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How Have the COVID-19 Pandemic Precautions Affected the Frequency of Rotavirus and Enteric Adenovirus in Pediatric Patients?

COVID-19 Pandemi Önlemleri Pediatrik Hastalarda Rotavirüs ve Enterik Adenovirüs Görülme Sıklığını Nasıl Etkiledi?

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Abstract

Introduction: Approximately 70-80% of diarrheal cases in children are caused by viral pathogens. Viral gastroenteritis agents include rotavirus and adenovirus 40 and 41, particularly in those under two years of age, while norovirus and sapovirus can cause epidemics in individuals of all ages. In this study, we investigated the effect of Coronavirus disease-2019 (COVID-19) pandemic measures on the incidences of rotavirus and enteric adenovirus, which are the main viral agents of acute gastroenteritis in the pediatric age group.

Materials and Methods: Patients <18 years of age, who were admitted to Tatvan State Hospital with the suspicion of acute gastroenteritis and whose rotavirus and enteric adenovirus antigen stool tests were analyzed, were scanned retrospectively. One year of the pre-pandemic period (01.03.2019-29.02.2020) and 1 year of the pandemic period (01.03.2020-28.02.2021) were included in the study. The rotavirus and adenovirus monthly test numbers, positivity rates, age, and gender of the patients were evaluated.

Results: A total of 1,438 pediatric patient samples were analyzed during the pre-pandemic period and 345 pediatric patient samples had a preliminary diagnosis of acute gastroenteritis during the pandemic period. The adenovirus positivity rate was 1.8% (n=26) and the rotavirus positivity rate was 12% (n=173) during pre-pandemic period. These rates were 0.8% (n=3) for adenovirus and 8.6% (n=30) for rotavirus during the pandemic period, (respectively p=0.215; p=0.080). A significant decrease in stool sample analyses was observed during the pandemic (p<0.001). Rotavirus positivity rates were significantly lower in October (p=0.001), November (p=0.04), and December (p=0.04) during the pandemic period compared to the same months during the pre-pandemic period.

Conclusion: As a result, COVID-19 pandemic precautions, such as maintaining social distance, wearing a mask, and complying with hygiene rules may have decreased the incidence of acute gastroenteritis and consequently reduced the number of stool samples analyzed during the pandemic period. Precautions taken during the pandemic period helped to prevent intestinal viral infections in children.

Keywords: COVID-19 pandemic precautions, enteric adenovirus, rotavirus

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Öz

Giriş: Çocuklarda görülen ishal olgularının yaklaşık %70-80'inde virüsler etken patojendir. Viral gastroenterit etkenleri, özellikle iki yaş altında rotavirüs ve adenovirus 40, 41; her yaştaki bireylerde ise salgınlara neden olabilen norovirüs ve sapovirüs'tür. Çalışmamızda Koronavirüs hastalığı-2019 (COVID-19) pandemi önlemlerinin çocuk yaş grubunda akut gastroenteritin başlıca viral etkenleri olan rotavirüs ve enterik adenovirusün görülme sıklığını ne kadar etkilediğinin araştırılması amaçlanmıştır.
Yöntem: Çalışmamız için Tatvan Devlet Hastanesi mikrobiyoloji laboratuvarına akut gastroenterit şüphesiyle 18 yaşından küçük hastalardan gönderilen rotavirüs ve enterik adenovirüs çalışılan gaita örnekleri dahil edildi. Bu amaçla pandemi öncesi bir yıl (01.03.2019-29.02.2020) ve pandemi dönemi bir yıl (01.03.2020-28.02.2021) içerisinde gönderilen gaita örnekleri retrospektif olarak tarandı. Hastalar rotavirüs ve adenovirüs görülme sıklığı, yaş, cinsiyet ve görüldüğü mevsim açısından değerlendirildi.
Bulgular: Pandemi öncesi toplam 1.438, pandemi dönemi toplam 345 pediatrik hastadan akut gastroenterit şüphesiyle gaita örneği gönderilmiştir. Pandemi dönemi gönderilen aylık gaita örnek sayısı pandemi öncesi döneme göre anlamlı olarak azalmıştır. Pandemi öncesi dönemde adenovirüs görülme oranı %1,8 (n=26), rotavirüs görülme oranı %12 (n=173) olarak bulunmuştur. Pandemi döneminde ise adenovirüs %0,8 (n=3), rotavirüs %8,6 (n=30) oranında görülmüştür (sırasıyla p=0,215; p=0,080). Pandemi döneminde analiz edilen dışkı örneklerinde önemli bir düşüş olduğu gözlendi (p<0,001). Rotavirüs pozitiflik oranları pandemi döneminde Ekim (p=0,001), Kasım (p=0,04) ve Aralık (p=0,04) aylarında pandemi öncesi aynı aylara göre anlamlı derecede düşük bulundu.
Sonuç: Sonuç olarak, sosyal mesafeyi korumak, maske takmak, hijyen kurallarına uymak gibi COVID-19 pandemisine yönelik önlemler, akut gastroenterit insidansını ve dolayısıyla pandemi döneminde analiz edilen dışkı örnek sayısını azaltmış olabilir. Pandemi döneminde alınan önlemler, çocuklarda intestinal virüs enfeksiyonlarını önlemeye yardımcı olabilir.
Anahtar Kelimeler: COVID-19 pandemik önlemleri, enterik adenovirüs, rotavirüs

Introduction

Acute gastroenteritis and diseases accompanied by acute diarrhea are important because they can cause epidemics resulting in high morbidity and mortality rates, particularly in children and older subjects[1]. Diarrheal diseases are a leading cause of morbidity and mortality in children <5 years of age, particularly in low-income countries, and cause more than 500,000 deaths per year worldwide[2]. Viruses are the causative pathogen in 70-80% of diarrheal cases in children. Bacteria, such as *Campylobacter* and *Enterotoxigenic E. coli,* and rarely *Enteroinvasive E. coli* are the causative agents in 10-20% of cases[3]. The viral gastroenteritis agents, particularly in those <2 years of age, are rotavirus and adenovirus 40 and 41, while norovirus and sappovirus can cause epidemics in individuals of all ages. The main transmission routes of these enteropathogens are person-to-person, the fecal-oral route, or by ingesting contaminated water or food[4].

On March 11, 2020, Coronavirus disease-2019 (COVID-19) caused by Severe acute respiratory syndrome-Coronavirus-2 was declared a pandemic and various precautions were taken worldwide[5]. Wearing a face mask, maintaining social distance, restricting group activities, closing schools and kindergartens and participation in online education were some of the precautions taken in our country[6].

This study investigated the effect of COVID-19 pandemic precautions on the incidence rates of rotavirus and enteric adenovirus, which are the main viral agents of acute gastroenteritis, in the pediatric age group.

Materials and Methods

Patients <18 years of age who were admitted to Tatvan State Hospital with the suspicion of acute gastroenteritis and whose rotavirus and enteric adenovirus antigen stool tests were analyzed, were scanned retrospectively. One year of the pre-pandemic period (01.03.2019-29.02.2020) and one year of the pandemic period (01.03.2020-28.02.2021) were included in the study. Monthly rotavirus and adenovirus test numbers, positivity rates, age, and gender of the patients were evaluated.

Ethics committee approval was obtained from Van Training and Research Hospital Clinical Research Ethics Committee on 27.04.2022 (decision number: 2022/09-04).

Rotavirus and adenovirus tests were performed via a card test using the immunochromatographic horizontal flow method following the manufacturer's recommendations (Turklab, Menderes/İzmir, Turkey). This test detects viral antigens in stool samples using anti-rotavirus and anti-adenovirus antibodies, respectively. The sensitivity of the test for adenovirus was 99.9% and the specificity was 99.0%. The sensitivity of the test for rotavirus was 99.9% and the specificity was 98.4%.

Statistical Analysis

A statistical analysis of the data was performed using Statistical Package for the Social Sciences version 21.0 software (IBM Corp., Armonk, NY, USA). The chi-square test was used to compare categorical variables. The Mann-Whitney U test was used to compare the quantitative data that did not fit a normal distribution. A p value <0.05 was considered significant.

Results

A total of 1,438 pediatric patient samples were analyzed during the pre-pandemic period and 345 pediatric patients were given a preliminary diagnosis of acute gastroenteritis during the pandemic period. Significantly fewer stool samples were analyzed during the pandemic period than those during the pre-pandemic period (p<0.001). The total number of stool samples analyzed and the number of enteric adenovirus and rotavirus positive results by month are given in Figure 1.

Rotavirus positivity rates were highest in November (32%, n=32) during the pre-pandemic period and in February (23.2% n=13) during the pandemic period. The rates were significantly lower in October (p=0.001), November (p=0.04), and December (p=0.04) during the pandemic period than the same months during the pre-pandemic period. No significant differences were observed between the two periods for the other months (Figure 2A).

The adenovirus positivity rate was highest in July and August (2.7%) during the pre-pandemic period, (n=6 and n=5, respectively), while it was highest in January (8.3%, n=1) during the pandemic period. No significant differences in monthly adenovirus positivity rates were detected between the pandemic period and the pre-pandemic period for the same months. (Figure 2B).

The adenovirus positivity rate was 1.8% (n=26) and the rotavirus positivity rate was 12% (n=173) during the pre-pandemic period. These rates were 0.8% (n=3) for adenovirus and 8.6% (n=30) for rotavirus during the pandemic period. No significant differences in the adenovirus or rotavirus positivity rates were observed between the two periods (p=0.215 for adenovirus; p=0.080 for rotavirus).

The adenovirus positivity rate was 1.5% (n=13) in male patients and 2.2% (n=13) in female patients during the pre-pandemic period, whereas the rotavirus positivity rate was 11.8% (n=101) in male patients and 12.2% (n=72) in female patients during the pre-pandemic period. The adenovirus positivity rate was 1.05% (n=2) in male patients and 0.6% (n=1) in female patients during the pandemic period, whereas the rotavirus positivity rate was 10.5% (n=20) in males and 6.4% (n=10) in females. No significant differences in the positivity rates of either virus were observed between males and females during either period.

The rotavirus positivity rate was highest in the ≤1 year age group before and during the pandemic. When the rotavirus positivity rates were compared during the pre-pandemic period, the ≤1 year age group was significantly higher than the 1-3 year (p=0.006), 3-5 year (p=0.003), and more than 5 year (p<0.001) age groups. The rotavirus positivity rate of the 1-3 year age group was significantly higher than that of the >5 year age group (p=0.001).

The rotavirus positivity rate of the ≤1 year age group was only significantly higher than the >5 year age group during the pandemic period, (p=0.003). No significant differences in

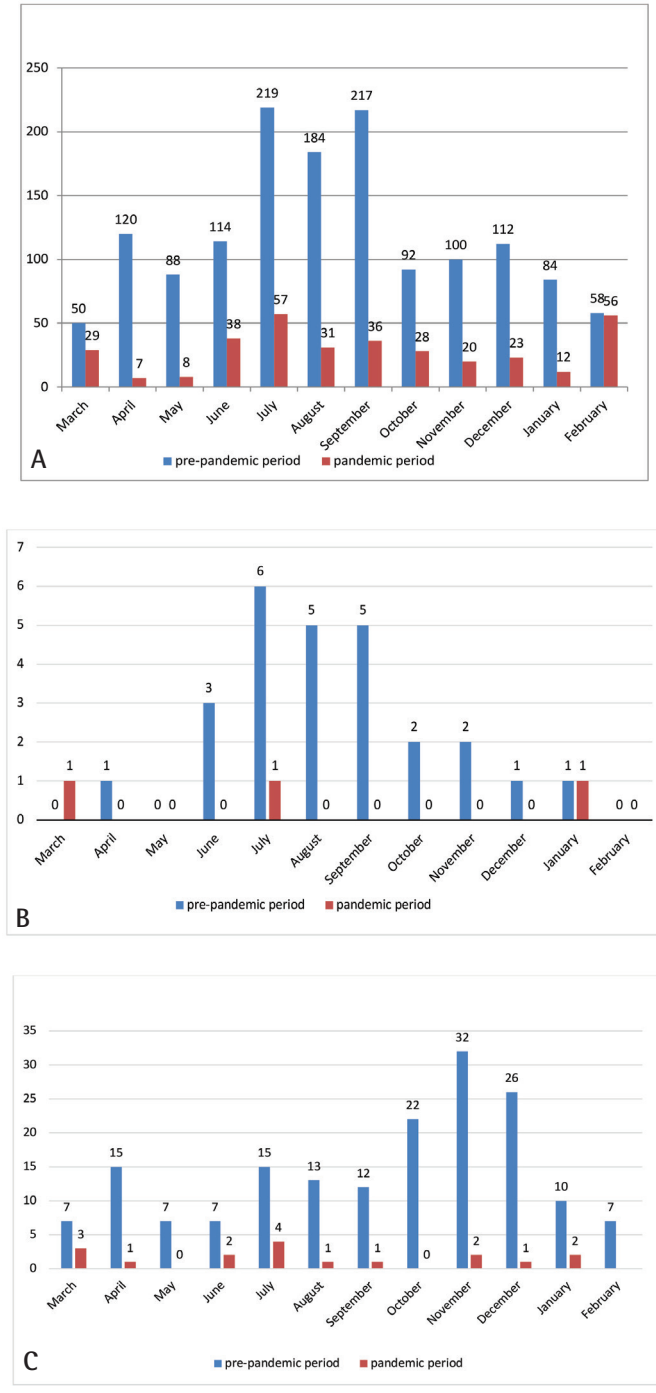

Figure 1. Total number of stool samples and number of enteric adenovirus and rotavirus samples by month. A) Total number of analyzed stool samples by month. B) Number of enteric adenovirus positive results by month. C) Number of rotavirus positive results by month

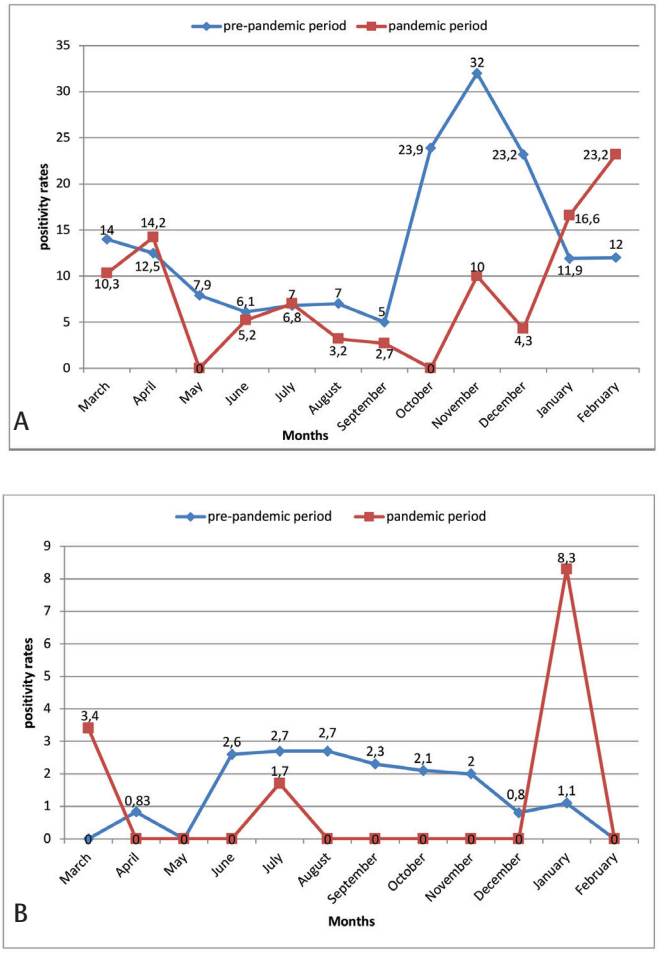

Figure 2. Rotavirus and adenovirus positivity rates in the pandemic and pre-pandemic period A) Rotavirus B) Adenovirus

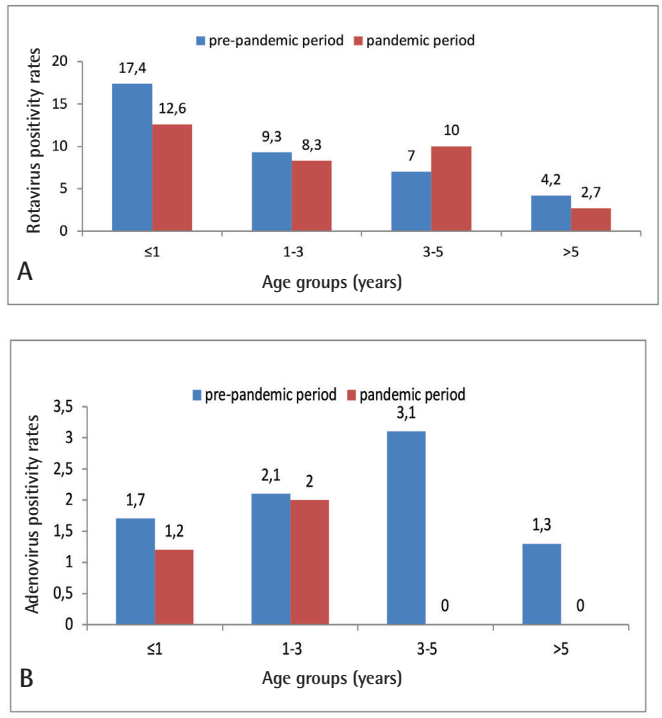

Figure 3. Adenovirus and rotavirus positivity rates by age groups A) Rotavirus B) Adenovirus

the rotavirus positivity rates were observed between the pre-pandemic and pandemic periods in any of the age groups (≤1 year age group 17.4% vs. 12.6% p=0.129; 1-3 year age group 9.3% vs. 8.3% p=0.829; 3-5 year age group 7% vs. 10% p=0.646; >5 year age group 4.2% vs. 2.7% p=0.585) (Figure 3A).

The adenovirus positivity rate was highest in the 3-5 year age group during the pre-pandemic period, and in the 1-3 year age group during the pandemic period. However, no significant difference was detected between the age groups in terms of adenovirus positivity rates in either period (≤1 year age group 1.7% vs. 1.2% p=1; 1-3 year age group 2.1% vs. 2% p=1; 3-5 year age group 3.1% vs. 0% p=1; >5 year age group 1.3% vs. 0% p=0.327) (Figure 3B).

Discussion

Coronavirus disease-2019 was declared a pandemic in March 2020, and various precautions have been taken in all countries since that time[5]. The precautions taken include restricted travel, wearing a mask, social distancing, closing schools and kindergartens, and switching to online education[6]. These precautions have also affected the incidence of other diseases. In this study, the number of stool samples sent from pediatric patients who were admitted to the hospital with the suspicion of acute gastroenteritis during the pandemic period decreased significantly compared to the pre-pandemic period. This observation shows that the precautions taken to prevent the transmission of viruses, which are the main agents of acute gastroenteritis, had an effect on the number of cases of acute gastroenteritis. Li et al.[7] compared the pre-pandemic and pandemic periods and reported a decrease in the number of pediatric patients presenting with intestinal infection during the pandemic period, similar to our study.

Rotavirus outbreaks are seasonally distributed and are most common during the winter[8]. In this study, the rotavirus positivity rate was highest in November during the pre-pandemic period, and in February during the pandemic period. Li et al.[7] reported that the rotavirus positivity rate was highest in December before the pandemic and in November during the pandemic. The highest rotavirus positivity rate occurs during the winter and autumn seasons[9-11].

In this study, rotavirus positivity rates decreased during the pandemic period, from May to December, when compared with the same months of the pre-pandemic period. However, significant differences were detected between the two periods

only in October, November, and December. The rotavirus positivity rates increased in January and February during the pandemic compared to the pre-pandemic period, when pandemic precautions were relaxed. No significant difference was found between the two periods for January and February. Chan[12] reported a sudden decrease in rotavirus positivity rates in February 2020, when the COVID-19 precautions were first implemented. They also observed lower rotavirus positivity rates until September, compared to previous years. However, they reported that the rotavirus positivity rate returned to its pre-pandemic level during the winter of 2020-2021, when pandemic precautions were relaxed.

Adenovirus positivity rates were lower from April to December during the pandemic period than during the pre-pandemic period in this study. Growhowska et al.[13] reported that gastrointestinal viruses decreased by 66% with pandemic precautions in place, and a slight increase was observed in May with the opening of nurseries. Li et al.[7] reported that rotavirus positivity rates decreased in all months during the pandemic period. They also reported that the adenovirus positivity rates decreased significantly from March to September compared to the pre-pandemic period. Burnett et al.[14] showed that the number of rotavirus tests decreased by 50% during the second quarter of 2020 compared to the first quarter. Similarly, Maruo et al.[15] reported that the incidence rates of rotavirus and adenovirus decreased significantly during the pandemic period. In their study in South Korea, Ahn et al.[16] discovered that the rotavirus incidence rate decreased by 31.8% and the adenovirus incidence rate decreased by 13.4% in the year after the pandemic compared to the two years before the pandemic Wang et al.[17] also compared the seven years before the pandemic period with the first year of the pandemic and reported that the adenovirus positivity rate decreased by 72% and the rotavirus positivity rate decreased by 54% during the pandemic period.

No relationship was found between sex and rotavirus or adenovirus positivity during either period in this study. However, Li et al.[7] reported that rotavirus and adenovirus positivity rates were higher in women than men. In other studies, no significant correlations were detected between the rotavirus and adenovirus positivity rates and gender, which was similar to the present study[9-11,17,18].

In this study, the rotavirus positivity rate was significantly higher in the ≤1 year age group than in the other age groups before and during the pandemic period, whereas Li et al.[7] reported the highest rotavirus positivity rate in the 1-3 year age group. Coşkun and Kasap[11] and Çaycı et al.[18] determined the highest rotavirus positivity rate in the 13-24 month group, while Doğantekin[9] and Asena et al.[10] reported the highest rotavirus positivity rate in the 5-24 month group[11,18]. In this study, no significant relationship was found between adenovirus positivity rate and any of the age groups. Similar studies conducted in our country support this result[9].

The adenovirus positivity rate decreased in all age groups during the pandemic period, and the rotavirus positivity rate decreased in all age groups, except the 3-5 year age group. However, no significant difference was found between the two periods for any age group. In contrast, Li et al.[7] reported that the rotavirus positivity rates were significantly lower in the <6 month, six month-1 year, 1-3 year, and 3-5 year age groups during the pandemic compared to the pre-pandemic period, and the adenovirus positivity rates were significantly lower in the six month-1 year, 1-3 year, and 3-5 year age groups during the pandemic period.

Study Limitations

This study was a retrospective study. The limitations of the study are that the number of rotavirus and enteric adenovirus positive samples was very low during some months of the pandemic and no significant difference was observed compared to the pre-pandemic period.

Conclusion

Coronavirus disease-2019 pandemic precautions, such as maintaining social distance, wearing a mask, and complying with hygiene rules, may have reduced the incidence of acute gastroenteritis and consequently reduced the number of stool samples analyzed during the pandemic period. Although the monthly rotavirus and enteric adenovirus positivity rates during the pandemic period decreased with the pandemic precautions in place, no significant difference was found between the two periods in some of the months. This result may be related to the small number of samples in those months.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from Van Training and Research Hospital Clinical Research Ethics Committee on 27.04.2022 (decision number: 2022/09-04).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: A.A., Design: A.A., Data Collection or Processing: A.A., Analysis or Interpretation: S.Ç., Literature Search: A.A., S.Ç., Writing: A.A., S.Ç.

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References

1. World Health Organization. Guidelines for the Collection of Clinical Specimens During Field Investigation of Outbreaks, 2000. 2018.
2. Crawford SE, Ramani S, Tate JE, Parashar UD, Svensson L, Hagbom M, Franco MA, Greenberg HB, O'Ryan M, Kang G, Desselberger U, Estes MK. Rotavirus infection. Nat Rev Dis Primers. 2017;3:17083.
3. Florez ID, Niño-Serna LF, Beltrán-Arroyave CP. Acute infectious diarrhea and gastroenteritis in children. Curr Infect Dis Rep. 2020;22:4.
4. Ulusal Mikrobiyoloji Standartları. C. III. Ankara: UMS; 2014.
5. World Health Organization. Coronavirus disease (COVID-19) Pandemic [İnternet]. 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/ events-as-they-happen.
6. BBC NEWS. Koronavirüs: Adım adım Türkiye'nin Covid-19'la Mücadelesi. 08 July 2020; Available from: Erişihttps://www.bbc.com/turkce/haberlerturkiye-52899914
7. Li W, Zhu Y, Lou J, Chen J, Xie X, Mao J. Rotavirus and adenovirus infections in children during COVID-19 outbreak in Hangzhou, China. Transl Pediatr. 2021;10:2281-6.
8. Bernstein DI. Rotavirus overview. Pediatr Infect Dis J. 2009;28(3 Suppl):50-3.
9. Doğantekin E. Investigation of Rotavirus and Adenovirus Frequency Among Child Patient in Bingol. Journal of Harran University Medical Faculty. 2015;13:42-7.
10. Asena M, Canan A, Öztürk Ü, Öztürk PA, Pirinççioğlu AG. Evaluation of Patients Admitted for Gastroenteritis in Terms of Rotavirus / Adenovirus. Dicle Med J. 2019;46:799-806.
11. Coşkun USŞ, Kasap T. Frequency of rotavirus and adenovirus in pediatric patients with acute gastroenteritis. J Contemp Med. 2019;9:85-8.
12. Chan MCW. Return of Norovirus and Rotavirus Activity in Winter 2020-21 in City with Strict COVID-19 Control Strategy, China. Emerg Infect Dis. 2022;28:713-6.
13. Grochowska M, Ambrożej D, Wachnik A, Demkow U, Podsiadły E, Feleszko W. The Impact of the COVID-19 Pandemic Lockdown on Pediatric Infections-A Single-Center Retrospective Study. Microorganisms. 2022;10:178.
14. Burnett E, Parashar UD, Winn A, Tate JE. Trends in Rotavirus Laboratory Detections and Internet Search Volume Before and After Rotavirus Vaccine Introduction and in the Context of the Coronavirus Disease 2019 Pandemic-United States, 2000-2021. J Infect Dis. 2022;226:967-74.
15. Maruo Y, Ishikawa S, Oura K, Shiraishi H, Sato N, Suganuma T, Mikawa M, Sato T. The impact of the coronavirus disease 2019 pandemic on pediatric hospitalization in Kitami, Japan. Pediatr Int. 2022;64:e14937.
16. Ahn SY, Park JY, Lim IS, Chae SA, Yun SW, Lee NM, Kim SY, Choi BS, Yi DY. Changes in the Occurrence of Gastrointestinal Infections after COVID-19 in Korea. J Korean Med Sci. 2021;36:e180.
17. Wang LP, Han JY, Zhou SX, Yu LJ, Lu QB, Zhang XA, Zhang HY, Ren X, Zhang CH, Wang YF, Lin SH, Xu Q, Jiang BG, Lv CL, Chen JJ, Li CJ, Li ZJ, Yang Y, Liu W, Fang LQ, Hay SI, Gao GF, Yang WZ; Chinese Centers for Disease Control and Prevention (CDC) Etiology of Diarrhea Surveillance Study Team. The changing pattern of enteric pathogen infections in China during the COVID-19 pandemic: a nation-wide observational study. Lancet Reg Health West Pac. 2021;16:100268.
18. Çaycı YT, Yılmaz G, Birinci A. Investigation of the frequency of rotavirus and adenovirus in acute gastroenteritis cases. Pamukkale Medical Journal. 2017;10:61-5.