Journal of Biosciences and Medicines, 2025, 13(11), 37-51
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Impact of Rotavirus Vaccination on Acute Gastroenteritis Characteristics and Admission Rates: A Retrospective Observational Study from a Single Center in Jordan

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How to cite this paper: Al Zùbi, Y.O., Al Sharie, A.H., Wafai, F.H., Al-Mwajeh, T., Al Hamoud, M., Aburayya, H., Alkhasawneh, M. and Altamimi, E. (2025) Impact of Rotavirus Vaccination on Acute Gastroenteritis Characteristics and Admission Rates: A Retrospective Observational Study from a Single Center in Jordan. *Journal of Biosciences and Medicines*, **13**, 37-51.
https://doi.org/10.4236/jbm.2025.1311004

Received: September 23, 2025
Accepted: October 27, 2025
Published: October 30, 2025

Abstract

Background: Acute gastroenteritis (AGE) is a prevalent condition in childhood and poses a significant burden on healthcare systems, especially in low- and middle-income countries. Viral pathogens are the primary causative agents, with rotavirus being the most common in pediatric populations. Aim: This study aimed to evaluate the burden of rotavirus as a causative agent of AGE requiring hospitalization in children, and to assess trends in disease incidence following the introduction of rotavirus vaccination in Jordan. Methods: This retrospective observational study was conducted at King Abdullah University Hospital (KAUH) and included children aged 18 years and below who were hospitalized with AGE between January 2015 and December 2020. Stool diagnostic workups were performed for all patients. Clinical and laboratory data were extracted from electronic medical records. AGE episodes were categorized into two groups: "Rota" (rotavirus-confirmed cases) and "Other" (all other causes). Results: A total of 675 children experienced 709 AGE episodes during the study period. Of these, 237 cases (33.4%) were attributed to rotavirus infection. The incidence of rotavirus-related AGE declined over the five-year period, with a seasonal peak consistently observed in May. Rotavirus vaccination was associated with a lower proportion of rotavirus-positive cases; however, this association did not reach statistical significance. Conclusion: Rotavirus remains a significant contributor to pediatric AGE requiring hospitalization. A downward trend in rotavirus incidence over the years may reflect the positive impact of vaccination. Further prospective studies are needed to confirm vaccine effectiveness and better understand causality.

Keywords

Acute Gastroenteritis, Rotavirus, Vaccine, Jordan

1. Introduction

Acute gastroenteritis (AGE) is a prevalent childhood condition that places a heavy burden on healthcare systems, particularly in low- and middle-income countries (LMICs). It is characterized as a syndrome of nausea, vomiting, diarrhea, and abdominal discomfort with an underlying infectious etiology [1]. Three or more bouts of loose, watery stools in a 24-hour period meet the World Health Organization's (WHO) criteria for diagnosis [2]. Estimates show that acute diarrhea alone causes more than 1.5 million outpatient visits, 200,000 hospitalizations, and 300 fatalities per year in the United States (US) alone. It is important to note that when third-world countries are taken into consideration, diarrheal diseases are responsible for about 2 million deaths annually [3]. Most AGE patients only require minimal medical attention, although in rare circumstances hypoglycemia and severe dehydration may occur [4]. Despite the slight differences across various geographical zones, AGE management is a global endeavor. The gold standard for treating patients with acute gastroenteritis (AGE) who seek medical care remains supportive therapy, with oral rehydration solutions playing a central role in fluid replacement [1].

Rotavirus is the most common enteric virus that causes pediatric AGE [5]. A meta-analysis demonstrated the enormous impact of rotavirus AGE, showing that 111 million episodes required home management, 25 million clinic visits, 2 million hospitalizations, and a median of 440,000 deaths annually worldwide [6]. Another analysis showed a total of 215,000 deaths attributed to rotavirus AGE in 2013, with India, Nigeria, Pakistan, and the Democratic Republic of Congo accounting for approximately half of deaths in the same period [7]. The clinical spectrum of rotavirus infection can manifest as anything from a preclinical illness to frequent, excessive vomiting and diarrhea that can cause shock, electrolyte imbalance, and even death [8]. Rotavirus vaccines licensed in 2006 have gained approval as being strongly recommended [5] [9]. A decreasing incidence of rotavirus cases has been detected by a rate of 57% - 89% annually [10].

In 2015, the Rotateq® vaccine was introduced to the Jordanian national immunization program, and it is given in three separate doses at the 61st, 91st, and 121st days of life [11]. Worth mentioning, children on Jordanian grounds are all eligible for the Jordanian national immunization program vaccines, and childhood vaccination is mandatory. Prior to the introduction of the vaccine, the prevalence of rotavirus AGE in children below the age of five was 39.9% [12]. To the best of our knowledge, there is no large cohort study evaluating the efficacy of the rotavirus vaccine among Jordanians or assessing the impact of vaccination on the clinical course of rotavirus cases. In this retrospective analysis, we sought to determine the significant clinical manifestations among patients as well as the prevalence of rotavirus as a causal agent of AGE after the introduction of rotavirus vaccination. In addition, we aimed to compare the clinical and laboratory manifestations between Rota and Non-Rota gastroenteritis.

2. Materials and Methods

This retrospective study aimed to investigate the prevalence of acute AGE cases at a tertiary care center and to assess the burden of rotavirus as a causative agent for AGE following the introduction of the rotavirus vaccine. This is an observational retrospective study. The study was conducted at King Abdullah University Hospital (KAUH) between 1st January 2015 and 31st December 2020. The center, in collaboration with other healthcare facilities, is the sole tertiary care facility in northern Jordan that provides care for more than 2 million people. Northern Jordan also hosts a substantial Syrian refugee population, among whom childhood vaccination coverage—including rotavirus vaccine—is variable. This represents a potential confounder in interpreting vaccine impact.

2.1. Patient Identification and Data Collection

The diagnostic criteria for AGE include clinical signs such as diarrhea (more than three loose or watery stools per day), vomiting, abdominal pain, and cramps, often accompanied by fever. Symptoms typically last for less than 14 days, with most cases resolving within 3 - 5 days. Stool characteristics, including the presence of blood or mucus, are evaluated, and stool lab tests are conducted to identify potential pathogens. Stool analysis reports during the five-year period were retrieved from the electronic medical records, along with the corresponding medical files. Patients admitted with AGE were identified. Patients who possessed an AGE diagnosis not necessarily supported by microbiological evidence and were admitted to our center at the time of presentation were included in the primary analysis. However, patients were excluded due to the unavailability of data or the absence of AGE diagnosis with neither clinical nor microbiological evidence. AGE stool workup includes stool wet mount and stool culture, which are routinely performed. Rotavirus testing was performed using a one-step immunochromatographic test from a stool sample (Operon, S.A. (Zaragoza), Spain). Stool testing for cryptosporidium and stool testing for *Clostridium difficile* toxin A and B were done on a case-by-case basis. Viral panel testing, stool antigen detection, and nucleic acid amplification tests were not available at our hospital.

The electronic medical files were used to extract the following data, including date of presentation, demographics, clinical signs and symptoms at presentation, growth parameters, arterial blood gases, kidney function tests, emergency management, cause of admission, feeding, and subsequent complications. Fever, dehydration, vomiting, and diarrheal bouts, together with their corresponding traits, were among the signs and symptoms. The total number of patients included was 675 individuals, with 709 AGE attacks. Multiple AGE episodes reported by the same individual were considered distinct if separated by ≥ 14 days; otherwise, they were considered part of the same episode.

2.2. Statistical Analysis

Included patients were divided into two categories. First and foremost, confirmed AGE patients with hospital admissions and microbiological evidence supporting the diagnosis of rotavirus AGE. Otherwise, patients were included in the second cohort of patients named as "other," the patients admitted with AGE regardless of the microbiological evidence of AGE and the causative agent if identified. Collected data were analyzed using IBM SPSS Statistics for Windows v.26 (Armonk, NY, USA) as previously described [13] [14]. Data were presented as frequency (percentage) for categorical data. On one hand, non-normally distributed data were presented as median (interquartile range (IQR)). On the other hand, normally distributed data were presented as mean ± standard deviation of the mean (SD). Normality was tested using the Kolmogorov-Smirnov test or Shapiro-Wilk test. Categorical data were compared using the chi-square test or Fisher's exact test. Normally and non-normally distributed data were compared using the independent t-test and Mann-Whitney U test, respectively. Graphs were illustrated using GraphPad Prism 8 (San Diego, CA, USA).

2.3. Ethical Approval

The KAUH Institutional Review Board (IRB) approved the study's ethical conduct under approval number (20210174). The study is carried out in compliance with the ethical guidelines in place at our institute, taking the Helsinki Declaration as an ethical guideline for research involving human subjects. The requirement for written informed consent was waived since the data were analyzed in aggregates and in a completely anonymized process, excluding any data which might reveal the patient's identity.

3. Results

3.1. The Cohort's Demographics and Baseline Characteristics

The analysis incorporated 709 AGE attacks in 675 patients during a five-year period between 2015 and 2020. The median age was 1.33 (2.3) years, with most patients aged 2 years and younger. Males predominated in the cohort (n = 442, 62.7%). Patients mostly presented with both diarrhea and vomiting (n = 506, 76.3%), followed by diarrhea only (n = 69, 10.4%), vomiting (n = 49, 7.39%), and fever (n = 16, 2.41%). However, 23 (3.47%) other children had unusual chief complaints along with diarrhea, vomiting, or both, such as abnormal movements, cough, hypoactivity, cyanosis, decreased oral intake, altered level of consciousness, and hematuria. The rotavirus group was older (P < 0.001) and weighed more (P < 0.001). **Table 1** illustrates the demographics and baseline characteristics.

Table 1. Demographics and baseline characteristics of patients with AGE.

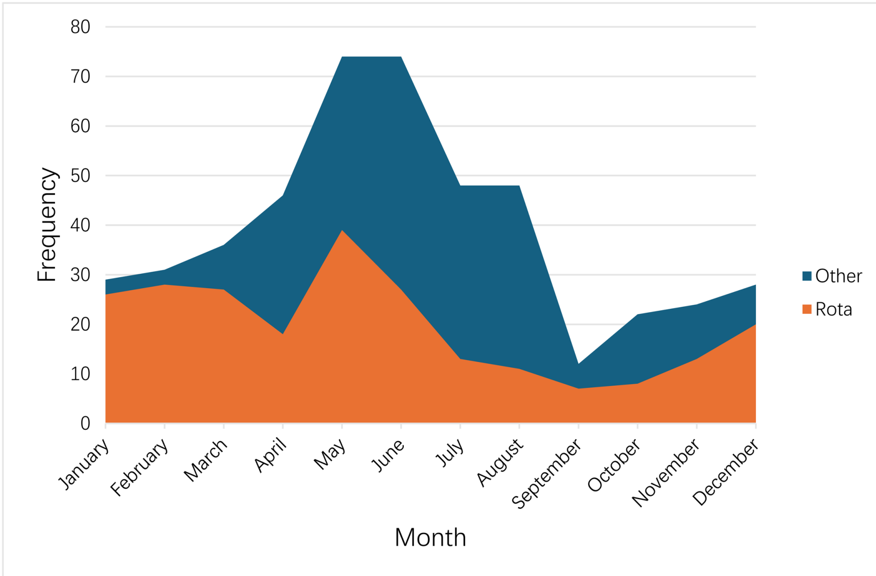
Variables	Total (*n* = 709)	Rota (*n* =237)	Other (*n* = 472)	*P*-value
Age (Years)	1.33 (2.3)	1.8 (3.0)	1.00 (2.5)	<0.001
Gender				
Female	263 (37.3)	102 (43.4)	161 (34.3)	0.020
Weight (Kg)	9.80 (6.5)	12.0 (7.3)	9.1 (6.0)	<0.001
Chief complaint				
Diarrhea	69 (10.4)	17 (7.73)	52 (11.7)	0.102
Vomiting	49 (7.39)	13 (5.91)	36 (8.13)	0.287
Fever	16 (2.41)	6 (2.72)	10 (2.26)	0.938
Diarrhea and vomiting	506 (76.3)	177 (80.5)	329 (74.3)	0.067
Others*	23 (3.47)	7 (3.18)	16 (3.61)	0.768

Data are presented as frequency (percentage). *Others include multiple other symptoms including abdominal pain, abnormal movements, bloody stool, cough, hypoactivity, cyanosis, decreased oral intake, altered level of consciousness, and hematuria.

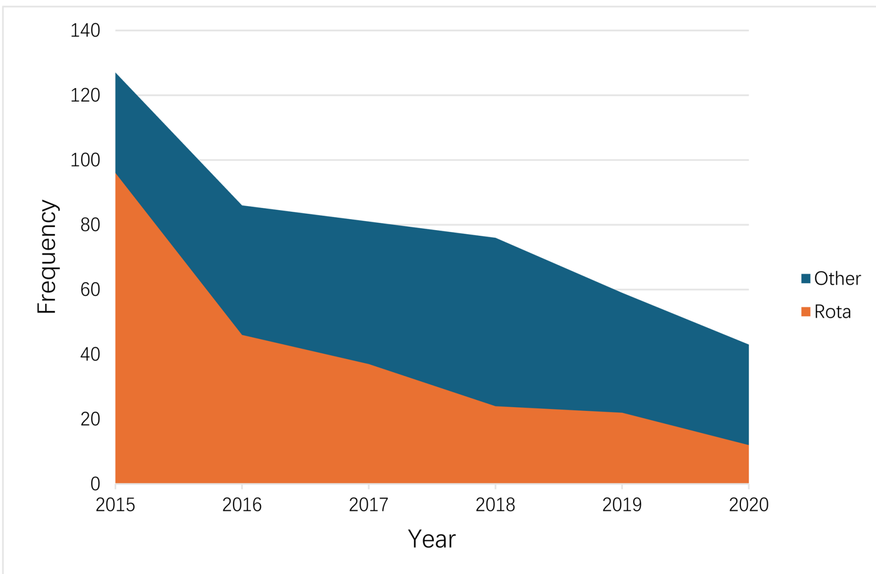
3.2. Epidemiological Patterns and Clinical Characteristics of AGE Groups

Figure 1(A) depicts the monthly variations of cases. May was the highest month recording rotavirus-associated AGE; likewise, other causes recorded the maximum cases during May and June. As illustrated, the overall recorded cases of AGE are decreasing during the study period (Figure 1(B)). Of the 709 AGE attacks included, 237 (33.4%) were due to rotavirus, while 472 (66.6%) were caused by multiple other causes. Causes of admission varied among cases; however, high-grade fever was the most common cause, followed by failed home management and severe dehydration. Patients with AGE due to causes other than Rota have been prescribed antibiotics and received intravenous fluid in the emergency room more than those with Rota-caused AGE (n = 126 (26.7%) vs n = 35 (14.8%), P = 0.002, and n = 92 (19.5%) vs n = 30 (12.7%), P = 0.022, respectively) (Table 2).

Table 3 illustrates that neither vital signs nor growth parameters differed between the causes of AGE. Patients with rotavirus AGE were likely to have more vomiting episodes per day compared to other causes of AGE (n = 5 (5%) vs n = 4 (3%), P = 0.033). In comparison to diarrheal consistency, which was more likely to be loose in other causes of AGE (n = 62 (30.1%) vs n = 16 (15.5%), P = 0.005), children with Rota AGE had more watery stool. The reporting of diarrheal volumes ($P = 0.043$), irritability ($P = 0.012$), and respiratory symptoms ($P = 0.044$) indicates that other causes of AGE resulted in more fluid loss than rotaviral AGE; however, this contradicts findings of the laboratory tests (**Table 4**). Alternatively, raised hematocrit ($P = 0.001$), urea ($P = 0.003$), creatinine ($P = 0.002$), and serum Na^+ levels ($P = 0.026$) indicated more severe dehydration caused by rotaviral illness.



(A)



(B)

Figure 1. (A) Monthly variations of AGE requiring hospitalization. May was the highest month recording rotavirus-associated AGE; likewise, other causes recorded the maximum cases during May and June. (B) Yearly variations of AGE requiring hospitalization. A declining pattern of the overall cases of AGE requiring admission was observed over 2015-2020, with the same pattern observed among rotavirus cases.

Table 2. Age-related hospital admissions and the corresponding treatment regimens.

Variables	Total (*n* = 709)	Rota (*n* =237)	Other (*n* = 472)	*P*-value
Cause of admission				
Failed home management /Failed ORT	44 (6.2)	21 (8.9)	23 (4.9)	0.010
Family issue/recurrent ER visits	23 (3.2)	5 (2.1)	18 (3.8)	<0.001
High grade fever	81 (11.4)	28 (11.8)	53 (11.2)	0.416
Intractable vomiting	4 (0.6)	1 (0.4)	3 (0.6)	0.137
Neurological	8 (1.1)	1 (0.4)	7 (1.5)	0.006
Comorbidities				
Severe dehydration	41 (5.8)	11 (4.6)	30 (6.4)	0.155
Suspected surgical cause	4 (0.6)	1 (0.4)	3 (0.6)	0.128
Young age	27 (3.8)	3 (1.3)	24 (5.1)	0.066
Other	35 (4.9)	11 (4.6)	24 (4.1)	0.397
IV therapy in ER	122 (17.2)	30 (12.7)	92 (19.5)	0.022
Antiemetics in ER	12 (1.7)	4 (1.7)	8 (1.7)	0.659
IV fluids duration*	2.00 (1.00)	2.00 (1.00)	2.00 (1.00)	0.940
Antibiotics use	161 (22.7)	35 (14.8)	126 (26.7)	0.002
Antiemetic use	40 (5.6)	11 (4.6)	29 (6.1)	0.188

*Median, data presented as frequency (percentage); ORT, oral rehydration therapy; IV, intravenous; ER, emergency department.

Table 3. Vital signs and growth parameters of the AGE cohort.

Variables	Total (*n* = 709)	Rota (*n* = 237)	Other (*n* = 472)	*P*-value
Blood pressure	100/62 (19/17)	99.5/63.5 (19/20)	100/60.5 (20/17)	0.825/0.949
Heart rate	131 ± 23	133.8 ± 22.1	130 ± 23.3	0.491
Oxygen saturation	98 (2.0)	98 (2.0)	98 (1.0)	0.903
Temperature	37.0 (1.0)	36.7 (0.8)	37 (1.1)	0.773
Weight percentile	N = 428	N = 148	N = 280	0.806
<5^{th}	90 (21.0)	29 (19.6)	61 (21.8)	
5^{th} - 95^{th}	327 (76.4)	114 (77.0)	213 (76.1)	
>95^{th}	11 (2.6)	5 (3.4)	6 (2.1)	

Data presented as median (interquartile range), mean ± standard deviation, frequency (percentage).

Table 4. Comparative presentation between Rota AGE and other AGE; vomiting and diarrhea characteristics, dehydration and vaccination status, and laboratory results.

Variables	Total (*n* = 709)	Rota (*n* = 237)	Other (*n* = 472)	*P*-value
Vomiting analysis				
Times per day	4.00 (3.00)	5.00 (5.00)	4.00 (3.00)	0.033
Volume				0.493
Large	24 (68.6)	5 (71.4)	19 (67.9)	
Moderate	2 (5.71)	1 (14.3)	1 (3.57)	
Small	9 (25.7)	1 (14.3)	8 (28.6)	
Characteristics				0.476
Bilious	4 (11.4)	1 (7.69)	3 (13.6)	
Food content	6 (17.1)	3 (23.1)	3 (13.6)	
Hematemesis	6 (17.1)	3 (23.1)	3 (13.6)	
Mucous	2 (5.71)	-	2 (9.09)	
Projectile	17 (48.6)	6 (46.2)	11 (50.0)	
Diarrhea analysis				
Times per day	6 (6.00)	7.00 (5.00)	6.00 (4.00)	0.057
Volume				0.043
Small	10 (10.8)	1 (4.5)	9 (12.7)	
Moderate	8 (8.60)	-	8 (11.3)	
Large	75 (80.6)	21 (95.5)	54 (76.1)	
Characteristics				0.290
Blood	18 (11.6)	4 (9.09)	14 (12.6)	
Mucous	119 (76.8)	35 (79.5)	84 (75.7)	
Blood and Mucous	10 (6.45)	4 (9.09)	6 (5.41)	
Other*	8 (5.16)	1 (2.27)	7 (6.31)	
Consistency				0.005
Loose	78 (25.2)	16 (15.5)	62 (30.1)	
Watery	231 (74.8)	87 (84.5)	144 (69.9)	
Weight loss	4 (1.08)	-	4 (1.7)	0.135
Nausea	13 (3.80)	3 (2.4)	10 (4.6)	0.324
Abdominal pain	91 (19.0)	38 (22.1)	53 (17.2)	0.190

Continued

Crying upon micturition	6 (1.62)	2 (1.48)	4 (1.69)	Not applicable
Irritable	39 (8.88)	6 (4.08)	33 (11.3)	0.012
Respiratory symptoms	71 (12.5)	16 (8.51)	55 (14.4)	0.044
Lack skin turgor	11 (4.85)	2 (2.22)	9 (6.57)	0.207
Skin rash	10 (1.73)	4 (2.14)	6 (1.54)	0.735
Vaccinated	420 (82.8)	124 (82.1)	296 (83.1)	0.74
Hemoglobin	11.9 (1.70)	12.1 (1.60)	11.8 (1.80)	0.001
Hematocrit	34.8 (4.90)	35.6 (4.75)	34.6 (4.90)	<0.001
MCV	74.7 (8.50)	74.6 (8.60)	74.7 (8.35)	0.391
MCH	25.4 (3.20)	25.5 (3.10)	25.4 (3.30)	0.432
RDW	14.7 (2.30)	14.4 (2.20)	14.8 (2.40)	0.595
WBC	10.5 (6.69)	10.5 (6.52)	10.6 (7.10)	0.269
Platelets	351 (163)	333 (157)	358 (163)	0.134
Na^+	138 (4.00)	138 (5.00)	138 (4.00)	0.026
K+	4.40 (0.80)	4.20 (0.69)	4.50 (0.81)	<0.001
Urea	4.10 (2.90)	4.50 (2.70)	4.00 (2.73)	0.003
Creatinine	28.0 (12.0)	30.0 (13.5)	28.0 (12.0)	0.002

Data presented as frequency (percentage). *Other characteristics include change in color. Laboratory data presented as median (interquartile range); MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; RDW, red cell distribution width; WBC, White Blood Count; Na^+, Sodium; K+, Potassium.

3.3. The Introduction of the Rotavirus Vaccine and Its Effects on the Population Sample

Although the overall incidence of rotavirus AGE declined across the study years, this temporal trend reflects a population-level reduction. In contrast, the cross-sectional comparison of individual vaccination status and test result did not reach statistical significance ($P = 0.74$); thus, the absence of significance at the patient level does not imply vaccine ineffectiveness. However, the observed decline in the number of rotavirus gastroenteritis cases over the study period suggests that the rotavirus vaccine may be effective in reducing the incidence of acute gastroenteritis in children (Table 4).

4. Discussion

Although the global incidence of AGE has declined due to improved hygiene and vaccination [15], AGE continues to be a significant global health issue, leading to mortality primarily in sub-Saharan Africa and South Asia, despite the availability of cost-effective treatment options [16]-[18]. Our study highlights that rotavirus continues to be a major causative agent of AGE requiring hospital admission despite the vaccination measures taken in our community. Herein, 709 AGE attacks were included; 33.4% were due to rotavirus. Neither vital signs nor growth parameters differed between the causes of AGE. Patients with rotavirus AGE were more likely to have vomiting episodes per day compared to other causes of AGE. It is evident that rotavirus vaccination could be protective against rotavirus AGE. Raised hematocrit, urea, creatinine, and Na^+ levels indicated more severe dehydration caused by rotaviral illness.

In our study, almost one third of our patients were due to Rota infection. The second identified microorganism was *E. histolytica* (13.6% of the non-rota AGE). Of note, 84.1% of non-rotavirus AGE cases lacked an identified pathogen. Given the limited viral diagnostics available, it is likely that norovirus, adenovirus, astrovirus, and sapovirus account for a significant portion of these 'other' cases. The facilities to identify viruses other than Rota were not available in our facility. Our results contradict what Salami *et al.* reported in Lebanese children; *E. histolytica* was the leading microorganism [19]. Rota was responsible for 13.6% of the cases. We believe that sanitation conditions might be responsible for the discrepancy in *E. histolytica* rates, while the lower rates of Rota infection could be due to the younger age group of their cohort. Interestingly, an older study by Yuosef and colleagues on children below 5 with acute gastroenteritis presented to the pediatric hospital in Northern Jordan showed that Rota was responsible for almost one third of the cases, and *E. coli* subtypes were responsible for the other one third of the cases [20].

The clinical presentation of patients is variable. Viral AGE mostly results in non-bloody watery diarrhea with low-grade fever, in contrast to bacterial AGE, which results in bloody diarrhea, high-grade fever, and leukocytes in stool samples [21] [22]. The peak age is below 2 years, and the mode of transmission is fecal-oral or respiratory. The degree of dehydration can be determined by the clinical presentation of patients, such as weight loss. In mild to moderate dehydration, oral rehydration solutions were equally effective when compared with the intravenous counterpart when weight gain, duration of diarrhea, and hospitalization period were taken into consideration. In cases of vomiting and refusal of oral hydration, continuous nasogastric application is as effective as intravenous rehydration [23]. In the present study, although included, physical signs of dehydration were considered a less reliable mode of determining and comparing the dehydration status, due to the cross-sectional nature of the study and variability among reporters. This discrepancy may arise from the subjective nature of parental assessment, recall bias, or underestimation of insensible losses, whereas laboratory indices provide an objective biochemical measure of dehydration severity. Additionally, rotavirus-related dehydration may develop more rapidly, leading to disproportionate biochemical changes despite similar clinical impressions. Therefore, laboratory parameters were used to indicate the severity of dehydration among the two study groups, including hematocrit ($P = 0.001$), urea ($P = 0.003$), creatinine ($P = 0.002$), and Na^+ levels ($P = 0.026$). This is consistent with previous reports that Rota is more likely to cause dehydration compared to other microorganisms [24] [25].

According to Tafalla *et al*., rotavirus was responsible for 38.1% of all cases of AGE, and 40.7% of those cases were classified as severe. In contrast, only 19.5% of patients who tested negative for rotavirus experienced severe symptoms [26]. Similarly, Almatti's study in Jordan showed that rotavirus accounted for 35% of all cases of AGE [27]. Additionally, Nafi found that 39.9% of children, mainly those under two years old, were ELISA-positive for rotavirus in their stool samples [12]. In another study by Meqdam *et al*., ELISA assay detected rotaviruses in 39.6% of cases [28]. The present study indicated that rotavirus was the cause of 33.4% of all cases of AGE. Although such numbers might be interpreted as a non-effective vaccination program, we believe that our numbers might be affected by the fact that our hospital is the referral center for North Jordan and is surrounded by a couple of pediatric hospitals that deal primarily with less severe conditions. In addition, as North Jordan is the main host for Syrian refugees, the influx of unvaccinated children might result in diluting the effect of vaccination in Jordan.

It is evident that rotavirus AGE cases vary across time and geographical locations [29]. Rotavirus infection is seasonal in temperate climates, peaking in late winter, but occurs throughout the year in the tropics [22]. As stratified cases, AGE shows no seasonal variation; however, rotavirus AGE was clearly more prominent during the period between March and May [26]. Similar seasonal variations were observed as well in a Polish study by Toczylowski *et al*., in which peak prevalence was between February and May [30]. In Pakistan, most of the cases were during June, October, and November [31]. Correspondingly, bacterial AGE tends to vary considerably during the year, predominating amidst warmer weather, and more frequently being foodborne [21]. In our study, the rate of rotavirus cases peaked in May.

Sun and colleagues conducted a meta-analysis that showed that both Rotarix and RotaTeq vaccines were effective in reducing the risk of rotavirus and rotavirus-associated hospitalization in fully vaccinated children, especially those with severe symptoms [32]. Likewise, Burnett *et al*. found that the effectiveness of the Rotarix vaccine against laboratory-confirmed rotavirus was 86%, 77%, and 63% in low-, middle-, and high-mortality countries, respectively, alongside RotaTeq vaccine, which was likely effective among children younger than 12 months [33]. The introduction of the rotavirus vaccine in Latin America resulted in a decline in the proportion of diarrhea cases caused by rotavirus from 24.3% to 16.1% [34]. In terms of effectiveness, Rotarix was found to prevent 84% of severe rotavirus diarrhea cases and possibly 41% of cases of severe all-cause diarrhea after one year of follow-up, while RotaTeq prevented 92% of severe rotavirus diarrhea cases. In low-mortality countries, Rotarix was found to prevent 82% of severe rotavirus diarrhea cases and possibly 37% of severe all-cause diarrhea episodes in children vaccinated and followed up for two years, whereas RotaTeq prevented 82% of severe rotavirus diarrhea cases [35]. Because our hospital serves as a referral center for areas hosting many unvaccinated refugees, their inclusion may have diluted the apparent vaccine effect.

The duration of the study (over 5 years) starting with the introduction of the vaccination is not the best way to assess the vaccination effect. Although it is noticeable that Rota AGE decreased each year compared with previous years. A panoramic view of the results of the present study and older studies in Jordan shows almost a 6% drop in the incidence of rotaviral AGE post-vaccine administration. In our cohort over the six years of the study, a steady drop in the rate of AGE was noticed. A 50% reduction was noticed between 2015 and 2020. All in all, the significant protection provided by these vaccines, coupled with the low risk of serious adverse events, highlights the importance of their use.

The study still carries a spectrum of limitations, mainly reassembled by its retrospective nature. Laboratory tests included were routinely performed, with no thorough microbiological assessment, leading to many unidentified etiologies for AGE. *E. histolytica* identification was mainly through microscopy, which carries low sensitivity. The lack of comprehensive genetic screening for all viruses contributed significantly to unlabeled AGE cases. The study data is only applied to a specific time period (5 years), and its results could not be generalized across other time frames. Further national surveys and screening studies are warranted to confirm the obtained results.

5. Conclusion

The infection of rotavirus has been associated with severe dehydration, leading to increased levels of hematocrit, urea, creatinine, and serum Na^+. While the administration of the rotavirus vaccine appeared to reduce the incidence of rotavirus-related AGE, this observation requires prospective controlled studies to confirm the extent of its impact. Additionally, the observed decrease in rotavirus cases may reflect broader trends or other contributing factors that warrant additional research. Continued rotavirus surveillance remains essential, and expanding diagnostic capabilities for other enteric viruses in Jordan will improve case attribution and guide preventive strategies.

Funding

There is no funding to report.

Availability of Data and Materials

Data are available upon request from the corresponding author. The data collection sheets used are available in the appendix for use.

Acknowledgements

None.

Conflicts of Interest

The authors declare no conflicts of interest.

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