of interest.

Ethical approval
Ethical approval was obtained from Edo state University Ethics committee, Nigeria with the reference number EDSU/AHS/ERC/VOL.1/38/2022

Data availability statement
All datasets generated for this study are available from the corresponding author upon reasonable request

Author contribution
Pius Omoruyi Omosigho, Ugiagbe Victory Osayekewmen, Guobadia Precious Oghogho, Okesanya Olalekan John, Oladejo Janet Mosunmola and Uyigue Paulinus Osarodion conceived and designed the research, reviewed, analysed, performed the research, interpreted the data, wrote the paper, supervision, review-editing and proofread. All authors have read and approved the final draft of this paper.

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