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Investigation of the Number of International Passengers at Türkiye Airports During the First Year of the COVID-19 Pandemic from a Public Health Perspective

COVID-19 Pandemisinin İlk Yılında Türkiye Havalimanlarındaki Dış Hat Yolcu Sayısının Halk Sağlığı Bakış Açısıyla İncelenmesi

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ABSTRACT

Background: Our study aims to contribute to the literature by examining the change in the number of coronavirus disease-2019 (COVID-19) cases between 1 January 2020 and 31 December 2020 and the reflection of the health measures taken by and health and aviation authorities on the number of international passengers at Türkiye airports from a public health perspective.

Materials and Methods: This cross-sectional study was conducted using secondary data obtained from national health and aviation authorities. The data were analyzed using time series analysis methods with the SPSS 25 software package, along with descriptive statistics in Excel 2013. The findings were presented in tables and figures.

Results: In 2020, the total number of international passengers at 56 airports open to civil air traffic in Türkiye decreased by 71% compared to 2019, with the sharpest decline, nearly 100%, occurring in the second quarter of the year. The time series analysis did not identify any evidence of a trend effect in the data. Monthly variations in international passenger numbers were determined to be non-random. Additionally, the breakpoints observed in the time series graph aligned with the implementation dates of international travel measures introduced in response to the COVID-19 pandemic.

Conclusion: It was found that the increase in the number of cases in the early stages of the COVID-19 pandemic directly increased the public health measures taken at airports in the context of international travel and caused a significant decrease in the number of international passengers. It is recommended that public health measures and travel restrictions taken in prolonged epidemic situations implemented by conducting a multidimensional risk assessment.

Keywords: Airport, COVID-19, international passengers, international travel restrictions, public health, Türkiye

ÖZ

Amaç: Çalışmamız, 1 Ocak 2020 ile 31 Aralık 2020 tarihleri arasında koronavirüs hastalığı-2019 (COVID-19) olgu sayılarındaki değişimi ve sağlık ve havacılık otoriteleri tarafından alınan sağlık tedbirlerinin Türkiye havalimanlarındaki dış hat yolcu sayılarına yansımasını halk sağlığı perspektifinden inceleyerek literatüre katkı sağlamayı amaçlamaktadır.

Gereç ve Yöntemler: Bu araştırma kesitsel tipte yapılmıştır. Araştırmada, ulusal sağlık ve havacılık yetkili otoritelerinden elde edilen ikincil veri kaynaklarından yararlanılmıştır. Veriler, SPSS 25 paket programı kullanılarak zaman serisi analizi yöntemleri ve Excel 2013 programında tanımlayıcı istatistik düzeyinde değerlendirilerek tablo ve şekillerle gösterilmiştir.

Bulgular: Türkiye'de sivil hava trafiğine açık 56 havalimanının 2020 yılındaki toplam dış hat yolcu sayısı 2019 yılına göre %71 azalış göstermiş olup, en keskin düşüş %100'e yakın seyreden yılın ikinci çeyreğinde yaşanmıştır. Zaman serisi analizinde seride trend etkisine ilişkin bir kanıt elde edilememiştir. Aylık dış hat yolcu sayılarındaki değişimin rassal olmadığı tespit edilmiştir. Zaman

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***This article is produced from the Master's thesis titled "INVESTIGATION OF HEALTH MEASURES TAKEN AGAINST The COVID-19 PANDEMIC AT AIRPORTS IN TURKEY IN 2020" prepared by researcher Züleyha TEKİN under the supervision of Prof. Dr. Güven BEKTEMÜR.**

ÖZ

serisi grafiğindeki kırılma noktalarının, COVID-19 pandemisi sebebiyle uluslararası seyahate yönelik getirilen tedbirlerin tarihleriyle uyumlu olduğu bulgusuna ulaşıldı.

Sonuç: COVID-19 pandemisinin erken dönemlerinde olgu sayısı artışının uluslararası seyahat bağlamında havalimanlarında alınan halk sağlığı tedbirlerini direkt olarak artırdığı ve dış hat yolcu sayısında ciddi düşüşlere neden olduğu saptanmıştır. Uzamış salgın durumlarında alınan halk sağlığı tedbirlerinin ve seyahat kısıtlamalarının çok boyutlu risk değerlendirmesi yapılarak uygulanması önerilir.

Anahtar Kelimeler: Havalimanı, COVID-19, uluslararası yolcular, uluslararası seyahat kısıtlamaları, halk sağlığı, Türkiye

Introduction

Throughout human history, epidemics such as, plague, measles, smallpox, and others that caused mass deaths have caused serious material and moral losses in various fields, especially social, economic, cultural, and political, to civilizations. Today, epidemics have the potential to move and spread much faster with the development of air transportation, the increase in global passenger-freight transportation, and extraordinary human mobility (1,2). In other words, the international air transportation network, which is an important component of globalization, may also have the effect of accelerating the development and spread of potential epidemics.

On December 31, 2019, cases of pneumonia of unknown cause were reported in Wuhan, Hubei province, of China. On January 7, 2020, the causative agent was identified as a new coronavirus (2019-nCoV) that had not been detected in humans before, and the disease was later named coronavirus disease-2019 (COVID-19). The virus with close similarities to severe acute respiratory syndrome-coronavirus (SARS-CoV) was named SARS-CoV-2. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic (3).

While the risk of the spread of epidemics through air transportation and the threat this risk poses to global health is known, the COVID-19 pandemic in 2020 has once again underscored this threat by amplifying its global impact. The COVID-19 pandemic has been the most vivid example of how air transportation affects epidemics and epidemics affect air transportation, bidirectionally.

In the early days of 2020, many countries took the first measures against the pandemic in the aviation sector because the COVID-19 disease, which contains many unknowns, is transmitted by droplet and that many passengers are together in airports and aircraft cabins (4). To prevent the entry of the virus into the country and/or to reduce its spread, measures that started in the aviation sector, where human mobility is the highest, sometimes aligning with the WHO's recommendations and sometimes not, have rapidly spread to cover all public areas. Countries have implemented a series of health measures for travelers both domestically and in the context of international travel, including air transportation (5-7). The main public health measures taken, such as reciprocal or non-reciprocal border closures, flight suspension, travel restrictions, entry-exit health screenings, health declarations, quarantine and isolation practices, testing practices such as polymerase chain reaction (PCR)/antigen testing, contact tracing, mask, social distancing, hygiene, have been adjusted according to additional measures in line with the course of the outbreak (5,8). As of January 7, 2021, within the first year of SARS-CoV-2 identification, a total of 87,198,403 confirmed cases and 1,953,783 deaths were reported worldwide (9).

The International Health Regulations (10), to which Türkiye is also a party, require each state party to develop basic public health capacities for both routine operations and public health emergencies at designated points of entry (PoE) (airports, ports, land crossings), using existing national structures and resources. In Türkiye, five international airports have been designated as PoE that fulfill the required capacities. These airports, where the specified capacity requirements are implemented and maintained, include Adnan Menderes, Antalya, Esenboğa, İstanbul, and Sabiha Gökçen Airports (11).

In the context of international travels, airports, which are the windows of countries to the outside world by allowing people from many continents and countries who prefer air transportation to share the same environment for a certain period of time, are special areas that can directly affect global health in terms of the spread and control of infectious diseases. However, the successful continuation of preventive health services provided to the public within the country is undoubtedly closely related to the health conditions and health measures taken at airports where international passenger mobility is most intense.

The literature review reveals that studies on COVID-19 pandemic measures at Türkiye, airports are primarily focused on the social, economic, and management aspects within the aviation sector. However, there is a notable gap in addressing

the issue from a public health perspective. Our study aims to contribute to the literature by examining the change in the number of COVID-19 cases between 1 January 2020, and 31 December 2020; and the reflection of the health measures taken by health and aviation authorities on the number of international passengers (arrivals and departures) at Türkiye airports, from a public health perspective.

Materials and Methods

The research is a cross-sectional study as it deals with a certain period of time and a descriptive study because it endeavours to explain the existence of a certain phenomenon. Our study focuses on the number of international passengers (arrival and departure) at 56 airports open to civil air traffic in Türkiye and the national number of COVID-19 cases between 1 January 2020 and 31 December 2020.

The study excludes data on direct transit passengers and domestic passengers. The aim here is to see the change in international passenger numbers in relation to travel restrictions imposed as part of national public health interventions during pandemic periods in 2020, including international passenger numbers in 2018-2019.

Data Sources

The data used in this study include international passenger numbers obtained from the website of the General Directorate of State Airports Authority and confirmed COVID-19 case numbers published by the Ministry of Health on its COVID-19 information platform.

Furthermore, NOTAMs related to COVID-19, issued by the Directorate General of Civil Aviation, were obtained from the relevant institution, reviewed, and utilized as a data source. Notice to Airmen (NOTAM) is defined as "a broadcast made to promptly inform flight operations personnel about any aviation facility, service, method, or the presence, conditions, or changes of a hazard." NOTAMs were reviewed for health measures for passengers, and international travel restriction information during the COVID-19 pandemic.

The necessary approvals for conducting the research were obtained from the Non-Interventional Research Ethics Committee of Hamidiye University of Health Sciences (approval number: 2021/29, dated: 17/09/2021).

Statistical Analysis

Descriptive statistics were used to summarize monthly international passenger volumes and COVID-19 case numbers. Time series analysis was conducted using Kwiatkowski Phillips Schmidt and Shin test (KPSS) and Augmented Dickey Fuller (ADF) unit root tests to assess stationarity. Autocorrelation and partial autocorrelation functions were plotted to evaluate temporal dependency. These data were transferred to the Microsoft Office Excel 2013 program, analyzed using descriptive statistics, and presented in tables and figures. Additionally, international passenger numbers were analyzed using time series analysis methods after being imported into the Statistical Package for the Social Sciences (SPSS) for Windows (version: 25.0; Armonk, NY: IBM Corp., USA), with the analysis results presented in detail through tables and figures.

Results

Descriptive Findings on Total the Number of International Passengers at Airports

The international passenger numbers for the pre-COVID-19 period (2018-2019) and the COVID-19 pandemic period (2020) has been compiled based on data publicly shared by the General Directorate of State Airports Authority on a monthly basis. Monthly and yearly variations in the total number of international passengers at Türkiye airports are presented in Table 1, while the total number of international passengers specific to individual Türkiye airports is shown in Table 2.

Table 1 shows that the total number of international passengers was 97,587,056 in 2018 and 108,427,124 in 2019, while in 2020, it dropped to 31,875,837. In 2020, the total number of international passengers carried decreased by 71% compared to 2019. The highest decline occurred in the second quarter of 2020, with a nearly 100% reduction. In 2018 and 2019, the international passenger numbers decreased by 55% and 57%, respectively, in December compared to August, the month with the highest number of international passengers. In 2020, international passenger numbers decreased by 56% in December compared to the peak month of September.

Table 2 shows that in 2020, İstanbul Airport represented 50% of the total percentage of international passengers, followed by Antalya Airport with 21%, İstanbul Sabiha Gökçen Airport with 16%, İzmir Adnan Menderes Airport with 3%, Muğla Dalaman Airport with 3%, and other airports, accounting for 7%.

In 2020, 54% of the total number of international passengers at designated PoE (comprising five airports) were at İstanbul Airport, followed by Antalya Airport with 22%, İstanbul Sabiha Gökçen Airport with 18%, İzmir Adnan Menderes Airport with 3%, and Ankara Esenboğa Airport with 3%.

Findings on Time Series of Total International Passenger Numbers at Airports

As a result of KPSS and ADF unit root tests conducted to examine the stationarity of the series in time series, it was found that the series was not stationary (pKPSS: 0.016;

pADF: 0.456; p<0.05). Additionally, in the time series graph in Figure 1, there is no evidence of a trend effect. The lack of stationarity suggests a high degree of correlation. Table 3 shows the autocorrelation results between the lag values of the series; Figure 2 shows the autocorrelation graph and Figure 3 shows the partial autocorrelation graph. It was found that the changes in monthly international passenger numbers are not random.

In the time series graph of international passenger numbers for the year 2020 shown in Figure 4, several breakpoints are worth noting. Based on the NOTAM reviews published during the COVID-19 pandemic (Table 4), the breakpoints in the time series graph align with the dates when international travel measures were introduced.

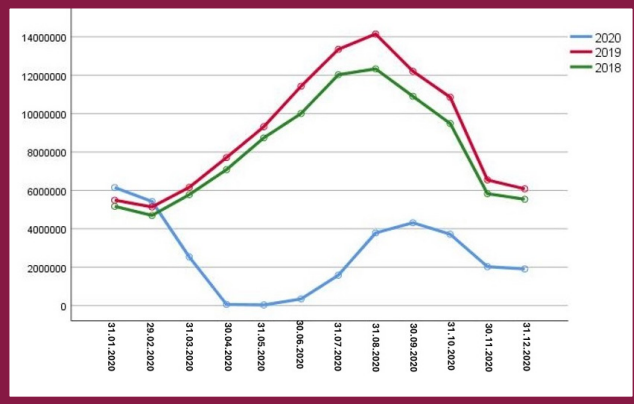

Figure 1. Time series graph of the number of international passengers for the years (2018, 2019 and 2020)

Table 1. Monthly and yearly changes in the total number of international passengers at Türkiye airports

Months	Years				Years			
	2018	2019	Change	Change (%)	2019	2020	Change	Change (%)
January	5.169.937	5.489.751	319.814	6,19%	5.489.751	6.150.060	660.309	12.03%
February	4.695.638	5.137.969	442.331	9,42%	5.137.969	5.424.274	286.305	5.57%
March	5.778.644	6.160.367	381.723	6,61%	6.160.367	2.535.235	-3.625.132	-58.85%
April	7.083.650	7.711.442	627.792	8,86%	7.711.442	60.163	-7.651.279	-99.22%
May	8.737.437	9.316.809	579.372	6,63%	9.316.809	32.782	-9.284.027	-99.65%
June	10.007.807	11.427.985	1.420.178	14,19%	11.427.985	344.152	-11.083.833	-96.99%
July	12.026.182	13.349.825	1.323.643	11,01%	13.349.825	1.582.720	-11.767.105	-88.14%
August	12.332.042	14.150.587	1.818.545	14,75%	14.150.587	3.783.054	-10.367.533	-73.27%
September	10.903.327	12.204.381	1.301.054	11,93%	12.204.381	4.313.672	-7.890.709	-64.65%
October	9.487.068	10.855.875	1.368.807	14,43%	10.855.875	3.717.626	-7.138.249	-65.75%
November	5.828.225	6.544.396	716.171	12,29%	6.544.396	2.024.275	-4.520.121	-69.07%
December	5.537.099	6.077.737	540.638	9,76%	6.077.737	1.907.824	-4.169.913	-68.61%
Total	**97.587.056**	**108.427.124**	**10.840.068**	**11,11%**	**108.427.124**	**31.875.837**	**-76.551.287**	**-70,60%**

Table 2. Number of international passengers by year for Türkiye airports

No.	Airport name	2018		2019		2020	
		Number of passengers (n)	Percent (%)	Number of passengers (n)	Percent (%)	Number of passengers (n)	Percent (%)
1	Atatürk	49.130.261	50.35	11.876.601	10.95	0	0
2	İstanbul	30.199	0.03	39.434.579	36.37	15.936.505	50
3	Sabiha Gökçen	11.619.569	11.91	14.055.522	12.96	5.263.612	16.51
4	Esenboğa	2.241.901	2.3	2.277.395	2.1	746.764	2.34
5	Adnan Menderes	2.730.772	2.8	3.333.332	3.07	995.334	3.12
6	Antalya	24.127.993	24.72	28.720.491	26.49	6.584.984	20.66
7	Dalaman	2.935.900	3.01	3.321.930	3.06	830.652	2.61
8	Others (49 airports)	4.770.461	4.88	5.407.274	5	1.499.986	4.76
Total (56 airports)		**97.587.056**	**100**	**108.427.124**	**100**	**31.875.837**	**100**

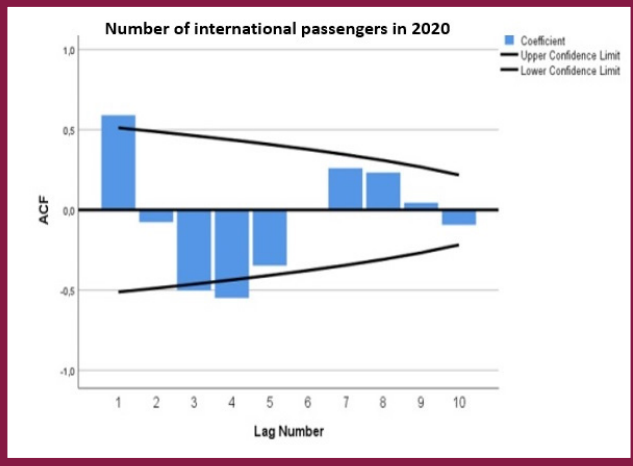

Figure 2. Autocorrelation graph

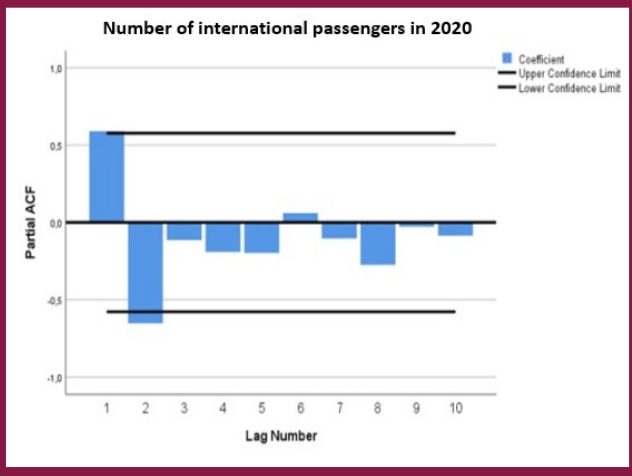

Figure 3. Partial autocorrelation graph

Table 3. Autocorrelation results

Lag	Autocorrelation	Standard error
1	0.591	0.256
2	-0.076	0.244
3	-0.502	0.231
4	-0.549	0.218
5	-0.347	0.204
6	-0.004	0.189
7	0.26	0.173
8	0,233	0.154
9	0.044	0.134
10	-0.093	0.109

International Travel Restrictions and Related Health Measures in Airline Transport

A total of 36 NOTAMs related to COVID-19 were analyzed. Travel restrictions began on February 3, 2020, with the suspension of flights with China, and they changed throughout the year in response to the progression of the pandemic. In our research, these measures were categorized into five distinct time periods: "first flight restrictions to risky countries (February 3)", "complete suspension of international flights (March 27)", "gradual reopening of international flights (June 11)", "new flight restrictions to risky countries (December 21)", and 'PCR test requirement for passengers from all countries (December 30)'. These time periods are shown in Table 4.

Descriptive Findings on the Total Number of International Passengers and COVID-19 Cases at Airports

The changes in Türkiye's number of international air passengers and the number of COVID-19 cases in 2020, organized based on publicly available data shared by the General Directorate of State Airports Authority and the Ministry of Health (12,13) are shown in Figure 5.

Discussion

In Türkiye, during the COVID-19 pandemic, the majority of international passengers (93%) traveled through international airports where core capacity requirements are met during routine and internationally important public health events within the scope of The International Health Regulations (2005).

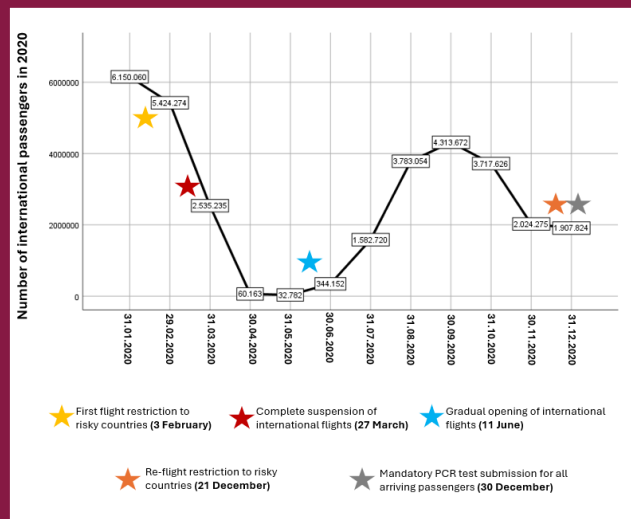

Figure 4. Time series graph of the number of international passengers in 2020

Table 4. International travel restrictions and related health measures in airline transport at Türkiye	
3 February 2020	**All flights from China have been stopped**
27 March 2020	**All flights from the airports of all countries to airports in Türkiye and from Türkiye to airports in all countries (except for the flights specified) are prohibited:** 1. Flights to repatriate Turkish citizens from restricted countries are subject to special authorization. All Turkish citizens on board the flight are quarantined for 14 days 2. The ban on flights to and from restricted countries does not apply to the following situations: 1) Cargo flights, 2) Government flights, 3) Emergency medicine flights, 4) Emergency landings for technical reasons
11 June 2020	**All flights to and from Türkiye airports are authorized and are subject to the following rules:** 1. All passengers must wear masks at airports and on aircraft 2. All passengers are required to fill in the passenger information form upon arrival on flights 3. All arriving passengers will be examined and those showing symptoms will be tested. This procedure will be announced to passengers by the airline before and during the flight 4. Passengers with positive test results will not be deported but will be treated 5. Flight permits for destination countries will be coordinated with the Ministry of Health 6. On all flights, airlines will comply with the rules outlined in the airline and airport pandemic guide published by the Directorate General of Civil Aviation
21 December 2020	**Flights from the United Kingdom, Denmark, and South Africa to Türkiye airports have been canceled. It is stated that the following conditions are valid:** 1. Unless special authorisation is granted for the carriage of Turkish citizens and persons residing in Türkiye, operators of the restricted countries may operate only transport flights from Türkiye carrying their own citizens of the operating country's nationality. 2. Turkish operators may carry only Turkish citizens, foreigners with residence permits, state officials and diplomatic personnel to Türkiye 3. Evacuation flights will be exempt from this restriction. All arriving passengers will undergo PCR testing upon arrival 4. Passengers who have been to the three countries mentioned above will be tested using PCR upon arrival. These passengers will be quarantined for 7 days starting from the date of arrival from these countries. On the 7th day, a second PCR test will be performed, and if the test result is negative, the quarantine will end 5. General aviation and business flights may be authorized, provided that they are coordinated with the Ministry of Health 6. Ambulance, humanitarian aid, and all cargo flights are exempt from these restrictions 7. There is no PCR test and quarantine requirement for the crew
30 December 2020	**It is stated that the following conditions are valid for flights to Türkiye:** 1. Passengers aged 6 years and older who will enter Türkiye by air from abroad are required to present negative SARS-CoV-2 PCR test results taken within 72 hours prior to departure of the aircraft 2. Those who do not submit a negative SARS-CoV-2 PCR test result will not be accepted for boarding. This requirement does not apply to transit and transfer passengers 3. This application will continue until March 1, 2021 4. There is no PCR test and quarantine requirement for crew members **Flights from the United Kingdom, Denmark and South Africa to Türkiye airports have been canceled. It is stated that the following conditions are valid:** 1. Unless special authorization is granted for the carriage of Turkish citizens and persons residing in Türkiye, operators of the restricted countries may only operate transport flights from Türkiye carrying their own citizens 2. Turkish operators may only carry Turkish citizens, foreigners with residence permits, government officials, diplomatic personnel, and transit/transfer passengers to Türkiye 3. Evacuation flights will be exempted from this restriction and passengers aged 6 years and older must present negative SARS-CoV-2 PCR test results taken within the last 72 hours prior to departure before boarding the aircraft. These passengers will be quarantined for 7 days. On the 7th day, the PCR test will be performed, and if the test result is negative, the quarantine will end 4. Passengers aged 6 years and older who have been in the three countries mentioned in the last 10 days must submit negative SARS-CoV-2 PCR test results which were performed within the last 72 hours before the departure of the aircraft, before boarding the aircraft. These passengers will be quarantined for 7 days. On the 7th day, the PCR test will be performed and if the test result is negative, the quarantine will end 5. General aviation and business flights may be permitted provided that coordination with the Ministry of Health 6. Ambulance, humanitarian aid and all cargo flights are exempt from these restrictions 7. There are no PCR test and quarantine requirement for the crew
PCR: Polymerase chain reaction, SARS-CoV-2: Severe acute respiratory syndrome-coronavirus	

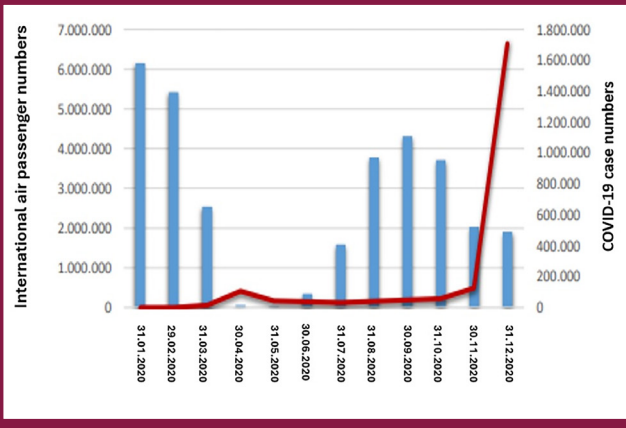

Figure 5. Changes in Türkiye's international air passenger numbers and COVID-19 case numbers in 2020
COVID-19: Coronavirus disease-2019

When comparing the international passenger numbers of these airports in 2020 to those in 2019, Antalya, Adnan Menderes, Esenboğa, Sabiha Gökçen, and İstanbul Airport saw decreases of 77%, 70%, 67%, 63%, and 60%, respectively (Table 2). Despite these declines, İstanbul Airport remained the busiest Türkiye airport for international passengers during the first year of the COVID-19 pandemic, as it was in 2019.

In 2020, the total number of international passengers decreased by 70.6% compared to 2019, while domestic passengers declined by 50.2%. Overall, the combined total of international and domestic passengers dropped by 60.8%. In Türkiye, the decline in passenger numbers in air transportation was significant throughout 2020, with international passenger numbers experiencing an almost complete drop-nearly 100%-in April, May, and June (Table 1). This decline is attributed to the COVID-19 measures, beginning with the cancellation of all flights from China on February 3, 2020 (14), followed by flight restrictions on other high-risk countries in March, and the suspension of all international flights on March 27, 2020, to curb the spread of the virus. The months of April and May, during which only evacuation flights were operated, marked the periods of the most significant decline (Figure 4 and Table 4). When the number of daily new cases during the same period is examined, the peak of the pandemic in this wave occurred on April 11, with 5,138 cases. A downward trend began thereafter, and on May 20, the number of cases dropped to triple digits for the first time, reaching 972 cases (14).

Following the announcement of the normalization roadmap in Türkiye on May 3, 2020, studies on the "new normal" steps began. The Coronavirus Scientific Advisory Board provided recommendations for the normalization plan and prepared guidelines for various sectors (14). As part of the "Controlled Social Life" steps initiated by Türkiye on June 1, 2020, and reflecting the gradual resumption of international flights on June 11, 2020 (15), the number of international passengers began to rise in the second half of the year and continued to increase until the end of the third quarter. The international passenger movement, driven by the revival of summer tourism activities in Türkiye, reflects this trend, with the number of international passengers exceeding 1.5 million in July. In August, the number of international passengers more than doubled compared to July, reaching 3,783,054. In the fourth quarter of the year, the decline in the number of international passengers, which had resumed, continued until year-end. This period, marked by growing concerns worldwide about the global spread of SARS-CoV-2 variants (16,17), coincided with a further decrease in the number of international passengers in Türkiye. As seen in the number of international passengers in 2018-2019 (Figure 1), the decline that began after August, and continued throughout the fourth quarter of the year, can be attributed to the end of the summer season and the decrease in tourism activities. In other words, the decrease observed in the fourth quarter of 2020 can be considered a seasonal decline, as expected (Table 1). Starting from the end of December, in this new period, when the number of cases both globally and nationally increased again, Türkiye introduced new regulations for all passengers coming from all countries, including those with observed variants, via airline transport (Table 4).

On January 10, 2020, when the WHO issued its first recommendations for international travel and trade (18), the first death due to the disease was reported in China (19). Before this announcement, the Coronavirus Scientific Advisory Board established by the Türkiye Ministry of Health and comprising 26 experts and academicians from various medical disciplines (14) played a crucial role in guiding the implementation of COVID-19 measures at airports. The airport pandemic certification circular (20), prepared based on the recommendations of the Scientific Advisory Board and implemented prior to the gradual reopening of flights, serves as the most concrete example of this particular emphasis. Similarly, when the International Health Regulations (2005) Emergency Committee first convened on January 22, 2020 (21), the Coronavirus Scientific Advisory Board of the Ministry of Health, which also convened on the same date, made recommendations for airport measures based on a risk assessment (22). In this context, it can be said that the decisions to implement infectious disease control measures for all flights arriving from China to screen passengers with thermal cameras upon arrival,

to require passenger information forms, and to inform ground personnel (22) contributed relatively positively to preventing or delaying the entry of the epidemic into the country. The lack of academic studies on the effects, results, and evaluations of health screenings and public health measures taken at Türkiye airports during past epidemics and pandemics, including the COVID-19 pandemic, does not allow for sufficient scientific clarification and discussion on the subject. More research is needed on these issues.

The range of health measures taken in the country was further expanded following the detection of the first COVID-19 case in Türkiye on 11 March 2020 and the WHO's declaration of a pandemic on that day (14,23). With the first COVID-19 case known to have acquired the virus through European contact, the number of new cases detected from people with international travel history and their contacts increased rapidly, and by March 18, 2020, the total number of confirmed cases in Türkiye had reached 191 (24). Following the declaration of a pandemic and the rapid increase in cases, various time-limited restrictions and measures were implemented to protect public health and manage social life. These measures included national and international travel restrictions, the suspension of in-person education with a shift to distance learning, bans on mass gatherings, curfews, and lockdowns, all aimed at preventing the local spread of the virus and reducing case numbers (14,23).

Bakırcı (25) assessed the "impact of the COVID-19 pandemic on Türkiye air transportation" by analyzing changes in airline passenger and cargo volumes between January and August 2020. In his study, he also highlighted the changes in passenger and cargo volumes during the SARS and Swine Flu outbreaks in the recent past. He concluded that the COVID-19 pandemic followed a significantly different trajectory compared to those of these epidemics, with far more drastic decline rates (25).

The travels of millions of people via national and international transportation networks due to the Lunar New Year holiday in China coincided with the beginning of the COVID-19 outbreak (26). This played a role in the increase in imported cases and the spread of the disease around the world, as predicted by the WHO in its travel advisories dated January 10 and January 24 (18,27). Considering that approximately 415 million people travelled during the Lunar New Year in 2019 (28), that Wuhan, identified as the origin of the outbreak serves as a major air and rail transportation hub in central China (26), that 13.5% of all outbound flights in Wuhan are international outbound flights (26), and that the disease is caused by a novel coronavirus previously undetected in humans (29) which raises many uncertainties, the significance of the outbreak in terms of the risk of international spread was clear from the outset.

Wu et al. (26) conducted a modeling study to estimate the potential local and international spread of the 2019-nCoV outbreak, which originated in Wuhan, China. Given that Beijing, Shanghai, Guangzhou, and Shenzhen account for 53% of all international air travel from China, the study indicated that a significant outbreak in these cities would contribute to the spread of 2019-nCoV both within and beyond mainland China. It also projected that countries outside China would be at risk of experiencing 2019-nCoV outbreaks during the first half of 2020 (26). The predominance of air travel as the primary mode of international transportation within mainland China has been a key factor in facilitating the global spread of COVID-19 (30).

The disease continued to spread rapidly worldwide, with the global cumulative number of cases reaching 798,396 in March and 3,110,429 in April (9). The flight restrictions imposed by countries one after another as part of international travel measures (8) indicate that health measures implemented in air transportation continue to intensify. Although countries that began implementing different policies regarding public health measures on international travel and social life in the second half of the year attempted to ease various strict measures introduced after the declaration of the pandemic, the ongoing increase in the number of global cases generally led to these measures being tightened again throughout the year (5,8,9). The B.1.1.7 variant (Alpha), which emerged in the UK in December, was reported to have first appeared in the second half of September and spread rapidly despite strict lockdown measures (16). Similarly, the B.1.351 variant (Beta), which became dominant in South Africa in early December, drew attention due to its increased transmission rate. SARS-CoV-2 variants have heightened concerns about global public health by accelerating the pandemic and altering the current epidemiological situation (16,17). In particular, the rapid increase in cases from November to December, resembling a snowball in growth, led countries to introduce new regulations for international travel, especially to countries where the variant had been detected (5,8,9,16). During the 2020 COVID-19 pandemic, the number of global airline passengers experienced significant declines due to international travel restrictions (31), while the number of global COVID-19 cases continued to rise (9). In other words, travel restrictions alone were not effective in reducing the number of COVID-19 cases. This situation highlights the importance of adopting a risk-based and multi-layered approach to public health measures in aviation as a key strategy in combating epidemics (32).

Lau et al. (30) in their study on "the association between international and domestic air traffic and the COVID-19 outbreak", found that there was a direct relationship between the number of passengers between mainland China and international destinations and the number of COVID-19 cases diagnosed outside China (30). Additionally, it was stated that the number of flight routes and total passenger volume were significant risk factors in the spread of COVID-19 (30). Oztig and Askin (33), in their study involving 144 countries, found that countries with higher volumes of airline passenger traffic and more airports were associated with more COVID-19 cases. Due to the limitations mentioned in our study, we cannot provide a reliable explanation for the number of international passengers and the course of COVID-19 cases throughout the year (Figure 5).

In the COVID-19 data shared publicly by the Ministry of Health there are some differences in the definition and representation of patient and case (symptomatic-asymptomatic) categories in the daily coronavirus table over time (13,34). Unfortunately, since these differences do not provide an accurate representation during the process of the course and development of the total number of cases, examining changes in the numbers of international passengers and cases constitutes a limitation of the study. Also, seasonality analysis could not be performed due to data limitations.

Conclusion

This study demonstrated a substantial decrease in the number of international air passengers at Türkiye's airports during 2020, coinciding with the implementation of international travel restrictions and public health measures in response to the COVID-19 pandemic. While this decline was expected, the analysis identified that key turning points in passenger volumes were temporally aligned with major regulatory actions, such as flight suspensions and testing requirements. However, it remains unclear to what extent these measures directly contributed to controlling the spread of the virus, due to the lack of case-based epidemiological data.

These findings underscore the need for future studies that integrate transportation data with robust epidemiological indicators to better assess the effectiveness of airport-based public health interventions. In prolonged outbreaks, public health strategies in the aviation sector should be guided by multidimensional risk assessments that incorporate not only infection rates but also mobility trends, behavioral responses, and international policy shifts. Strengthening data systems and analytic capacity at PoE will be essential for evidence-informed decision-making in future public health emergencies.

Ethics

Ethics Committee Approval: The necessary approvals for conducting the research were obtained from the Non-Interventional Research Ethics Committee of Hamidiye University of Health Sciences (approval number: 2021/29, dated: 17/09/2021).

Informed Consent: Not required.

Footnotes

Authorship Contributions

Concept: G.B., Design: G.B., Data Collection or Processing: G.B., Z.T., Analysis or Interpretation: G.B., Z.T., Literature Search: Z.T., Writing: Z.T.

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