

Incidence of Rotavirus and Adenovirus Infection among Under-2 Children with Acute Watery Diarrhoea at a Tertiary Care Hospital

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Abstract

Background: Diarrhea is a leading cause of childhood death in the world, accounting for 5-10 million deaths per year. Worldwide, rotavirus is estimated to cause more than 111 million cases of diarrhea annually in children younger than 5 year of age. It is considered as a major cause of childhood morbidity and mortality particularly in developing countries like Bangladesh. Considering the high morbidity and significant mortality, this study was designed to determine the incidence of rotavirus and adenovirus associated diarrhea among under 2 years.

Materials and methods: This cross-sectional study was conducted in the Department of Pediatric Gastroenterology, Chattogram Maa-O-Shishu Hospital Medical College from 1st September 2022 to 28th February 2023. Total of 150 patients were enrolled in this study who were admit with acute watery diarrhoea. Stool samples were obtained and assayed for rotavirus antigen by Immunochromatography Test (ICT) – ICT Quick Rotavirus kits (Arco Biotech, Germany) were used to detect rotavirus antigen in stool samples.

Results: Viral antigens were detected in 116 (77.33%) out of 150 samples analysed during the study period. Of the antigen-positive samples, 70(60.3%) belonged to boys and 46 (39.65%) belonged to girls. Of the total antigen-positive samples the Rotavirus antigen was identified in 101 (87.06%) specimens, the Adenovirus antigen was identified in 11 (9.48%) and Rota adeno was identified in 4 (3.44%) specimens. The high prevalence of rotavirus and adenovirus between the ages of 7 and 12 was found 47 (40.51%) and 6 (5.17%) respectively which is to be statistically significant ($p < 0.05$). High incidence rate of rotavirus infections in winter months was determined. This was found to be statistically significant ($p < 0.05$).

Conclusion: This study showed a high prevalence of Rotavirus (67.33%) infection in patients under 2 years of age. Peak age incidence under 12 months and in January. Using the rotavirus vaccine in this population can reduce diarrhoea prevalence and eliminate unnecessary antibiotic use.

Key words: Acute watery diarrhoea; Children; Rota and adeno virus infection.

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INTRODUCTION

Diarrhea is a leading cause of childhood death in the world, accounting for 5-10 million deaths per year. In early childhood, the single most important cause of severe dehydrating diarrhoea is rotavirus infection. Rotavirus and other gastroenteric viruses are not only major causes of pediatric deaths but also lead to significant morbidity.¹ Worldwide, Rotavirus is estimated to cause more than 111 million cases of diarrhoea annually in children younger than 5 yr of age. Of these, 18 million cases are considered at least moderately severe, with approximately 500,000 deaths per

year.² Rotavirus is in the Reoviridae family and causes disease in virtually all mammals and birds. These viruses are wheel-like, triple-shelled icosahedrons containing 11 segments of double-stranded RNA. The diameter of the particles on electron microscopy is approximately 80 nm.¹ There are three rotavirus groups, A, B and C, which are both antigenically and genetically distinct. The inner capsid protein, VP6 is the common or group-specific antigen. Indeed, rotavirus is responsible for destroying mature enterocytes, thereby reducing the absorption capacity of the villi and causing diarrhoea.^{3,4} Group A rotaviruses are the predominant cause of rotavirus disease throughout the world.

More than 95% of all children have been infected by group A rotaviruses by the age of 4 and in developing countries, infection occurs primarily between 4 months and 2 years of age.⁵

Typically, rotavirus gastroenteritis is more frequently observed in winter months under temperate climate conditions. Symptoms of rotavirus Acute Gastroenteritis (AGE) usually begin with vomiting followed by frequent passage of stools, associated with fever in about half the cases. Recovery with complete resolution of symptoms generally occurs within 7 days.² Diarrhea and vomiting may lead to hypovolemic shock and dehydration.^{8,9} Severe cases may lead to death.⁴

In Bangladesh, Rotaviruses cause 6,000–14,000 deaths each year in children <5 years of age.⁸ Due to overcrowding, poor sanitation and hygienic practices, they have been under significant health risks including diarrheal diseases. It has been estimated that 29% of all diarrheal deaths in children <5 years of age are due to Rotavirus and about 23% of them are in the Indian subcontinent.⁹ Approximately 95% of children are infected before 3–5 years of age, and the highest incidence occurs between 6 and 24 months of age.¹⁰ It has been noticed that antibiotics are randomly used in diarrhoea by registered and unregistered doctors without knowing the causative organism. The diarrhoea aetiology remains obscure which is very important in deciding treatment, prevention, and control of diarrhoea. Early diagnosis of rota and adenovirus infection prevents unnecessary use of antibiotics, minimizes its spread and helps to determine the appropriate treatment. For all these reasons this study aimed to know the viral etiology associated with diarrhea.

MATERIALS AND METHODS

This cross-sectional observational study was conducted among children under 2 years of age who were admitted with acute gastroenteritis in the Department of Pediatric Gastroenterology, Hepatology & Nutrition of Chattogram Maa-O-Shishu Hospital Medical College (CMOSHMC) during the period of 1st September 2022 to 28th February 2023. A total of 150 patients were enrolled in this study. The inclusion criteria were patients aged less than 2 years with acute gastroenteritis were enrolled in this study. The medical data was analyzed

from previously taken questionnaires for each patient. The exclusion criteria are chronic diarrhoea (Which is defined as diarrhoea that lasts for more than two weeks) loose stool mixed with blood and mucus. Fresh stool samples will be obtained within 24 to 48 hours of admission. Sterile wide-necked plastic containers will be used to collect and transport the samples. Detection of rotavirus by Immunochromatography Test (ICT) ICT Quick Rotavirus kits (Arco Biotech, Germany) were used to detect rotavirus antigens in stool samples.

Ethical approval was obtained from the Research Ethical Committee. Written consent was taken from adult subjects and also from children's mothers.

The participants were informed using simple language about infection, the aim of the research and the benefit of the study.

All information regarding disease complaints, history, risk factors and stool samples for viral antigen reports was collected by both principal and co-investigators and analyzed by professional data manager SPSS version 27.

RESULTS

Viral antigens were detected in 116 (77.33%) out of 150 samples analysed during the study period. Of the antigen-positive samples, 70 (60.3%) belonged to boys and 46 (39.65%) belonged to girls. Male female ratio is 1.52:1. Although viral antigenicity was observed most commonly in boys, the difference between the genders was not statistically significant ($p > 0.05$).

Of the total antigen-positive samples 116 (77.33%) the Rotavirus antigen was identified in 101 (87.06%) specimens, the Adenovirus antigen was identified in 11 (9.48%) and Rota adeno was identified in 4 (3.44%) specimens. Of the patients with positive Rotavirus antigen, 6 (5.17%) were between the ages of 0 and 6, 47 (40.51%) were between the ages of 7 and 12, 36 (31.03%) were between the ages of 13 and 18 and 12 (10.34%) were between the ages of 19 and 24 months. Of the patients with positive adenovirus antigen, 2(1.72%) were between the ages of 0 and 6, 6 (5.17%) were between the ages of 7 and 12, 2 (1.72%) were between the ages of 13 and 18 and 1(0.86%) were between the ages of 19 and 24 months. Of the patients with positive Rota adenovirus, 2 (1.72%) were between the ages of 0 and 6, 6(5.17%) were between the ages of 7 and 12, 2(1.72) were between the ages of 13 and 18 and 1(0.86%) were between the ages of 19 and 24 months. The high prevalence of rotavirus and adenovirus between the ages of 7 and 12 was found to be statistically significant ($p < 0.05$). When the relationship of antigen positivity of rotavirus and adenovirus with the seasons was scrutinized, we found that 35.34% (41) in autumn and 64.65%(75) in winter, a high incidence rate of rotavirus infections in winter months was determined. This was found to be statistically significant ($p < 0.05$). The relationship between the antigen positivity of the adenovirus and the co-positivity of the adenovirus rotavirus with the seasons was not statistically different ($p > 0.05$).

Table I Gender of respondents according to case positive finding

Sex	Number (%)	Rota(+VE) %	Adeno (+VE)%	Rota Adeno (+VE)%
Male	86 (57.3)	59 (50.86)	8 (6.89)	3 (2.58)
Female	64 (42.7)	42 (36.20)	3 (2.58)	1 (0.86)
Total	150 (100)	101(87.06)	11(9.48)	4 (3.44)

Table II Age group distribution according to case positive finding

Age group (Month)	Number (%)	Rota (+VE) %	Adeno (+VE) %	Rota Adeno (+VE) %
0-6	13(8.6)	6(5.17)	2(1.72)	2(1.72)
7-12	63(42)	47(40.51)	6(5.17)	1(0.86)
13-18	51(34)	36(31)	2(1.72)	1(0.86)
19-24	23(15.3)	12(10.34)	1(0.86)	4(3.44)

Table III Demographic characteristics and clinical presentation of respondents

Variables	n=150, % (n)
Age in year (Year, Mean±SD)	13.32±5.37
GENDER (% , n/total)	
Male	57.3 (86)
Female	42.7 (64)
Antibiotics before admission	42.7 (64)
Duration of diarrhea before arrival at hospital	
<1 Day	22(33)
1-3Days	62(93)
4-6 Days	16(24)
Character of stool	
Loose watery	80.66(121)
Rice	4 (6)
Mucus mixed	8 (12)
Bloody mucoid	7.3 (11)
Symptoms	
Fever	43.3(65)
Abdominal pain	10(15)
Vomiting	58(87)
Source of water	
Safe water	73.33(110)
Unsafe water	26.66(40)
Hand hygiene	
Yes	75.3(113)
No	24.7(37)
Economic status	
Lower	58.66(88)
Middle	36(54)
Upper	5.3(8)
Rota vaccination	2.66(4)

Variables n=150, % (n)

Feeding in 1st 6month	
Exclusive breast feeding	49.33(74)
Formula	28.66(43)
Mixed	22(33)
Education of Mother	
Illiterate	19.33(29)
Primary	20.66(31)
Secondary	32.66(49)
Higher secondary	15.33(23)
Graduate	12(18)

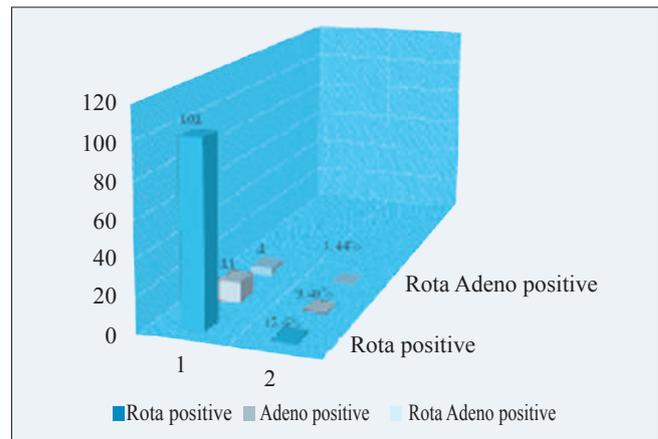


Figure 1 Prevalence of infection among positive sample

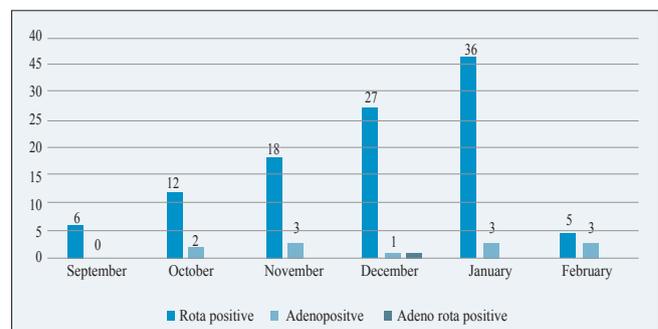


Figure 2 Rate of antigen positivity according to Autumn and Winter

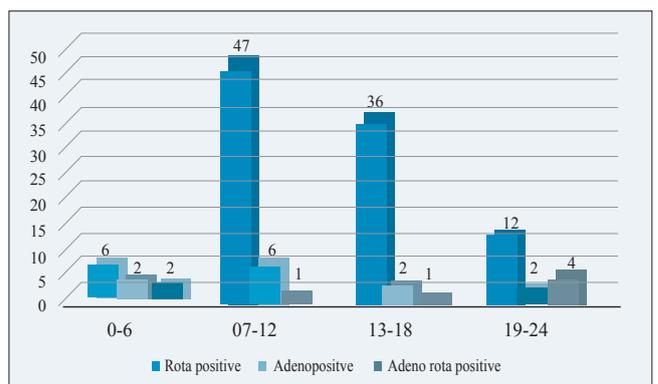


Figure 3 Distribution of infection by age group

DISCUSSION

This study showed higher numbers of viral infections in males than in females, as seen by other researchers.^{11,12} The reasons for the observed higher prevalence among the male gender are not quite clear.¹³ Other studies have found that girls were more susceptible to rotavirus and adenoviruses gastroenteritis than boys but these differences were however not significant ($p > 0.05$).^{14,15}

We detected 116 (77.33%) cases of viral antigen positivity in stool specimens from a total of 150 patients aged 0-24 months with gastroenteritis. Of the antigen-positive sample Rotavirus was identified in 101 (87.06%) Adenovirus in 11 (9.48%) and Rota-Adeno virus 4(3.44%) for a total of 150 patients.

Another similar finding by TaherehZiaeiKajbaf et al. obtained that 92% of the patients positive for rotavirus were under 2 years of age, with the highest prevalence between 7-12 months 44.4%.¹⁶ This age distribution is comparable to previous reports.¹⁷

Our study also showed that the prevalence of rotavirus-positive cases according to age groups was highest among 7-12 months age group children 47(40.51%) followed by 13-18 months age group children 36 (31%), which is similar to other studies done by in south Bangladesh, Iran and Iraq.^{12,16,13} So we conclude that rotaviral diarrhoeal incidence is more common under 12 month age.

Adenovirus was responsible for 11(7.33%) of diarrhoea among the population studied. Similar prevalence was reported in North-Western Nigeria and South-Western Nigeria at 12.4% and 18% respectively.^{14,15} However, the low detection of enteric adenovirus prevalence was reported in Tanzania (3.5%) and Iran (3.3%).^{18,19} The great majority of diarrhoea with adenoviruses in our setting is probably undiagnosed and under-reported as it is not routinely tested for.

In this study, monthly distribution analysis of rotavirus and adenovirus incidence revealed that rotavirus alone was highest in January 36(35.64%) followed by December 27(26.73%). This epidemiology is consistent with previous studies.^{20,21}

Infants younger than 3 months are relatively protected by transplacental antibodies and possibly breastfeeding.² We found only 6 (5.17%) and 2(1.72%) rota and Adeno positive cases respectively among 0-6month age which indicate lower incidence in this age group.

Our study showed that 53% of positive cases took antibiotics before hospital admission, which is common in developing countries. Ahmed S, et al. from Bangladesh found that 76% and 52% of under-5 children in urban and rural areas, respectively, received antimicrobials for diarrhoea.²²

Frequent antibiotic treatment of diarrhoea leads to antimicrobial resistance. Knowing the aetiology and vaccination can prevent unnecessary antibiotic use in Rota viral-associated gastroenteritis.

Our study revealed that rotaviral diarrhoea was higher among children who belong to lower socio-economic status than the

children from middle socio-economic status. This finding is similar to the findings of Bangladeshi studies.^{8,12} This can be explained by unimmunization, the lack of infrastructure, and inadequate knowledge about the disease.

Rotavirus and other gastrointestinal viruses spread efficiently via a fecal-oral route. The virus is shed in stool at a very high concentration before and for days after the clinical illness.² Our study findings indicate that the high prevalence of rotavirus and enteric adenovirus is primarily due to the lack of insufficient access to adequate hygiene, sanitation and clean drinking water are the main factors leading to the heavy burden of acute gastroenteritis in developing countries.

It has been shown that a vaccine effective in the prevention of rotavirus infection, the most common cause of viral gastroenteritis, provides 70% - 85% protection against rotavirus diarrhoea and 85%-100% protection against severe diarrhoea.²³

In our study, when we contacted the families, particularly those with children who tested positive for the viral antigen for rotavirus, we asked whether they had their children vaccinated and learned that only 4(2.66%) children were vaccinated. Although it is available in the private market, it is expensive and outside the reach of many poor population.

Effective rotavirus vaccination could reduce the overall burden of the disease. To date, rotavirus vaccines have not been introduced into the routine immunization schedule in Bangladesh.

LIMITATIONS

There are several limitations of our study. First, as it is a small sample size and single center study, so actual population parameters may not be represented. Second, This study targeted only those who presented to the hospital and a good number may not have had access to hospital care. Besides we did not consider other possible enteric pathogens or the use of molecular methods for the detection of the diarrhoeal etiologic agents.

CONCLUSIONS

This study showed a high prevalence of rotavirus 116 (67.33%) infection in patients less than 2 years of age. Seasonal distribution was found in January. It seems rational to use the rotavirus vaccine in this population to reduce the prevalence of acute watery diarrhoea. The result of our study can also eliminate unnecessary use of antibiotics.

RECOMMENDATIONS

This study was done for 6-month period in which period the prevalence of viral diarrhoea was high. To know the exact aetiology, More detailed studies with longer duration are necessary to determine the viral strains and other epidemiological and clinical features of childhood diarrhoea caused by these viruses. Whole-year evaluation is recommended.

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DISCLOSURE

All the authors declared no competing interest.

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