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Frequency and Clinical Characteristics of Astrovirus Infections in Children Aged 0 to 5 Years with Diarrhoeal Syndrome in Ouagadougou, Burkina Faso (2024-2025)

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Abstract

Acute gastroenteritis most often affects children under 5 years of age and is the cause of the second highest mortality rate in the world after pneumonia. Gastrointestinal infections are therefore a major cause of morbidity and mortality in children under five years old, particularly in developing countries. Among the viral agents responsible for acute gastroenteritis, Astroviruses are frequently detected alongside Rotavirus and Norovirus. In Burkina Faso, in the absence of commonly available diagnostic tests at primary health care facilities, management often relies on empirical treatment without confirmation of the causative agent. This underscores the need to build diagnostic capacity to improve case management and guide public health interventions. This study aimed to evaluate the frequency and clinical characteristics of Astrovirus infections in children from 0 to 5 years old in Ouagadougou, Burkina Faso. It was a cross-sectional study that took place from August 15, 2024, to January 15, 2025. The study focused on children aged 0 to 5 years. The biological samples were stool taken from sterile jars according to the standards of ordinary examinations in the medical biology laboratory. The results were considered

significant when the value of $p < 0.05$. The detection of Astroviruses was carried out using multiplex Polymerase Chain Reaction in real time with a detection kit from Sacace Biotechnologies. A total of 75 cases of acute diarrhea were recorded, including 7 Astrovirus-positive cases with a frequency of 9.3% CI95% [6.8 - 11.8]. Children aged 0 to 24 months were the most affected. The most frequently observed clinical signs in children infected with astroviruses were abdominal pain, diarrhea, vomiting and fever. They affect children aged between 0 and 24 months more often. Abdominal pain, diarrhoea, vomiting and fever were significantly associated with Astrovirus infections. Faced with this situation, appropriate solutions must be considered in order to better protect children under 5 years against diarrhoeal syndromes due to Astrovirus. Strengthened epidemiological surveillance and optimization of vaccination strategies could reduce the burden of Astrovirus infections in Burkina Faso.

Keywords

Frequency, Clinical Characteristics, Astrovirus Infections in Children, Diarrhoeal Syndrome, Ouagadougou, Burkina Faso

1. Introduction

Gastroenteritis is the main factor of infant morbidity and mortality, significantly contributing to malnutrition and growth retardation [1] [2]. Diarrhoeal diseases cause 1.6 million deaths and constitute about 27% of all deaths among children under 5 years old per year [2]. Human Astroviruses, the third cause of viral gastroenteritis after rotavirus and calicivirus, are experiencing a recrudescence in all age groups, indicating an increasingly significant spread of these viruses [3]. They induce moderate or severe diarrhea, fever, loss of appetite, abdominal pain, nausea and vomiting [4]. Human Astroviruses are recognized as an endemic cause of acute gastroenteritis worldwide [5]. They are responsible for about 10% of sporadic diarrhea cases in children, with detection rates ranging from 2% to 9% in children with acute diarrhea. In low-income countries, prevalences of up to 26% have been reported [6]. Serological studies have shown that up to 90% of individuals in certain populations have antibodies against human Astroviruses [7]. Contamination can be of food, water, interhuman or sometimes zoonic origin [5].

Astroviruses are present worldwide, affecting populations of all ages and regions. They are considered one of the leading causes of viral gastroenteritis in infants and young children, particularly in developing countries where access to safe drinking water and sanitation may be limited. Studies from around the world have shown a wide range of prevalence, with prevalences ranging from 8.6% in Thailand to 4.3% in Australia and 3% in Iran [1]. In Brazil, Astroviruses were found in 33% of children under 5 years with diarrhea [8].

The epidemiology of Astroviruses in Africa is a crucial area of research due to the high prevalence of childhood gastroenteritis on the continent. Although spe-

cific data on the distribution of Astroviruses in Africa are still limited, several studies have highlighted their significant role in child morbidity. Studies conducted in different African countries reported a prevalence of 7% in South Africa [9], 7% in Nigeria [10], 6.3% in Gabon [11], 4% in Côte d'Ivoire [12].

The epidemiology of Astroviruses in Burkina Faso, as in many developing countries, is an area that requires special attention due to the significant impact of these viruses on child health. Although data specific to Burkina Faso are still somewhat limited, three studies (4.9% by Ouédraogo *et al.* (2016) [13], 6.3% by Badjo *et al.* (2024) [14] and 9% by Dakouo *et al.* (2024) [15]) provide valuable information on prevalence, the distribution and risk factors associated with Astrovirus infections in this West African country. However, in this country, the management of diarrhea of viral origin is mainly based on oral rehydration and monitoring for signs of severe dehydration. In addition, in the absence of commonly available diagnostic tests at primary health care centres, management often relies on empirical treatment without confirmation of the causative agent. This underscores the need to build diagnostic capacity to improve case management and guide public health interventions. Thus, the epidemiological data on Astroviruses in children in Burkina Faso require more updates despite the studies and publications already carried out. It is in this context that this study using molecular diagnostics to update the epidemiological profile of Astrovirus infections among children aged 0 to 5 years in Burkina Faso, takes place.

2. Methods

2.1. Framework of Study

This study took place in Ouagadougou, capital of the province of Kadiogo, located in the central region of Burkina Faso. The collection of biological samples was carried out in three health centers in Ouagadougou, including the Saint Camille Hospital in Ouagadougou, the Paul VI Hospital in Ouagadougou and the Pietro Annigoni Biomolecular Research Center (CERBA). Molecular diagnosis by real-time RT-PCR was carried out at CERBA, the national reference laboratory for human papillomavirus (HPV), located in the southeast of Ouagadougou city in the Karpala district, sector 50 of district 11. The area where it was carried out is represented by **Figure 1**.

2.2. Type, Period and Population of Study

It was a cross-sectional descriptive study over a period of five (05) months from August 15, 2024, to January 15, 2025. The population of this study consists of children whose age is between 0 and 5 years old and who presented with a diarrheic syndrome during the study period, the diarrheic syndrome is defined by doctors or pediatricians at the consultation.

2.3. Sampling Method and Data Collection

In this study, all children meeting the inclusion criteria were systematically re-

cruited. More specifically, these were children aged 0 to 5 years who were seen for diarrhoeal syndrome, or diagnosed with acute gastroenteritis and admitted to the laboratory for microbiological analyses prescribed by doctors, or hospitalized for diarrhoeal syndrome in one of the centers included in the study, and whose parents have given free and informed consent. The biological samples were stool taken from children included in the study. The stools were collected by parents/guardians at home or directly in the laboratory in sterile jars, respecting the standards for ordinary examinations in the medical biology laboratory. A consent sheet and individual questionnaire were completed for each child included in this study. The data provided were name and first names, age, sex, weight, height, vaccination status and symptoms observed by parents/guardians or detected on physical examination (Gastroenteritic diarrheic syndrome with associated clinical signs such as diarrhoea, fever, vomiting, abdominal pain and bloating). After receiving the stool and talking with parents/guardians, the samples were aliquoted and then stored at 80˚C to preserve their integrity for further molecular analyses.

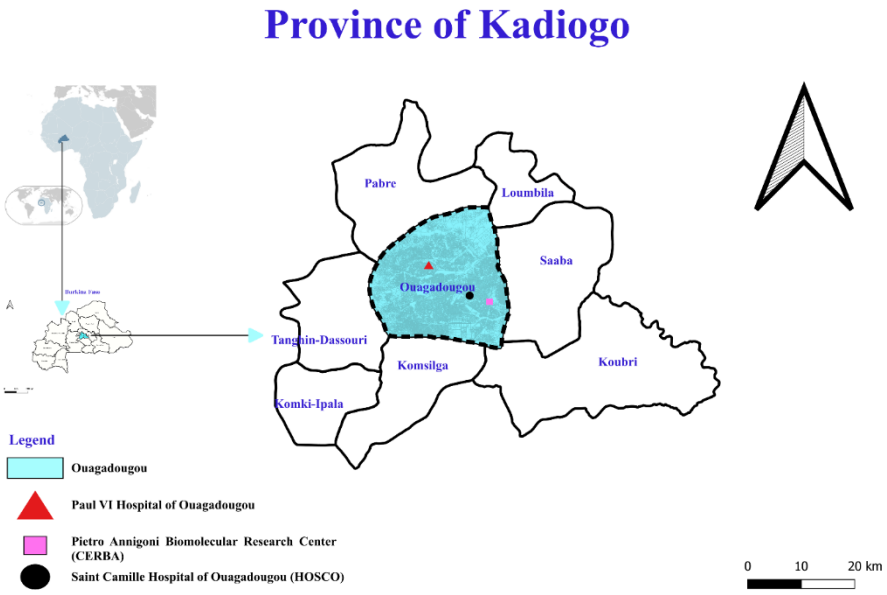

Figure 1. Geographical presentation of the study area (Source: Tialla *et al*., 2026).

2.4. Laboratory Diagnostic

For the realization of real-time RT-PCR, a SaCycler-96 Real-Time PCR cycler (Sacace Biotechnologies) was used. The reagents were composed of two ready-to-use kits (Sacace Biotechnologies), including the kit for extracting Ribo-Sorb RNAs (K-2-1/100) and the real-time RT-PCR amplification kit|V40-50FRT. The extraction kit was provided with an internal control that allowed to ensure the quality of the extraction independently for each sample. The amplification kit contained a negative control and a positive control that served as controls for all samples. The Rotavirus/Norovirus/Astrovirus Real-TM kit is intended for a real-time test for qualitative detection and differentiation of RVA, Geno-

type 2 Norovirus and Astrovirus in feces. RNA is extracted from samples, amplified by RT-PCR and detected using specific fluorescent reporter dye probes of Rotavirus/Norovirus/Astrovirus RNA and internal control. The reaction is based on three main processes: isolation of virus RNA from feces, reverse transcription of RNA and real-time amplification of cDNA. Detection is based on amplification of a specific region of the pathogen genome using specific primers and detection by fluorescent markers. These markers are linked to oligonucleotide probes that specifically bind to the amplified product. Real-time monitoring of fluorescence intensity by PCR allows detection of product accumulation without having to reopen the reaction tubes after performing the PCR. The kit is equipped with an internal control. This internal control allows to control the extraction process of each individual sample and also serves to identify a possible inhibition of the reaction. Before extraction, each sample was subjected to pre-treatment at a ratio of 20% fecal matter and 80% saline water in a 1.5 mL polypropylene tube. Then, all the tubes were shaken vigorously to obtain a homogeneous suspension. Finally, all the tubes were centrifuged for 5 minutes at 10,000 g and the supernatant was used for RNA extraction. The extraction of RNA was carried out in six (06) major steps (strictly respectively) following the instructions of the kit manufacturer and strictly respecting good laboratory practices in force at CERBA. To lyse the samples, 100 µL of the supernatants previously collected in the 1.5 mL tubes were added to 450 µL of the lysis solution and 10 µL from the internal control. For RNA binding, 25 µL of an absorbent solution containing silica particles was added. Impurities were removed in a single washing step using 400 µL of wash solution. RNA precipitation was achieved by adding 500 µL of 70% ethanol in one repeated step. The proteins were precipitated and eliminated by adding 400 µL of acetone. Finally, the RNAs were extracted from the silica particles using 50 µL of elution buffer. The reverse transcription and amplification were performed in a total reaction volume of 25 µL, consisting of 15 µL of reaction mixture and 10 µL of RNA from each sample. The amplification was carried out using the real-time thermocycler SaCycler-96 (Sacace Biotechnologies), following the program specified by the manufacturer. The detection limit value (Ct) was set at 40 cycles. The results were interpreted by the device's software through the presence of a crossing of the fluorescence curve with the detection limit line (Ct). A sample is considered positive if and only if its Internal Control is valid, and the corresponding fluorescence is detected with a non-zero Ct value and below the limit value.

2.5. Statistical Analyses

An input mask was created with the software Epidata. The data was imported and analyzed using IBM SPSS (version 30.0.0). A multivariate analysis was performed to account for age and gender. The chi-square test was used for comparisons. The significance threshold was set at $p < 0.05$.

3. Results

3.1. Frequency of Astrovirus Infections among Children Aged 0 to 5 in Ouagadougou, Burkina Faso

Over a period of five (05) months from August 15, 2024 to January 15, 2025, seventy-five (75) stool samples were collected. Among the 75 samples, seven (07) patients were positive for the Astrovirus, with a frequency of 9.3% CI95% [6.8-11.8].

3.2. Clinical Characteristics of Astrovirus Infections in Children Aged 0 to 5 Years in Ouagadougou, Burkina Faso

3.2.1. Distribution of Astrovirus-Positive Cases by Sex and Age of the Children Tested

The male sex represented 55% of the overall population. The Astrovirus was positive in both sexes with a predominance of the male sex, *i.e.* 71% of cases (n = 5). The average age of our population was 22 months with extremes of 1 and 6 months. The average age of patients positive to Astrovirus was 30 months with extremes of 10 and 48 months and that of negative patients was 21 months with extremes of 1 and 60 months. The]1 - 24] month age group represented 50% of the total population. The Astrovirus was positive in patients over 24 months in four cases. The distribution of children by sex and age groups is shown in Table 1.

Table 1. Distribution of astrovirus-positive cases by sex and age of the children tested.

Socio-demographic characteristics		Children tested	Positive	Frequency (%)	Odds ratio ($CI_{95\%}$)	p-value
Sex	Feminine	34	2	5.9	0.3 (0.1 – 0.5)	**0.04**
	Masculine	41	5	12.2	0.6 (0.2 - 0.9)	
Age groups (months)	]0 - 1]	32	0	0.0	0.0 (0.0 - 0.0)	**0.01**
	]1 - 24]	38	3	7.9	0.3 (0.1 - 0.5)	
	]24 - 60]	5	4	80	3.1 (2.5 - 3.8)	

CI: Confidence interval.

3.2.2. Distribution of Astrovirus-Positive Cases According to the Clinical Signs Observed in the Children Tested

Diarrhea was present in 80% of the population and in 57% of patients positive to the Astrovirus. Table 2 illustrates the distribution of Astrovirus-positive cases according to clinical signs.

3.2.3. Aspects of the Stool Observed in the Children Tested

The duration of diarrhea was 4 days with extremes of 0 and 14 days in the general population. The mean duration of diarrhea was 2 days with extremes of 0 and 4 days in Astrovirus positive patients and 3 days with extremes of 0 and 14 days in Astrovirus negative patients. The onset of stool was fluid in 56% of cases and bloody in 3% of cases in the general population. Astrovirus-positive patients had liquid stools in 43% of cases. No Astrovirus positive had bloody-looking stools.

Table 3 shows the distribution of patients by stool appearance.

Table 2. Distribution of astrovirus-positive cases according to the clinical signs observed in the children tested.

Clinical characteristics	Presence	Children tested	Positive	Frequency (%)	Odds ratio ($CI_{95\%}$)	p-value
Diarrhea	No	15	3	20	0.7 (0.2 - 0.9)	**0.02**
	Yes	60	4	6.7		
Fever	No	32	4	12.5	0.4 (0.1 - 0.5)	**0.03**
	Yes	43	3	6.9		
Abdominal pains	No	15	3	20	0.7 (0.2 - 0.9)	**0.02**
	Yes	60	4	6.7		
Vomiting and bloating	No	39	5	12.8	0.2 (0.1 - 0.4)	**0.04**
	Yes	36	2	5.6		

CI: Confidence interval.

Table 3. Distribution of positive cases by patients by stool appearance.

Clinical characteristics	Presence	Children tested	Positive	Frequency (%)	Odds ratio ($CI_{95\%}$)	p-value
Fluid	No	33	4	12.1	0.5 (0.2 - 0.7)	**0.03**
	Yes	42	3	7.1		
Slimy	No	62	6	9.7	0.3 (0.1 - 0.6)	**0.04**
	Yes	13	1	7.7		
Mellow	No	55	4	7.3	0.6 (0.3 - 0.8)	**0.03**
	Yes	20	3	15		
Bloody	No	73	7	9.6	0.4 (0.2 - 0.9)	**0.01**
	Yes	2	0	0.0		

CI: Confidence interval.

4. Discussion

In our study, the frequency of Astrovirus infections (9.3%) was relatively higher than the results obtained, 4.9% by Ouédraogo *et al.* (2016) [13], 6.3% by Badjo *et al.* (2024) [14] and 9% by Dakouo *et al.* (2024) [15], in three previous studies carried out in Burkina Faso. We observe a gradual increase over time, which justifies addressing this issue from a public health perspective. This increase is explained by the deterioration of hygiene conditions in certain working-class districts of the city of Ouagadougou with the massive arrival of internally displaced persons. Indeed, astroviruses are considered one of the main causes of viral gastroenteritis in infants and young children, particularly in developing countries where access to safe drinking water and sanitation may be limited. The study by Meyer *et al.*

(2015) [16] conducted in two African countries (Gambia and Kenya) found a prevalence of 9.9% among children with acute diarrhea. The study by Arowolo *et al.* (2020) [17] in Nigeria between 2015 and 2018 found a prevalence of 19.4%, with a peak at 41.4% in 2015. Gelaw *et al.* (2019) [18] in Ethiopia found a prevalence of 3.6% and Tsague *et al.* (2020) [19] in the Republic of Congo found a prevalence of 10.3%. In Burkina Faso, as in other sub-Saharan African countries, the incidence of viral gastroenteritis remains high due to environmental and socio-economic factors such as limited access to drinking water, poor sanitation and child malnutrition. Astrovirus transmission occurs mainly through the oro-fecal route, favored by water and food contamination; a parallel circulation between Rotavirus and Astrovirus with a dry season peak in tropical countries [20]. Furthermore, the prevalence of Astrovirus infection remains relatively low in developed countries. In Greece, a prevalence of 2.4% was observed over a six-year monitoring period [21] and only 0.97% in Italy between 2003 and 2013 [22]. The variability in the prevalence of the Astrovirus in different countries could be the effect of social and economic factors, geographical factors and hygiene and sanitation conditions. However, this prevalence may be underestimated due to the variability in detection techniques and seasonality of Astrovirus infections and the variability in prevalence depending on the season [19] [22] [23].

The average age of Astrovirus positive children in our study was 30 months with a predominance in infants (0 - 24 months). Ouédraogo *et al.* (2016) [13] and Badjo *et al.* (2024) [14] had found average ages of 14 months and 4.5 years, respectively. But, the study by Badjo *et al.* (2024) [14] included adults. In contrast, statistical analyses showed a high risk of viral infection in children under 5 years with a ratio of 3.9 and a confidence interval between 2.2 and 7.4 [14]. Both studies noted a high prevalence of Astrovirus in infants under two years old [13] [14]. Meyer *et al.* (2015) [16] found a mean age of 17.4 months in Kenya and 16.4 months in the Gambia. In Nigeria, infants (0 - 24 months) were most affected by Astrovirus (44%) with a peak in children from 0 - 12 months (24%) [17]. In the Republic of Congo, the average age of children was 12 months with a high prevalence among children under 18 months [19]. The same observation was made in developed countries regarding the high prevalence of infection among children under 24 months [21]. The high prevalence of infection in infants could be explained by the fact that it is the period of growth and an immaturity of immunity of children at this time [24]. In addition, at this phase of life, children learn to walk and make all four paws with hands that are dirty during this period. They can easily get infected by putting their hand in the mouth without the parents' knowledge.

The results of our study showed that Astrovirus infections were mainly associated with diarrhea, vomiting, abdominal pain, fever and bloating. Fever was present in 43% of positive cases and abdominal pain in 57% of cases. In Republic of Congo, Tsague *et al.* (2020) [19] had found symptoms such as fever (34%), vomiting (93%) and dehydration (93%). Other studies have shown that Astrovirus infections are often associated with less severe symptoms and faster recovery [24]. Only seven events limit the robustness of significance tests.

5. Conclusion

In conclusion, this study aimed to evaluate the frequency and clinical characteristics of Astrovirus infections in children aged 0 to 5 years who received consultation for diarrheal syndrome in Ouagadougou, Burkina Faso. Age was significantly associated with Astrovirus infections, children aged 0 to 24 months are the most affected. The prevalence of Astrovirus infections in children from 0 to 5 years was 9.3%. Abdominal pain, diarrhea, vomiting and fever were also significantly associated with Astrovirus infections. As a result of these results, a strengthening of the epidemiological surveillance of Astrovirus infections in children from 0 to 5 years is necessary. By carrying out the molecular diagnosis, this study made it possible to update the epidemiological information on Astrovirus infections in Ouagadougou in Burkina Faso. This information can reduce the impact of Astrovirus infections on child health in the country. In view of the importance of the pathology, an effective fight must be envisaged through the awareness of children's parents on good hygiene practices to reduce the burden of this pathology.

Ethical Approval

This study was conducted in strict adherence to the ethical principles set out in the Declaration of Helsinki [25]. In addition, the research protocol has received approval from the Ethics Committee for Health Research (CERS) of Burkina Faso under the number 2024-07-223.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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