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Original Article

Determining the Factors in Acute Gastroenteritis

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ABSTRACT

Objective: The study aims to give information about the sociodemographic characteristics and the gastroenteritis agents detected in the patients hospitalized in the pediatric service with the diagnosis of acute gastroenteritis.

Methods: The patients hospitalized in the pediatric service diagnosed with acute gastroenteritis were investigated by age, gender, place of residence, season of arrival, duration of hospitalization, and gastroenteritis factors.

Results: Out of a total of 328 patients, 126 (38.4%) were girls and 202 (61.6%) were boys. The average age was 43.3 months; the average length of stay in the hospital was 4.75 days. A total of 118 (35.9%) of the patients were in the age group of 2-23 months, 139 (42.3%) of them were 24-71 months old, and 71 (21.6%) of them were over 6 years old (P=.001). The average number of days of hospitalization is 5 days (P=.001) in the preschool period; the seasons with the most hospitalization were summer and spring. The majority of patients lived in urban areas. In a total of 230 (70.1%) patients, the factors that could cause gastroenteritis were not detected; the agent was rotavirus in 56 (57.1%) of the 98 patients which was found to be causative.

Conclusion: Among children hospitalized for acute gastroenteritis, younger children have a longer hospital stay. The most common infectious agent of acute gastroenteritis is rotavirus. Including the rotavirus vaccine in the national vaccination program in our country may be beneficial in preventing the rotavirus. A stool test may guide the diagnosis.

Keywords: Acute gastroenteritis, child, factors, season

INTRODUCTION

Gastroenteritis of infectious origin is the most common cause of morbidity and mortality after lower respiratory tract infections in the world. In infectious gastroenteritis, clinical findings may be different depending on the age of the child, the level of development of the country, living in an urban or rural area, season, sociocultural status, compliance with cleaning rules, nutritional status, and the infectious agent. Most children under the age of 5 years experience acute gastroenteritis (AGE) at least once. Acute gastroenteritis can be self-limiting if uncomplicated. However, if not handled properly, it can lead to severe dehydration and death in young children.[1-3] Viral factors mostly cause AGE in the first years of life due to low stomach acidity and nutritional characteristics. Although rotavirus and adenovirus are very common all over the world, many different viral agents can cause diarrhea. Rotavirus vaccine administration is common in developed countries, so the virus that most commonly causes AGE is norovirus.[1,2,4] While AGE can be caused by viruses, enteric bacteria, or parasites in the summer, it is mostly caused by viruses in the winter.[1]

The causative agent for AGE can often not be determined in patients admitted to the outpatient clinic or hospitalized due to AGE. Detectable causes of AGE are mostly viral infections. In some publications, it has been stated that in patients who present with AGE symptoms, stool examination (parasite examination, culture, immunochromatographic tests, and polymerase chain reaction (PCR)) is performed to detect the agent of AGE, and the results of the examination are mostly learned after the symptoms have resolved and treatment is started; therefore, routine stool examination is not recommended for diagnosis.[5,6]

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Treatment of AGE is generally supportive. Hospitalization rates for AGE range from 0.3% to 4.6% across all age groups and can have a significant cost.[7]

Our study is aimed to evaluate the sociodemographic characteristics of the patients hospitalized in the pediatric service with the diagnosis of AGE, the gastroenteritis factors detected, and the season of admission to the hospital.

METHODS

Study Design and Patient Selection

The files of the patients who were hospitalized and followed up in the education and research hospital pediatric health and diseases service between January 01, 2019, and December 31, 2019, were retrospectively scanned. Patients who were not requested to have stool examinations, who did not have stool examination results, and those who had nosocomial gastroenteritis while hospitalized due to a different disease were not included in the study. Those who did not detect an infectious agent in their stool were considered negative. Patients' age, gender, place of residence, season of arrival, length of hospital stay, and stool examination results were recorded. The patients were grouped according to their age ranges (2-23 months, usually during the period of breastfeeding; 2- to 5-year-old preschool period; ≥6 years old school-age period). The place of residence of the patients was grouped as city, rural, and tourist (urban, people coming from the city, people with clean drinking water and living conditions; rural, people coming from places with poor infrastructure for drinking water/probability of contamination from water; tourist, people from different city and country).

Microbiological Evaluation

Direct microscopy/parasite examination and microbiological cultivation were performed on fresh stool samples that were brought to the laboratory with the request for stool culture. Samples for stool culture were processed without waiting. First, a small amount of stool sample was homogenized with a drop of physiological saline on a clean slide. Then, it was evaluated in terms of erythrocytes, leukocytes, parasitic cysts, and trophozoites at ×10 and then ×40 magnification. Samples were cultivated on eosin methylene blue (EMB) agar (Biomerieux, Marcy l'Etoile, France), Salmonella Shigella (SS) agar (bioMerieux®), and Campylosel agar (bioMerieux®). Eosin methylene blue and SS agar plates were incubated at 37°C in an aerobic environment, and Campylosel agar plates at 42°C in a microaerophilic environment for 24-48 hours. Simultaneously, some samples taken into enriching selenite F medium were kept at 37°C for 6-8 hours, then inoculated on EMB and SS agar plates and incubated in the same way. At the end of the specified period, the identification of the agents grown in the culture was done by conventional methods and Matrix-assisted laser desorption/ionization-time of flight (MALDI-TOF) mass spectrometry (MS) (Vitek MS, bioMerieux, France) system. There are immunochromatographic card tests for the qualitative detection of rotavirus (Acro Biotech, Inc., California, USA), adenovirus (Acro Biotech), *Giardia intestinalis* (Acro Biotech), and *Entamoeba histolytica* (MonlabTest®, Spain) antigen in stool. These tests were performed in accordance with the manufacturer's recommendations. Biofire Diagnostics FilmArray® GI panel rapid diagnosis kit was used for the detection of enteric pathogens based on multiplex real-time PCR. With this kit, 15 species of bacterial agents (*Campylobacter jejuni, Campylobacter coli, Campylobacter upsaliensis, Clostridium difficile* (toxin A/B), *Plesiomonas shigelloides*, *Salmonella*, *Yersinia enterocolitica*, *Vibrio parahaemolyticus, Vibrio vulnificus, Vibrio cholerae, Enteroaggregative E. coli* (EAEC), *Enteropathogenic E. coli* (EPEC), *Enterotoxigenic E. coli* (ETEC), *Shiga-like* toxin-producing *E. coli* (STEC), *Shigella/Enteroinvasive E. coli* (EIEC)) 5 viral agents (adenovirus F40/41, astrovirus, norovirus, rotavirus, and sapovirus) and 4 parasites (*Cryptosporidium, Cyclospora cayetanensis, E. histolytica*, and *Giardia lamblia*) can be detected.

Ethics committee approval was received for this study from the local ethics committee of help_outline Erzincan Binali Yıldırım University (Date: March 20, 2020, Number: 03/19).

Statistical Analysis

IBM's Statistical Package for Social Sciences 22.0 package program was used for statistical analysis of the data (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0, Armonk, NY, USA). Mean ± standard deviation and median (minimum–maximum) values were used for summarizing continuous variables, and number (n) and percentage (%) were used for qualitative variables. The chi-square test was used in the analysis of categorical

MAIN POINTS

- Children under the age of 5 constitute the majority of hospitalizations due to acute gastroenteritis.
- Children under the age of 5 have a longer hospital stay.
- The most common infectious agent of acute gastroenteritis is rotavirus.
- Rotavirus infection can be prevented by including the rotavirus vaccine in the national vaccination program in our country.
- Stool examination can be a guide for diagnosis and treatment

variables. The conformity of continuous variables to normal distribution was evaluated with Kolmogorov–Smirnov test. In group comparisons, the Mann–Whitney *U* test was used because age and length of hospitalization did not fit the normal distribution. In all tests performed, $P < .05$ was considered statistically significant.

RESULTS

Of the 328 patients, 126 (38.4%) were female and 202 (61.6%) were male. Boy/girl ratio was 1.6. The mean age of the patients was 43.3 months (minimum 2-maximum 192). The mean hospital stay was 4.75 days (min:1-max:14). The age of the majority of the patients was between 2 and 23 months (P =.001) and the number of hospitalization days of the patients between 2 and 23 months was higher than the other age groups (P =.001). Hospitalization due to AGE was mostly in summer and spring. The majority of patients admitted to the pediatric department for AGE lived in urban areas. Acute gastroenteritis agent was not detected in 230 (70.1%) of the patients and was found in 98 (29.8%) of the patients out of 328 patients hospitalized in the pediatric service. Only rotavirus was detected in 56 (17%) of 328 patients. Rotavirus was detected in 23 (7%) of the patients out of a total of 328 patients with other factors. The causative agent was rotavirus in 56 (57.1%) of 98 patients with AGE. The median age of the patients who were found to be causative was 24 months (P=.019). The demographic characteristics, seasonal and microbiological findings, the number of days hospitalized, and the age range of the patients hospitalized with the diagnosis of AGE are presented in Table 1. Table 2 presents which factors are seen at which age. The relationship between the agent and gender, age, living conditions, and season in patients with AGE agents is presented in Table 3. *E. histolytica* cyst was seen in only one of the patients with positive *E. histolytica* antigen. In a patient with positive rotavirus antigen and adenovirus antigen, 3-4 *E. histolytica*/*E. dysparous* cysts were seen. In addition, *Salmonella* spp and in another patient, 3-4 *E. histolytica*/*E. dysparous* cysts were seen.

DISCUSSION

Age, diet, and breast milk intake are important in AGE.[2] Acute gastroenteritis can be seen at any age, especially in

Table 1. Information on Patients Hospitalized with the Diagnosis of AGE and the Distribution of AGE Agents

		n (%)	Median Age (Min–Max)	*P*	Number of Days of Hospitalization	*P*
Gender	Female	126 (38.4)	30 (2-192)	.987	4.5 (2-14)	.523
	Male	202 (61.6)	24 (2-192)		4.0 (1-13)	
Age	2-23 months	118 (35.9)	12 (2-23)	**.001**	5 (1-14)	**.001**
	24-71 months	139 (42.3)	36 (24-71)		4 (2-11)	
	≥6 years	71 (21.6)	108(72-192)		4 (2-11)	
Place of residence	City	177 (54.0)	36 (3-192)	.395	4 (1-14)	.144
	Rural	118 (36.0)	24 (2-192)		4 (2-11)	
	Tourist	33 (10.1)	24 (6-192)		4 (2-9)	
Season	Spring	92 (28.0)	24 (2-144)	**.001**	5.0 (2-11)	**.001**
	Summer	102 (31.1)	36 (9-192)		3.0 (2-9)	
	Autumn	68 (20.7)	36 (4-156)		4.0 (2-11)	
	Winter	66 (20.1)	12 (6-120)		6.0 (1-14)	
Infection factor	The causative agent could not be detected	230 (70.1)	36 (2-192)	**.019**	4.0(1-14)	.519
	RV+	56 (17.1)	24 (2-180)		5.0 (2-13)	
	AV+	7 (2.1)	24 (7-120)		4.0 (2-8)	
	EH+	4 (1.2)	30 (12-48)		4.5 (3-7)	
	RV+ AV+	12 (3.7)	24 (6-196)		4.0 (2-8)	
	RV+ EH+	5 (1.5)	24 (12-84)		4.0 (3-5)	
	RV+ AV+ EH+	6 (1.8)	24 (24-108)		6.0 (5-8)	
	Salmonella spp.	8 (2.4)	48 (24-144)			

AV, Adenovirus; EH, *Entamoeba histolytica*; n, number of patients; RV, rotavirus.

Table 2. In the Patients Are Age and Detected AGE Agents

Age (years)	n (%)	The Causative Agent Could Not Be Detected n (%)	RV+ AV+ n (%)	RV+ EH+ n (%)	RV+AV+EH+ n (%)	RV+ n (%)	AV+ n (%)	*Salmonella* spp. n (%)	EH+ n(%)	*P*
0-1	115 (35.1)	78 (67.8)	4 (3.5)	2 (1.7)	0 (0.0)	27 (23.5)	3 (2.6)	0 (0.0)	1 (0.9)	.854
2	54 (16.5)	30 (55.6)	3 (5.6)	1 (1.9)	4 (7.4)	13 (24.1)	1 (1.9)	1 (1.9)	1 (1.9)	
3	48 (14.6)	39 (81.3)	2 (4.2)	0 (0.0)	0 (0.0)	3 (6.3)	1 (2.1)	2 (4.2)	1 (2.1)	
4	23 (7.0)	18 (78.3)	0 (0.0)	0 (0.0)	1 (4.3)	0 (0.0)	1 (4.3)	2 (8.7)	1 (4.3)	
5	17 (5.2)	12 (70.6)	1 (5.9)	0 (0.0)	0 (0.0)	4 (23.5)	0 (0.0)	0 (0.0)	0 (0.0)	
6	18 (5.5)	13 (72.2)	1 (5.6)	1 (5.6)	0 (0.0)	2 (11.1)	0 (0.0)	1 (5.6)	0 (0.0)	
7	9 (2.7)	7 (77.8)	0 (0.0)	1 (11.1)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)	
8	6 (1.8)	5 (83.3)	1 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
9	7 (3.1)	3 (42.9)	0 (0.0)	0 (0.0)	1 (14.3)	2 (28.6)	0 (0.0)	1 (14.3)	0 (0.0)	
10	11 (3.4)	8 (72.7)	0 (0.0)	0 (0.0)	0 (0.0)	2 (18.2)	1 (9.1)	0 (0.0)	0 (0.0)	
11	7 (2.1)	7 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
12	4 (1.2)	3 (75.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	
13	3 (0.9)	2 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	
14	1 (0.3)	1 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
15	2 (0.6)	1 (50)	0 (0.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	
16	3 (0.9)	3 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
T	328 (100)	230 (70.1)	12 (3.7)	5 (1.5)	6 (1.8)	56 (17.1)	7 (2.1)	8 (2.4)	4 (1.2)	

AV, Adenovirus; EH, *Entamoeba histolytica*; n, number of patients; T, total; RV, Rotavirus.

Table 3. Comparison of Determined Infectious Agents with Gender, Age, Living Conditions, Application Season

	RV+ AV+ n (%)	RV+ EH+ n (%)	RV+ AV+ EH+ n (%)	RV+n (%)	AV+n (%)	*Salmonella* spp. n (%)	EH+n (%)	Total	*P*
Female	3 (8.1)	1 (2.7)	3 (8.1)	23 (62.2)	1 (2.7)	4 (10.8)	2 (5.4)	37	.602
Male	9 (14.8)	4 (6.6)	3 (4.9)	33 (54.1)	6 (9.8)	4 (6.6)	2 (3.3)	61	
2-23 months	4 (10.8)	2 (5.4)	0 (0.0)	27 (73.0)	3 (8.1)	0 (0.0)	1 (2.7)	37	.178
24-71 months	6 (14.0)	1 (2.3)	5 (11.6)	20 (46.5)	3 (7.0)	5 (11.6)	3 (7.0)	43	
≥6 years	2 (11.1)	2 (11.1)	1 (5.6)	9 (50.0)	1 (5.6)	3 (16.7)	0 (0.0)	18	
City	6 (10.7)	2 (3.6)	3 (5.4)	30 (53.6)	4 (7.1)	8 (14.3)	3 (5.4)	56	.378
Rural	5 (14.3)	2 (5.7)	3 (8.6)	22 (62.9)	3 (8.6)	0 (0.0)	0 (0.0)	35	
Tourist	1 (14.3)	1 (14.3)	0 (0.0)	4 (57.1)	0 (0.0)	0 (0.0)	1 (14.3)	7	
Spring	4 (12.5)	0 (0.0)	2 (6.3)	21 (65.6)	1 (3.1)	3 (9.4)	1 (3.1)	32	.399
Summer	5 (18.5)	3 (11.1)	2 (7.4)	11 (40.7)	2 (7.4)	2 (7.4)	2 (7.4)	27	
Autumn	0 (0.0)	1 (6.7)	2 (13.3)	7 (46.7)	3 (20)	2 (13.3)	0 (0.0)	15	
Winter	3 (12.5)	1 (4.2)	0 (0)	17 (70.8)	1 (4.2)	1 (4.2)	1 (4.2)	24	
Total	12 (12.2)	5 (5.1)	6 (6.1)	56 (57.1)	7 (7.1)	8 (8.2)	4 (4.1)	98	

AV, Adenovirus; EH, *Entamoeba histolytica*; n, number of patients, T, total; RV, rotavirus.

young children, with a more frequent and severe clinical picture. Malnutrition and dehydration can quickly lead to acute dehydration, sometimes even death.[1,4]

According to the World Health Organization, preventable and treatable infectious diarrheal diseases are the second most common cause of morbidity and mortality under the

age of 5 in the world. About 1300 children die every day due to AGE.[8] More than half of our patients (73.1%) were under 5 years old and one-third of them were younger than 12 months.

Studies have reported that there is no difference between the incidence of viral AGEs and gender in our country.[4,9] Celik et al[8] reported that the incidence of rotavirus in girls was higher than in boys. In our study, the number of male patients was generally higher than female patients (M/F=1.6). In our study, the incidence of rotavirus in girls and boys was similar.

In approximately two-thirds of patients with AG, the causative microorganism cannot be demonstrated. Most AGEs can be treated on an outpatient basis and do not require hospitalization, and oral rehydration therapy may be sufficient. Severe dehydration, shock, presence of neurological findings, biliary vomiting/persistent vomiting, suspicion of surgical pathology, social indication, and insufficient oral fluid intake are indications for hospitalization in patients with AGE.[2] Our patients were mostly hospitalized because of poor oral intake, persistent vomiting, and electrolyte imbalance.

In developing countries, enteric bacteria or parasites are more common than viruses, typically in summer. Viral AGE causes are more common in winter. Especially rotavirus is seen in winter–spring. Adenovirus is seen equally in all seasons. In some publications, it has been stated that adenovirus is more common in winter.[4,10-13]

In our study, rotavirus antigen was positive in 57.1% of the patients detected with AGE and in 24% of all patients (7% combined with other factors, 17.1% isolated). Consistent with the literature, most of those detected with rotavirus were admitted to the hospital in winter and spring. It may be beneficial to include the rotavirus vaccine in the national program since most of the detected agents are rotavirus that can be prevented by vaccination.

In only seven of our patients, stool adenovirus antigen was positive, in other patients, rotavirus or *E. histolytica* were detected in similar numbers in all seasons.

Among the causes of invasive bacterial AGE, *Salmonella* spp. is also an important agent. It can be seen in all age groups. It can cause different clinical findings such as bacteremia, enteric fever, and local infections, especially in developing countries. It is usually self-limited. *Salmonella* spp. in 3.3-8.4% of AGE cases has been shown in our country.[14,15] In our study, *Salmonella enterica* was isolated in 8 (2.4%) of all patients.

E. histolytica/*E. dispar*, which is the most common parasitic cause of acute gastroenteritis, affects 10.2% of the world population and is one of the important causes of AGE in rural areas. It may be asymptomatic, mild diarrhea, or diarrhea with intense blood may be present[16,17] For the diagnosis of amebiasis, parasite antigen positivity could not be demonstrated in the stool or serum of some of the patients with amoeba cysts in direct parasite examinations. Since *E. histolytica* adhesion antigen positivity may be falsely positive, it is recommended to be considered positive by comparing it with stool microscopy (cyst/trophozoite) results.[18] Özer et al[19] in their study with 975 cases stated that *E. histolytica*/*E. histolytica*-specific antigen was detected in only 4 of 21 cases with dysparous cysts and/or trophozoites. In the direct microscopic examination, *E. histolytica*/*E. histolytica*-specific antigen was found positive in three cases without dispar cysts and/or trophozoites. *E. histolytica* antigen positivity was present in a total of 15 (15.3%) of our patients (isolated in 4 patients, combined with other factors in 11 patients). *E. histolytica* cyst was seen in only one of the patients with positive *E. histolytica* antigen.

Giardiasis, one of the most common parasites seen in humans, has been shown with a frequency of 9.3% in children under the age of 13.[17] Parasitic diseases should be investigated in gastroenteritis lasting longer than 2 weeks.[20] In our study, Giardia antigen positivity was not detected in the stool of the patients.

The level of development of countries, rural–urban living conditions, socioeconomic level, nutritional conditions, ease of applying to health institutions, the prevalence of the disease, and the cause of the disease are effective factors for the progression of the disease.[1] More than half of our inpatients came from the city center, one-third came from rural areas, or the outskirts of the city, which is slightly worse in socioeconomic terms, and 10% came to our city as tourists. There was no significant difference between the factors coming from the city center, rural areas, and tourists.

As a result, most of the time, the causative agent of AGE cannot be detected in childhood. Viruses are the most common cause of infectious AGE. Rotavirus is the most common cause of viruses. Including the rotavirus vaccine in the national vaccination program in our country may be beneficial for the prevention of rotavirus, which is the most common viral agent identified. Age and seasonal changes are important. Stool examination (direct microscopy/parasite examination, culture, immunochromatographic tests, and PCR test) can be a guide for diagnosis and treatment.

Ethics Committee Approval: Ethics committee approval was received for this study from the local ethics committee of

Erzincan Binali Yıldırım University (Date: March 20, 2020, Number: 03/19).

Informed Consent: Consent was obtained from the hospital management to obtain data from patient files.

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