



## Prevalence of Rotavirus Infection in Infants and Young Children with Gastroenteritis in Two North-East States, Nigeria

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### Authors' contributions

*This work was carried out in collaboration among all authors. Author SOO designed the study, wrote the protocol and wrote the first draft of the manuscript and did subsequent corrections. Authors JI, MA, AD and AS managed the literature searches. Analysis of the study was performed by author MAL. All authors read and approved the final manuscript.*

### Article Information

DOI:10.9734/BJMMR/2017/22773

#### Editor(s):

(1) Fuhong SU, ICU Laboratory, Erasme Hospital, Free University Brussels, Brussels, Belgium.

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Complete Peer review History: <http://www.sciencedomain.org/review-history/18122>

Original Research Article

Received 26<sup>th</sup> October 2015  
Accepted 7<sup>th</sup> December 2015  
Published 9<sup>th</sup> March 2017

### ABSTRACT

**Introduction:** Rotavirus, is an eleven segmented double stranded ribonucleic acid virus in the family of Reoviridae, and is a leading cause of gastroenteritis among infants and young children.

**Aims:** This study was aimed at conducting a preliminary survey of rotavirus antigen in diarrheic stool of children (< 5 years) in Taraba and Yobe states in Nigeria to determine the prevalence.

**Methodology:** One hundred and fifty children, each, in two north east states (Taraba (TR) and Yobe (YB) Nigeria with acute diarrhea were selected by random sampling in a cross-sectional, hospital-based study. Fifty two non-diarrheic and three hundred diarrheic stool samples from children less than five years old were assayed for rotavirus antigen by enzyme linked

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immunosorbent assay (Cortez Diagnostic Automation, Inc, USA) kit. Demographic data of the children were collected and result analysed using chi-square.

**Result:** All non-diarrheic stool (n=52) were negative for rotavirus antigen while of the total of 300 children sampled, overall prevalence of 4.0% and 9.3% were obtained in Taraba (mean age = 25.85months) and Yobe (mean age = 25.65months) respectively. Type of toilet used in both states was a factor in infection (TR p=0.007; YB p=0.00004). There was preponderance of infected male over female children in both states but this was not significant (p=0.55; p=0.48). Also, the source of drinking water had no significant effect on the prevalence of infection in both states (TR: p=0.177; YB: p=0.134). Playing with toys was found to serve as a predisposing factor of infection in Yobe state only (p=0.001).

**Conclusion:** The result of this study shows that rotavirus is a significant aetiologic agent of diarrhea among infants and young children in the study area. Public enlightenment on the predisposing factors to infection should be emphasized in order to mitigate transmission. Also, determination of the circulating genotypes in the study area is recommended.

*Keywords: Rotavirus; prevalence; Taraba; Yobe; Nigeria.*

## 1. INTRODUCTION

Acute gastroenteritis (AGE) is a major cause of morbidity and mortality in pediatric populations world-wide. Globally, an estimated 800 000 infants and young children die from diarrhea every year [1]. Mortality is uncommon in developed countries, but diarrhea is often associated with substantial medical and health-care costs and thus has a high economic impact on society [2]. According to recent estimates, nearly 179 million gastrointestinal illnesses occur each year in the United States, of which 141.8 million (approximately 80%) are caused by unspecified and/or unknown agents. Viruses are the major etiological agents of AGE in children <5 years of age. Group A rotavirus, norovirus, enteric adenovirus, human astrovirus, and sapovirus are established etiological agents of AGE [3-7]. The World Health Organization (WHO) attributed a worldwide estimate of 17% mortality due to diarrhoea in children younger than 5 years of age with 40% in Africa [8].

Acute gastroenteritis (AGE) is an extremely common disease characterized by diarrhoea, vomiting and fever. The diagnosis of AGE is a clinical one based on a child's clinical presentation. The occurrence of at least three loose or watery stools (taking the shape of the container) in a 24-hour period is generally required to confirm the presence of diarrhea [9].

Rotavirus gastroenteritis is a mild to severe disease, once a child is exposed to rotavirus infection, it takes about 1-2 days incubation period before symptoms often start with fever, nausea and vomiting which are often followed by abdominal cramps and frequent watery diarrhoea

(which may last for 3-8 days). Diarrhoea especially when it occurs along with vomiting can quickly lead to dehydration. Sign of dehydration include thirst, irritability, restless, lethargy, dry mouth, dry skins and fewer trips. Dehydration is a serious complication of rotavirus, and it can lead to hypovolemia (a disorder in which the volume of circulatory blood decreases) and collapse and eventual death [10].

In Jos, Ile-Ife and Zaria – Nigeria, a 10.98%, 13.8%, and 15.6% rotavirus prevalence have been reported respectively [11,12,13]. Yet, there is dearth of information on the current prevalence of human rotavirus infection in the north east region of Nigeria. Therefore the aim this study was to conduct a preliminary survey of rotavirus antigen in diarrheic stool of children (< 5 years) in Taraba (TR) and Yobe (YB) states in Nigeria and determine the prevalence.

## 2. MATERIALS AND METHODS

### 2.1 Study Design and Population

This was a hospital-based cross-sectional study in which three hundred diarrheic stool samples were collected from children who presented with diarrhea to Goggoji Specialist Hospital Taraba, Tudun-Wada Clinic Majidadi Ward, Jalingo, Taraba State, and Potiskum General Hospital, Yobe State. Diarrhoea was defined as passage of three or more watery stool within the last 24-hour period. The choice of these health facilities was informed by high patronage and the vast populace they service. Structured questionnaire was used to obtain information from the parent or guardian who accompanied the child to hospital.

## 2.2 Ethical Issue

Ethical clearance was obtained from the Ethics Committees of the participating hospital.

## 2.3 Inclusion Criteria

Young children confirmed to be suffering from diarrhea were included in this study.

## 2.4 Exclusion Criteria

Children who were either unwilling to participate in the study or not suffering from diarrhea were excluded from the study.

## 2.5 Sample Collection

A total of three hundred diarrheic specimens were collected from children less than five years of age presenting with gastroenteritis. The samples were collected in clean specimen bottles and transported to University of Maiduguri Teaching Hospital for storage at the cold-room. Each sample was then spun at 10,000 g for 8 minutes and supernatant decanted to cryovials and stored at -20°C until analysed.

## 2.6 Sample Analysis

ELISA (Cortez Diagnostic Automation, Inc, USA) detection of rotavirus and antigen:

One hundred microlitre (100 µl) of the negative control was added to well #1 and 100µl of positive control was added to well #2. One hundred microlitre (100 µl) of stool supernatant was added to the appropriate test wells. It was incubated at room temperature for 30 minutes and then washed. The wells were slapped out on a clean absorbent towel to remove excess wash buffer. One hundred microlitre (100 µl) of reagent 1 (blue solution) was added to each well and incubated at room temperature for 30 minutes and then washed, the well were slapped out on a clean absorbent towel to remove excess wash buffer. One hundred microlitre (100 µl) of reagent 2 (red solution) was added to each well and incubated at room temperature for 5 minutes and then washed, the wells were slapped out on a clean absorbent towel to remove excess wash buffer. One hundred microlitre (100 µl) of chromogen was added to each well and incubated for 5 minutes. One hundred microlitre (100 µl) of stop solution was added to each well. The wells were mixed by gently tapping the side of the strip holder with index finger. Results were read visually and by using an ELISA plate reader.

Rotavirus (Reagent 1: Anti-rotavirus monoclonal antibodies with blue dye and Thimersol) (Reagent 2: Antibodies conjugated to horseradish peroxidase with red dye and thimerosol).

## 2.7 Interpretation of Results

### 2.7.1 Visual

**Positive:** Any sample well that is obviously more yellow than the negative control well, the result is positive.

**Negative:** Any sample well that is not obviously more yellow than the negative control well, the results is negative.

## 2.8 Quantitative Result

**Positive:** Absorbent reading of 0.15 OD and above indicates the sample contains rotavirus antigen.

**Negative:** Absorbent reading less than 0.15 OD indicates the sample does not contain detectable levels of rotavirus antigen.

## 2.9 Data Analysis

Online Easy Chi-Square statistical package was used to compare the various proportions obtained in the study. A p value less than 0.05 was considered statistically significant.

## 3. RESULTS

The prevalence of rotavirus in stools of children presenting with gastroenteritis in Taraba and Yobe states, North-East, Nigeria were 4% (6/150) and 9.33% (14/150) respectively (Table 1). In Taraba state, six children within age group 37-48 month were positive ( $p=0.00048$ ) while in Yobe state, positivity rate was observed to reduce with increasing age (Table 2). Based on sex, in Taraba, 4/82 males; 2/68 females were positive ( $p=0.55$ ) while in Yobe 9/83 males and 5/67 females were positive ( $p=0.48$ ) (Table 2). All positive cases in Taraba ( $p=0.177$ ) and six in Yobe ( $p=0.134$ ), consumed tap water. Fever and vomiting combined was the predominant symptom of illness in this study (Taraba:  $p=0.95$ ; Yobe:  $p=0.654$ ; Table 3). In Yobe, playing with toys and attendance of day-care centre ( $p=0.001$ ); use of pit and water system toilets were significant (Taraba:  $p=0.007$ ; Yobe:  $p=0.00004$ ) factors of infection (Table 3).

**Table 1. Overall prevalence of rotavirus antigen in Taraba and Yobe**

State	n	Rotavirus antigen in stool	
		+ve (%)	-ve (%)
Taraba	150	6(4.0)	144(96)
Yobe	150	14(9.3)	136(90.7)

**4. DISCUSSION**

Most rotavirus infections occur in children less than 5 years of age with an overall prevalence of

rotavirus positive children ranging from 30-50% [14]. It is instructive to state however that a decade on, rotavirus prevalence appear to be on a decline. This may be attributed to increased awareness of the public health burden of viruses as etiology of diarrhea in developing countries thus provoking governmental intervention. The introduction of rotavirus vaccine in some West African countries may have influenced the downward trend in prevalence of the rotavirus-diarrhea.

**Table 2. Distribution of rotavirus among children in Taraba and Yobe States according to age and sex**

Age group (month)	No. of sample/State		Positive Rotavirus (%)		p-value	
	Taraba	Yobe	Taraba	Yobe	Taraba	Yobe
0-12	46	35	0(0)	0(0)		
13-24	25	50	0(0)	6(12)		
25-36	26	29	0(0)	3(10.3)		
37-48	31	25	6(19.4)	3(12)	0.00048	0.0003
49-60	22	11	0(0)	2(18.2)		
<b>Sex</b>						
Male	82	83	4(4.9)	9(10.8)	0.55	0.48
Female	68	67	2(2.9)	5(7.5)		

**Table 3. Clinical sign/symptoms and risk factors of rotavirus infection among children less than five years in Taraba and Yobe States**

Sign/Symptoms	No. of sample/State		Positive rotavirus (%)		p-value	
	Taraba	Yobe	Taraba	Yobe	Taraba	Yobe
Fever (F) only	33	31	1(3.03)	2(6.45)		
Abdo/cramp	27	10	1(3.7)	1(10)		
F & vomiting	51	81	3(5.9)	10(12.3)	0.905	0.654
Vomiting only	28	20	1(3.6)	1(5)		
Mucoid stool	10	08	0(0)	0(0)		
Bloody stool	01	00	0(0)	0(0)		
<b>Risk factors</b>						
<b>Source of drinking water</b>						
Tap	80	68	6(7.5)	6(8.8)	0.177	0.134
Borehole	50	70	0(0)	5(7.14)		
Well	13	10	0(0)	3(30)		
Stream	07	02	0(0)	0(0)		
Others	00	00	0(0)	0(0)		
<b>Type of toilet used</b>						
Water system	48	20	2(4.2)	3(15)		
Pit toilet	86	51	2(2.3)	6(11.7)	0.007	0.00004
Bush	14	77	1(7.1)	3(3.9)		
Others	02	02	1(50)	2(100)		
<b>Play with toys</b>						
Yes	110	90	59(53.6)	14(15.5)	0.571	0.001
No	40	60	1(2.5)	0(0)		
<b>Attendance of Day-care centre</b>						
Yes	127	88	6(4.7)	8(9.1)	0.287	0.001
No	23	62	0(0)	6(9.7)		

Our study showed a rotavirus prevalence of 4% (6/150) and 9.3% (14/150) in Taraba and Yobe respectively. The prevalence of 4% in Taraba is lower than 10.98% reported in Jos, [11], 13.8% in Ile-Ife [12], 46.7% in Vietnam [13] 15% in Jamaica [15], 15.6% in Zaria [13] and 20.7% in Tanzania [16]. However, the 9.33% prevalence observed in Yobe is comparable with a reported prevalence of 9.2% in Botswana [17] and 9% in Zaria in a community based study in randomly selected districts [18].

In Yobe state, the outcome of rotavirus infection was significantly associated with the age of the children ( $p=0.0003$ ). Only 6 (12%) children were less than 24 months old. The proportion decreased with increasing age till the age of 37-48 months (Table 2). The pattern in this result was identical to those of other studies [10,13,19]. In Taraba, no child less than 24 months (< 2 years) was rotavirus positive. Rather, all 6 (19.35%) rotavirus positive children were above 36 months old. This is contrary to reports in some previous studies [10,14,13,16,18]. A possible explanation for the observed trend may be difficult. But Taraba women are known to engage in long-term breast feeding of their children for well above eighteen months. This may have conferred on such children immunity, although this assertion has yet to be proven scientifically. Also, older children acquire protective immunity during repeated exposures to the virus which makes subsequent infections to be mild or asymptomatic.

In the present study, we observed a preponderance of infected males than females in both states (Table 2) though it was not significant (TR: $p=0.55$ ; YB: $p=0.48$ ). The result is similar to previously reported findings in India [20], Vietnam [21], and China [22]. The ratio of male to female infection in Taraba was 2:1. This is similar to 1.9:1 previously reported [14]. In Yobe, the ratio was 1.8:1. This is identical with 1.8:1 reported in Jos, Nigeria [10]. Males' greater susceptibility to rotavirus infection has been attributed to genetic and immunological factors [23]. This may be applicable in this study.

Of the total of 20 rotavirus positive diarrheic children in both states, the most recurring clinical symptom observed was fever and vomiting 13/20 (65%), followed by fever only 3/20 (15%), vomiting only 2/20 (10%) and abdominal cramp 2/20 (10%). These were not significant in both states (TR  $p=0.905$ ; YB  $p=0.654$ ). Since vomiting featured prominently as a clinical symptom of

rotavirus infection, it follows that the sequelae will be dehydration. This study did not determine the association of rotavirus diarrhea with dehydration. However, a previous study in Zaria, Nigeria, reported a rotavirus prevalence of 21% among those not dehydrated and 78.4% among those that were dehydrated [13]. Therefore we advocate public enlightenment/education about the use of oral rehydration solution in order to reduce number of deaths due to severe dehydration.

Type of toilet used was a significant factor of infection in both states (TR  $p=0.007$ ; YB  $p=0.00004$ ; Table 3). Due to under development, some of the children sampled still used toilet systems such as pit toilet, bush toilet (a system where inhabitants defecate in the bush surrounding their settlements or houses), and even bucket toilets. After such toilet use, it is common place that users hardly wash their hands. Sometimes, the faeces are excreted close to houses where flies which perched on them could fly back to contaminate edibles. This is an alternative source of infection and explains why, though source of drinking water may not have been a significant factor of spread in this study, yet the infection exists.

In Yobe state, use of toys by children was a significant factor in the spread of infection ( $p=0.001$ ). This is because these toys are thrown around on the floor and make them prone to contamination. Contaminated hands of these children are hardly washed before they handle whatever they would eat. In Taraba state, the use of toys was not a significant factor of infection spread.

## 5. CONCLUSION

This study reveals that rotavirus is a significant aetiologic agent of diarrhea in young children. The prevalence obtained were comparable to those of previous studies and decreased with increasing age of children. Male children were found to be more susceptible to infection often characterized by fever and vomiting. Type of toilet used and playing with toys were found to be significantly associated with acquisition of the virus by children.

It is hoped that this report will enrich the scant data base existing for rotavirus infection in northeast Nigeria and also highlight the health hazard posed by this virus among children.

Molecular study on circulating strains in the study area is hereby recommended as it will show circulating strains and facilitate the development of a more potent vaccine in the nearest future.

## CONSENT

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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*The peer review history for this paper can be accessed here:*  
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