

Frequency of Rotavirus Infection among Children with Diarrhea in Omdurman Pediatric Hospital, Sudan

Abdalla AE^{1*}, Nagi AM², Elawa HE³

ABSTRACT

Background: Rotaviruses are the major cause of gastroenteritis and diarrhea in infants and young children worldwide. Basic epidemiological data concerning rotaviruses among infants and children are necessary for health planners and care providers in Sudan.

Method: Cross-sectional study was conducted at Omdurman Pediatric Hospital, Sudan to investigate the frequency of rotavirus infection and associated possible risk factors among children. The solid-phase sandwich enzyme-linked immunosorbent assay (ELISA) was used to detect rotavirus antigens. Structured questionnaire was used to gather socio-demographic data.

Results: Out of 92 diarrheal cases, 23 were rotavirus-antigen positive (25%). Most of the positive subjects (91.3%) were in children less than 3 years of age and the infection rate decreased with the increasing age ($p > .05$). Children infected with rotaviruses were more likely to have vomiting (82.6%) ($p > 0.05$) and fairly low frequency of fever (60.9%) ($p > 0.05$). Out of the 23 rotavirus positive subjects, 13 (30.2%) were breast-fed, 6 (25%) were both breast and bottle-fed and 4 (16.6%) were neither breast nor bottle-fed ($p > 0.05$). Furthermore, the antibiotic treated children revealed the highest percentage of rotavirus antigen (26.9%) compared to the non-treated children (14.3%).

Conclusion: Rotavirus frequency was 25% among children less than 5 years. Rotavirus vaccine, routine and proper diagnosis of rotavirus infection in children with acute diarrhea help to determine appropriate treatment, prevents the unnecessary use of antibiotics and minimizes the spread of the disease among susceptible children in Sudan.

Keywords: Rotavirus, Antigens, Gastroenteritis, Diarrhea, Infants, Children.

Rotaviruses, the most important cause of severe childhood diarrhea, belong to the Reoviridae family of non-enveloped double-stranded RNA viruses. Members of the genus rotavirus have an 11-segment genome encased within three icosahedral protein shells and are referred to as triple-layered viruses 1, 2. According to their antigenic specificities, rotaviruses are classified into serogroups A through G. However, only groups A to C have been shown to infect humans and most animals, significant gastrointestinal disease, primarily in children less than 5 years of age and the young of other mammalian species.

1. Faculty of Medical Laboratory Sciences, OIU.

2. College of Medical Laboratory Science, University of Science and Technology, Sudan.

3. Faculty of Medical Laboratory Sciences, Omdurman Islamic University, Omdurman, Sudan

*Correspondent: Abu Algasim Elgaili Abd alla (AAE)

E-mail: Gasim82@live.com

Each year rotaviruses cause approximately 111 million episodes of gastroenteritis in children, which result in 25 million visits to clinics, 2 million hospitalizations, and 352,000 - 592,000 deaths. On a worldwide basis, nearly every child experiences rotavirus gastroenteritis by age 5, 1 in 5 visits a clinic, 1 in 65 is hospitalized, and 1 in 293 dies. Children in the poorest countries account for 82% of rotavirus deaths³.

Although death due to rotavirus gastroenteritis is rare in industrialized regions such as Europe, because of access to adequate medical care, the burden of rotavirus gastroenteritis is substantial, given the high frequency of infection and resulting morbidity among infected children. The symptoms of rotavirus gastroenteritis include diarrhea and vomiting, which may lead to severe dehydration and even death if rehydration therapy is not promptly initiated⁴. Although gastroenteritis among children is of high

clinical importance, few recent investigations were performed in human rotaviral infection in Sudan^{5, 6}. Some recent other unpublished observations suggest that diarrhea among children less than 5 years of age is highly prevalent all over the Sudan. The basic data concerning rotaviral infections among children is important for health planners and care providers. Thus, this was the aim of the current study as to investigate prevalence, associated possible risk factors for rotaviral infections among children in Omdurman, Sudan.

Methods:

This was a cross-sectional study conducted in Omdurman Pediatric Hospital, Sudan during the period of January- April 2011. Children below five years of age suffering from diarrhea were included in the study. The parents of children were informed for the purpose of the study before collection of the specimens, and verbal consent was taken. Personal and clinical data were obtained by direct interviewing questionnaire from the parents of the children. The stool specimens were collected in sterile stool containers. Then stools were stored at -20° C till processed. Enzyme-linked immunosorbent assay (ELISA) was used for rotavirus group A antigens using commercial diagnostic kits (ProSpecT Oxoid Ltd, UK). The ProSpecT Rotavirus ELISA kit (Oxoid, UK) is used to assign stools as rotavirus positive or negative. Data were entered in the computer using SPSS for windows version 16.0 and doubled checked before analysis. Significance of difference was determined using chi-square test. Statistical significance was set at P values < 0.05.

Results:

Detection of rotavirus antigen among the diarrhea stools tested by antigen capture ELISA:

When the 92 fecal specimens from diarrheal cases were examined by antigen capture ELISA, 23 of the samples were positive (25%), while 69 gave negative results (75%) (Figure 1).

The effect of age of children on rotavirus infection:

The results in figure 2 revealed that the highest positive cases for rotavirus infection were 26.4% among the age group 1- 3 years and 24.4% among the age group less than 1 year, with no significant difference (P > 0.05) between the age groups examined.

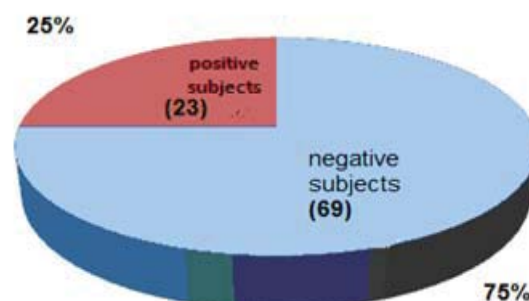


Figure 1: Detection of rotavirus antigen from fecal specimens tested by using antigen capture ELISA.

The effect of type of feeding on rotavirus infection among children:

Table 1 demonstrates that there was no significant difference (P > 0.05) between prevalence of rotavirus infection among breast feeding (30.2%), breast and bottle feeding (25%) and no breast and no bottle feeding (16.6%).

Table 1: The effect of type of feeding on rotavirus infection among children.

Type of feeding	Subjects examined	Rotavirus antigen Frequency	Percentage
Breast	43	13	30.2%
Bottle	1	0	0%
Breast & bottle	24	6	25%
No breast or bottle	24	4	16.6%
Total	92	23	25%

P value = 1.85 (P > 0.05)

Clinical presentation of children with and without rotavirus among the diarrheal cases:

The infantile diarrhea is usually accompanied with clinical symptoms like vomiting and fever. Rotavirus positive cases revealed that there were 82.6% with vomiting and 60.9% had fever; however, among rotavirus negative

cases there were 75.4% with vomiting and 65.2% with fever (Table 2).

The effect of antibiotics therapy on rotavirus infection among children:

The results presented in table 3 demonstrate that there was no significant difference (P > 0.05) between rotavirus infection among

antibiotic treated cases 26.9% and those without treatment 14.3%.

Discussion

In the current study, rotavirus antigens were detected in 23 of the 92 children (25%) less than 5 years of age, suffering from diarrhea by using antigen capture ELISA.

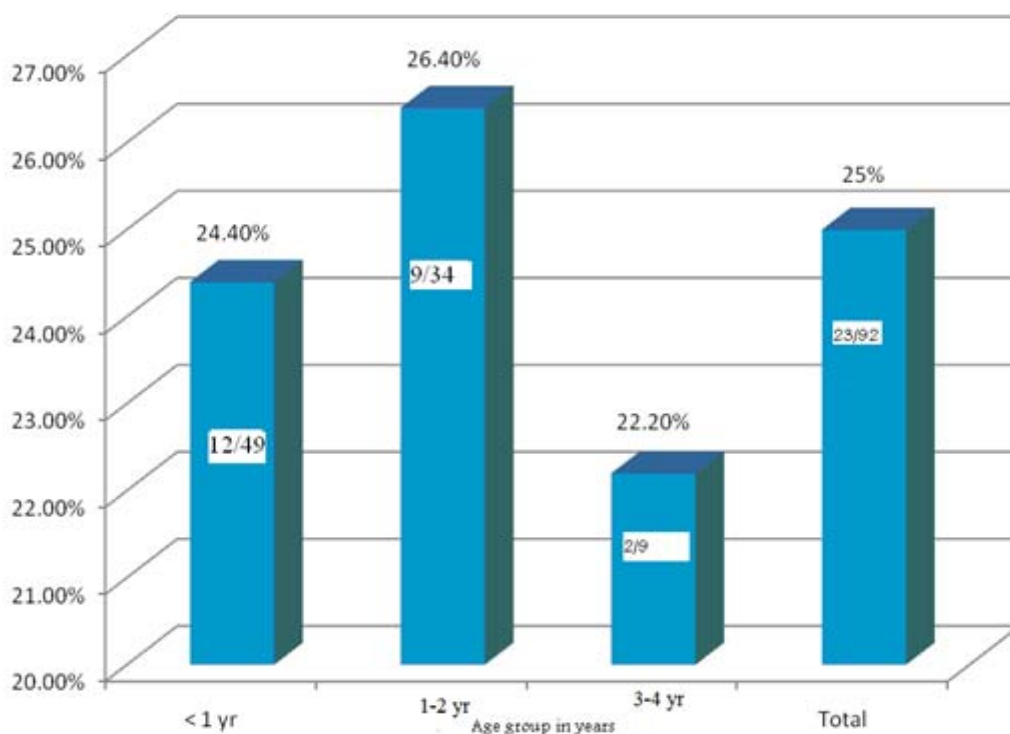


Figure 2: The effect of age of children on rotavirus infection

Table 2: Clinical presentation of children with and without rotavirus among the diarrheal cases

Clinical presentation	Number and percentage of samples			
	Rotavirus positive (n = 23)	Percentage of positive*	Rotavirus negative (n = 69)	Percentage of negative**
Vomiting	19	82.6%	52	75.4%
Fever	14	60.9%	45	65.2%
Total	23	25%	69	75%

*P value = 0.514 (p > 0.05)

**P value = 0.142 (p > 0.05)

The detected frequency of infection appears to be less than the findings previously reported in Gaza, Palestine (28%)⁷, Burkina Faso (33.8%)⁸, Sudan (42%)⁹ and the Middle East and North Africa (61%)¹⁰. However, rotavirus frequency obtained in this study was similar to those reported in Atlanta, Georgia (22%)¹¹ and Africa, Asia and Latin America

(25%)¹² but higher than that reported in Khartoum, Sudan (8.3%)⁶, China, India, Mexico, Myanmar and Pakistan (16%)¹³, Burkina Faso (14%)¹⁴ and European Union (15%)⁴.

The various rates of rotavirus infections observed by different investigators in different places could be attributed to several

factors including, the study population, the diagnostic techniques used, the incidence rate of the virus in different environments, the socio-economic status of the target populations, the season during which the study was conducted and the different subgroups and serotypes of rotaviruses prevalent in the area of the study².

The highest rate of infection was observed among the age group 1-2 years (26.4%), reflecting a strong tendency of rotaviral diarrhea among children less than 2 years of age. This finding is consistent with the previous studies conducted in the Gaza, Palestine⁷, and Burkina Faso⁸, where most of

rotavirus infections occur in the first and second year of life.

In this range of age, there is no need for gender classification, since children entertain the same environmental conditions².

Because breast feeding protects the infants up to 6 months from rotavirus infection, the highest incidence of rotavirus infection was observed in children above 6 months of age^{14,15,16}.

This study revealed that rotavirus infection occurred mostly among breast-fed infants compared to other subgroups of children. This fairly high rate of rotaviral infections could be due to the absence of maternal antibodies that

Table 3: The effect of antibiotics therapy on rotavirus infection among children

Antibiotic treatment	Subjects examined	Rotavirus infection	
		No. positive	Percentage
Children treated	78	21	26.9%
Children not treated	14	2	14.3%
Total	92	23	25%

P value = 1.011 (p > 0.05)

protect the infants below 6 months of age. In addition, they could be due to the poor hygienic environment, where the breast (mother skin) and the bottle (fomites) were, possibly, contaminated with children feces.

Most of the mothers of the infected children were coming from rural areas where poverty and illiteracy are highly prevailing. Obviously, it is not unexpected, that some children could have contracted the disease or become reinfected from their own mothers. Rotavirus reinfections are common, and it has been shown that young children can suffer up to five reinfections by 2 years of age. Asymptomatic infections are more common with successive reinfections^{17,18}.

Some recent studies have shown that adult contacts may be infected, as evidenced by seroconversion; however, they rarely exhibit symptoms, and the virus is infrequently detected in their stools¹⁸. Although the common source of rotavirus infection is the direct contact with pediatric cases, epidemics of severe disease have occurred in adults, especially in closed populations as in geriatric wards¹⁷. Group B rotaviruses have been

implicated in large outbreaks of severe gastroenteritis in adults in China¹⁸. Furthermore, the high virus particle number in the feces of children with acute rotavirus disease, and the very small minimum diarrhea-causing dose, ensure wide and efficient spreading to any susceptible host².

Although vertical transmission of human rotaviruses has not been reported in the literature, one could argue that children above 6 months of age may get infected through the breast milk itself. Interestingly, some recent studies reported that rotaviruses could spread from intestinal lumen into the blood circulation^{3,19}. These observations were supported by the detection of rotaviral antigens and RNA in serum samples collected from 65% of children with rotavirus diarrhea, indicating that antigenemia, and, possibly, viremia occurs during rotavirus infection¹⁹. Recently, many viruses have shown to be transmitted from the mother to her own child through breast milk, e.g. cytomegalovirus, rubella virus, and human T-lymphotropic viruses.

In our study the clinical symptoms, fever and

vomiting were found in 60.9% and 82.9%, of infected children with rotavirus, respectively. The comparison of the clinical symptoms of the acute gastroenteritis among the rotavirus positive and rotavirus negative cases indicated that fever and vomiting were more frequently observed among diarrheal children with rotavirus infection than those without rotavirus infection, as reported in previous studies^{8, 20, 21}. Obviously fever, vomiting and watery diarrhea are seen in the majority of infected children lasting 2-7 days⁶.

The results observed among children treated with antibiotics disclosed that the inappropriate use of antibiotics may cause imbalance of normal microflora and, consequently, this may increase the severity of gastroenteritis because the normal microflora play important role in the body defense by interference with the invasion of pathogenic bacteria. It is possible that gastroenteritis caused by pathogenic bacteria is a strong predisposing factor for rotavirus-induced diarrhea, or vice versa²².

Conclusion:

Rotavirus frequency was 25% among children less than 5 years. Rotavirus vaccine, routine and proper diagnosis of rotavirus infection in children with acute diarrhea help to determine appropriate treatment, prevents the unnecessary use of antibiotics and minimizes the spread of the disease among susceptible children in Sudan.

Competing interests:

The authors declare that they have no competing interests.

Ethics:

This study was approved by the Medical Specialization Ethics Review Board, Sudan.

Author's contribution:

AAE carried out the study and participated in the statistical analysis and procedure.

AHE carried out the practical part of the study. NAM coordinated and participated in the design of the study, statistical analysis and drafting of the manuscript. All the authors read and approved the final version.

Acknowledgements:

The authors are very grateful to all the parents of children for their co-operation. Thanks are

also extended to the nurses of Omdurman Pediatric Hospital for their proper collection of the fecal samples and for their cooperation and unlimited help.

References:

1. World Health Organization: Manual of rotavirus detection and characterization methods, 2009; 1-143.
2. Desselberger U, Gray J: Viruses Associated with Acute Diarrheal Disease. In: Zukerman AJ, Banatvala JE, Schoub BD, Griffith PD and Mortimer P. (ed.) Principles and Practice of Clinical Virology, 6th ed, John Wiley & Sons, Hoken, USA, 2009; 249- 270.
3. Ramig RF: Pathogenesis of Intestinal and Systemic Rotavirus Infection. *J Virol* 2004; 78(19): 10213-10220.
4. Giaquinto C, Van Damme P, Huet F, Gothefors L and Wielen MV: Costs of Community- Acquired Pediatric Rotavirus Gastroenteritis in 7 European Countries. *J Infect. Dis* 2007; 195(suppl 1): 36- 44.
5. Mukhtar, Selma A: Electropherotypes of rotavirus isolated from children in Khartoum Teaching Hospital; M. Sc. Thesis, 2006; University of Khartoum, Sudan.
6. Hemidan MN, Shigidi MT, Ali YA: Prevalence of group A rotavirus among children in Khartoum State, Sudan. *Sud Med Lab J* 2011; 1: 83- 87.
7. Abu Elamreen FH, Abed AA, Sharif FA: Rotavirus Infection in Infants and Young Children with Acute Gastroenteritis in Gaza, Palestine. *Annals of Alquds Medicine* 2006; 2(1): 11-17.
8. Bonkougou LJ, Sanou I, Bon F, Benon B, Coulibaly SO, Haukka K, Traoré AS, Barro N: Epidemiology of rotavirus infection among young children with acute diarrhoea in Burkina Faso. *BMC Pediatr* 2010; 10(94): 1- 6.
9. World Health Organization: Global Rotavirus Information and Surveillance Bulletin 2010.
10. Khoury H, Ogilvie I, El Khoury AC, Duan Y, Goetghebeur MM: Burden of rotavirus gastroenteritis in the Middle Eastern and North African pediatric population. *BMC Infect Dis* 2011; 7(11): 1- 9.
11. Parashar UD, Gibson CJ, Bresee JS, Glass R: Rotavirus and Severe Childhood Diarrhea. *Emerg Infect Dis* 2006; 12(2): 304- 306.
12. Knipe DM, David M, Howley, Peter M, Chanock RM: Rotaviruses. In: Fields Virology, Knipe DM and Chanock RM, 5th ed, Vol 2, Lippincott Williams & Wilkins, New York, 2007; 1918-1963.
13. Huilan S, Zhen LG, Mathan MM, Mathew MM, Olarte J, Espejo R, Maung K, Ghafoor MA, Khan MA, Sami Z and Sutton RG: Etiology of acute diarrhea among children in developing countries: a multicentre study in five countries. *WHO Bulletin*, 1991; 69(5): 549- 555.

14. 14. Bonkougou LJ, Barro N, Sanou I, Toe L, Sanfo MS, Ouedraogo-Traore R, Traore AS: Electrophoretotypes Characterization of Human Rotavirus in Two Pediatric Services in Burkina Faso. *J. Med. Sci* 2008; 8(4): 371- 377.
15. 15. Levinson W: Reoviruses. In: Levinson Review of Medical Microbiology and Immunology, 10th ed, McGraw Hill Medical, New York, 2008; 290-291.
16. 16. Haffejee EI: The Epidemiology of Rotavirus Infection: A Global Perspective. *J Pediatr Gastroenterol Nutr*, 1995; 20: 275- 286.
17. 17. Cunliffe NA, Nakagomi O: Rotaviruses. In: Greenwood D, Slack R, Peutherer J and Barer M. (ed.) *Medical Microbiology: A guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control*, 17th ed, Churchill Livingstone - Elsevier, Edinburgh, 2007; 546-552.
18. Brooks GF, Caaroll, Butel JS, Morse SA and Mietzner TA: Rotaviruses. In: Jawetz, Menlick & Adelberg's *Medical Microbiology*, 25th ed, Mc Graw Hill Medical, New York, 2007; 508- 5012.
19. Fisher TK, Ashely D, Kerin K, Reynolds-Hedmann E, Gentsch J, Widdowson MA, Westerman L, Ruhr N, Turcios RM, Glass RI: Rotavirus antigenemia with acute gastroenteritis. *J. Infect. Dis* 2005; 192: 913-919.
20. Nguyen T, Le PV, Huy CL, Weintraub A: Diarrhea Caused by Rotavirus in Children Less than 5 Years of Age in Hanoi, Vietnam. *J Clin Microbiol* 2004; 42(12): 5745–5755.
21. Zvizdić S, Telalbasić S, Beslagić E, Cavaljuga S, Maglajlić J, Zvizdić A, Hamzić S: Clinical characterization of rotavirus. *Bosn J Basic Med Sci* 2004; 4(2):22-24.
22. Ananthanarayan R and Paniker CK: Normal Microbial Flora of the Human Body. In: *Text Book of Medical Microbiology*, 7th ed, Orient Longman Private Ltd, Bangalore, 2005; 599- 602