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Burden of Nosocomial and Community-Acquired Rotavirus Gastroenteritis in Children

Burcu Ceylan Cura Yayla[1], Tuğba Bedir Demirdağ[2], Cemalettin Güneş[2], Hasan Tezer[2], Gülendam Bozdayı[3], Anıl Tapısız[2]

1 University of Health Sciences, Ankara Training and Research Hospital, Ankara, Türkiye

2 Division of Pediatric Infectious Diseases, Faculty of Medicine, Gazi University, Ankara, Türkiye

3 Department of Microbiology, Faculty of Medicine, Gazi University, Ankara, Türkiye

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Abstract

Background: This study aimed to evaluate the demographic and clinical characteristics, seasonal distribution, vaccination status, and complications of rotavirus gastroenteritis (RVGE) in children, as well as the frequency and clinical features of nosocomial RVGE.

Methods: This retrospective study included pediatric patients aged 1 month to 18 years who were diagnosed with RVGE at a tertiary university pediatric hospital in Türkiye over a five-year period. The diagnosis of RVGE was based on the detection of rotavirus antigen in stool samples. Data on demographics, hospitalization, nosocomial status, complications, seasonal distribution, and vaccination status were obtained from hospital records, and vaccination status was confirmed via caregiver interviews. Nosocomial RVGE was defined as symptom onset ≥48 hours after admission or within 72 hours of discharge.

Results: A total of 391 children were diagnosed with RVGE; 227 (58.1%) were outpatients and 164 (41.9%) were hospitalized. Nosocomial infection occurred in 60 (15.3%) of all RVGE cases, corresponding to 36.6% of hospitalized RVGE cases. The median age was 11 months (1–52) for outpatients, 10 months (1–61) for inpatients, and 5 months (1–40) for nosocomial cases. RVGE was most frequently observed in winter (36.6%). Complications occurred in 123 (31.5%) patients, the most common was dehydration, followed by bacteremia, pneumonia, seizures, and elevated liver enzymes. Only 8 children (2%) were vaccinated against rotavirus.

Conclusion: Rotavirus remains a significant cause of gastroenteritis and hospitalization in children, particularly among the unvaccinated. The high rate of nosocomial transmission highlights the need for strengthened infection control practices and consideration of routine rotavirus vaccination in national immunization programs.

Keywords: Rotavirus, gastroenteritis, children, vaccination, nosocomial infection.

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Correspondence / Yazışma Adresi: *Burcu Ceylan Cura Yayla, University of Health Sciences, Ankara Training and Research Hospital, Ankara, Türkiye e-mail: dr.bcc.83@gmail.com*

Çocuklarda Nozokomiyal ve Toplum Kökenli Rotavirüs Gastroenteritinin Yükü

Öz

Giriş: Bu çalışmada, çocuklarda rotavirüs gastroenteritinin (RVGE) demografik ve klinik özellikleri, mevsimsel dağılımı, aşılanma durumu ve komplikasyonları ile hastane kökenli RVGE sıklığı ve klinik özelliklerinin değerlendirilmesi amaçlandı.

Yöntemler: Bu retrospektif çalışmaya, beş yıllık bir süre boyunca Türkiye'deki üçüncü basamak bir üniversite çocuk hastanesinde RVGE tanısı alan, 1 ay ile 18 yaş aras pediatrik hastalar dâhil edildi. RVGE tanısı, dışkı örneklerinde rotavirüs antijeninin saptanmasına dayandırıldı. Demografik veriler, hastaneye yatış durumu, nozokomiyal durum, komplikasyonlar, mevsimsel dağılım ve aşılama durumu ile ilgili veriler hastane kayıtlarından elde edildi ve aşılama durumu, bakım verenlerle yapılan görüşmeler yoluyla doğrulandı. Nosokomiyal RVGE, semptomların yatıştan sonraki ≥48 saat içinde veya taburcu olduktan sonraki 72 saat içinde başlaması olarak tanımlandı.

Bulgular: Toplam 391 çocukta RVGE saptandı; bunların 227'si (%58,1) ayaktan, 164'ü (%41,9) yatarak tedavi edildi. Tüm RVGE olgularının 60'ında (%15,3) nozokomiyal enfeksiyon vardı; bu, yatan RVGE olgularının %36,6'sına karşılık gelmekteydi. Ortanca yaş, ayaktan hastalarda 11 ay (1–52), yatanlarda 10 ay (1–61) ve nozokomiyal olgularda 5 ay (1–40) idi. En sık kış mevsiminde (%36,6) görüldü. Toplam 123 hastada (%31,5) komplikasyon gelişti; en yaygın komplikasyon dehidratasyondu, bunu bakteriyemi, pnömoni, nöbet ve karaciğer enzim yüksekliği izlendi. Sadece 8 çocuk (%2) rotavirüs aşılıydı.

Sonuç: Rotavirüs, özellikle aşısız çocuklarda, gastroenterit ve hastaneye yatışların önemli bir nedenidir. Nozokomiyal bulaşın yüksek oranı, enfeksiyon kontrol önlemlerinin güçlendirilmesi ve rotavirüs aşısının ulusal bağışıklama programına dahil edilmesinin önemini vurgulamaktadır.

Anahtar kelimeler: Rotavirüs, gastroenterit, çocuk, aşılama, nozokomiyal enfeksiyon.

INTRODUCTION

Rotaviruses are the most common cause of acute gastroenteritis in children worldwide. Rotavirus is responsible for approximately 40% of diarrhea-related hospitalizations in children under five years of age, with an estimated half a million deaths attributable to rotavirus gastroenteritis (RVGE) annually[1]. Although the burden of RVGE has significantly decreased following the introduction of rotavirus vaccines, before their implementation the virus was the leading cause of severe acute gastroenteritis in infants and young children worldwide, accounting for an estimated 440.000 deaths, 2 million hospitalizations, and 25 million outpatient visits annually among those under five years of age[2-4]. More recent global estimates indicate that by 2019, rotavirus was responsible for approximately 235.331 deaths in under-5 children and ~1.76 million hospitalizations globally in this age group, illustrating the decline in disease burden following vaccine introduction[5,6]. Although RVGE is usually self-limited, it can result in severe dehydration and serious complications requiring hospitalization. Vaccination remains the most effective strategy to reduce the associated morbidity and mortality[1].

The implementation of rotavirus vaccines in over 120 countries has substantially reduced disease burden[7]; however, the vaccine is not yet included in Türkiye's national immunization program, contributing to the continued impact of RVGE on childhood morbidity and hospitalizations[8]. Nosocomial RVGE is of particular concern, especially in pediatric wards where the virus can spread rapidly via contaminated hands, surfaces, and fomites. These infections prolong hospital stays, increase costs, and can complicate the clinical course of already vulnerable patients[9,10].

The aim of this study is to evaluate the clinical and epidemiological characteristics of pediatric RVGE cases diagnosed at a tertiary care center with a focus on vaccination status and the prevalence of nosocomial transmission.

METHODS

This was a retrospective observational study conducted at a tertiary care pediatric hospital in Türkiye over a five-year period. Children aged 1 month to 18 years who were diagnosed with acute gastroenteritis and tested positive for rotavirus antigen in stool samples were included. Stool samples were tested for rotavirus antigen using a commercial enzyme-linked immunosorbent assay (ELISA) kit, according to the manufacturer's instructions. Demographic and clinical data were collected from hospital records, including age, sex, hospitalization status (inpatient or outpatient), seasonal distribution, presence of complications, vaccination status, and whether the infection was classified as nosocomial.

Exclusion criteria included patients with incomplete or missing medical records, those with co-infections detected in stool samples (e.g., bacterial or parasitic pathogens), patients transferred from other hospitals with ongoing diarrhea at the time of admission.

Patients were categorized as having community-acquired or nosocomial rotavirus infection based on the timing of symptom onset in relation to hospitalization. Nosocomial RVGE was defined as diarrhea beginning at least 48 hours after hospitalization or within 72 hours of discharge, with stool positive for rotavirus antigen. Community-acquired rotavirus gastroenteritis (CA-RVGE) was defined as diarrhea present at the time of admission or beginning within first 48 hours of hospitalization[11]. All outpatients were classified as CA-RVGE cases, except for those who presented with symptoms within 72 hours after discharge who were classified as nosocomial cases. Vaccination status was obtained through hospital records and verified via telephone interviews with caregivers. Patients were classified as either "vaccinated" or "unvaccinated".

The patient groups with community-acquired and nosocomial rotavirus infection were compared in terms of age, gender, seasonal distribution, vaccination status, complication rates, hospitalization status and length of hospital stay. Similarly, patients with and without complications were compared using the same parameters, as well as in terms of the presence or absence of nosocomial infection, to evaluate their association with adverse outcomes.

Statistical Analyses

Statistical analysis was performed using SPSS version 23. Continuous variables were expressed as means ± standard deviations or medians (minimum–maximum), depending on the results of normality testing. Normality was assessed for all parameters using the Kolmogorov–Smirnov test. Since a normal distribution was observed, continuous variables (e.g., age, length of hospital stay) were compared using the Student's t-test. Categorical variables (gender, seasonal distribution, vaccination status, complication rates) were expressed as frequencies and percentages and compared using the chi-square or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 391 children were diagnosed with RVGE during the study period. Of these, 220 (56.3%) were males and 171 (43.7%) females. The median age was 10 months (1–61 months). Overall, 227 patients (58.1%) were treated as outpatients. There were 164 (41.9%) hospitalized patients with rotavirus gastroenteritis. Among all RVGE cases, 60 (15.3%) were nosocomial, corresponding to 36.6% of hospitalized RVGE cases, while 331 (84.7%) had community-acquired infection. Seasonal distribution revealed that cases were most frequently diagnosed in winter (36.6%), followed by spring (26.3%), autumn (22.3%),

and summer (14.8%). Only 8 patients (2%) had received rotavirus vaccination, while 383 (98%) were unvaccinated. Complications occurred in 122 children (31.2%), most commonly mild (14.3%) and moderate-to-severe dehydration (14.1%). Less frequent complications included bacteremia (1.3%), pneumonia (0.7%), seizures (0.5%), and elevated liver function tests (0.3%) (Table I). These were clinical complications associated with RVGE rather than separate nosocomial bacterial or viral infections.

Outpatient Subgroup

Among the 227 children diagnosed in the outpatient setting, 134 (59%) were males and 93 (41%) were females. The median age was 11 months (1–52 months). Infections were most diagnosed during winter (33.9%), followed by spring (28.2%), autumn (23.8%), and summer (14.1%). Only 8 children (3.5%) were vaccinated against rotavirus, while 219 (96.5%) were unvaccinated. Complications were rare, with only one patient (0.4%) experiencing mild dehydration.

Inpatient Subgroup

Of the 164 hospitalized patients, 86 (52.4%) were males and 78 (47.6%) were females. The median age was 10 months (1–61 months). Most cases occurred in winter (40.2%), followed by spring (23.8%), autumn (20.1%), and summer (15.9%). All hospitalized patients were unvaccinated. Among the 164 hospitalized patients, 121 (73.8%) experienced at least one complication, most commonly mild dehydration (45.5%) and moderate-to-severe dehydration (45.5%). Other complications included bacteremia (4.1%), pneumonia (2.5%), seizures (1.6%), and elevated liver function tests (0.8%).

Nosocomial Subgroup

A total of 60 patients were diagnosed with nosocomial rotavirus infection, with a median age of 5 months (1–40 months). Of these, 31 (51.7%) were females and 29 (48.3%) were males. Most nosocomial infections were detected in winter (36.7%) and spring (30%), followed by summer (18.3%) and autumn (15%). All patients in this group were unvaccinated. Complications occurred in 21 patients (35%), most commonly mild dehydration (85.7%), followed by moderate-to-severe dehydration (14.3%). The remaining 39 patients (65%) experienced an uncomplicated clinical course.

Comparison of subgroups

The rate of complications was significantly higher in inpatients compared to outpatients ($p<0.001$), while no difference was observed between patients with nosocomial RVGE and those with CA-RVGE ($p= 0.490$). In the comparison between patients with and without complications, there was no significant difference in gender ($p = 0.583$) or seasonal distribution ($p = 0.315$).

The median age of patients with complications was 7 months (1–40 months) compared to 10 months (1–61 months) in those without complications, with no statistically significant difference ($p= 0.630$). The patients with complications had longer hospital stays than those without complications (median 6 days (2-14 days) vs. 3 days (1-5 days), $p<0.001$). Unvaccinated patients had a significantly higher rate of complications compared to vaccinated patients ($p= 0.049$).

No significant differences were found between

patients with and without nosocomial RVGE in terms of gender, season, or vaccination status (p= 0.178, 0.114, and 0.224, respectively). The median age of the patients with nosocomial RVGE was 5 months (1–40 months) whereas the median age of patients with CA–RVGE was 11 months (1–61 months). The patients with nosocomial RVGE were significantly younger than CA–RVGE (p< 0.001). The duration of hospital stays of nosocomial RVGE were not different than the duration of CA–RVGE (median 5 days (2–14 days) vs. 4 days (1–7 days), (p= 0.490) (Table II).

Table I: Demographic and clinical characteristics of children with rotavirus gastroenteritis

Characteristic	**n (%)**
Sex	
Male	220 (56.3%)
Female	171 (43.7%)
Age (months), median (min–max)	10 (1–61)
Seasons	
Autumn	87 (22.3%)
Winter	143 (36.6%)
Spring	64 (28.2%)
Summer	32 (14.1%)
Vaccination status	
Vaccinated	8 (2.0%)
Unvaccinated	383 (98.0%)
Complications	
Mild dehydration	56 (14.3%)
Moderate/severe dehydration	55 (14.1%)
Bacteremia	5 (1.3%)
Pneumonia	3 (0.7%)
Seizures	2 (0.5%)
Elevated liver enzymes	1 (0.3%)

Table II: Comparison of RVGE cases by complication status and acquisition type

	Complication (n=122)	No complication (n=269)	p	Nosocomial RVGE (n=60)	CA-RVGE (n=331)	p
Age (months), median (min–max)	10 (1–61)	10 (1–52)	0.630	5 (1–40)	11 (1–61)	**<0.001**
Gender (n, %)			0.583			0.178
Female	56 (45.9%)	115 (42.8%)		31 (51.7%)	140(42.3%)	
Male	66 (54.1%)	154 (57.2%)		29 (48.3%)	191(57.7%)	
Season (n, %)			0.315			0.114
Autumn	22 (18%)	65 (24.2%)		18 (30%)	69 (20.8)	
Winter	52 (42.6%)	91(33.8%)		22 (36.7%)	121(36.6%)	
Spring	32 (26.2%)	71 (26.4%)		9 (15.0%)	94 (28.4%)	
Summer	16 (13.1%)	42 (15.6%)		11 (18.3%)	47 (14.2%)	
Hospitalization status (n, %)			**<0.001**			**<0.001**
Inpatient	121 (99.2%)	43 (16%)		60 (100%)	104(31.4%)	
Outpatient	1 (0.8)	226 (84%)		0	227(68.6%)	
Nosocomial infection (n, %)			0.490			
Yes	21 (17.2%)	39 (14.5%)		60 (100%)	0	
No	101 (82.8%)	230 (85.5%)		0	331 (100%)	
Vaccination status (n, %)			**0.049**			0.224
Vaccinated	0	8 (3%)		0	8 (2%)	
Unvaccinated	122 (100%)	261 (97%)		60 (100%)	323 (98%)	
Hospital stays days, median (min–max)	6 (2–14)	3 (1–5)	**<0.001**	5 (2–14)	4 (1–7)	0.490

CA-RVGE: Community-acquired rotavirus gastroenteritis

DISCUSSION

Nosocomial RVGE represented 15.3% of all RVGE cases and 36.6% of hospitalized RVGE cases in our cohort, highlighting it as a substantial yet preventable cause of morbidity in pediatric patients. The markedly low rotavirus vaccination rate (2%) among our patients, coupled with the younger median age of those with nosocomial RVGE, underscores the heightened vulnerability of unprotected infants and young children in hospital settings. This considerable burden likely reflects the absence of routine rotavirus vaccination in Türkiye, seasonal clustering during peak winter months, and delays in isolating symptomatic patients. Notably, complications occurred more frequently among inpatients than outpatients, and their presence was associated with prolonged hospital stays. These findings highlight the urgent need to reinforce infection prevention measures in pediatric wards and to implement effective immunization strategies aimed at reducing the burden of both community-acquired and nosocomial RVGE.

Before routine vaccination, a meta-analysis reported that, on average, 27% (range: 14–51%) of RV hospitalizations in developed countries were nosocomial[12]. More recent studies have shown lower proportions, ranging from 11% to 32%, likely due to improvements in infection control and vaccine uptake[13]. Country-specific data vary: 24% in Poland[14], 27.75% in Slovakia[15] and 16.7% in Spain[16]. In countries with long-standing vaccination programs, such as the United States and the Netherlands, overall rotavirus burden—measured by hospitalizations and test positivity—has declined markedly following vaccine introduction, although specific data on nosocomial cases remain limited[12,17]. Our study found that nosocomial RVGE accounted for 36.6% of hospitalized cases, aligning with the higher end of previously reported ranges. However, we also calculated the proportion among all RVGE cases, which was 15.3%, to better reflect the overall burden in our setting, as many children were admitted for non-RVGE reasons before acquiring the infection in the hospital. This dual approach provides both comparability with prior studies and a more comprehensive view of nosocomial RVGE in pediatric wards. The relatively high rates observed in our cohort likely reflect seasonal clustering during peak winter months, delayed isolation of symptomatic patients, and the absence of routine rotavirus vaccination in Türkiye. These findings highlight the urgent need to strengthen infection control measures and to incorporate universal rotavirus vaccination into the national immunization program to reduce the burden of both community-acquired and nosocomial RVGE.

In RVGE, most complications and fatalities arise from dehydration and its consequences, including electrolyte disturbances and metabolic acidosis[1]. In a Turkish cohort, complications occurred in 44.2% of cases, with electrolyte imbalance (32.6%) and septicemia (6.5%) being predominant[18]. Similarly, a Swedish study reported complication rates >10%, with hypertonic dehydration seen in 5.3% and seizures in 1.7% of hospitalized children with RVGE[19]. In our cohort, complications developed in 31.2% of children, most commonly dehydration, followed by bacteremia, pneumonia, seizures, and elevated liver enzymes.

Complications were more frequent in inpatients, as hospitalization was frequently required for severe dehydration or related complications. The median length of hospital stay was similar between nosocomial and community-acquired RVGE but was notably longer in patients with complications. Although Ogilvie et al. did not directly compare overall complication rates between inpatients and outpatients, their findings indicate that community-acquired RVGE was associated with

a higher prevalence of dehydration and severe dehydration compared to nosocomial cases, and that nosocomial infections prolonged hospitalization, in some reports by 4–12 days[20]. Consistent with these findings, Festini et al. described a longer hospital stay for nosocomial RVGE in Italy, and Nitsch-Osuch et al. reported an even greater difference in Poland. Differences in reported complication rates and hospital stay across studies may be explained by variations in study populations, underlying comorbidities, case definitions, and healthcare practices and vaccination coverage[14,21].

Rotavirus vaccination significantly reduces severe RVGE outcomes—including hospitalizations and serious clinical courses—beyond merely lowering infection incidence. For instance, a Canadian study demonstrated a 94% vaccine effectiveness in preventing RVGE-related hospitalizations among children who received two doses of the vaccine[22]. In the United States, rotavirus vaccine introduction was associated with marked declines in both inpatient visits and severe infections among young children[23]. Meta-analysis data further support these findings, showing a median reduction of 67% in rotavirus-related hospital admissions across vaccinated populations[24]. In our study, with a vaccination coverage of only 2%, unvaccinated children experienced a significantly higher complication rate than vaccinated children; however, this finding should be interpreted with caution due to the very small number of vaccinated cases. Likewise, a study from Turkey, despite reporting a modest vaccination coverage of 12–17% in the private sector, demonstrated a marked (>50%) reduction in both RVGE incidence and related hospitalizations[25]. Similarly, a study from Vietnam with a vaccination coverage of only 10.9% reported a significantly lower risk of RVGE and milder clinical courses among vaccinated children, further supporting the protective effect of rotavirus immunization even at modest coverage levels[26]. These findings underscore the substantial public health benefits that could be achieved if rotavirus vaccination were incorporated into the national immunization program.

In our cohort, children with nosocomial RVGE were significantly younger than those with CA-RVGE (median 5 vs. 11 months), consistent with previous reports indicating that younger age, particularly in infancy, is associated with increased risk of nosocomial transmission due to prolonged hospitalization and greater exposure to healthcare environments[12]. The seasonal distribution of nosocomial RVGE cases, with a predominance in winter and a secondary peak in spring, mirrors findings from Italy, where both community-acquired and nosocomial infections follow similar patterns[27]. Broader European data also confirm that RVGE activity peaks during the winter months, a factor that may facilitate rapid in-hospital spread when pediatric wards operate at or near full capacity[20].

Limitations

First, the retrospective design and single-center nature of this study may limit the generalizability of our findings. Second, data collection relied on hospital records, which may be subject to missing or incomplete entries, particularly regarding the onset of symptoms and precise timing of exposure. Third, vaccination status was obtained from medical records and/or caregiver reports, introducing the possibility of misclassification. Another limitation of our study is that rotavirus subtyping was not available at our center during the study period; therefore, we were unable to provide genotype-specific data. Despite these limitations, our study provides valuable insight into the epidemiology and clinical burden of nosocomial RVGE in a setting without universal rotavirus vaccination.

CONCLUSION

Our findings demonstrate that nosocomial RVGE remains a significant and preventable cause of morbidity in pediatric populations, particularly in settings without universal rotavirus vaccination and among unvaccinated, younger children. Strengthening infection prevention measures and incorporating rotavirus vaccination into the national immunization program could substantially reduce the burden of both community-acquired and nosocomial RVGE.

Ethics Committee Approval: This study was approved by the Institutional Clinical Research Ethics Committee (Approval No: 2025-307).

Conflict of Interest: No conflicts of interest was declared by the authors.

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