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CLINICAL OUTCOMES OF SINGLE AND CO-INFECTED RESPIRATORY VIRAL INFECTIONS IN HOSPITALIZED ADULTS AFTER THE PANDEMIC

PANDEMİ SONRASI YATAN ERİŞKİN HASTALARDA SOLUNUM YOLU VİRÜSLERİNİN TEKLİ VE EŞZAMANLI ENFEKSİYONLARINA İLİŞKİN KLİNİK SONUÇLAR

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ABSTRACT

Objective: In the post-pandemic era, SARS-CoV-2 continues to circulate alongside other respiratory viruses. This study aimed to evaluate the epidemiology of single and co-infections after the pandemic and to assess intensive care unit (ICU) requirements as the main prognostic outcome.

Methods: This retrospective cohort study was conducted between May 2023 and January 2024 at a tertiary care center. Adult hospitalized patients with respiratory symptoms and laboratory-confirmed viral infections were included in the study. The clinical characteristics, viral distribution, and predictors of ICU admission were analyzed.

Results: Among 231 patients, SARS-CoV-2 (51.9%), influenza (16.9%), and rhinovirus/enterovirus (12.6%) were the most frequently detected viruses. Viral co-infections were identified in 6.1% of the cases. ICU admission was required in 18.2% of the patients, with no significant difference by virus type or between single and co-infections. In multivariable analysis, diabetes mellitus (aOR: 2.63; 95% CI: 1.03-6.70), chronic kidney disease (aOR: 3.89; 95% CI: 1.41-10.69), congestive heart failure (aOR: 6.12; 95% CI: 2.23-16.77), cerebrovascular accident (aOR: 4.06; 95% CI: 1.22-13.50), and metastatic solid tumors (aOR: 10.27; 95% CI: 2.09-50.39) were independently associated with ICU admission.

Conclusion: SARS-CoV-2 remains the predominant respiratory virus in hospitalized adults in the post-pandemic era. Viral co-infections were uncommon and not associated with an increased risk of ICU admission, whereas comorbidities such as cardiovascular, metabolic, and oncological conditions were associated with severe outcomes.

Keywords: Respiratory tract infections, viruses, coinfection, SARS-CoV-2 virus, influenza, intensive care units

ÖZ

Amaç: Pandemi sonrası dönemde, SARS-CoV-2 diğer solunum virüsleriyle birlikte dolaşmaya devam etmektedir. Bu çalışma, pandemi sonrası tek ve eşzamanlı enfeksiyonların epidemiyolojisini değerlendirmek ve ana prognostik sonuç olarak yoğun bakım ünitesi (YBÜ) gereksinimlerini değerlendirmek amacıyla yapılmıştır.

Yöntem: Bu retrospektif kohort çalışması, Mayıs 2023 ile Ocak 2024 tarihleri arasında bir üçüncü basamak sağlık merkezinde gerçekleştirilmiştir. Hastanede yatan solunum semptomları olan ve laboratuvar tarafından doğrulanmış viral enfeksiyonları olan yetişkin hastalar çalışmaya katılmıştır. Klinik özellikler, viral dağılım ve YBÜ yatışının öngörücüleri analiz edilmiştir.

Bulgular: Toplam 231 hastanın %51,9'unda SARS-CoV-2, %16,9'unda influenza ve %12,6'sında rinovirüs/enterovirüs saptanmıştır. Viral ko-enfeksiyonlar olguların %6,1'inde tespit edilmiştir. Hastaların %18,2'sinde YBÜ yatışı gerekmiş olup virüs türüne göre veya tek enfeksiyon ile ko-enfeksiyonlar arasında anlamlı fark bulunmamıştır. Çok değişkenli analizde, diabetes mellitus (aOR: 2,63; %95 CI: 1,03-6,70), kronik böbrek hastalığı (aOR: 3,89; %95 CI: 1,41-10,69), konjestif kalp yetmezliği (aOR: 6,12; %95 CI: 2,23-16,77), serebrovasküler olay (aOR: 4,06; %95 CI: 1,22-13,50) ve metastatik solid tümörler (aOR: 10,27; %95 CI: 2,09-50,39) yoğun bakım ünitesi yatışı ile bağımsız olarak ilişkili bulunmuştur.

Sonuç: Pandemi sonrası dönemde hastanede yatan yetişkinlerde SARS-CoV-2 baskın solunum virüsü olmaya devam etmektedir. Viral ko-enfeksiyonlar nadirdir ve YBÜ yatış riskinin artmasıyla ilişkili değildir; ancak kardiyovasküler, metabolik ve onkolojik komorbiditeler ciddi klinik sonuçlarla bağımsız olarak ilişkilidir.

Anahtar Kelimeler: Solunum yolu enfeksiyonları, virüsler, koenfeksiyon, SARS-CoV-2 virüsü, influenza, yoğun bakım üniteleri

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Introduction

On May 5, 2023, the public health emergency of international importance related to Coronavirus disease 2019 (COVID-19) was declared to have ended. The World Health Organization (WHO), noting a decline in hospitalizations and deaths, stated that the disease no longer posed a global threat and that people could return to their lives as they were accustomed to. Although the pandemic phase of the disease has ended, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) continues to affect populations worldwide.[1]

Measures to prevent the transmission of SARS-CoV-2 during the COVID-19 pandemic had been implemented worldwide. By reducing physical contact, avoiding contaminated surfaces, and using masks that prevent inhalation of the virus, the prevalence of other respiratory viruses declined during the pandemic.[2] At the end of the pandemic, both the positivity proportion and the number of cases tested for respiratory viruses in the second half of 2023 increased significantly compared to the previous years.[3] However, SARS-CoV-2 has been circulating along with other respiratory viruses since the pandemic. Additionally, the proportion of viral co-infection in SARS-CoV-2 positive samples was 28.2%.[4] Dyspnea and higher fatality rates were observed more frequently in these patients.[5]

The Ministry of Health of the Republic of Turkey has been conducting sentinel influenza-like illness surveillance in outpatients across 23 provinces over the past ten years, in conjunction with sentinel surveillance for Severe Acute Respiratory Infections (SARI) in 11 hospitals from eight provinces. These systems monitor influenza and other respiratory viruses. SARI is defined as an acute respiratory infection occurring within 10 days, accompanied by fever, cough, and clinical findings requiring hospitalization.[6]

Respiratory virus surveillance in Turkey is conducted in a limited number of hospitals and only in hospitalized patients diagnosed with SARI. The primary objective of this study was to evaluate changes in respiratory viruses in hospitalized adult patients during the post-pandemic era. The secondary objective was to examine the proportion and clinical characteristics of patients with viral co-infections. Additionally, the risk factors associated with the need for intensive care unit (ICU) admission in terms of prognosis were evaluated. Therefore, this investigation focused on identifying which patient groups require closer monitoring and whether co-infections have a detrimental impact on clinical outcomes.

Methods

This retrospective cohort study was conducted between May 5, 2023, and January 2024 at an 830-bed tertiary care medical center. It was conducted in compliance with the Declaration of Helsinki of the World Medical Association, revised in 2013, for experiments involving humans and with the protocols of the Ethics Committee of Kocaeli University, Faculty of Medicine. The project was assigned number 2024/140 and received approval under the code GOKAEK-2024/05.17. This study was reported following the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines of the EQUATOR Network.[7]

All patients hospitalized with clinical symptoms of respiratory tract infection during the study period were considered for inclusion, and no prior sample size calculation was performed. Patients were enrolled if they had consulted the Infectious Diseases department and a viral pathogen was detected by multiplex PCR. Limiting the study to hospitalized patients who were evaluated by the Infectious Diseases Department allowed for a more homogeneous cohort. All patients were from diverse socioeconomic backgrounds.

Eligible patients included those admitted to the intensive care unit (ICU) from the emergency department with viral respiratory tract infections, as well as those who developed them during hospitalization. The recorded symptoms included respiratory complaints (cough, sputum production, dyspnea, and wheezing), nasal symptoms, and systemic findings such as fever, chest discomfort, myalgia, headache, disturbed sleep, general malaise, and impaired daily functioning.[8]

Patients were excluded if multiplex PCR results were negative, if alternative diagnostic methods such as rapid antigen tests were used, or if bacterial pathogens or viral–bacterial co-infections were identified. Outpatients and pediatric patients were also excluded from this study.

For microbiological diagnosis, viral respiratory pathogens were detected from nasopharyngeal swabs using BIOFIRE® Respiratory 2.1 plus multiplex PCR (BioFire Diagnostics, LLC, Salt Lake City, UT, USA).

The primary outcome was the distribution of respiratory viruses. The secondary outcome focused on patients with viral co-infections and examined their demographic profiles, underlying comorbidities, pneumonia incidence, and hospital outcomes. ICU requirement was considered as the prognostic outcome. This was defined as admission to the ICU, either from the emergency department or hospital wards, within seven days after the detection of the respiratory virus in symptomatic patients. ICU admission was indicated based on the need for ventilatory or vasopressor support.[9] We compared the demographic characteristics, comorbidities, and laboratory values according to the ICU requirements. The comorbidities evaluated in this study were selected based on parameters previously identified in the literature as potential risk factors for increased severity of viral respiratory infections.[10,11] These included diabetes mellitus and insulin requirement, chronic kidney disease and dialysis requirement, congestive heart failure, connective tissue diseases, chronic obstructive pulmonary disease, cerebrovascular accidents, hematopoietic malignancies, solid organ malignancies, and metastatic solid tumors. Furthermore, the use of corticosteroids, other immunosuppressive therapies, and recent major surgeries within the previous month were also considered.[12] In terms of laboratory parameters, leukocyte, neutrophil, and lymphocyte counts as well as

the neutrophil-to-lymphocyte ratio, a biomarker suggested as a predictor of disease severity, were compared between patients who required ICU admission and those who did not.[13] The occurrence of mortality within the first seven days after diagnosis was also documented. Patient data were obtained retrospectively through a review of hospital electronic medical records.

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 29.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was tested using the Kolmogorov-Smirnov test. Since most variables showed a non-normal distribution, continuous data were presented as medians with interquartile ranges (IQRs), while categorical data were described as frequencies and percentages. The Mann-Whitney U test was used to compare continuous variables between the groups, and the chi-square test was used for categorical comparisons. To explore the risk factors for ICU requirement, univariable logistic regression analyses were performed first, followed by multivariable regression including significant variables. A p-value <0.05 was accepted as the threshold for statistical significance.

Results

This study included 231 patients, of whom 42 (18.2%) required ICU. Multiple respiratory viruses were detected in 14 patients (6.1%) and a single virus was identified in 217 patients (93.9%). Baseline clinical characteristics and laboratory values of the study population are summarized in Table 1. Furthermore, the patient population included five individuals with obesity, five with HIV infection, four pregnant women, three with solid organ transplantation, and two with chronic liver disease.

Table 1. Baseline characteristics of the cohort according to ICU admission

Characteristics	Total cohort (n=231)	Not ICU admitted (n=189)	ICU admitted (n=42)	*p*
Age (year), median (IQR)	63 (49-73)	62 (47.5-71)	68.5 (52.75-80)	**0.018***
Sex, n (%)				0.466†
Female	119 (51.5)	100 (52.9)	19 (45.2)	
Male	112 (48.5)	89 (47.1)	23 (54.8)	
Diabetes mellitus, n (%)	80 (34.6)	54 (28.6)	26 (61.9)	**<0.001†**
Insulin requirement, n (%)	26 (11.3)	15 (7.9)	11 (26.2)	**0.002†**
Chronic kidney disease, n (%)	73 (31.6)	47 (24.9)	26 (61.9)	**<0.001†**
Dialysis requirement, n (%)	20 (8.7)	11 (5.8)	9 (21.4)	**0.003†**
Congestive heart failure, n (%)	41 (17.7)	21 (11.1)	20 (47.6)	**<0.001†**
Connective tissue disease, n (%)	17 (7.4)	14 (7.4)	3 (7.1)	1
COPD, n (%)	51 (22.1)	41 (21.7)	10 (23.8)	0.926†
CVA, n (%)	26 (11.3)	15 (7.9)	11 (26.2)	**0.002†**
Hematopoietic malignancy, n (%)	41 (17.7)	32 (16.9)	9 (21.4)	0.641†
Solid organ malignancy, n (%)	35 (15.2)	23 (12.2)	12 (28.6)	**0.015†**
Metastatic solid tumor, n (%)	21 (9.1)	11 (5.8)	10 (23.8)	**0.001†**
Steroid usage, n (%)	17 (7.4)	11 (5.8)	6 (14.3)	0.094†
Other immunosuppressive therapy, n (%)	13 (5.6)	8 (4.2)	5 (11.9)	0.065†
Recent major surgery (last month), n (%)	12 (5.2)	2 (1.1)	10 (23.8)	**<0.001†**
Leukocyte (µL), median (IQR)	7550 (4620-10510)	7300 (4500-10410)	8500 (5507.5-12560)	0.112*
Neutrophil (µL), median (IQR)	5290 (2920-8280)	4960 (2760-7995)	6930 (3782.5-9535)	**0.033***
Lymphocyte (µL), median (IQR)	1130 (700-1640)	1140 (740-1695)	970 (577.5-1340)	0.113*
Neutrophil-to-lymphocyte ratio, median (IQR)	4.48 (2.39-8.55)	4.20 (2.31-7.40)	6.50 (3.28-11.38)	**0.010***
Mortality, n (%)	8 (3.5)	2 (1.1)	6 (14.3)	**<0.001†**

ICU: Intensive care unit, COPD: Chronic obstructive pulmonary disease, CVA: Cerebrovascular accident, IQR: Interquartile range *Mann-Whitney U Test, †Chi-square test

The distribution of the respiratory viruses is presented in Table 2. The most frequently isolated viruses were SARS-CoV-2 (n=120), followed by influenza (n=39) and rhinovirus/enterovirus (n=29). All the patients diagnosed with influenza received oseltamivir, whereas all the patients with COVID-19 were treated with molnupiravir. For other viral infections, the patients received only supportive therapy. When different types of viral infections, including co-infections, were compared in terms of ICU requirements, no statistically significant difference was observed (p=0.397). Patients with viral co-infections are presented in Table 3, including the distribution of viruses, underlying characteristics, presence of pneumonia, and clinical outcomes. Among these patients, two were admitted to the ICU and both died. Overall, eight patients died during hospitalization.

Two deaths occurred among patients who did not require ICU admission, which accounted for a mortality proportion of 1.1%. In contrast, six deaths occurred in the ICU group, accounting for a markedly higher mortality proportion of 14.3%.

Table 2. Distribution of viruses

Viruses	Total, n (%)	Not ICU admitted, n (%)	ICU admitted, n (%)
Adenovirus	2 (0.9)	1 (0.5)	1 (2.4)
Coronavirus (229E, HKU1, OC43)	6 (2.6)	5 (2.6)	1 (2.4)
Human metapneumovirus	3 (1.3)	1 (0.5)	2 (4.8)
Human rhinovirus/enterovirus	29 (12.6)	23 (12.2)	6 (14.3)
Influenza A virus (H1N1/2009 and H3)	39 (16.9)	31 (16.4)	8 (19)
Parainfluenza virus	12 (5.2)	11 (5.8)	1 (2.4)
RSV A/B	6 (2.6)	3 (1.6)	3 (7.1)
SARS-CoV-2	120 (51.9)	102 (54)	18 (42.9)
Viral co-infection	14 (6.1)	12 (6.3)	2 (4.8)
Total	231	189 (81.8)	42 (18.2)

ICU: Intensive care unit, RSV: Respiratory syncytial virus, SARS-CoV-2: Severe acute respiratory syndrome coronavirus

Table 3. Distribution of viral co-infections and associated clinical characteristics

Age	Sex	Viruses	Comorbid diseases	Pneumoniae	ICUadmission	Mortality
52	Male	Influenza virus A SARS-CoV-2	Hypertension Renal transplantation	No	No	**No**
28	Female	Influenza virus A SARS-CoV-2	Pregnant	No	No	**No**
66	Male	Influenza virus A RSV	Hypertension COPD	No	No	**No**
42	Male	Influenza virus A RSV	Diabetes mellitus	No	No	**No**
35	Female	Influenza virus A RSV	Hypertension Diabetes mellitus Renal transplantation	No	No	**No**
22	Female	Influenza virus A RSV	Absent	No	No	**No**
58	Male	Influenza virus A Coronavirus 229E	Person living with HIV	Yes	No	**No**
79	Female	Influenza virus A Metapneumovirus	Hypertension, COPD Congestive heart failure Chronic kidney disease	Yes	No	**No**
26	Male	Parainfluenza virus Metapneumovirus Rhinovirus/ Enterovirus	ALL Allogeneic HSCT	Yes	Yes	**Yes**
74	Male	Parainfluenza virus RSV	Hypertension CML	Yes	Yes	**Yes**
81	Female	SARS CoV-2 Coronavirus HKU1	Diabetes mellitus Atrial fibrillation Chronic kidney disease Colon cancer	No	No	**No**
35	Male	SARS-CoV-2 Coronavirus OC43	Absent	No	No	**No**
73	Male	SARS-CoV-2 Rhinovirus/ Enterovirus	B-cell lymphoma	No	No	**No**
46	Female	SARS-CoV-2 Rhinovirus/ Enterovirus	Absent	No	No	**No**

ICU: Intensive care unit, RSV: Respiratory syncytial virus, SARS-CoV-2: Severe acute respiratory syndrome coronavirus, HIV: Human immunodeficiency virus, COPD: Chronic obstructive pulmonary disease, ALL: Acute lymphoblastic leukemia, HSCT: Hematopoietic stem cell transplantation, CML: Chronic Myeloid Leukemia

The factors associated with ICU admission are presented in Table 4. In the multivariable analysis, diabetes mellitus, chronic kidney disease, congestive heart failure, cerebrovascular accident, and metastatic solid tumor were independently associated with ICU requirements. An odds ratio plot of these findings is also presented (Figure 1).

Table 4. Logistic regression analysis of risk factors associated with ICU admission

Variable	Univariable		Multivariable	
	OR (95% CI)	*p*	aOR (95% CI)	*p*
Age (year)	1.02 (1.00-1.05)	**0.042**	0.971 (0.94-1.00)	0.062
Neutrophil (µL)	1 (0.99-1.00)	0.107	1 (0.99-1.00)	0.387
Diabetes mellitus	4.06 (2.02-8.17)	**<0.001**	2.63 (1.03-6.70)	**0.043**
Chronic kidney disease	4.91 (2.43-9.93)	**<0.001**	3.89 (1.41-10.69)	**0.009**
Dialysis requirement	4.41 (1.70-11.48)	**0.002**	2.17 (0.63-7.50)	0.221
Congestive heart failure	7.27 (3.41-15.50)	**<0.001**	6.12 (2.23-16.77)	**<0.001**
CVA	4.12 (1.73-9.79)	**0.001**	4.06 (1.22-13.50)	**0.022**
Solid organ malignancy	2.89 (1.30-6.41)	**0.009**	1.12 (0.28-4.47)	0.872
Metastatic solid tumor	5.06 (1.98-12.89)	**<0.001**	10.27 (2.09-50.39)	**0.004**

ICU: Intensive care unit, CVA: Cerebrovascular accident, OR: Odds ratio, aOR: Adjusted odds ratio, CI: Confidence interval

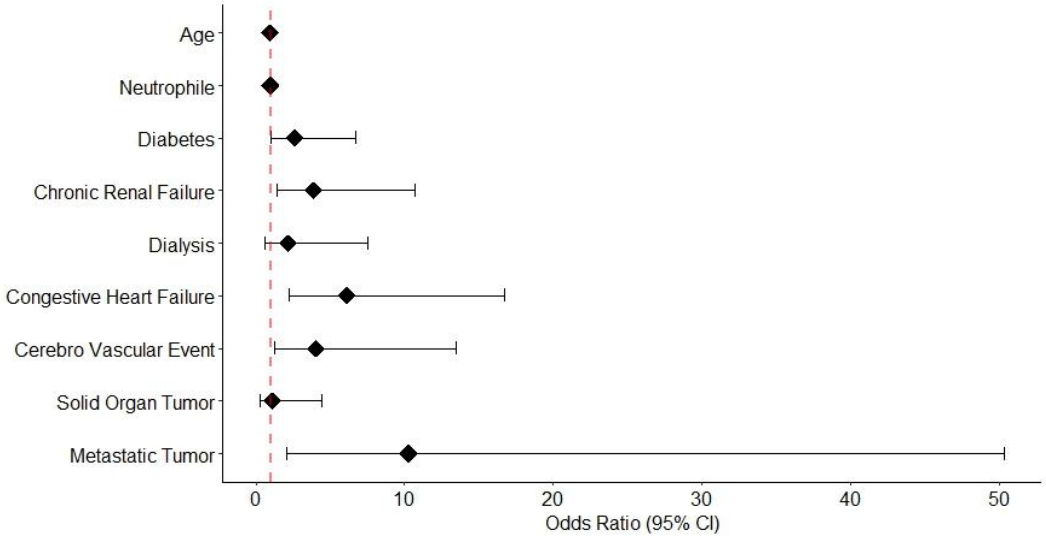

Figure 1. Odds ratio plot showing odds ratios (95% confidence intervals) for factors associated with intensive care admission

Discussion

In this retrospective cohort study that included 231 hospitalized adult patients with viral respiratory infections, we found that SARS-CoV-2 was the most frequently isolated virus, followed by influenza and rhinovirus/enterovirus. The proportion of viral co-infections was 6.1%. The overall ICU requirement was 18.2%, and the presence of viral co-infections did not significantly increase the likelihood of ICU admission. Mortality occurred in eight patients (3.5%), six of whom required ICU admission. In multivariate analysis, diabetes mellitus, chronic kidney disease, congestive heart failure, cerebrovascular accident, and metastatic solid tumors were independently associated with the need for intensive care.

A recent study of 15,134 patients with acute respiratory infections in China by Ye et al. revealed that influenza, particularly type A, was the most prevalent virus among adults and elderly individuals aged ≥ 60 years following the pandemic. Following influenza, the most prevalent viruses were SARS-CoV-2 and human rhinovirus. While the most frequently isolated viruses were consistent with those in our study, the predominance of influenza virus in this study is noteworthy.[14]

In a study conducted by Mostafa et al. in the United States during the 2023-2024 respiratory virus season, the following percentages of total samples tested positive: influenza A (4.1%), influenza B (0.68%), RSV (5.5%), SARS-CoV-2 (6.1%), and enterovirus/rhinovirus (14%). In our study, SARS-CoV-2 was the most frequently isolated viral pathogen (51.9%), followed by influenza (16.9%) and rhinovirus/enterovirus (12.6%). Although the proportions of rhinovirus/enteroviruses were similar in both studies, SARS-CoV-2 was the predominant virus in our cohort.

Additionally, the RSV proportion was 5.5% in the other study but was lower in our study (2.6%).[15]

Currently, the rate of SARS-CoV-2 infection remains high among SARI patients. According to the WHO European Region's weekly report for week 34 of 2025 (August 18-24, 2025), the proportion of influenza virus in samples tested under sentinel SARI surveillance was 1% (2% in the previous week), with a median positivity rate of 0% (range: 0-10%) reported from eight countries/regions. SARS-CoV-2 positivity was reported to be 15% (from 14% of the previous week), with a median positivity proportion of 14% (range: 0-29%). Mortality rates related to SARS-CoV-2 remain low in 41 countries that have reported data. These results were consistent with our study's findings.[16]

In a study from China after the pandemic, Du et al. examined 1,513 samples from hospitalized patients and outpatients. The study showed influenza virus activity peaked and successive SARS-CoV-2 outbreaks occurred. These findings suggest immune-mediated interactions may cause one virus to decline during another virus's peak period. Researchers noted SARS-CoV-2 was detected more frequently in adult patients. Similarly, our study found the most frequent viral pathogens in the post-pandemic period were SARS-CoV-2 and influenza virus. Additionally, only 18 patients had co-infections with both viruses. Co-infections have been reported to increase respiratory infection complexity and prolong illness duration.[17]

The proportion of viral co-infection varies in literature, with lower rates in adults than pediatric patients. A study by Mandelia et al. in the United States before the pandemic found viral co-infection rates of 5.8% in adults[18]. A meta-analysis during the pandemic investigating co-infection with SARS-CoV and other respiratory viruses showed 3.51% in adults, with influenza viruses (1.54%) and enteroviruses (1.32%) most common.[5] In our study, influenza A virus was detected in eight of 14 patients with co-infection, making it the most prevalent. A study by Gilca et al. in Canada of hospitalized patients during pre- and pandemic periods found a co-infection rate of 6.1%.[19] In our cohort, viral co-infections were also detected in 6.1% of patients, showing no significant change post-pandemic. A meta-analysis comparing single and co-infections found no difference in clinical severity regarding hospital stay, oxygen requirement, ICU admission, or mechanical ventilation[20]. Our cohort similarly showed no significant difference in ICU admission between patients with co-infections and single infections.

However, in multivariate analysis, several comorbidities emerged as independent risk factors for ICU admission. Diabetes mellitus (adjusted odds ratio [aOR]: 2.63; 95% confidence interval [CI]: 1.03-6.70; p=0.043), patients with chronic kidney disease had an almost 3.9-fold higher risk (aOR: 3.89; 95% CI: 1.41-10.69; p=0.009). Congestive heart failure was also significantly associated with ICU admission, with a 6.1-fold increased risk (aOR: 6.12; 95% CI: 2.23-16.77; p<0.001). A history of cerebrovascular accident further increased the risk (aOR: 4.06; 95% CI: 1.22-13.50; p=0.022), while the presence of metastatic solid tumors conferred the highest risk, with nearly a 10-fold increase (aOR: 10.27; 95% CI: 2.09-50.39; p=0.004). Several studies have investigated factors associated with more severe diseases in infections caused by different viruses. Advanced age, diabetes mellitus, obesity, cardiovascular disease, chronic lung diseases such as chronic obstructive pulmonary disease, chronic renal disease, chronic liver disease, the presence of cancer, particularly lung cancers and immunocompromising conditions have been identified as prominent comorbidities.[11,21,22,23,24,25] Age did not play a significant role in our cohort. As the study cohort included only two patients with chronic liver disease and five patients with obesity, no significant differences were detected in these parameters. Diabetes mellitus, congestive heart failure, and chronic kidney disease were associated with more severe disease, consistent with the literature.

Notably, a history of cerebrovascular accident was associated with an increased risk of ICU admission. This finding is inconsistent with those of previous reports. As highlighted in studies on SARS-CoV-2, patients admitted to the ICU have an increased risk of both arterial and venous thrombotic events, which may partially explain this observation.[26] Moreover, recent reports suggest that viral infections can trigger an excessive immune response or cytokine storm. This may further contribute to endothelial injury, coagulopathy, tissue edema, and shock, thereby playing an additional role in the development of encephalopathy and the need for ICU admission.[27]

Although hematological parameters are considered to have prognostic value, particularly in the context of COVID-19, we found that leukocyte, neutrophil, and lymphocyte counts were not significantly associated with ICU admission.[28] This may be due to the heterogeneous distribution of viruses and the small size of our study population.

Our study had certain limitations. First, the single-center retrospective design and relatively small number of patients limited the generalizability of the findings. Owing to the retrospective nature of the study, certain clinical data could not be obtained. Additionally, the respiratory viruses included in this study exhibited a heterogeneous distribution. Furthermore, although specific treatments are available for influenza and SARS-CoV-2, only supportive care could be administered for other respiratory viruses. This should be considered when interpreting our results.

The primary strength of our study is its focus on the post-pandemic period. Additionally, these findings reflect the current situation. Another important feature is that all cases were confirmed by laboratory tests, which increased the diagnostic reliability. The fact that the research was conducted with hospitalized adult patients represents a high-risk clinical population. Furthermore, the clinical significance of co-infections adds another dimension to this study. In this respect, the study emphasizes the patient groups that require closer monitoring for viral respiratory tract infections.

Our study revealed the clinical effects of viral respiratory tract infections and co-infections in hospitalized adult patients during the post-pandemic period. Our findings indicated an increased need for intensive care in patients with certain comorbidities. However, the single-center nature of the study and the limited number of patients restrict its generalizability. Prospective studies with larger populations are needed to better understand the clinical significance of viral co-infections. Our findings emphasize the importance of close monitoring, particularly for high-risk patient groups.

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Ethical Approval
The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to and appropriate ethical review committee approval has been received. This study was conducted in accordance with the Declaration of Helsinki of the World Medical Association, revised in 2013, for experiments involving humans, and with the protocols of the Ethics Committee of Kocaeli University. The project was assigned number 2024/140 and received approval under the code GOKAEK-2024/05.17.

Conflict of Interest
The authors declare that they have no conflict of interest.

Author Contributions
ÖG: Conceptualized the study methodology, wrote the original draft of this manuscript; SA: Reviewed the manuscript as a mentor. Other authors have curated data from patient files. All authors have read and approved the final manuscript.

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