Original Research Article

Prevalence of rotavirus and adenovirus in patients with acute viral gastroenteritis in Dakar, Senegal, 2018-2022

Abstract

Objective : The aim of this study was to retrospectively determine prevalence of rotavirus and adenovirus in patients presenting with gastroenteritis symptoms and the distribution of pathogens according to gender, age and season. **Material and methods :** Stool samples received at the medical microbiology laboratory between January 2018 and December 2022 were evaluated for rotavirus/adenovirus antigen with BIOSYNEX Rotavirus/Adenovirus BSS kit (BIOSYNEX, Switzerland). **Results :** Rotavirus was detected in 36 (6.96%) of the 517 stool samples evaluated and 16 (3.09%) samples were positive for adenovirus. Co-infection was detected in 10 samples (1.93%). Prevalence of rotavirus and adenovirus was 12.22% (28/229) and 4.80% (11/229) respectively in children aged 0-12 months. Our results showed a significant difference between the patients among the three study groups (rotavirus, adenovirus and mixed) with regard to their age categories. Regarding the monthly distribution, the highest detection rate of rotavirus gastroenteritis was found between the months of September (12.28%) and February (14.89%). Adenoviruses were detected continuously over a period from June to December with a significant difference ($p<0.05$). **Conclusion :** Due to the high prevalence of viral diarrhoea in children in our region and the morbidity and mortality that can be associated with it, it is important that medical laboratories are equipped to detect viruses specifically rotavirus and adenovirus for efficient management. All of these actions combined with vaccination will contribute to a significant reduction in the burden of these infections on our health system.

Key-words : adenovirus, rotavirus, prevalence, children

Introduction

Gastroenteritis is a major global health problem that manifests itself as three or more watery or loose bowel movements within a 24-hour period that can last several days, accompanied by fever and vomiting. The most common pathogens that cause viral gastroenteritis are rotavirus, enteric adenovirus, astrovirus, norovirus and sapovirus **(1)**.

Rotavirus infection is the most important cause of severe, dehydrating, infectious diarrhoea and death in children aged 5 years and under and continues to have a significant impact on

child morbidity and mortality **(2)**. Group A rotavirus is primarily responsible for acute gastroenteritis, which causes severe dehydration in children under the age of 5. Recurrent infections are widely observed throughout life, but the severity of infections decreases with each recurrence **(3)**. The virus is transmitted by the faecal-oral route **(4)**.

Rotavirus is a non-enveloped double helix RNA (dsRNA) virus composed of three concentric capsids surrounding a genome of 11 dsRNA segments **(3)**. There are nine different types (A-D, F-J) **(5)**. The most common strains are G1P[8], G2P[4], G3P[8], G4P[8] and G9P[8] **(6)**. Each year, approximately 111 million episodes of rotavirus gastroenteritis are reported in children worldwide, of which 2 million require hospitalisation and 400,000 deaths occur, mainly in Asian and African countries **(7)**. In addition, a total of 365 million US dollars (USD) is spent annually on treating rotavirus gastroenteritis in China alone **(8)**. Therefore, use of rotavirus vaccines in routine immunisation programmes worldwide is now strongly recommended by the World Health Organization (WHO **(9)**.

Adenovirus is another important etiological agent of severe gastroenteritis in infants and young children. Adenoviruses are double-stranded DNA viruses, belonging to the genus Mastadenovirus of the family Adenoviridae. More than 57 serotypes of adenovirus have been identified. They are divided into 7 species (A-G). Different serotypes differ in their tissue tropism and site of infection **(10)**. Although adenoviruses are most commonly associated with respiratory infections, some serotypes are associated with diarrhoeal disease. Adenoviruses most commonly associated with diarrhoeal disease in young children are species F (serotypes 40 and 41) and species A (serotypes 12, 18 and 31).

For management, no effective treatment has been developed for viral gastroenteritis. However, there are six live attenuated oral rotavirus vaccines accepted for worldwide use by World Health Organization. In Senegal, few published studies have associated adenovirus and rotavirus with gastroenteritis. The present study aimed to retrospectively determine the prevalence of rotavirus and adenovirus in patients presenting with gastroenteritis symptoms in 2018-2022 and the distribution of pathogens by sex, age and years.

Material et methods

Design and implementation of study

Rotavirus/adenovirus antigen test results were evaluated retrospectively, based on stool samples delivered to the medical microbiology laboratory of the Institut Pasteur de Dakar in patients presenting with gastroenteritis symptoms between January 2018 and December 2022. The socio-demographic data of the patients (age, sex, years) were obtained from the laboratory information system.

Sample collection

Stool samples were collected in clean, dry, leak-proof screw-top jars without detergent or preservative and transported immediately to the laboratory. Best results will be obtained if the test is performed within 6 hours of sample collection.

Viral detection

Rotavirus and adenovirus antigens were tested according to the manufacturer's recommendations with BIOSYNEX Rotavirus/Adenovirus BSS kit (BIOSYNEX, Switzerland), which qualitatively detects rotavirus and adenovirus antigens by the immunochromatographic method. 1-2 ml of diarrhoeal stool or 1-2 mg of solid stool are diluted in the extraction buffer and 2 large drops (80µL) are poured into the sample well (S) of the cassette. The results are read at 10 minutes and the result is uninterpretable after 20 minutes.

Interpretation of results

Adenovirus

Appearance of a red band in the test area (A) appears with the control band (C) signifying a positive test.

Rotavirus

Appearance of a red band in the test area (R) appears with the control band (C) signifying a positive test.

Adenovirus/Rotavirus

A coloured band appears in the control area (C) and two other coloured bands appear in the test areas (R) and (A).

Statistical analysis

Data entry was performed using Excel version 2016 (Microsoft, USA) and statistical analysis was performed using STATA 14.0 (Stata Corp, USA) version 20.0. A bivariate analysis was performed and the Chi-square test was performed with a statistically significant difference at a p-value < 0.05.

Results

Socio-demographic characteristics

A total of 517 children with a mean age of 28 months and ages ranging from 1 to 108 months were included in the study. Study population was composed of 58.03% (54.0-62.7) girls (n=300) and the most represented age group was 0-12 months with 229/517 or 44.29% (40.0-48.5) (n=229).

Table 1 : Characteristics of study population

	Number	% (95% CI)
Gender		
Women	217	41.97 (37.3-46.0)
Men	300	58.03 (54.0-62.7)
Gender ratio M/F	1.38	
Mean age	28,80 months (22.5-25.1)	
(Extremes)	(1-108 months)	
Age group		
0-12	229	44.29 (40.0-48.5)
13-24	106	20.50 (17.0-24.2)
25-36	103	19.92 (16.8-23.2)
37-48	74	14.31 (11.4-17.4)
49-60	4	0.77 (0.2-1.5)
>60	1	0.19 (0.0-06)
Total	517	100

Rotavirus and adenovirus antigen positivity

We found 52/517 or 10.05% were diagnosed with rotavirus and/or enteric adenovirus infections. A prevalence of 6.96% (5-9.1), 3.09% (1.7-4.6) and 1.93% (0.8-3.1) respectively for rotavirus, adenovirus and co-infection was obtained.

Antigen distribution by age and sex

In terms of antigen positivity by age group, a high prevalence of rotavirus 12.22% (28/229) and adenovirus 3.88% (1/74) was noted in children aged 0-12 months. Eight (8) patients aged 0-12 months were co-infected with both viruses. Our results showed a significant difference between the patients among the three study groups (rotavirus, adenovirus and mixed) with respect to their age categories (Table II). Table III shows that prevalence of rotavirus and adenovirus infection in males was higher (8% and 2.66% respectively) than in females (5.52% and 2.66%) with a difference that was not statistically significant.

Table 2 : Distribution of rotavirus and adenovirus antigens and co-infection by age

	Rotavirus	***Adenovirus***	**Co-infection**

Age group	N	+ve (%)	+ve (%)	+ve (%)	p-value
0 – 12	229	28 (12.22)	11 (4.80)	8 (3.49)	<0.001
13 – 24	106	2 (1.88)	2 (1.88)	0 (0)	
25 – 36	103	4 (0.77)	2 (1.94)	1 (0.97)	
37 – 48	74	1 (3.88)	0 (0)	0 (0)	
49 – 60	4	0 (0)	0 (0)	0 (0)	
>60	1	1 (100)	1 (100)	1 (100)	
Total	517	36 (6.96)	16 (3.09)	10 (1.93)	

Table 3 : Distribution of rotavirus and adenovirus antigens and co-infection by gender

		Rotavirus	Adenovirus	Co-infection	
Gender	**N**	**+ve (%)**	**+ve (%)**	**+ve (%)**	**p-value**
M	300	24 (8)	8 (2.66)	5 (1.66)	
W	217	12 (5.52)	8 (2.66)	5 (1.66)	
Total	517	36 (6.96)	16 (3.09)	10 (1.93)	

Distribution of rotavirus and adenovirus positivity by month

Figure 1 shows the monthly distribution of adenovirus and rotavirus infections in patients with acute diarrhoea. Rotaviruses were found almost throughout the year with peaks in February (14.89%), September (12.28%) and December (12.90%) without significant difference (p=0.083). Adenoviruses were detected continuously over a period from June to December with peaks in September (12.28%) and December (9.67%). There was a significant difference when adenovirus and rotavirus + adenovirus positivity rates were examined by

month ($p<0.05$).

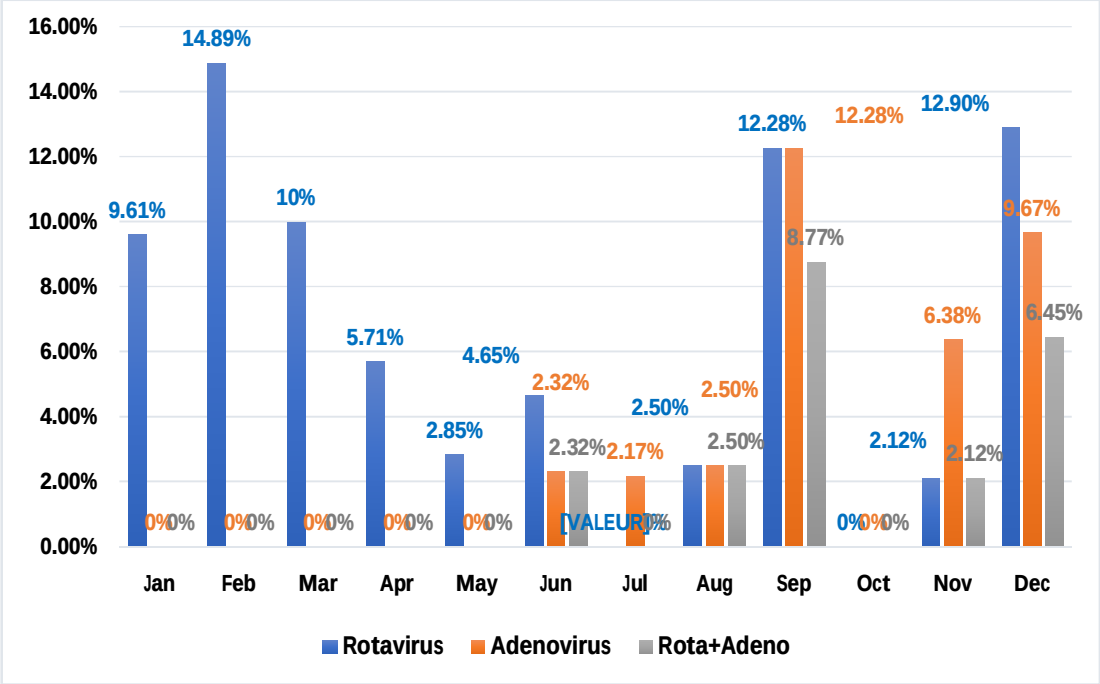

Figure 1 : Distribution of rotavirus and adenovirus positivity by month

Discussion

Diarrhoea is one of the most common public health problems, particularly in developing countries. Viral gastroenteritis is the most common cause of hospitalization of newborns and older children with severe dehydration due to diarrhoea in both developing and industrialized countries, and is also a cause of infant mortality **(11,12)**.

In this study, the detection of rotavirus and adenovirus antigens was 6.96% (n=36), 3.09% (n=16). However, 1.93% (n=10) was found for co-infection.

Available studies show that the frequency of rotavirus and adenovirus varies between countries, and in different geographical regions within a country, between years and age groups. In a study conducted in many countries with different levels of socio-economic development, the prevalence of rotavirus and adenovirus ranged from 4.8% to 45.05% and from 1.5% to 17.6% **(13–15)**.

In countries such as Japan and France, rotavirus frequency was 6.1 (16) % and 21% respectively **(17)**. In Nigeria studies showed a prevalence of rotavirus of 13.8% and 16.3% obtained in Jos and Zaria **(18,19)** higher than ours. For adenovirus our study showed a lower prevalence than the trend in Africa with 3.8% in Nigeria **(20)**, 33.6% In Tanzania **(21)** et 7.8% in Gabon **(22)**. Differences in results may be due to the duration of studies, age of patients,

different study seasons and methods used **(23)**. This study was conducted during the hot and cold seasons of the year and gastroenteritis outbreaks vary by season **(24)**.

The 1.93% prevalence of rotavirus and adenovirus co-infection observed in this study is lower than the 3.2% reported in Nigeria **(25)**. Although the contributory effect of individual virus on diarrhoea condition has not been assessed, the diarrhoea in these cases may also be due to the synergistic effect of the two viruses. In any case, co-infection is attributable to the poor hygienic conditions and overcrowding in the study area. This is supported by Guix **(26)** who reported that it has been suggested that poor hygiene conditions contribute to multiple infections in developing countries.

Regarding distribution of viruses by time of year, rotavirus infection is common in many countries in winter and spring **(27)**. This study found that rotavirus infections increased from December to April and then decreased until September. Adenovirus infection was observed in second half of the year (June-December) with highest positivity rate observed in September. The seasonal pattern of rotavirus varies by climatic zone and is also associated with local weather conditions **(28)**. In both developed and developing countries, viral diarrhoea pathogens, particularly rotavirus, have a negative relationship with ambient temperature **(29)**.

The reason why the prevalence of rotavirus and adenovirus detected in our study was lower than in many other studies may also be due to the method used for virus detection. The molecular methods used in the studies are more sensitive tests than the immunochromatographic method.

The highest prevalence was observed in children aged 0-12 months ($p<0.001$), which is similar to several reports **(30–32).** Most of the literature considers that the incidence of rotavirus is maximal during the first 2 years of life **(33,34)**, the same conclusion was also reached in our study. It was also observed that most children were infected with both viruses before the age of two years, indicating a possible reflection of behavioural uniqueness. Indeed, for those aged 0-12 months, one could assume that due to their crawling attitude, the tendency to ingest soiled objects is high. Given that the route of infection is faecal-oral, it is expected that these categories of children may be considered susceptible and therefore victims.

No significant relationship was observed in this study between gender and the incidence of viral gastroenteritis. This is consistent with other studies that found no significant difference in rotavirus or adenovirus positivity between the sexes **(24,35,36)**. In contrast, another study found that adenovirus positivity was significantly higher in men than in women **(37)**.

The limitations of the study were that the immunochromatographic method used in the detection of the virus was not equal to the molecular methodologies. Sequencing could not be performed to identify the circulating genotypes in the population. Vaccine uptake was not documented either.

Conclusion

In conclusion, results of the present study highlight the importance of detecting enteric viral pathogens, particularly rotavirus in stools of children with acute gastroenteritis. The high incidence of disease burden due to rotavirus strongly supports the concept that development of immunisation and vaccination programmes can have a major impact on reducing morbidity. We believe that such studies are important to draw attention to the disease in areas such as West Africa with low socio-economic status and poor infrastructure.

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