

The Prevalence of Rotavirus and Adenovirus in Children 0-5 years old Suffering from Acute Diarrhea in the University Hospital Center of Mother and Child (UHC-MC) in N'Djamena, Chad

Fombotioh Ndifor¹, Abakar Idriss Lawane^{1*}, Nadjioroum Ngam-Asra^{1, 2}, Mouktar Abaya Adoum², Brahim Boy Otchom² and Hamit Mahamat Alio¹

¹Department of Biomedical Sciences and Pharmacy, Faculty of Human Health Sciences, University of N'Djamena. P.O. Box: 1117, N'Djamena, Chad.

²Departement of Biomedical and Pharmaceutical Sciences, Toumai University, P.O. Box: 1764, Chad, N'Djamena.

E-mail: fombotioh2020@gmail.com; benlawane@gmail.com; nngamzolata10@gmail.com; abayamouktar@gmail.com; bbrahim5@hotmail.com; hamitalio@yahoo.fr

*Corresponding author details: Dr. Abakar Idriss Lawane; benlawane@gmail.com

ABSTRACT

Acute diarrhea is one of the leading causes of morbidity and mortality in children from 0-5 months old, especially in Africa and many developing countries. Rotavirus and Adenovirus have been recognized as the common pathogens for this public health problem. However, little or no investigation has been carried out on the two viruses in Chad. In view of this fact, we decided to study the prevalence of Rotavirus and Adenovirus in children suffering from acute diarrhea at the University Hospital Center of Mother and Child (UHC-MC).

Fresh stool samples were collected from 440 children ages 0-5 years (225 females and 215 males). They were brought for medical consultation from March 2019- September 2019 at the pediatric department. Specimens were analyzed and Rotavirus and Adenovirus were detected using Rapid Immunochromatographic Test kit (Vikia BioMerieux, France).

Out of the 440 children examined, 228 had viral infection with a prevalence of 51.81%. Based on gender infection, females 140 (62.22%) were significantly more infected than males 88(40.93%). Prevalence of mono infection of Rotavirus in children 110 (48.24%) was higher than that of Adenovirus 74(32.45%). More males had Rotavirus infection 60(68.18%) than girls 50 (37.71%). Co-infection was found to be 44 (19.29%). Distribution of viral infection indicated that children between 6-11 months had the highest viral burden 101(77.69%). Among clinical symptoms recorded, dehydration was the highest in children 84(61.76%).

Due to the high prevalence of Rotavirus and Adenovirus discovered, we suggest that vaccines for the two viruses should be included in the national immunization program.

Keywords: Prevalence; Rotavirus; Adenovirus; acute diarrhea; children; N'Djamena

INTRODUCTION

The causes of acute diarrhea in many countries and especially in tropical and sub-tropical regions may be attributed to different enteropathogens and various agents such as viruses, parasites, fungi bacteria or toxins. Diarrhea remains a second leading cause of death around the world for children under five years of age [1]. Diarrheal diseases are still leading causes of morbidity and mortality in children in many developing countries [2]. More than 700 million cases of acute diarrhea are estimated to occur annually in children less than five years old and mortality associated with this problem is estimated to be 0.8 to 2 million per year [3]. Rotavirus belongs to the family of Reoviridae, non-enveloped with a triple-layered icosahedral protein capsid and a genome of 11 double stranded RNA segments [4].

Rotavirus is the most common etiological agents associated with severe gastroenteritis leading to the dehydration and death in young infants worldwide [5]. Rotaviruses are classified into groups, subgroups, serotypes and on the basis of electrophoretic migration of gene segments. The group and sub group specificity are present on the inner capsid VP6. Currently, only Rotavirus groups A, B, C have been identified as human and animal pathogens, while groups D, E, F and G have only been identified in animal and birds [6]. Among the known species Rotavirus (RVA) group A is commonly found in children worldwide [7]. Most of the Rotavirus morbidity and mortality are concentrated in developing countries in Asia, Africa and Latin America because access to health care facilities are limited in these areas [8].

Transmission of Rotavirus occurs primarily through faecal oral route, person to person contact with contaminated hands, objects and surfaces in the environment and through respiratory droplets. Once the virus gates established in the small intestine, it usually replicates in the villi of epithelium, which then leads to a reduction in the absorption of sodium, glucose and water in the intestine [9]. Clinically, Rotavirus infection is characterized by symptoms that range from mild or watery diarrhea with short or limited duration to serious and more frequent diarrhea, which could be accompanied by abdominal pain, vomiting, fever, dehydration, shock, electrolyte in-balance and possibly death [10]. Contrary to Rotavirus that is double-stranded RNA, Adenovirus is a double-stranded DNA virus [11]. Adenoviruses, are double-stranded DNA viruses, and affects various organs of the body and mostly associated with gastrointestinal diseases; on the other hand, Adenoviruses have been responsible for respiratory and ocular diseases in children [10]. Common clinical manifestations of Adenoviruses are pneumonia, cystitis, conjunctivitis, myocarditis and hepatitis [12]. Rotavirus is responsible for an estimated 37 % diarrhea deaths, translating to 453000 deaths in children less than 5 yaers old across the world in 2008 [13]. In 2013, it was responsible for about 215,000 deaths among children less than 5 years [14]. Developing countries bear the major burden of mortality with five countries, India, Nigeria, Pakistan, Ethiopia and Democratic Republic of the Congo contributing the majority of deaths [15]. The development of Rotavirus vaccines was a major breakthrough in the fight against diarrheal diseases. Two Rotavirus vaccines are licensed and widely available in several countries, Rotarix and Rotatex [16].

Many countries have included Rotavirus vaccination in their national immunization schedule. The use of these vaccines has now been shown to clearly translate to a large decrease in hospital admission due to rotaviral diarrhea [13].

Rotavirus vaccination is a key part of a comprehensive approach to prevent and control diarrheal disease which includes the use of oral rehydration therapy, promotion of breastfeeding and improvement of environment and the nutritional factors [16]. Many research works are being carried out on Rotavirus and Adenovirus in several countries, however to the best of our knowledge, these viruses have not yet been studied in Chad. Moreover, there is no national Rotavirus vaccination program in our country. The present study is concerned with the prevalence of Rotavirus and Adenovirus in the University Hospital Center of Mother and Child in N'Djamena-Chad.

MATERIALS AND METHODS

Location and samples collection

This study was conducted at the University Hospital Center of Mother and Child (UHC-MC) in N'Djamena. UHC-MC is one of the three reference hospitals in the capital city of N'Djamena, Chad. It is located in the 3rd District. (fig1).

Samples were collected using stool vials. A total of 440 stool samples was collected from patients ages ranging from 0 to 5 years old with symptoms of acute diarrhea, from the University Hospital Center of Mother and Child (UHC-MC). The collected samples were transported and stored (2–8 °C) in the laboratory center from March 2019 to September 2019 where the examination was conducted.

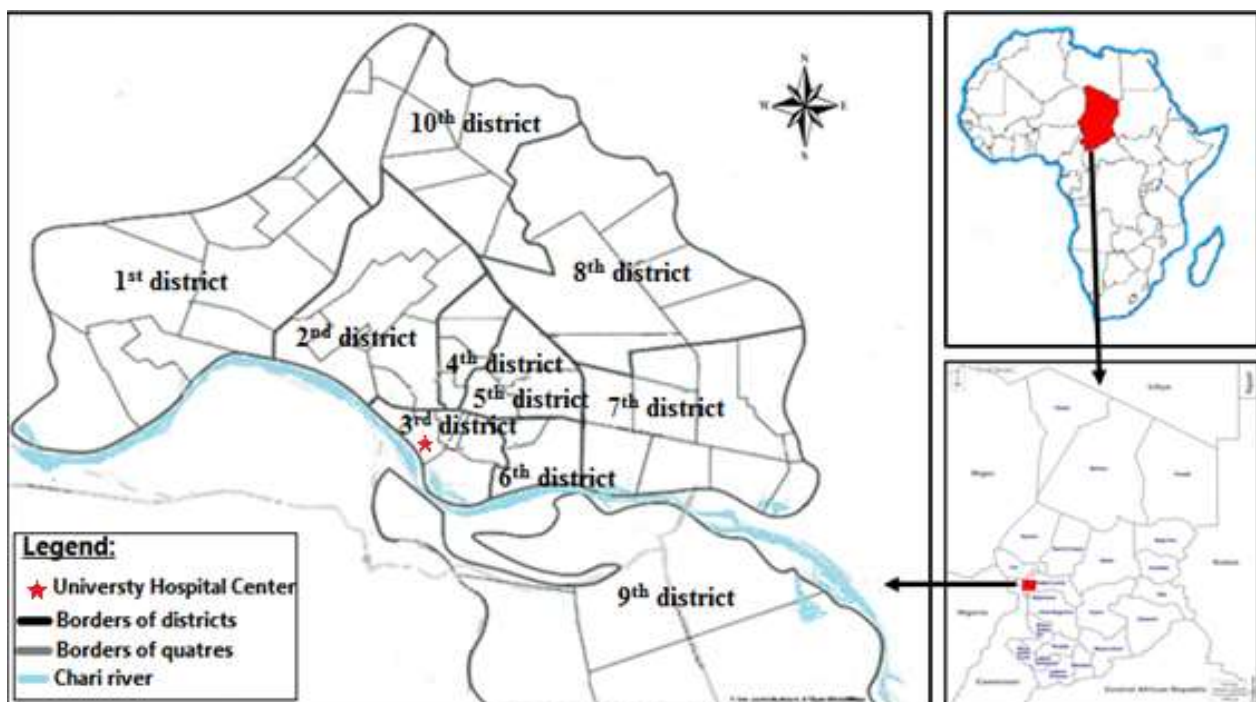


FIGURE 1: Location of University Hospital Center of Mother and Child in N'Djamena. It is represented by the red star on the map.

Preparation of stool and analysis

The Rapid Immunochromatographic Test for Detection of Rota/Adenovirus in Human stools, using a commercial kit (Vikia BioMerieux, 69 280 Marcy l'Etoile- France) was performed immediately on the fresh stool samples according to the manufacturer's instructions. Fresh stool sample was added to a tube containing 1 mL of diluent, and well mixed. Then, 4-5 drops (approximately 100-125 μ L) of this mixed suspension were added to the sample well of the test, and the result was read after 15 min.

Eligible children

All the children not more than five years old consulting in the paediatric service and suffering from acute diarrhea were included in the study.

Parents of all the paediatric patients were well informed on the nature of our study. Their verbal consent was obtained before stool specimens and data were collected from March 2019 to September 2019.

Ethical approval

Ethical clearance for this study was obtained from the National Ethics Committee of Chad (NECC). The administration of the University Hospital Center of Mother and Child (UHC-MC) authorized us to conduct our research.

Statistical analysis

The data were coded and entered in Microsoft Excel version 2013 and transferred to SPSS Version 24. Chi-square test was used to compare categorical data and the p-value < 0.05 was considered statistically significant.

Results

During the period of this study, 440 stools specimens from children with acute diarrhea were examined and clinical data consisting of symptoms of fever, vomiting and dehydration were recorded. The specimens were tested for Rotavirus and Adenovirus. Among the children, 225 (51.13%) females and 215 (48.86%) males were examined. This participation had a sex ratio of 1.04 in favor of female gender. The prevalence (Table 1) of this study showed that the female subjects were more infected, 140 children with a percentage of (62.22%) than the male subjects 88 (40.93%).

TABLE 1: Prevalence of viral infection according to gender

Gender	N 440 (100%)	n 228 (51.81%)
Female	225 (51.13%)	140 (62.22%)
Male	215 (48.86%)	88 (40.93%)

N= Examined; n=Infected

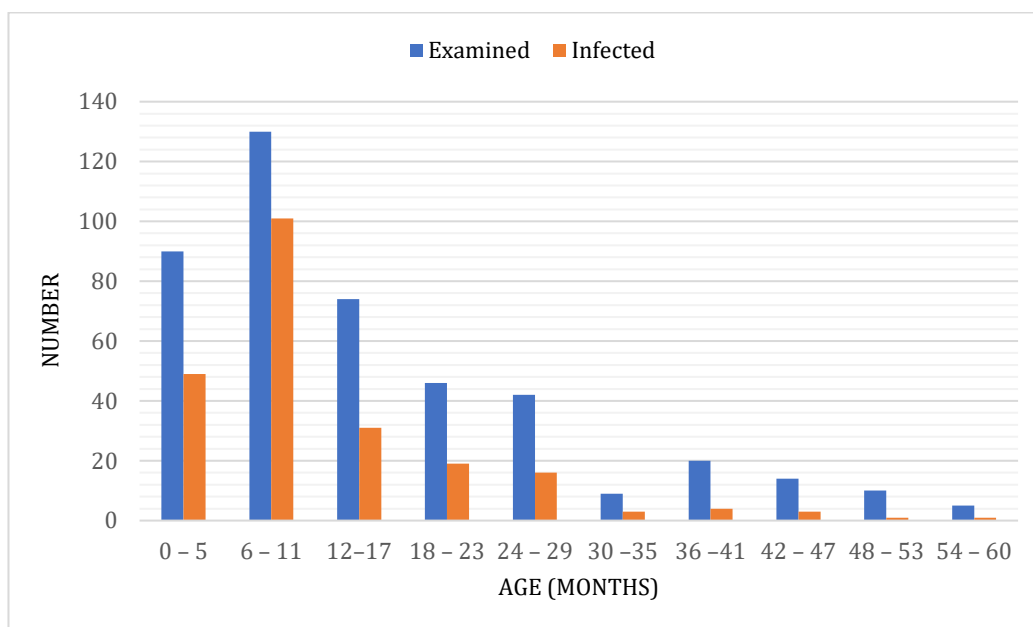


FIGURE 2: Distribution of viral infection according to age group

The distribution of viral infection according to age group showed that children 0 -5 months were 49 (54.44%), while 6-11 months old, 101 (77.69%) and for the age range of 12 - 17 months, the infected were 31 (41.89%). The highest infected age group observed was 6-11 months, meanwhile the least was 48 -53 (10.00%).

TABLE 2: Clinical symptoms of patients

Symptoms	Examined 440 (100%)	Infected 228 (51.81%)
Fever > 37°C	146(33.18%)	70(47.94%)
Vomiting	158(35.90%)	74(46.83%)
Dehydration	136(30.90)	84(61.76%)

Clinical symptoms have shown that dehydration occupied the first rank 84 (61.76%), followed by vomiting 74 (46.83%) and finally by fever 70 (47.94%).

TABLE 3: Prevalence of mono and co-infection of patients according to sex

Sex	Rotavirus	Adenovirus	R+ A
Female	50 (35.71%)	54 (38.57%)	36 (25.71%)
Male	60 (68.18%)	20 (22.72%)	8 (9.09%)
Total	110 (48.24%)	74 (32.45%)	44 (19.29%)

In table 3 mono and co-infection indicated that Rotavirus infected 50 female patients, Adenovirus 54 of them and co-infection 36. The male patients were more infected by Rotavirus 60 of them than the girls. However, Adenovirus and co-infection were lower in the male sexes than the females.

DISCUSSION

The current study which took place in the city of N'Djamena, examined 440 children ranging in age from 0 to 5 years old. The male sex represented 215 (48.86%) of the study population and the female 225 (51.13%). Of the 440 children examined, 228 were infected with viruses, corresponding to a prevalence of 51.81%. This prevalence is lower than that found by Ouédraogo et al. [17], which showed a prevalence of 225 (85.6%). This difference may be due to the specificity of their experiment and number of patients examined.

We found a higher infection rate in female children 140 (62.22%). These results are almost in agreement with results that have been obtained by Ngum et al. [18], who showed that the infection prevalence was 50.8% in female children. On the other hand, Kargar et al. [19], found that more males (68.75%) were infected than females (31.25%). This difference could be explained by the fact that our sampling population had more females than males.

Mono- infection found in our study was 110 (48.24%) for Rotavirus and 74 (32.45%) for Adenovirus. This is higher than that obtained by Bonkoungou et al. [20], who showed a 33.8% prevalence for Rotavirus. However, the prevalence determined in our study for both viruses were lower than those of Ouédraogo al. [17]. These authors found a prevalence of 167 (63.5%) for Rotavirus and 82 (31.2%) for Adenovirus in children suffering from diarrhea in the city of Ouagadougou, Burkina Faso.

On the distribution of viral infection according to age group, we observed that the infected number of children in the age group, 0-5 months, 6-11, 18-23 and 24- 29 were highly infected. The highest infected were 6-11 months, 101 (77.69 %) and followed by 0-5 months, 49 (54.44%). The predominance of viral infection in children ranging from 0-5 months and 6-11 months old has also been reported by Sanou et al. [21] in Ouagadougou and Coulibaly et al. [22] in Ivory Coast. This confirms our findings. This may be explained by the fact that infants are more vulnerable to infections during this period. They are fragile and gradually develop their immune systems. On the other hand, we observe that children above 24-29 months were less infected than the infants. This can be attributed to protective acquired immunity obtained by older children who might have been previously exposed to the pathogens.

The symptoms reported on the 228 infected subjects showed that 70(47.94%) had fever (> 37°C), 74(46.83%) vomiting, 84 (61.76%) were dehydrated. Reports made in Burkina Faso by Bonkoungou et al. [20] and O'Ryan et al. [23] in Santiago, Chile on a study of gastroenteritis in infants, found that 77% of children had fever. Other studies have also reported that rotavirus infection in infants and young children can lead to severe diarrhea, vomiting and dehydration [24]. These studies are in accord with our results.

CONCLUSION

The study undertaken consisted of determining the prevalence of Rotavirus and Adenovirus in children aged 0 to 5 years old suffering from acute in the University Hospital Center of Mother and Child (CHU-ME) in the city of N'Djamena. Rotavirus and Adenovirus have been identified. These viruses appeared with a prevalence of 51.81%. The most infected age group was between 6-11 months with a prevalence of 77.69 % and the least infected age group was 48-53 months old with a prevalence of 10.00%. Rotaviruses and Adenoviruses constitute a real public health problem given the high prevalence obtained during this study. The administration of Rotavirus and Adenovirus vaccines should be included in the national immunization program in order to resolve this public health problem.

ACKNOWLEDGEMENT

We sincerely thank the entire administration, the Doctors and Staff of the University Hospital Center of Mother and Child, N'Djamena for their wonderful collaboration.

REFERENCES

- [1] Kane, E. M., Turcios, R. M., Arvay, M. L., Garcia, S., Bresee, J. S., & Glass, R. I. (2004). The epidemiology of rotavirus diarrhea in Latin America: anticipating rotavirus vaccines. *Revista Panamericana de Salud Publica*, 16, 371-377.
- [2] Yilgwan, C. S., & Okolo, S. N. (2012). Prevalence of diarrhea disease and risk factors in Jos University Teaching Hospital, Nigeria. *Annals of African medicine*, 11(4), 217.
- [3] Black, R. E., Cousens, S., Johnson, H. L., Lawn, J. E., Rudan, I., Bassani, D. G., ... & Child Health Epidemiology Reference Group of WHO and UNICEF. (2010). Global, regional, and national causes of child mortality in 2008: a systematic analysis. *The lancet*, 375(9730), 1969-1987.
- [4] Kapikan A. Z., Hishino Y., Chanock R.M., (2001). Rotaviruses. In D. M. Knipe and M. J. Hudson. *Fields Virology*. 4th Edition; 1787- 1833.
- [5] Parashar, U. D., Gibson, C. J., Bresee, J. S., & Glass, R. I. (2006). Rotavirus and severe childhood diarrhea. *Emerging infectious diseases*, 12(2), 304.
- [6] Estes MK, Knipe DM, Howley PM, Griffin DE, Lamb RA, Martin MAB. Roizman B and Straus SE (ed) Rotaviruses and their replication, *Fields virology*, 4th ed, vol 2. Lippincott Williams &Wilkins, Philadelphia, Pa. 2001; p 1747 - 1786.
- [7] Crawford, S. E., Ramani, S., Tate, J. E., Parashar, U. D., Svensson, L., Hagbom, M., ... & Estes, M. K. (2017). Rotavirus infection. *Nature Reviews Disease Primers*, 3(1), 1-16.

- [8] Phua, K. B., Emmanuel, S. C., Goh, P., Quak, S. H., Lee, B. W., Han, H. H., ... & Bock, H. L. (2006). A rotavirus vaccine for infants: the Asian experience. *Annals-Academy of Medicine Singapore*, 35(1), 38.
- [9] Das, S., Jayaratne, R., & Barrett, K. E. (2018). The role of ion transporters in the pathophysiology of infectious diarrhea. *Cellular and molecular gastroenterology and hepatology*, 6(1), 33-45.
- [10] Enitan, S. S., Ihongbe, J. C., Ochei, J. O., Oluremi, A. S., & Ajulibe, G. E. (2019). Detection of rotavirus and adenovirus Co-infection among apparently healthy school aged children in Ilishan-remo community of Ogun state, Nigeria. *Asian Journal of Pediatric Research*, 1-12.
- [11] Kang, G. (2017). Viral Diarrhea. *International Encyclopedia of Public Health*, 360.
- [12] Echavarría, M. (2008). Adenoviruses in immunocompromised hosts. *Clinical microbiology reviews*, 21(4), 704-715.
- [13] Tate, J. E., Burton, A. H., Boschi-Pinto, C., Steele, A. D., Duque, J., & Parashar, U. D. (2012 a). 2008 estimate of worldwide rotavirus-associated mortality in children younger than 5 years before the introduction of universal rotavirus vaccination programmes: a systematic review and meta-analysis. *The Lancet infectious diseases*, 12(2), 136-141.
- [14] Ojobor, C. D., Olovo, C. V., Onah, L. O., & Ike, A. C. (2020). Prevalence and associated factors to rotavirus infection in children less than 5 years in Enugu State, Nigeria. *VirusDisease*, 31(3), 316-322.
- [15] Tate, J. E., Patel, M. M., Cortese, M. M., Lopman, B. A., Gentsch, J. R., Fleming, J., ... & Parashar, U. D. (2012 b). Remaining issues and challenges for rotavirus vaccine in preventing global childhood diarrheal morbidity and mortality. *Expert review of vaccines*, 11(2), 211-220.
- [16] Babji, S., & Kang, G. (2012). Rotavirus vaccination in developing countries. *Current opinion in virology*, 2(4), 443-448.
- [17] Ouédraogo, N., Kaplon, J., Bonkougou, I. J. O., Traoré, A. S., Pothier, P., Barro, N., & Ambert-Balay, K. (2016). Prevalence and genetic diversity of enteric viruses in children with diarrhea in Ouagadougou, Burkina Faso. *PLoS One*, 11(4), e0153652.
- [18] Ngum, V. N., Adiogo, D., Gonsu, K. H., Tembe-Fokunang, E. A., & Obama, M. T. A. (2010). Enteric prevalence of rotavirus and adenovirus in under five children predisposed to acute diarrhea in yaounde-cameroon. *HEALTH SCIENCES AND DISEASE*, 11(3).
- [19] Kargar, M., Jafarpour, T., & Najafi, A. (2012). Burden and typing of rotavirus group A in children with acute gastroenteritis in Shiraz, Southern Iran. *Iranian Red Crescent Medical Journal*, 14(9), 531.
- [20] Bonkougou, I. J., Sanou, I., Bon, F., Benon, B., Coulibaly, S. O., Haukka, K., ... & Barro, N. (2010). Epidemiology of rotavirus infection among young children with acute diarrhoea in Burkina Faso. *BMC pediatrics*, 10(1), 1-6.
- [21] Sanou I. et al. Diarrhées Epidémiologiques, cliniques et évolutifs en milieu hospitalier à Ouagadougou. 2003 Recherche Médicale: *Publications pédiatriques*.
- [22] Coulibaly, A., Rey, J. L., Davis, C. E., Soro, B., Diarra, A., Houénou, Y., & Trolet, C. (1988). Morbidité et mortalité hospitalières dues aux maladies diarrhéiques (Côte d'Ivoire). *Publications médicales africaines*, (91), 23-29.
- [23] O'Ryan, M. L., Peña, A., Vergara, R., Díaz, J., Mamani, N., Cortés, H., ... & Prado, V. J. (2010). Prospective characterization of norovirus compared with rotavirus acute diarrhea episodes in Chilean children. *The Pediatric infectious disease journal*, 29(9), 855-859.
- [24] Hull, J. J., Teel, E. N., Kerin, T. K., Freeman, M. M., Esona, M. D., Gentsch, J. R., ... & Bowen, M. D. (2011). United States rotavirus strain surveillance from 2005 to 2008: genotype prevalence before and after vaccine introduction. *The Pediatric infectious disease journal*, 30(1), S42-S47.