

Prevalence of Enteric Viruses Among Young Children With Acute Diarrhea in Benin City, Nigeria.

Abstract

Background: Viral intestinal infections are the most common cause of acute infectious diarrhea among children worldwide. **Aims:** This study was carried out to investigate the prevalence of enteric viruses in young children 0-24 months in an urban secondary health center in Benin City, Nigeria.

Methodology: Stool specimens were collected from 168 children with clinical signs of diarrhea and 45 apparently healthy age-matched children without diarrhea. The specimens were analyzed by immunochromatographic technique following manufacturer's instructions.

Results: The overall prevalence of viral agents was 39.3% for diarrheal patients. No viral agent was detected in the control. Rotavirus had a prevalence of 27.4%, adenovirus 9.5% and norovirus 2.4%. There was a significant association between age group and infection ($P < 0.0001$), but no statistical significance with respect to sex ($P > 0.05$). The distribution of viral infection showed that single infection was 32.1% while mixed infection was 7.1%. The effect of feeding patterns on viral diarrhea was not statistically significant ($P > 0.05$) while the effects of some variables on pediatric viral diarrhea showed statistical significance with respect to season ($P = 0.038$), and no statistical significance as regards family socioeconomic status, maternal level of education and maternal occupation ($P > 0.05$).

Conclusion: Viral diarrhea had a prevalence of 39.3%, and rotavirus was the most prevalent agent. Free rotavirus vaccination, other viral preventive measures such as proper education of the populace and viral diagnostic testing are advocated for children with diarrheal infection in this locality.

Key Words: Diarrhea, Enteric viruses, Secondary health center, Single infection, Mixed infection.

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31 **1.0**

Introduction

32 Viral intestinal infections are the most common cause of acute infectious diarrhea in the
33 pediatric population. Viral enteropathogens are important causes of childhood gastroenteritis in
34 both developed and developing countries (1,2). The commonest etiological agents include
35 rotavirus, astrovirus, adenovirus and norovirus, with differences in prevalence depending on
36 environmental, geographical or socio-economic factors (3,4). Globally, these viruses are
37 responsible for diarrhea episodes in hospitalized children with variations in detection rates (5,6,7)..
38 These four major families cause enteric childhood disease which affects children worldwide within
39 the first few years of life regardless level of hygiene, quality of water, food or sanitation (8). Viral
40 infections damage small bowel enterocytes and cause low grade fever and watery diarrhea without
41 blood. Viral intestinal infections account for approximately 70% of episodes of acute infectious
42 diarrhea in children. However, about 40% of cases of acute diarrheal illness in the first 5 years of
43 life are caused by rotaviruses, while a further 30% are caused by other viruses, mainly noroviruses
44 and adenoviruses (9,10).

45 In Nigeria, some studies on viral diarrhea have been conducted to show the role of viral agents
46 in childhood diarrhea. However, different prevalence rates have been reported in the different studies.
47 The incidence of rotavirus reported include 33.3% in Lagos (11), and 13.8% in Benin City (17).
48 Adenovirus include 6.7% in Lagos (11) and 23% in Northwestern Nigeria (19). The incidence of
49 norovirus reported in Lagos by Ayolabi *et al* .was 32.5% (23).

50 In many developing countries including Nigeria, data on viral enteropathogens are limited
51 especially with respect to the pediatric population. This may be due to the fact that diagnostic tests
52 for these viruses are not routinely carried out in most Nigerian hospitals and as a result, many
53 important viral pathogens of interest are missed out (i.e unidentified). This previous situation
54 makes it difficult to collect data as regards viral diarrhea and implementation of control strategy to
55 combat the disease becomes difficult to carry out. Against this background, this study was carried
56 out to ascertain the prevalence rates of viral enteropathogens (rotavirus, adenovirus and norovirus)
57 as causative agents of viral diarrhea among children attending Central hospital, Benin City, Nigeria.

This work is also aimed at assessing the relationship between feeding patterns and viral diarrhea, as well as the effect of some variables on viral diarrhea.

2.0 Patients and Methods.

Study location and population: This study was carried out at Central hospital, Benin City, Nigeria. It is a secondary health care center and it is located in Benin City, Edo State, Nigeria. It attends to all medical cases as well as referral cases from primary health care centers. A total of two hundred and thirteen (213) stool specimens were collected from children who were 0 to 24 months of age, comprising 168 children with clinical symptoms of diarrhea made up of 91 male and 77 female, and 45 apparently healthy age matched children without diarrhea made up of 28 male and 18 female. The patients and control subjects were residing in the same locality as at the time of this study. The inclusion criteria used in this study were children from birth to two years of age who were clinically diagnosed as having diarrhea, with the passage of watery stools 3 times or more within a 24 hour period. The population studied was made up of children with acute diarrhea (less than 2 weeks). Feeding patterns were also considered during this study. Exclusive breastfeeding was from birth to six months of age while mixed feeding and solid food were not age dependent. Verbal informed consent was obtained from parents or guardians of the participating children prior to sample collection. The study was carried out between May 2011 and December 2012. Ethical approval was obtained from the state health ethics committee.

2.1 Specimen collection and processing: The specimens were collected into sterile wide mouth specimen bottles and were processed within 4 hours of sample collection. Rotavirus, adenovirus and norovirus were detected by the Immunochromatographic Technique (ICT). VIKIA[®] Rota-Adeno rapid test device made by BioMerieux, France was used in rotavirus and adenovirus detection while norovirus was detected by the RIDA[®] Quick norovirus (NI403) made by R-Biopharm AG, Germany. Results were read and interpreted according to manufacturer's instructions.

2.2 Statistical analysis: This was carried out to test the effects of sex, age group, feeding patterns, seasons, family socioeconomic status and maternal education on the prevalence of viral infection by means of the statistical software "INSTAT". The data obtained were analyzed for odd ratio and Chi square, using the software which automatically calculates the values imputed into it to give the desired values and a P-value of less than 0.05 was considered as significant.

3.0 Results

A total of 168 children with clinical symptoms of diarrhea were evaluated in this study. Enteric viruses were detected in 66 (39.3%) subjects while there was no viral detection in the control. Rotavirus had a prevalence of 27.4%, adenovirus 9.5% and norovirus 2.4%. As regards types of infection, single infection was 32.1% while mixed infection had 7.1% (Table 1). Viral infection with respect to sex and age is showed in table 2. Age group was statistically significant ($P<0.0001$) while sex did not show statistical significance ($P=0.806$) (Table 2). Viral infection with respect to feeding patterns did not show significant association ($P=0.369$) (Table 3). Viral infection as regards some variables is showed in table 4. Seasonal pattern of infection was statistically significant ($P=0.038$) while family socioeconomic status, maternal level of education and occupation did not show statistical significance ($P>0.05$).

4.0 Discussion

A prevalence of 39.3% of enteric viral agents was found in this study. The prevalence of rotavirus infection (27.4%) obtained in this study is lower than rates previously reported in Nigeria and other parts of the world (11-15). It is higher than other studies reported (16-18). Similarly, adenovirus prevalence of 9.5% found in this study is lower than reports from Northwestern, Nigeria and Tanzania (19,20). It is higher than reports from Lagos, Nigeria, Iran, Denmark and Brazil (11,15,21,22). Norovirus prevalence of 2.4% reported in this study is lower than reports from Nigeria, Ghana, Brazil and Italy (23-25). The differences among studies reporting viral infections in different part of the world may be due to different age group, seasonal variation as well as the methods of detection used for the analysis.

There was a significant association between age group and infection ($P<0.0001$), 7-12 months had the highest detection rate of enteric viruses with 39(53.4%). This may be due to the fact that it is the period where children usually crawl and walk about in the surroundings which may be contaminated with infectious agents. The 0-6 months age group was the second most predominant group with viral agent. Thus viral infections were concentrated within the first year of life with prevalence rate of 73.2% while the second year of life had 26.8% prevalence. The reason for this may be due to the fact that the immune system of children are immature during the first year of life and by the second year, immunity begins to build up due to previous exposures of the virus (26).

In this study, the effect of feeding patterns on the prevalence of diarrhea was not statistically significant ($P=0.369$), although, exclusively breastfed infants had the lowest percentage of 30.8% of viral agents compared to others. The reason for this cannot be easily ascertained, however, Morrow and Rangel (27) reported that breast milk offers specific protection against diarrhea-causing pathogens including rotavirus, adenovirus and norovirus by the “decoy” action of human milk ,glycans. Quigley *et. al.* (28) also stated that breastfed babies are four times less likely to develop diarrhea associated with gastroenteritis than artificially fed babies. Moreover, Heinig (29) reported that risk for rotavirus infection did not differ for infants who were exclusively breastfed, partially breastfed or exclusively formula-fed. This was also the views from studies conducted in Canada and United States (30,31). Thus breastfeeding as a protection for diarrhea infections have divergent opinions from different researchers worldwide.

There was a significant association between season and infection ($P=0.038$), with rainy season having the highest prevalence of 46.1%. In Nigeria, viral diarrhea has been reported to occur throughout the year but with variations as regards seasons (14,19,23). This may be the reason for what was observed in this study. The effects of other variables such as family socioeconomic status, maternal level of education and occupation on the prevalence of viral infection did not show statistical significance ($P>0.05$).

Viral infection in this locality was found to have a prevalence of 39.3%. This could be prevented through proper education of the populace and other preventive measures that will help reduce morbidity and mortality of the disease. Moreover, rotavirus vaccines are available in many hospitals in Nigeria, but, the cost is still not affordable by the average family, hence, health care managers and administrators should make it a point of duty to include the vaccines into the country`s national immunization program and this will help to reduce childhood rotavirus infection in the locality.

It is important to point out here that other non-viral diarrheal cases (60.7%) which was not attended to in this study may be due to other possible causes of childhood diarrhea such as other infecting agents (bacteria, parasites or fungi), as well as lactose intolerance due to food intake. However, it is worthy of note that in this study, particular attention was paid on viruses with no attention on bacteria and parasitic agents. This was because laboratory diagnosis of viral agents in stool specimens of diarrheic patients is rarely done in most hospitals in this locality and thus, the need for the attention on viral agents in order to ascertain the state of viruses in children with

diarrhea in this environment. The main limitation of this study was the inability to carry out
astrovirus test due to the unavailability of astrovirus test kits as at the time of this study. It is hoped
that future research work will look at the prevalence of such virus in this locality.

5.0 Conclusion

A prevalence of 39.3% viral diarrhea was seen in this study with rotavirus as the most
prevalent agent. This is worrisome for the young children who are faced with the burden of these
viral agents as a result of the non- performance of viral diagnostic tests on routine basis for
patients in most of the health care centers in this locality. The report of this study calls for urgent
attention and concern on the part of the health care managers and administrators to rise up to the
occasion by providing the necessary diagnostic materials for the detection of viral agents in patients
with diarrheal infection. This measure will go a long way in checking the indiscriminate use of
antibiotics for diarrheal patients which sometimes may not be necessary.

References

- 1) Hart, C.A. Introduction to acute infective diarrhea. In: Cook, C., Zuma, A. Eds. Manson's
tropical diseases. 21st Edn. London. W.B. Saunders, 2003. Pp 907-913.
- 2) Hart, C.A., Cunliffe, N.A. Diagnosis and causes of viral gastroenteritis. *Curr. Opin. Infect.
Dis.* 1996. **9**:333-339.
- 3) Wilhelmi, I., Roman, E. Sanchez-Fauquier. Viruses causing gastroenteritis. *Clin. Microbiol.
Infect.* 2003. **9**:247-262.
- 4) Clark, B. and Mckendrick, M. A review of viral gastroenteritis. *Curr. Opin. Infect Dis.*
2004. **17**:461-469.
- 5) Jakab, F., Peterfai, J., Meleg, E., Banyai, K., Mitchell, D.K. and Szucs, G. Comparison of
clinical characteristics between astrovirus and rotavirus infections diagnosed in 1997 to
2002 in Hungary. *Acta P ediatr.* 2005. **94**:667-671.
- 6) Caracciolo, S., Minim, C., Colombrita, D., Foresti, I., Avolio, M., Tosti, G. *et. al.* A.
Detection of sporadic cases of norovirus infection in hospital children in Italy. *New
Microbiol.* 2007. **30**:49-52.

- 7) Fodha, I, Chouikha, A., Dewar, J., Trabelsi, A. Boujaafar, N. and Steele, A.D. Prevalence of adenovirus antigens in children presenting with acute diarrhea. *Med. Trop.* 2007. **67**:256-258.
- 8) Glass, R.I., Bresee, J., Jiang, B., Gentsch, J., Ando, T., Fankhauser, R. *et. al.* Gastroenteritis viruses: an overview, *Novartis found symp.* 2001. **238**:5-19.discussion 19-25.
- 9) Elliot, E.J and Dalby-Payne, J.R. Acute infectious diarrhea and dehydration in children. *MJA.* 2004. **181**:565-570.
- 10) Koletzko, S. and Osterrieder, S. Acute infectious diarrhea in children. *Disch Arztebl Int.* 2009. **106**:539-543.
- 11) Audu R., Omilabu, S.A. and Peenze, I. and Steele, I. Viral diarrhea in young children in two districts in Nigeria. *The Central Afr. J. Med.* 2002. **48**(5-6):59-63.
- 12) Gomwalk, W.E., Gosham, L.T., Umoh, U.J. Rotavirus gastroenteritis in paediatric diarrhea in Jos, Nigeria. *J. Trop. Paediatr.* 1900. **54**(5): 343-346.
- 13) Odimayo, M.S., Olanrewaju, W.I., Omolabu, S.A. and Adegboro, B. Prevalence of rotavirus-induced diarrhea among children under 5 years in Ilorin, Nigeria. *J. Trop. Paediatr.* 2008. **54**(5):343-346.
- 14) Binka, F.N., Anto, F.K. Odaro, A.R. *et. al.* Incidence and risk factors of rotavirus diarrhea in Northern Ghana. *Trop. Med. Int. Health.* 2003. **8**(9):840-846.
- 15) Motamedifar, M., Anuni, E. and Shirazi, P.T. Frequency of rotavirus and adenovirus gastroenteritis among children in Shiran, Iran. *Iranian Red Crescent Med. J.* 2003. **15**(8):729-733.
- 16) Basu, G., Rossouw, J. Sebunya, T.K. *et al.* Prevalence of rotavirus, adenovirus and astrovirus infection in young children with gastroenteritis in Gaborone, Botswana. *East Afr. Med. J.* 2003. **88**:651-655.
- 17) Paul, M.O. and Erinle, E.A. Rotavirus infection in Nigeria infants and young children with gastroenteritis. *The Amer. J. Trop. Med. Hyg.* 1982. **31**(2):374-375.
- 18) Chung, J.Y., Huh, K., Kim, S.W., Shin, B.M., Han, T.A., Lee J. and Song, M.O. Molecular epidemiology of human astrovirus infection in hospitalized children with acute gastroenteritis. *Korean J. Paediatr. Gastroenterol. Nutr.* 2006. **9**:139-146.

- 19) Aminu, M., Ahmed, A.A., Umoh, U.J., de Bear, M.C., Esona, M.D. and Steele, A.D. Adenovirus infection in children with diarrhea disease in Northwestern Nigeria. *Annals Afr. Med.* 2007. **6**(4):168-173.
- 20) Moyo, S.J., Gro, N., Kirsti, V., Matee, M.I., K.tundu, J., Masselle, S.Y., Langeland, N. and Myrmel, H. Prevalence of enteropathogenic viruses and molecular characterization of group A rotavirus among children with diarrhea in Dar es Salaam, Tanzama. *BMC. Public Health.* 2007. **7**:359.
- 21) Olesen, B., Neimann, J. Bottigar, B. *et al.* Etiology of diarrhea in young children in Denmark: a case control study. *J. Clin. Microbiol.* 2005. **43**:3626-3641.
- 22) Riberiro, L.R., de Oliveira Giuberti, R.S., Barreira, DMPE, Saick, K.W., Leite, J.P.G., Miagostorich, *et. al.* Hospitalization due to norovirus and genotypes of rotavirus in pediatric patients, State of Espirito Santo. *Memorias do Instituto Oswaldo Cruz.* 2008. **103**(2):201-206.
- 23) Ayolabi, C.I., Ojo, D.A., Armah, G.E., Akpan, I. and Mafiana, C.F. Detection and partial characterization of norovirus among children with acute gastroenteritis in Lagos Nigeria. *Int. J. Med. Medical Sci.* 2010. **2**(7):216-221.
- 24) Armah, G.E., Gallimore, C.I., Binka, F.N., Asmah, R.H., Green, J., Ugoji, U., Anto, F., Brtown, D.W.G. Gray. J.J. Characterization of norovirus strains in rural Ghanaian children with acute diarrhea. *J. Med viral.* 2006. **48**:1480-1485.
- 25) Colomba, C., Saporito, L., Giammanco, G.M., de Grazia, S., Ramirez, S., Arista, S. Titore, L. Norovirus and gestroenterits in hospitalized children in Italy. *Emerg. Infect. Dis.* 2007. **9**:1389-1391.
- 26) Perez-Schael, I., Gonzalez, R. Fernandez, R. *et. al.* Epidemiological features of rotavirus infection in carcass, Venezuela: Implications for rotevirus immunization programs. *J. Med. Virol.* 1999. **59**:520-526.
- 27) Morrow,A.L., and Rangel, J.M. Human milk protection against infectious diarrhea: Implications for prevention and clinical care. *Semin. Pediatr. Infect. Dis.* 2004. **15**:221-228.
- 28) Quigley, M.A., Cumberland, P., Cowden, J., Rodrigues, L. How protective is breastfeeding against diarrheal disease in infancy in 1990s England? A case-control study. *Arch. Dis. Child.* 2006. **91**(3):245-250.

- 29) Heinig, M.J. Host defense benefits of breastfeeding for the infant: Effect of breastfeeding duration and exclusivity. *Pediatr. Clin. North. Am.* 2001. **48**:105-123.
- 30) Gurwith, M., Weriman, W., Hinde, D., Feltham, S., Greenberg, H. A prospective study of rotavirus infection in infants and young children. *J Infect. Dis.* 1981. **144**:218-224.
- 31) Weinberg, R.J., Tipton, G., Klish, WJ, Brown, MR. Effect of breastfeeding on morbidity in rotavirus gastroenteritis. *Pediatr.* 1984. **74**:250-253.

Table 1: Incidence of enteric viruses and types of infection .

Characteristics	No. Positive	Percentage
Enteric viruses		
Rotavirus	46	27.4
Adenovirus	16	9.5
Norovirus	4	2.4
Total	66	39.3
Types of infection		
Single	54	32.1
Mixed	12	7.1
Total	66	39.3

Table 2: Viral infection with respect to sex and age

Sex	No. tested	No. Positive(%)
Male	91	37(40.7)
Female	77	29(37.7)
Total	168	66(39.3)
P=0.806		
Age group (months)	No. tested	No. Positive(%)
0-6	50	22(44.0)
7-12	73	39(53.4)
13-18	27	4(14.8)
19-24	18	1(5.6)
Total	168	66(39.3)
P<0.0001		

Table 3: Viral infection with respect to feeding patterns

Feeding patterns	No Tested	No. Positive(%)
Exclusively breastfed	39	12(30.8)
Breastfed+Bottle-fed	97	39(40.2)
Solid food only	32	15 (46.9)
Total	168	66(39.3)
P=0.369		

Table 4: Viral infection with respect to some variables.

Characteristics	No. examined	No infected(%)	P-value
Season:			0.038
Dry	66	19(28.8)	
Rainy	102	47(46.1)	
Family Socioeconomics Status:			0.088
Low income	92	42(45.7)	
Middle income	60	21(35.0)	
High income	16	3(18.8)	
Maternal level of Education:			0.206
Primary school	59	22(37.3)	
Secondary school	74	34 (45.9)	
Tertiary institution	35	10(28.6)	
Maternal occupation:			0.568
Civil servants	43	19(44.2)	
Traders	66	28(42.4)	
Artisans	48	15(31.3)	
Farmers	11	4(36.4)	