Investigation of the changes in the general characteristics of COVID19 patients with the vaccination program

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Abstract
Since the onset of the Coronavirus Disease 2019 (COVID-19) pandemic, many vaccine research studies have started. Changes in the demographic characteristics of the patients hospitalized from the emergency room to the intensive care unit due to COVID-19 has caught our attention since the vaccination program began in Turkey. The purpose of this study is to investigate whether our investigation is scientifically valid and meaningful. Thus, it will be helpful to investigate the effect of priority ordering in vaccination programs in future pandemics. Demographic characteristics and hospitalization processes of patients hospitalized in the intensive care unit before and after vaccination were compared. For comparison, Charlson Comorbidity Index (CCI) and Acute Physiologic Assessment and Chronic Health Evaluation (APACHE) scores, as well as intensive care unit duration of stay and mortality were used. While age [mean (SD); 70,8 (12,2) vs 66,2 (15,2), p=0,032] and duration of intensive care stay [day; mean (SD); 6,4 (6,3) vs 9,4 (7,4); p<0,001] increased in the post-vaccination group, a statistically significant decrease was observed in APACHE [mean (SD); 26,9 (9,2) vs 20,9 (9,0); p=0,008] and CCI scores [mean (SD); 4,3 (2,2) vs 3,6 (2,7); p<0,001]. Regulating the priorities of those to be vaccinated causes rapid changes in the patient population. For this reason, vaccination of vulnerable groups will contribute to the operation of the health system properly.

Keywords: COVID19, SARS-CoV-2, vaccination, prognostic factors

1. Introduction

Since the beginning of the coronavirus disease 2019 (COVID-19) pandemic, vaccine development studies have been initiated in almost all developed countries. Vaccines that were developed and approved for emergency use started to be applied even before a year had passed. After emergency use approval was obtained on January 13th, 2021 for COVID-19 vaccine studies in Turkey (CoronaVac), the Pfizer-BioNTech vaccine began to be used in Turkey as of March 12th, 2021.

Due to the limited number and distribution of vaccines in the early days, each country had to identify their own priority groups. The first group that received access to the vaccine in Turkey was healthcare workers considered to be at the highest risk. Then, the vaccination program was applied gradually, taking into account the people with advanced age and chronic diseases that experience a more severe course of the disease. After the vaccination program started, it was observed that the demographic characteristics of the patients hospitalized in the intensive care units changed in the clinic where we worked, and in the feedback that was received from colleagues around the world. This observation constituted the basis for this research. Whether there has been a statistically significant change in the demographic characteristics of patients who need intensive care before and after the vaccination program was examined. Thus, an attempt was made to measure the contribution of the vaccination program to the adequacy of the intensive care capacity even in the early period.

It was reported in the weekly epidemiological update of the World Health Organization that over 22 million new cases and over 59,000 new deaths occurred between January 24th and January 30th, 2022, and that there was a 9% increase in new deaths when compared to the previous week. As of January 30th, 2022, over 370 million confirmed cases and over 5.6 million deaths had been reported globally (1). The leading argument that anti-vaccinists put forward is the lack of sufficient research Therefore, it is necessary to demonstrate the value of vaccination using scientific evidence to counter anti-vaccination arguments.

2. Materials and Methods

Our hospital is 110 kilometers from the city center of İzmir and has a capacity of 300 beds, serving approximately 250,000 people. In this hospital, 24 beds, including isolated rooms, are reserved for intensive care pandemic patients. This was a retrospective, observational, pre-, and during cohort analysis. The study was approved by the Clinical Research Ethics Committee of the University of Health Sciences, İzmir Dr. Suat Seren Chest Diseases and Surgery Training and Research Hospital, dated 2021 and number 2021/48-59. The ethical guidelines of the Declaration of Helsinki were

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observed. This study covered the period of 2 months before the start of the vaccination program and 15 days after the second dose, which was thought to have established the effectiveness of the vaccine. For these dates, the data were extracted directly from a systematic query of the electronic health record as part of the Health Data & Management Solution System by examining the COVID-19 patients hospitalized in the intensive care unit day by day, and the average age, number of inpatients, average Acute Physiologic Assessment and Chronic Health Evaluation (APACHE) scores, average Charlson comorbidity index (CCI) scores, total hospital stay of the patients hospitalized on the specified day, length of stay in the intensive care unit, and intubation and discharge rates for each day were calculated. These data were recorded on the data record form separately for each day. Using this data, the pre-vaccination group (Grp 1) and post-vaccination group (Grp 2) were compared. The purpose of this study is to examine the effect of vaccination on intensive care hospitalizations and the clinical severity of patients with COVID-19.

2.1. Statistical analysis
The frequencies and percentages were given for the categorical variables, and the mean, standard deviation (SD), median, and range (minimum-maximum) values were given for the numerical variables as descriptive statistics. The categorical variables were compared using the Pearson chi-square test, while the numerical variables were compared using the Wilcoxon rank sum Mann Whitney U test between the groups. Statistical significance was assessed at $P < 0.05$ and all statistical analyses were performed using R software version 4.0.5 (R Foundation for Statistical Computing, Vienna, Austria).

3. Results
A total of 252 patients admitted to the emergency department and hospitalized in the pandemic intensive care unit were included in this study. The general data of all of the patients are shown in Table 1. When the patients were evaluated pre- and post-vaccination, the following statistically significant changes were observed: the mean age of the patients decreased, the number of hospitalization days increased, the APACHE score decreased, and the CCI score decreased (Table 2). Although the number of intubated patients and the number of patients receiving noninvasive mechanical ventilation decreased, these changes were not statistically significant, and although there was a decrease in intensive care deaths, there was no statistically significant change.

The change in the age group distribution of the patients hospitalized in the intensive care unit is highlighted in Fig. 1.

The aim of this study is not to compare the outcomes of vaccinated and unvaccinated patients, but to investigate the change in the general characteristics of patients who need intensive care with vaccination. However, when the patients were examined, 35 (14%) of 252 had one dose and 14 (5.5%)

had two doses of vaccine during their admission to the intensive care unit. Moreover, 203 (80.5%) patients were not vaccinated. All of the vaccines that the patients had were CoronaVac (by Sinovac) inactivated vaccine, which was approved for emergency use in Turkey on January 13th, 2021.

Table 1. Overall patients characteristics

	Mean (SD)	Median	Range	Yes	No
Age	69,1 (13,6)	70,0	25,0-94,0		
Apache score	24,3 (9,7)	24,0	4,0-47,0		
Icu day	7,7 (6,8)	6,0	1,0-36,0		
Entubation				85 (33,7%)	167 (66,3%)
MV				85 (33,7%)	127 (50,4%)
Ex				119 (47,2)	133 (52,8%)

Table 2. Comparison of before and after vaccine periods

|	Group 1	Group 2	Totally	P
Age				
Mean (SD)	70,8 (12,2)	66,2 (15,2)	69,1 (13,6)	**0,032**
Median	70,5	70,0	70,0	
Range	26,0-94,0	25,0-94,0	25,0-94,0	
Gender [N (%)]				
Man	95 (60,1%)	54 (57,4))	149 (59,1%))	0,676
Woman	63 (39,9%)	40 (42,6%)	103 (40,9%)	
Apache score				
Mean (SD)	26,9 (9,2)	20,6 (9,0)	24,3 (9,7)	**0,001**
Median	27,0	20,0	24,0	
Range	11,0-46,0	4,0-47,0	4,0-47,0	
CCI score				
Mean (SD)	4,3 (2,2)	3,6 (2,7)	4,0 (2,5)	**0,008**
Median	4,0	3,5	4,0	
Range	0,0-11,0	0,0-14,0	0,0-14,0	
ICU length of stay (day)				
Mean (SD)	6,4 (6,3)	9,4 (7,4)	7,7 (6,8)	**0,001**
Median	5,0	8,0	6,0	
Range	1,0-31,0	1,0-36,0	1,0-36,0	
Entubation [N (%)]				
Yes	57 (36,1%)	28 (29,8%)	85 (33,7%)	0,307
No	101 (63,9%)	66 (0,2%)	167 (66,3%)	
MV [N (%)]				
Yes	57 (36,1%)	28 (29,8%)	85 (33,7%)	0,214
No	73 (46,2%)	54 (57,4%)	127 (50,4%)	
Noninvaziv	28 (17,7%)	12 (12,8%)	40 15,9%)	
Ex [N (%)]				
Yes	81 (51,3%)	38 (40,4%)	119 (47,2%)	0,096
No	77 (48,7%)	56 (59,6%)	133 (52,8%)	
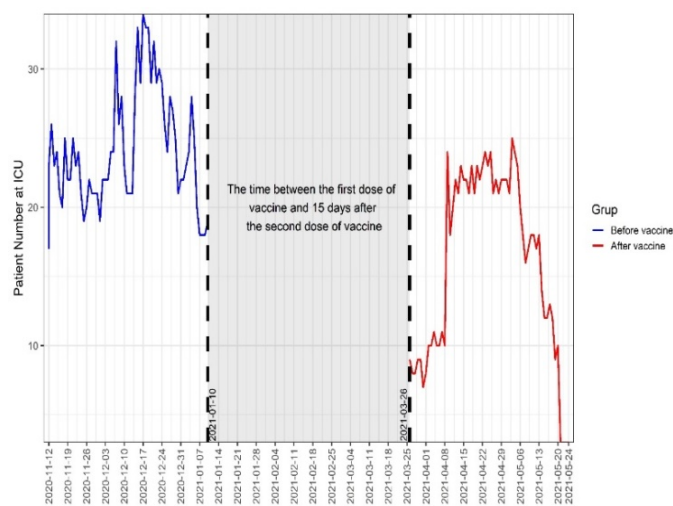
Fig. 1. Change in the number of patients hospitalized in intensive care unit over time

4. Discussion

Haas et al. (2) reported at the conclusion of a large-scale study in Israel that vaccination with two doses of BNT162b2 was quite effective in preventing symptomatic and asymptomatic SARS-CoV-2 infections, as well as COVID-19-related hospitalizations, severe illness, and death in all age groups (16 years, including adults over the age of 85).). These findings suggest that the COVID-19 vaccine may help to control the pandemic. In that study, the protection rate was 97% against symptomatic COVID-19. Polack et al. reported that the two-dose BNT162b2 regimen provided 95% protection against COVID-19 in people aged 16 and over, and the safety for a median of 2 months was similar to that of other viral vaccines (3). In a study investigating the effect of the vaccination program on reducing the burden of disease in South Korea, it was found that it reduced negative outcomes, such as intensive care unit admissions and deaths, by 45% and 43%, respectively (4). It was reported that SARS-CoV-2 vaccines administered in Brazil, by giving priority to people over the age of 75, were quite effective in reducing the number of deaths associated with COVID-19, with a protection ratio of 19.31 (95% CI: 18.20–20.48), and an attributable protection ratio of 94.8%. In the same study, it was also observed that the protection after the second dose was as high as 99.2% (5). In a Brazilian study, a rapid increase in vaccination coverage among the elderly was associated with a significant decrease in relative mortality rates when compared to younger individuals. It was stated that if mortality rates among the elderly remained proportional to those observed until the 6th week, an estimated additional 43,802 COVID-related deaths could be expected by the 19th week (6). In the study, in which the vaccination campaign in Israel was estimated to have prevented 158,665 COVID-19 infections, 24,597 hospitalizations, 17,432 critical or severe hospitalizations, and

5532 deaths (7), it was also estimated that these prevented deaths and hospitalizations were of people aged 65 years and older, and that prevented illness, hospitalization, and deaths were from the fully vaccinated group. In a study conducted in Poland, it was stated that vaccinated patients hospitalized for COVID-19 constituted a small (1.2%) group when compared to all of the hospitalized COVID-19 patients, and vaccination provided assurance in preventing severe infection and death (8).

In a multicenter study conducted in the USA, it was observed that the need for emergency room admission and hospitalization due to COVID-19 was an extremely rare incidence in fully vaccinated patients. Emergency room visit rates among fully vaccinated people were low. It was stated that if hospitalization was required, elderly patients with significant comorbidities were at high risk for serious consequences regardless of their vaccination status (9).

In a retrospective study conducted in Saudi Arabia, it was stated that most of the COVID-19 patients hospitalized to the intensive care unit were unvaccinated, and most of the partially vaccinated patients were infected before developing immunity (10).

This study aims to scientifically demonstrate the benefit of the vaccine as early as possible. Therefore, it is based on the evaluation of the entire patient group as a single patient rather than the individual conditions of the patients before and after the vaccination program. The most important limitations of the study were that it was conducted in a very early period, was single-centered, and it was designed retrospectively.

Even in the early period of vaccination, the demographic characteristics of patients in need of intensive care have changed, emphasizing the importance of vaccination in ending the pandemic. Larger multicenter, prospective, and controlled studies will be conducted in the future to confirm the effectiveness and the success of vaccination.)

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