

**ORIGINAL RESEARCH**

# Characterization of Acute Gastroenteritis in Hospitalized Children in Tertiary Hospital in Raipur City of India: Microbial Etiology

<sup>1</sup>Dr. Sanchita Nihal, <sup>2</sup>Dr. Neha Baid, <sup>3</sup>Dr. Vivek Kumar

<sup>1</sup>Associate Professor, <sup>2,3</sup>Assistant Professor, Department of Microbiology, Raipur Institute of Medical Science, Raipur, Chhattisgarh, India

**Corresponding author**

Dr. Vivek Kumar

Assistant Professor, Department of Microbiology, Raipur Institute of Medical Science, Raipur, Chhattisgarh, India

**Email:** [chauhanvivek184@gmail.com](mailto:chauhanvivek184@gmail.com)

Received: 11 May, 2023

Accepted: 16 June, 2023

**ABSTRACT**

**Background:** Acute gastroenteritis (AGE) is still one of the leading causes of hospitalisation and is regarded as having the second-highest burden of all infectious diseases. Understanding the microbiological cause of diarrhoea and how it relates to how long a patient stays in the hospital is crucial for the adoption of effective public health policies to reduce these diseases and, in many circumstances, for the right treatment. **Objective:** To investigate the epidemiology, clinical, and operational characteristics of AGE in hospitalized children in a tertiary pediatric center in Raipur, India. **Methods:** In this retrospective study we evaluated the 1120 paediatric patients who were admitted to the treatment of AGE between February 2021 and January 2023 and were younger than 14 years. We identified the microbial (causative agent), clinical (major symptoms) and functional aspects (Length of hospitalization) of gastroenteritis. **Results:** Mean age of the patients admitted for AGE was 9.5 years. Majority of patients were from the age group of 0 to 2 years old (55.5%). Vomiting and diarrhoea were the most frequent AGE symptoms. Microbial characterization report showed 172 samples with positive microbial growth. Out of 172 instances, 59 (34.3%) had bacterial pathogens, 110 (64%) had viral pathogens, 3 (1.7%) had protozoa. Salmonella was the most frequent bacteria and rotavirus was common causative virus for AGE. Length of hospitalization was more in viral AGE than bacterial one and it was also highest in 0-2 years age group and lowest in 10-14 years age group. **Conclusion:** According to this study, rotaviruses and Salmonella species were the most prevalent AGE pathogens in paediatric hospital patients. Although it was longer in viral AGE, the gender and age of children with AGE did not affect how long they stayed in the hospital.

**Keywords:** Acute gastroenteritis, Bacteria, Virus, Hospitalization, Children, Pathogens

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**INTRODUCTION**

In underdeveloped nations, diarrheal illness continues to be a major source of morbidity and mortality in young children [1]. It is characterised by vomiting, diarrhoea, and stomach pain, which in extreme cases can result in hypovolemic shock, dehydration, and mortality [1]. Three to five billion children are affected by gastroenteritis annually, and it causes 1.5 to 2.5 million deaths annually, or 12% of all fatalities in children under the age of five [2]. Acute gastroenteritis (AGE) causes 300 fatalities annually in affluent nations [2].

An infectious illness known as acute gastroenteritis is described as causing a brief inflammation of the

mucous membranes in the stomach and/or intestines [3]. The signs and symptoms of AGE can range from mild to moderate, and they can include one or more of the following: vomiting, diarrhoea, stomach pain, loss of appetite, fever, and blood in the stool [4]. Dehydration and coinfection are two AGE complications. Severe dehydration in some severe cases of acute gastroenteritis might result in hypovolemic shock or even death [5]. An accurate understanding of the relative relevance of the numerous etiological agents, particularly in relation to the disease burden in different age groups, is essential for the effective control of diarrheal disease in any community.

Adenovirus, astrovirus, and rotavirus are the next most frequent etiological agents for AGE globally [6]. Only one long-term study (spanning over 6 years) has described annual changes in the prevalence of pathogens, and there are comparatively few comprehensive studies of the viral, bacterial, and parasite aetiology of severe acute diarrhoea in children admitted to hospitals in affluent nations [7] and [8]. The cause of human amoebiasis is the intestinal protozoan parasite *Entamoeba histolytica*. This parasite infection is a significant contributor to morbidity and mortality, as well as to 50 million cases of invasive illness [9] and almost 70,000 global fatalities per year [10]. The National Institute of Health has classified *E. histolytica* and *Giardia lamblia* as category B priority biodefense pathogens because of their low infectious doses and potential for spread through tainted food and water supplies in the United States [11]. Parasitic infections are a social and economic issue in developing nations, with more severe illness being linked to early age, malnutrition, and immunosuppression [12]. Additionally, there was a link between the etiological component and hospitalisation. The duration of stay was longer following a salmonella infection than following other pathogenic diseases.

Only a few studies have been published that have shown a variety of diarrheal enteropathogens, including bacterial, viral, and parasite ones. Previous research has largely concentrated on a single cause of diarrhoea [13]. To the best of our knowledge, no studies have looked into the causes of paediatric gastroenteritis in Chhattisgarh, India, or how long it lasts in hospitals. In our cross-sectional study, we looked at the length of hospitalisation in connection to the gender, age, and characteristics of children with gastroenteritis as well as the characteristics of gastroenteritis in children. Additionally, we sought to link several causative agents to the length of stay in kids with AGE.

## **MATERIALS AND METHODS**

### **STUDY DESIGN**

The investigation was conducted in a retrospective cross-sectional manner. The information was gathered over a two-year period from known gastroenteritis cases. Additionally, the study was cross-sectional in nature because there were no follow-ups and all the information on the study participants was gathered in a limited window of time. At Children's Hospital, Raipur, where the study was done, there are more over 5000 paediatric emergency room visits and about 800 admissions every year. According to the electronic statistics, 1550 individuals were hospitalised to the hospital in 2021 and 2022 as a result of gastroenteritis.

### **PATIENT SELECTION**

Consecutive nonrandomizing sampling was the method of sampling utilised in the investigation.

Patients with acute gastroenteritis who were hospitalised to a children's hospital between February 2021 and January 2023 and were younger than 14 years old served as the denominator. We identified the clinical, epidemiological, and functional aspects of gastroenteritis.

### **INCLUSION CRITERIA**

1120 patients under the age of 14 who were diagnosed with AGE and were hospitalised to the paediatric department between February 2021 and January 2023 were chosen for the study based on the inclusion criteria. AGE was characterised as experiencing diarrheal symptoms (loose or watery stools more than three times per day) and/or vomiting for a whole week.

### **EXCLUSION CRITERIA**

This included people who had a chronic condition coexisting with them, such as chronic kidney disease, chronic liver disease, chronic inflammatory bowel disease, prolonged use of steroid therapy, malnutrition, cancer, cerebral palsy, immunosuppression or immunodeficiency. The study also excluded participants with any known past infection of the respiratory tract, including tonsillitis, pharyngitis, laryngitis, sinusitis, otitis media, and severe acute respiratory syndrome. Children who had undergone any previous gastrointestinal procedures were also excluded.

### **DATA COLLECTION**

The data was gathered by the co-investigator clinicians (including a paediatrician, a pathologist, and a microbiologist) and included all the variables required for this investigation. Age, gender, past medical history, surgical history, and any occurrence of signs or symptoms, such as diarrhoea, fever, nausea, vomiting, abdominal discomfort, or bloody stools, were the significant factors. Stool analysis was also done. In addition, the length of hospitalisation was recommended as the outcome variable, which was then connected to the pathogen type. It was calculated from the date of admission to the date of discharge. We decided that patients' direct agreement was not necessary because the study was retrospective.

### **STATISTICAL ANALYSIS**

A for-purchase version of the Statistical Package for the Social Sciences (SPSS for Mac, version 23.0) was used for the statistical analysis. For continuous variables, data were reported as mean standard deviation (SD), while for categorical variables, percentage was used. Depending on the type of data, several statistical tests were applied, and a p-value of 0.05 was regarded as statistically significant.

## RESULTS

A total of 1120 patients with acute gastroenteritis were enrolled during the study period, with ages ranging from 2 months to 14 years and a median age of 9.5 years. Of these children, 635 (56.7%) were male and 485 (43.3%) were female. The group with the highest risk of hospitalization with AGE was children aged from 0 to 3 years. Out of the 1120 patients, 884 patients (78.9%) had received the rotavirus vaccination. The demographic details of all cases are listed in Table 1. Majority of patients were from the age group of 0 to 2 years old (55.5%).

Description of the clinical symptoms experienced by children with gastroenteritis reveals that vomiting (88.1% of cases) and diarrhoea (85.2% of cases) were the most frequent AGE symptoms. In contrast, abdominal distention was the least frequent (2.5%). The number of patients admitted in the wetter months of the year (June to October) was roughly twice as high as that of patients admitted in the winter or summer (November to May), according to the overall hospital admissions data for AGE.

**Table 1: Demographic details of children with acute gastroenteritis**

Variable	Frequency	%
Gender		
Male	635	56.7
Female	485	43.3
Age at diagnosis (years)		
0 to 2	622	55.5
2 to 5	318	28.4
5 to 10	116	10.4
10 to 14	64	5.7
Vaccination taken for rotavirus		
Yes	884	78.9
No	236	21.1
Past medical history		
Yes	215	19.2
Complex	61	28.4
Not complex	154	71.6
No	905	80.8

## MICROBIAL CHARACTERISATION OF AGE

Out of 1120 patients, stool samples were taken from 739 (66%), of which 172 (23.3%) were positive and 567 (76.7%) were negative for viral and bacterial infections. Out of 172 instances, 59 (34.3%) had bacterial pathogens, 110 (64%) had viral pathogens, 3 (1.7%) had protozoa, and 3 (1.7%) had two pathogens detected simultaneously. Figure 2 presents the sample outcomes. Salmonella was the most frequent pathogen

found in the 59 stool samples that tested positive for bacteria; it was found in 28 patients (16.3%) and was followed by Klebsiella in 11 individuals (6.4%). Rotavirus was discovered in 87 samples (50.6%) and astrocytic virus in 15 samples (8.7%) out of 172 virus-positive cases. We also found Shigella (2.9%), Aeromonas (4.1%), and Escherichia coli (4.6%), with Adenovirus (4.6%) and Blastocyst hominis (1.1%) being the least common pathogens found.

**Table 2: Types of pathogens in the positive results**

Enteropathogens	Name of species	Frequency	%
Bacteria (59)	Salmonella	28	16.28
	Klebsiella pneumonia	11	6.40
	Escherichia coli	8	4.65
	Aeromonashydrophila	7	4.07
	Shigella	5	2.91
Protozoa (3)	Blastocyst hominis	2	1.16
	Entamoeba histolytica	1	0.58
Virus (107)	Rotavirus	87	50.58
	Astrovirus	15	8.72
	Adenovirus	8	4.65
<b>Total</b>		<b>172</b>	

According to the length of hospitalisation (in days), the factors of gender, age at diagnosis, and sample taken were compared (Table 3). With p-values of 0.778 and 0.195, respectively, it was discovered that gender and age at diagnosis were statistically unimportant for the length of hospitalisation. It was discovered that the period of

hospitalisation was longer for those who had a culture performed compared to those participants who did not (p 0.001).

**Table 3: Length of hospitalization (in days) with gender and age at diagnosis (in years).**

Gender	No of Subjects	Length of hospitalization
<b>Gender</b>		
Male	635	11.7±5.8
Female	485	12.3±6.4
<b>Age at diagnosis (years)</b>		
0 to 2	622	15.2±8.2
2 to 5	318	13.6±7.3
5 to 10	116	13.2±8.1
10 to 14	64	9.5±7.5
<b>Type of pathogens</b>		
Bacterial	59	11.2±6.3
Viral	107	17.3±6.5

## DISCUSSION

In this study, children hospitalised in a tertiary paediatric facility in Raipur, India, were examined for epidemiological, clinical, and operational aspects of AGE. In children with AGE at discharge, our study found no correlation between gender or age and length of hospital stay. According to our research, children with viral viruses spent more time in the hospital than kids whose cultures showed bacterial origins. Vomiting and diarrhoea were the most common signs of AGE in children, although abdominal distention was less common. Fever and anorexia were the main clinical symptoms of AGE, according to a global survey done in Taiwan [14].

In this study, rotavirus was found to be the major cause of paediatric gastroenteritis (AGE) among children who were hospitalised. Local and worldwide investigations [15] revealed that the main viral culprit causing AGE was the rotavirus. Children under the age of five bear the brunt of the rotavirus sickness. Nevertheless, rotaviruses were found to be the cause of severe AGE, and none of the patients had a condition that would have increased their risk of developing enteric infection or predisposed them to it. These older children presented to the hospital with clinical symptoms that required treatment and admission. Contrary to findings for experimental animals, in which clinically obvious diarrhoea is uncommon after the first few weeks of birth [16], this suggests that age does not inevitably result in physiological resistance to disease in humans. In earlier investigations, the frequency of astroviruses was understated. Three to four percent of children referred to the hospital with severe diarrhoea had astrovirus infection, according to a year-long study done in 1995 employing an astrovirus-specific cDNA probe [17]. Astrovirus was also found to be the culprit responsible for AGE.

Salmonella was the bacterial infection that caused the most problems. This outcome is consistent with a prior Taiwanese investigation [14] that discovered Salmonella to be the most frequent cause of bacterial AGE. AGE can also be brought on by other diseases.

As an illustration, *Entamoeba histolytica* was listed as the main contributor of AGE in Lebanon [18]. Individual pathogen prevalence varies greatly by geographic location and selection parameters. Mixed infections with parasites are uncommon.

This research had several restrictions. First, a single-center investigation was used to gather the data for our study. The results of this study cannot, therefore, be used at the regional or national level. Second, the number of cases admitted and the length of their stays may have been affected by variations in clinical practise among doctors. Third, aside from rotavirus, several viral diseases were left out of this study, including norovirus, astrovirus, and enteric-type adenovirus. This is because these tests need to be specifically ordered by the doctor at the time of admission based on their clinical judgement.

## CONCLUSION

The study found that the two AGE pathogens that were most common in pediatric hospital patients were rotaviruses and Salmonella species. The length of stay in the hospital was unaffected by the children's gender or age, despite being longer in viral AGE.

## REFERENCES

- Bern C, Martines J, de Zoysa I, Glass RI. The magnitude of the global problem of diarrhoeal disease: a ten-year update. Bull World Health Organ. 1992;70:705–714.
- Chow CM, Leung AK, Hon KL. Acute gastroenteritis: from guidelines to real life. Clin Exp Gastroenterol. 2010;3:97–112.
- Armon K, Elliott J. Acute gastroenteritis. In: Moyer A, Elliott J, Davis L, et al, editors. Evidence-based pediatrics and child health. London, UK: BMJ Books; 2004. pp 377–92.
- Jones M, Harrach B, Ganac R, Gozum M, Dela Cruz W, Riedel B. New adenovirus species found in a patient presenting with gastroenteritis. J Virol. 2007;81(11):5978–84.
- Reveals A. Acute Gastroenteritis among children in the developing world. South Afr J Epidemiol Infect. 2012;27(4):156–62.

6. Buttery JP, Kirkwood C. Rotavirus vaccines in developed countries. *Curr Opin Infect Dis.* 2007;20:253–258.
7. Aprioli A, Pizzella C, Morelli R, Giammanco A, Arista S, Crotti D, Faccini M, Guglielmetti P, Piersimoni C, Luzzi I the Italian Study Group on Gastrointestinal Infections. Enteropathogens associated with childhood diarrhea in Italy. *Pediatr Infect Dis J.* 1996;15:876–883.
8. Durepaire N, Pradie M P, Ploy M C, Mounier M, Ranger-Rogez S, Martin C, Denis F. Adenoviruses from stool samples in a university hospital. Comparison with other main enteropathogens (rotavirus, *Campylobacter*, *Salmonella*) *Pathol Biol.* 1995;43:601–610.
9. Walsh JA. Problems in recognition and diagnosis of amebiasis: estimation of the global magnitude of morbidity and mortality. *Rev Infect Dis.* 1986;8:228–238.
10. Stanley SL. Jr Amoebiasis. *Lancet.* 2003;361:1025–1034.
11. National Institute of Allergy and Infectious Diseases. NIAID emerging infectious diseases/pathogens [Internet] Bethesda (MD): National Institute of Allergy and Infectious Diseases; [cited 2016 Oct 28]. Available from: <https://www.niaid.nih.gov/research/emerging-infectiousdiseases-pathogens>.
12. Hegazi MA, Patel TA, El-Deek BS. Prevalence and characters of *Entamoeba histolytica* infection in Saudi infants and children admitted with diarrhea at 2 main hospitals at South Jeddah: a re-emerging serious infection with unusual presentation. *Braz J Infect Dis.* 2013;17:32–40.
13. AlGhamdi M, Bentham G, Hunter P. Environmental risk factors for diarrhea among male schoolchildren in Jeddah City, Saudi Arabia. *J Water Health.* 2009;7(3):380–91.
14. Chung N, Wang S, Shen C, Kuo F, Ho T, Hsiung C, et al. Clinical and epidemiological characteristics in hospitalized young children with acute gastroenteritis in southern Taiwan: according to major pathogens. *J Microbiol Immunol Infect.* 2017;50(6):915–22.
15. Wiegering V, Kaiser J, Tappe D, Weißbrich B, Morbach H, Girschick H. Gastroenteritis in childhood: a retrospective study of 650 hospitalized pediatric patients. *Int J Infect Dis.* 2011;15(6):401–7.
16. Bass DM, Greenberg HB. Pathogenesis of viral gastroenteritis. In: Field M, editor. *Diarrheal diseases.* New York, N.Y: Elsevier; 1991. pp. 139–157.
17. Palombo EA, Bishop RF. Annual incidence, serotype distribution, and genetic diversity of human astrovirus isolates from hospitalized children in Melbourne, Australia. *J Clin Microbiol.* 1996;34:1750–1753.
18. Hussein G, Salami A, Salloum L, Chedid P, Joumaa H, Fakhri H. Surveillance study of acute gastroenteritis etiologies in hospitalized children in south Lebanon (SAGE study). *Pediatr Gastroenterol Hepatol Nutr.* 2018;21(3):176–83.