

Original Research Article

Enteric Viruses Association With Diarrhea in Young Children 0-24 Months in an Urban Secondary Health Center in Benin City, Nigeria.

Abstract

Introduction: Viral intestinal infections are the most common cause of acute infectious diarrhea among children worldwide. 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, and 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 9.6% 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 methods on viral diarrhea was not statistically significant ($P > 0.05$) while the effect 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 respectively ($P > 0.05$).

Conclusion: Viral diarrhea had a prevalence of 39.3% and rotavirus was the most prevalent agent. Feeding methods, socioeconomic status, level of education and occupation respectively did not show significant association with viral infection..

Key Words: Diarrhea, enteric viruses, secondary health center, single infection, mixed infection.

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30 **1.0 Introduction**

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

44 In many developing countries including Nigeria, data on viral enteropathogens are limited
 45 especially with respect to the pediatric population. This may be due to the fact that diagnostic tests
 46 for these viruses are not routinely carried out in many Nigerian hospitals and as a result, many
 47 important viral pathogens of interest are missed out (i.e unidentified). This situation further
 48 compound data collation as regards viral diarrhea and implementation of control strategy to combat
 49 the disease becomes difficult to carry out. Against this background, this study was carried out to
 50 ascertain the prevalence rates of viral enteropathogens (rotavirus, adenovirus and norovirus) as
 51 causative agents of viral diarrhea among children attending Central hospital, Benin City, Nigeria.
 52 This work is also aimed at assessing the relationship between feeding methods and viral diarrhea, as
 53 well as the effect of some variables on viral diarrhea.

54 **2.0 Patients and Methods.**

55 Study location and population: This study was carried out at Central hospital, Benin City,
 56 Nigeria. It is a secondary health care center and it is located in Benin City, Edo State, Nigeria. It
 57 attends to all medical cases as well as referral cases from primary health care centers. A total of two
 58 hundred and thirteen (213) stool specimens were collected from children age 0 to 24 months
 59 comprising 168 diarrheic children and 45 apparently healthy age matched children . 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 using odd ratio and chi-square (X^2) tests. A P-value of less than 0.05 was considered as significant.

3.0 Results

Out of the 168 children with diarrhea, 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 9.6% and norovirus 2.4% (Table 1). Sex and age distribution 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). The distribution of infection showed that single infection was 32.1% while mixed infection had 7.1%. (Table 3). The relationship between feeding methods and viral diarrhea did not show significant association ($P = 0.369$) (Table 4). The effect of some variables on pediatric viral diarrhea is showed in table 5. Seasonal pattern of infection was statistically significant ($P = 0.038$) while family socioeconomic status, maternal level of education and occupation respectively did not show statistical significance ($P > 0.05$).

4.0 Discussion

Enteric viruses were investigated among children 0 to 24 months of age. The overall prevalence of viral agents was 39.3%. Rotavirus had 27.4%, adenovirus 9.6% and norovirus 2.4%. The prevalence of rotavirus infection 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 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 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 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, exclusively breastfed infants had the lowest percentage of viral agents with a total of 30.8%, The reason for this may be due to the immunity derived from breast milk. 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) stated that breastfed babies are four times less likely to develop diarrhea associated with gastroenteritis than artificially fed babies. However, 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 effect of other variables such as family socioeconomic status, maternal level of education and occupation did not show statistical significance.

5.0 Conclusion

Viral agents of diarrhea in infants and young children was found to be 39.3% and rotavirus was 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 many 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 infections. 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. Pp907-913.
- 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. Microbial. 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 Paediatr.* 2005; **94**:667-671.
- 6) Caracciolo, S., Minim, C., Colombrita, D., Foresti, I., Avolio, M., Tosti, G., Fiorentin S. and Caruso 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., Noel, J., Parashar, U., Rosen, B. and Monvoe, S.S. 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. and 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: **880**: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, M.P. Spario, L.C. Hospitalization due to norovirus and genotypes of rotavirus

- in pediatric patients. State of Espirito Santo Mem. Inst. Oswaldo Cruz, Rio de Janeiro. 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. Virol.* 2006; **48**:1480-1485.
- 25) Colomba, C., Saporito, L., Giammanco, G.M., de Grazia, S., Ramirez, S., Arista, S. Titore,
L. Norovirus and gastroenteritis 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 Caracas, Venezuela: Implications for rotavirus 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 MA, 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 MJ. 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 RJ., Tipton, G., Klish, WJ, Brown, MR. Effect of breastfeeding on morbidity in
rotavirus gastroenteritis. *Pediatr.* 1984. 74:250-253.

Table 1: Overall prevalence of enteric viruses among children with diarrhea.

Enteric viruses	Positive patients	Percentage
Rotavirus	46	27.4
Adenovirus	16	9.6
Norovirus	12	2.4
Total	66	39.3

Table 2: Sex and age distribution of viral enteropathogens

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: Distribution of single and mixed infection.

Types of infection	No. Positive	Percentage
Single	54	32.1
Mixed	12	7.1
Total	66	39.3

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Table 4: Relationship between feeding methods and viral diarrhea.



Feeding Methods	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

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266 **Table 5: Effect of some variables on pediatric viral diarrhea.**

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268 **Characteristics** **No. examined** **No infected(%)** **P-value**

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270 **Season:** 0.038

271 Dry 66 19(28.8)

272 Rainy 102 47(46.1)

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274 **Family Socioeconomics Status:** 0.088

275 Low income 92 42(45.7)

276 Middle income 60 21(35.0)

277 High income 16 3(18.8)

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279 **Maternal level of Education:** 0.206

280 Primary school 59 22(37.3)

281 Secondary school 74 34 (45.9)

282 Tertiary institution 35 10(28.6)

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284 **Maternal occupation:** 0.568

285 Civil servants 43 19(44.2)

286 Traders 66 28(42.4)

287 Artisans 48 15(31.3)

288 Farmers 11 4(36.4)

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