ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✓*Biology*
✓*Horticulture*
✓*Food products processing technology*
✓*Environmental engineering*

Vol. XXX (LXVI) - 2025

INFLUENCE OF SEVERAL FACTORS ON THE INCIDENCE OF DIGESTIVE VIRAL INFECTIONS

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Keywords*: digestive viruses, rotavirus, norovirus, adenovirus, incidence*

ABSTRACT

Digestive viral infections are a major cause of acute gastroenteritis worldwide, especially among children, the elderly, and immunocompromised individuals. The main viral agents are rotavirus, norovirus, and adenovirus, transmitted mostly through the fecal–oral route and influenced by hygiene, food and water safety, and seasonality. Rotavirus remains highly prevalent in children despite vaccination, while norovirus frequently causes outbreaks in both communities and healthcare settings. Adenovirus, though less common, plays a notable role in pediatric cases. Prevention relies on vaccination, strict hygiene, safe drinking water, and public health education, all crucial in reducing their overall impact.

INTRODUCTION

Acute viral gastroenteritis remains one of the most prevalent and burdensome infectious diseases worldwide, affecting millions of children and adults each year and representing a major cause of hospitalization, absenteeism, and healthcare costs. The clinical picture typically involves diarrhea, vomiting, abdominal pain, and dehydration, which can lead to life-threatening complications in vulnerable groups such as infants, elderly individuals, and immunocompromised patients (Kotloff et al. 2013). Although generally self-limiting in healthy persons, the global morbidity and mortality associated with these infections continue to pose significant public health challenges, particularly in low- and middle-income countries where sanitation and vaccination coverage remain suboptimal.

Among the most important etiological agents are rotaviruses, noroviruses, and adenoviruses, which together account for the vast majority of viral gastroenteritis cases. Each exhibits distinctive epidemiological characteristics and pathogenic mechanisms, influencing transmission patterns, severity, and prevention strategies. Historically, rotavirus has been recognized as the leading cause of severe diarrhea in children under five, responsible for nearly half a million deaths annually prior to the implementation of vaccination programs (Tate et al. 2016). The global introduction of rotavirus vaccines has drastically reduced severe disease and hospitalization rates, yet periodic outbreaks and regional differences in immunization coverage continue to sustain its clinical relevance. Moreover, the circulation of diverse genotypes and emerging variants highlights the need for continuous molecular surveillance.

Noroviruses, now identified as the most common cause of epidemic gastroenteritis across all age groups, are characterized by a very low infectious dose

and exceptional environmental stability. These properties allow the virus to spread rapidly in closed or semi-closed settings—including hospitals, nursing homes, schools, and cruise ships—resulting in explosive outbreaks with significant economic and healthcare impacts (Patel et al. 2009, Ahmed et al. 2014). Despite intensive research, the absence of an approved vaccine and the diversity of circulating genotypes complicate control efforts.

Adenoviruses, particularly serotypes 40 and 41, represent a smaller but clinically meaningful contributor to pediatric gastroenteritis. Although less frequent, they are capable of causing prolonged diarrhea and have been associated with outbreaks in daycare centers and pediatric wards. Their epidemiology varies according to seasonality, sanitation, and population density, often reflecting the local level of environmental hygiene and public health infrastructure (Uhnoo et al. 1986).

Understanding the complex interaction between environmental, social, and host-related factors is fundamental for designing effective prevention and control strategies. Elements such as hygiene practices, access to clean water, vaccination coverage, and public health awareness play decisive roles in disease dynamics. Consequently, continued epidemiological monitoring and research remain essential to inform targeted interventions and reduce the global burden of viral gastroenteritis.

MATERIAL AND METHODS

This paper was conceived as a descriptive and narrative study, aiming to synthesize up-to-date data from the scientific literature and epidemiological surveillance systems concerning the incidence and characteristics of digestive viral infections.

Data sources. Relevant information was collected through searches in international scientific databases—PubMed, Scopus, and Web of Science—using the following keywords: rotavirus, norovirus, adenovirus, acute gastroenteritis, and epidemiology. Priority was given to articles published between 2000 and 2024, including systematic reviews, meta-analyses, clinical trials, and surveillance reports from authoritative institutions such as the World Health Organization (WHO) and the European Centre for Disease Prevention and Control (ECDC).

Inclusion criteria. The analysis included studies reporting on incidence, prevalence, risk factors, seasonality, prevention, and vaccination related to viral gastroenteritis in human populations.

Exclusion criteria. Publications were excluded if they focused on non-viral etiologies, animal-only experimental studies, or lacked accessible English abstracts or primary data.

Data extraction and synthesis. Extracted data were analyzed narratively and structured according to:

(i) the etiological profile of the main viruses (rotavirus, norovirus, adenovirus);

(ii) their geographical and age-specific distribution;

(iii) risk factors associated with infection; and

(iv) temporal trends, particularly in the post-rotavirus-vaccination era.

Special attention was paid to rotavirus epidemiology following the introduction of vaccination, the seasonal and outbreak dynamics of norovirus, and the role of adenovirus in pediatric gastroenteritis.

This methodological approach enabled a comprehensive synthesis of epidemiological and clinical data, emphasizing the interplay between host susceptibility, environmental conditions, and public health interventions in shaping the global and regional burden of digestive viral infections.

RESULTS AND DISCUSSIONS

Local findings. In the present study, data collected from the observed population confirmed that rotavirus remains the most frequent viral agent of acute gastroenteritis in children under five years of age, followed by norovirus and adenovirus. Clear seasonal peaks were observed during the colder months for rotavirus infections, whereas norovirus was detected throughout the year, often linked to outbreak clusters. Adenoviruses were less frequent but persistently present, particularly in infants and young children. These local findings are in line with international data and reinforce the importance of sustained vaccination programs, hygiene measures, and public health education to control viral gastroenteritis (Fig. 1).

Overall incidence. Viral gastroenteritis continues to represent one of the most prevalent infectious diseases worldwide. Global estimates indicate nearly 700 million cases annually, with the greatest burden in children under five years of age (Troeger et al. 2018). The introduction of rotavirus vaccines has led to a substantial decline in severe diarrhea and hospitalization rates; however, rotavirus remains responsible for a significant proportion of pediatric gastroenteritis cases in many parts of the world (Tate et al. 2016).

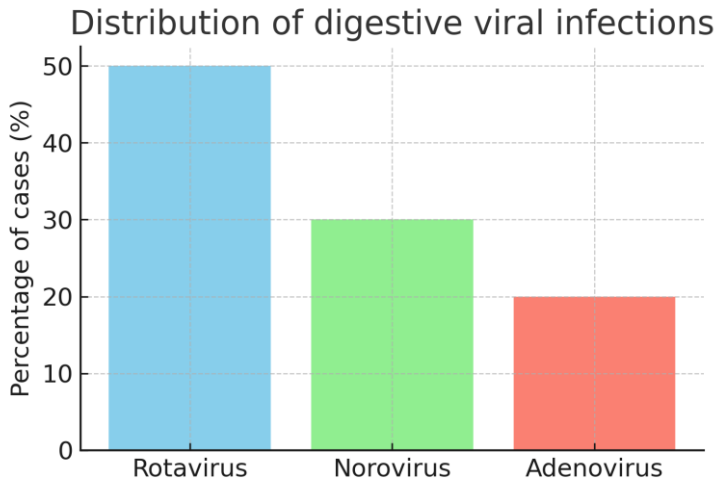

Figure 1. Distribution of digestive viral infections (Rotavirus, Norovirus, Adenovirus)

Rotavirus. Before widespread vaccination campaigns, rotavirus accounted for up to 40 % of severe diarrhea episodes in children (Parashar et al. 2006). Epidemiological studies consistently demonstrate a distinct seasonal pattern, with incidence peaking during the colder months in temperate climates. Following the introduction of immunization programs, both morbidity and mortality have declined, although challenges persist due to breakthrough infections and uneven vaccine coverage across regions (Burnett et al. 2020). The observed temporal trend in rotavirus activity is shown in Figure 2, which highlights the seasonal variation typical of these infections.

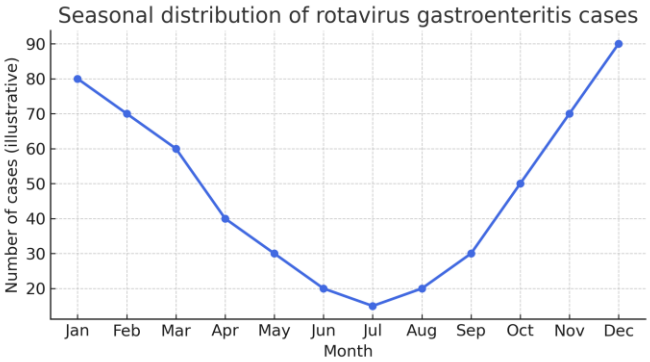

Figure 2. Seasonal distribution of rotavirus gastroenteritis cases (illustrative trend).

Norovirus. Noroviruses have now emerged as the leading cause of acute gastroenteritis across all age groups. Their high contagiousness—requiring only a few viral particles for transmission—and resistance to common disinfectants make them especially problematic in healthcare and institutional settings (Patel et al. 2009; Ahmed et al. 2014). Norovirus outbreaks are frequent in hospitals, nursing homes, schools, and other closed environments, where rapid person-to-person transmission can cause widespread infection and substantial economic burden. Figure 3 illustrates the main outbreak settings associated with norovirus transmission.

Adenovirus. Adenoviruses, particularly serotypes 40 and 41, contribute to 2–10 % of pediatric gastroenteritis cases worldwide (Uhnoo et al. 1986; Dey et al. 2016). Although less frequent than rotavirus and norovirus, they remain clinically relevant, particularly in children under two years and immunocompromised patients, where infections may be prolonged or severe.

Influence of factors. The incidence and transmission of digestive viral infections are modulated by a complex interplay of environmental, socio-economic, and host-related factors. Poor sanitation, limited access to clean water, household crowding, low educational levels, and inadequate healthcare infrastructure all contribute to heightened risk. Age, nutritional status, and immune competence further determine susceptibility. Rotavirus displays clear seasonal variation, while norovirus circulates year-round, typically peaking in winter months.

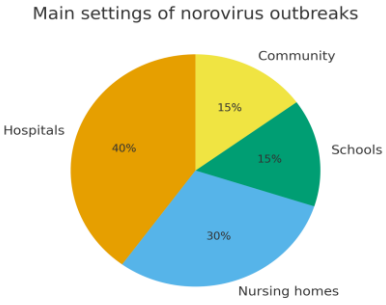

Figure 3. Main settings of norovirus outbreaks (hospitals, nursing homes, schools, community).

Prevention and control. Vaccination remains the most effective measure against rotavirus infection, whereas no licensed vaccines currently exist for norovirus or adenovirus. Preventive strategies therefore rely heavily on hygiene practices, safe food and water supplies, and rapid outbreak management. Strengthening public health education and global surveillance networks is essential to detect emerging viral strains, monitor vaccine effectiveness, and adapt preventive measures accordingly.

CONCLUSIONS

Digestive viral infections, primarily caused by rotavirus, norovirus, and adenovirus, remain a major cause of morbidity worldwide, especially in children under five years of age.

Rotavirus vaccination has significantly reduced severe diarrhea cases and hospitalizations, but global disparities in vaccine coverage persist.

Noroviruses have emerged as the leading cause of epidemic gastroenteritis, with high transmissibility and persistence in healthcare and community settings.

Adenoviruses contribute to a smaller yet clinically significant proportion of pediatric gastroenteritis cases.

Prevention relies on a multifactorial approach: vaccination (where available), hygiene measures, access to clean water, health education, and ongoing epidemiological surveillance.

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