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EFFECT OF COVID-19 VACCINATION ON HOSPITALIZATIONS

Emre ÖZGEN[1]*, Bahadır YAZICIOĞLU[2], Melek BİLGİN[3], Muhammet Ali ORUÇ[4]

[1]*Samsun Education and Research Hospital, Department of Emergency Medicine, 55090, Samsun, Türkiye*
[2]*Samsun Education and Research Hospital, Department of Family Medicine, 55090, Samsun, Türkiye*
[3]*Samsun Education and Research Hospital, Department of Microbiology, 55090, Samsun, Türkiye*
[4] *Kırşehir Ahi Evran University, Faculty of Medicine, Department of Family Medicine, 4100, Kırşehir, Türkiye*

Abstract: Coronavirus 2019 disease (COVID-19) continues to affect the World today with over 340 million cases and over 5.5 million deaths. This situation reveals the need for vaccination, given that it is not an effective treatment. Our purpose in this study is; to compare the vaccination status of hospitalized patients due to COVID-19 and to investigate their efficacy. The study is a descriptive study and cross-sectional type. The research was carried out by retrospective examination of hospital automation data in Samsun province. In the 4-months period between July 01 and October 31, 2021, patients hospitalized due to COVID-19 were classified according to their vaccination status and identified through descriptive statistical methods. 1174(15.58%) of 7534 COVID-19 patients were admitted to intensive care units (ICU), it was observed that 879(74.8%) of the patients admitted to the ICU were unvaccinated, 174(14.8%) were vaccinated with 2 doses of Sinovac, and 0.08% (n=1) were vaccinated with 2 doses of Biontech reminders on 2 doses of Sinovac. Of the 6360 patients hospitalized in the clinics due to COVID-19, 54.76% (n=3483) were female, and 41.03% (n=2610) were ≥ 65 years old. 49.31% (n=579) of the patients hospitalized in the ICU were women, 72.65% (n= 853) were ≥ 65 years old. Unvaccination increases the risk of hospitalization and ICU admission. Missing a reminder dose and advanced age are high risk factors for hospitalization. About half of those hospitalized and the majority of those admitted to the ICU are unvaccinated, and vaccination reduces hospitalizations.

Keywords: Covid-19, Pandemic, Hospital charges, Vaccination, Preventive health services

***Corresponding author:** Samsun Education and Research Hospital, Department of Emergency Medicine, 55090, Samsun, Türkiye
E mail: emreozgen46523@gmail.com (E. ÖZGEN)
Emre ÖZGEN https://orcid.org/0000-0001-8153-4132
Bahadır YAZICIOĞLU https://orcid.org/0000-0003-4397-2769
Melek BİLGİN https://orcid.org/0000-0003-0025-8717
Muhammet Ali ORUÇ https://orcid.org/0000-0002-4320-8579

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1. Introduction

The coronavirus 2019 disease (COVID-19) continues to affect the world today with over 340 million cases and over 5.5 million deaths (WHO, 2022). Despite unprecedented movement restrictions, social distancing and stay-at-home measures in many countries, the COVID-19 pandemic has caused devastating morbidity and mortality. In parallel, the vast majority of the global population remains susceptible to COVID-19, highlighting the need for effective vaccination (Iversen and Bavari, 2021). Vaccination is the most important weapon used to reduce both the risk of transmission and mortality in the COVID-19 Pandemic and to keep the pandemic under control. Results from two large efficacy trials (mRNA vaccines) demonstrated a vaccine efficacy of over 90% against symptomatic and severe disease (Yan et al., 2021). These vaccines have been approved for emergency use by the Food and Drug Administration, and vaccination has started in the United States of America (USA) by giving priority to healthcare workers, long-term nursing home residents, and high-risk individuals (Moghadas et al., 2021). In phase 3 clinical study to evaluate the safety and efficacy of the inactivated SARS-CoV-2 vaccine CoronaVac among volunteers in our country, CoronaVac was found to have a good safety and tolerability profile and high efficacy against symptomatic COVID-19 confirmed by PCR. (Tanriover et al., 2021). In our country, the COVID-19 vaccine application was first initiated with priority groups (health workers and individuals over the age of 65) on January 13, 2021, with the inactivated Sinovac vaccine, as 2 doses of 3mcg with an interval of 28 days, and the mRNA vaccine Biontech vaccine was also started to be administered as of April 2021 (T.C. Sağlık Bakanlığı, 2021). Before these dates, many healthcare workers died in Türkiye as well as in the rest of the world (Adrielle Dos Santos et al., 2021). Before the vaccination program, 107 of our health workers died, and after that, 39 of our health workers lost their lives. In this way, the protective shield effect of the vaccine on healthcare workers was seen (Akpolat and Uzun, 2021). When the literature is examined, there is no comprehensive study that examines the relationship between vaccination and hospitalizations. Our study will make an important contribution to the literature in this field. More work is needed in this area. Our aim in this study; to reveal, compare and investigate the

effectiveness of vaccination on hospitalized patients due to COVID-19.

2. Material and Methods

The study is a descriptive, cross-sectional and analytical study. Number, percentage, rate and frequency data were used as descriptive statistics. The records of patients hospitalized with a confirmed diagnosis of COVID-19 between 01.07.2021 and 31.10.2021 within the provincial borders of Samsun were retrospectively reviewed and noted through the automation system of the hospitals. Confirmed diagnosis of COVID in our country is made by Polymerase Chain Reaction (PCR). Bio-Speedy, SARS-CoV-2 Double Gene RT-qPCR (Bioeksen, Istanbul, Türkiye) kit was used to diagnose COVID-19 and studied with the BioRad CFX96 RT-PCR device. Then, the vaccination status of these patients was examined. Vaccines made in the last 14 days before the hospitalization date of hospitalized patients were not taken into account. Vaccines administered to the patients as per the vaccination program after hospitalization and discharge were not considered as "done". Patients were classified into 8 categories according to their vaccination status;

- Class I: Those who have never been vaccinated before the disease,
- Class II: 1 dose of Sinovac vaccine,
- Class III: 2 doses of Sinovac vaccine,
- Class IV: 3 doses of Sinovac vaccine,
- Class V: 1 dose of Biontech vaccine,
- Class VI: 2 doses of Biontech vaccine,
- Class VII: 2 doses of Sinovac + 1 dose of Biontech vaccine,

Class VIII: 2 doses of Sinovac + 2 doses of Biontech vaccine,

The categories mentioned were compared among themselves in terms of intensive care unit (ICU) and service hospitalization numbers.

Inclusion criterias of this study

1. Patients who were vaccinated before the COVID-19 disease,
2. Patients aged 18 years and over,

Exclusion criterias of this study

1. Those who are vaccinated after being sick with COVID-19,
2. Patients younger than 18 years old.

3. Results

In the study, the vaccination status of a total of 7534 patients, 1174 of whom were hospitalized in the ICU due to COVID-19 between 01.07.2021 and 31.10.2021, were examined. The mean age of these patients was 57.48 (±21.72), 54.00% (n=4062) were female and 46.00% (n=3472) was male. It was observed that 74.80% (n=879) of the patients hospitalized in the ICU were unvaccinated, 14.80% (n=174) were vaccinated with 2 doses of Sinovac, and 0.08% (n=1) were vaccinated with 2 doses of Biontech reminder over 2 doses of Sinovac. It has been determined that female patients are more numerous than male patients in almost every vaccine status group in hospitalizations due to COVID-19 (Table 1).

Table 1. Comparison of patients' Clinics / ICU hospitalization status

Vaccine Status	Clinics, n (%)	ICU, n (%)	Female	Male	Mean Age	Total
Unvaccinated	2548 (40.06)	879 (74.87)	1827	1600	54.62	3427 (%45.48)
1Sinovac	129 (2.02)	10 (0.85)	76	63	49.69	139 (%1.84)
2Sinovac	1822 (28.64)	174 (14.82)	1133	863	66.65	1996 (%26.49)
3Sinovac	422 (6.63)	34 (2.89)	227	229	70.02	456 (%6.05)
1Biontech	507 (7.97)	28 (2.39)	292	243	41.87	535 (%7.10)
2Biontech	583 (9.16)	24 (2.05)	316	291	43.66	607 (%8.05)
2+1*	342 (5.37)	24 (2.05)	185	181	68.41	366 (%4.85)
2+2**	7 (0.11)	1 (0.08)	6	2	61.50	8 (%0.10)

*2Sinovac+1Biontech, **2Sinovac+2Biontech.

Of the 6360 patients hospitalized due to COVID-19, 54.76% (n=3483) were female, and 41.03% (n=2610) were 65 years and older. It was observed that 1149 (44.02%) of 2610 patients aged 65 and over who were hospitalized in the clinics received 2 doses of inactivated vaccine (Table 2). Of the patients hospitalized in the ICU, 49.31% (n = 579) were female, 72.65% (n = 853) were 65 years and older (Table 3). As seen in Figure 1 and 2, the number of patients who received 1 dose or 2 doses of Biontech reminder dose after 2 doses of Sinovac is remarkably low. The effectiveness of the groups that were vaccinated for the first time in January and February of 2021 started to decrease after July 2021, and reminder doses were needed. As seen in Figure 3, COVID-19 has now become a pandemic of the unvaccinated and those with 2 doses of Sinovac.

Table 2. Distribution of patients admitted to the Clinics by age

Vaccine Status	<65 age, n	≥65 age, n	Total
Unvaccinated	1792	756	2548
1Sinovac	103	26	129
2Sinovac	673	1149	1822
3Sinovac	104	318	422
1Biontech	455	52	507
2Biontech	524	59	583
2+1*	95	247	342
2+2**	4	3	7
Total	3750 (%58.97)	2610 (%41.03)	6360 (%100)

*2Sinovac+1Biontech, **2Sinovac+2Biontech.

Table 3. Distribution of patients admitted to intensive care units by age

Vaccine Status	<65 age, n	≥65 age, n	Total
Unvaccinated	239	640	879
1Sinovac	9	1	10
2Sinovac	29	145	174
3Sinovac	7	27	34
1Biontech	19	9	28
2Biontech	17	7	24
2+1*	1	23	24
2+2**	0	1	1
Total	321 (%27.35)	853 (%72.65)	1174 (%100)

*2Sinovac+1Biontech, **2Sinovac+2Biontech.

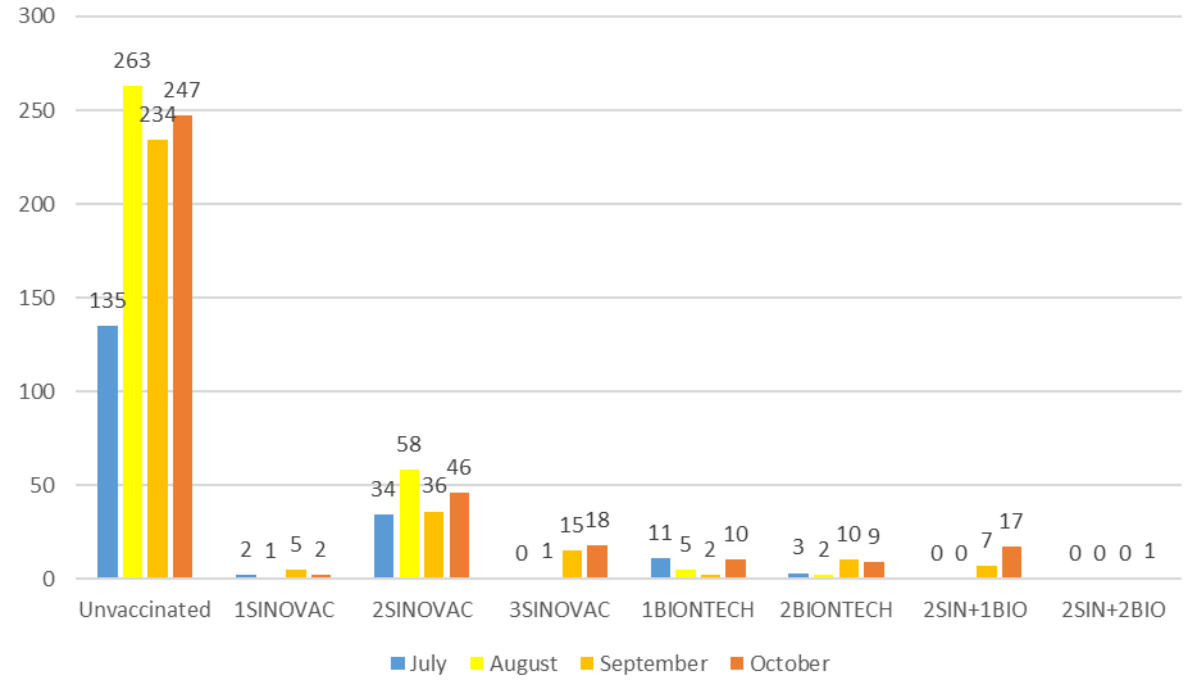

Figure 1. Distribution of patients in Intensive Care Units with covid-19 diagnosis in July-August-September-October 2021 according to vaccination status.

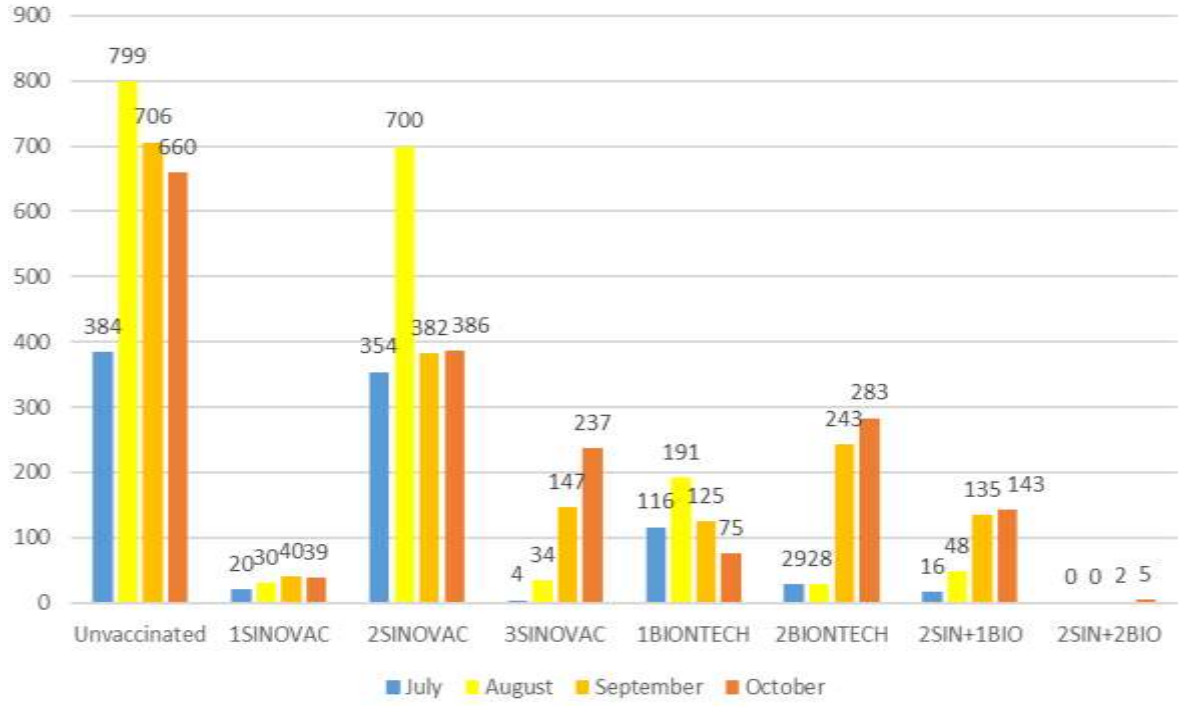

Figure 2. Distribution of patients in Clinics with covid-19 diagnosis in July-August-September-October 2021 according to their vaccination status.

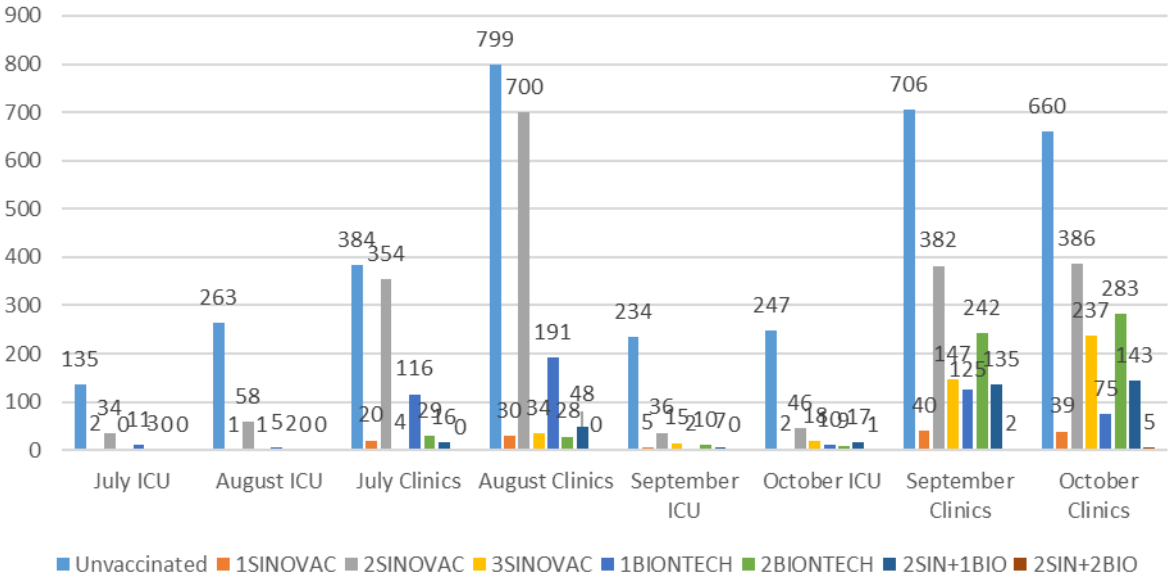

Figure 3. Distribution of patients in ICU and Clinics with covid-19 diagnosis in July-August-September-October 2021 according to vaccination status.

4. Discussion

In the fight against the pandemic, vaccination is the most important life-saving weapon for preventive medicine. In cases where there is no effective treatment, prevention of contagion and preventive medicine practices gain importance in the fight against the disease. In the light of the results obtained from this study, the importance of vaccination from preventive medicine practices was emphasized, since the hospitalization rates of individuals who did not receive full dose vaccination / six months after the full dose vaccination were found to be higher. These are also concretely revealed in the reports presented by the World Health Organization (WHO, 2022).

It was seen in the study that; about half of hospitalized patients are unvaccinated. In the vaccinated group, the most common vaccination situation is 2 doses of inactivated vaccination. Similarly, in the study of Uzun et al. (2022) reported that almost half of the hospitalized patients (48%) were unvaccinated, and the second largest group was those who received 2 doses of Sinovac vaccine (33%). The reason for this is thought to be due to the decrease in the effectiveness of the Sinovac vaccines

administered in January 2021, due to the fact that the effect period is not long enough in our study period, July-August-September-October 2021. We think it is due to the lack of effectiveness of 2 doses of SINOVAC.

In the study by Bajema et al. (2021) adult American veterans were hospitalized between February 1 and August 6, 2021 at five centers (Atlanta, Georgia; Bronx, New York; Houston, Texas; Los Angeles, California; and Palo Alto, California). It was reported that 1,093 (93.0%) of 1175 patients aged 18 and over were male and the mean age was 68. In the same study, the number of inpatients aged 65 and over was 701 (59.65%), which was parallel to our study. Although the male gender ratio was 46% in our study, it is thought that this difference in the number of male patients is due to the fact that the population in the other study consisted of American veteran citizens.

In the study of Tenforde et al. (2021a) it was found that vaccination with an mRNA COVID-19 vaccine significantly reduced hospitalizations with the diagnosis of COVID-19. Similarly, in our study, the share of hospitalized patients in the hospital and in the ICU was found to be low among those within the protection shield of vaccination.

Again, in another study by Tenforde et al. (2021b) the effectiveness of Pfizer-biontech and Moderna vaccines against COVID-19 was investigated in adults aged 65 and over in 14 states, 24 hospitals, hospitalized adults in the USA, 26 March 2021-19 April. In this multi-regional US review from 2021, they stated that vaccination provides protection against COVID-19-related hospitalization among adults aged 65 and over, and that the vaccine is a critical tool to reduce severe COVID-19 in high-risk groups.

In a study by Moline et al. (2021) the effectiveness of COVID-19 vaccines in preventing hospitalization in adults aged 65 and over between February 1 and April 30, 2021 in 13 states in the USA, among 7,280 COVID-19 patients, 5,451 (75%) were unvaccinated, 867 (12%) were partially vaccinated and 394 (5%) were fully vaccinated. In our study, the rate of unvaccinated patients who were admitted to the ICU was similarly 74.87%.

Rosenberg et al. (2022) investigated COVID-19 vaccine efficacy in New York state from May to August among adults 65 years of age and older who received BNT162b2 or mRNA-1273 vaccines, where efficacy against hospitalization with COVID-19 remained greater than 86%. reported that the effectiveness decreased.

Li et al. (2021) investigated the efficacy of inactivated SARS-CoV-2 vaccines against Delta variant infection in Guangzhou on 153 cases of COVID-19 between May 18 and June 20, 2021, against mild, moderate and severe COVID-19. -19, its efficacy against COVID-19 is 59.0% (95%CI: 16.0% to 81.6%), for two-dose full vaccination, 70.2% against moderate COVID-19. It has been estimated to be 95%CI: 29.6% to 89.3%. Vaccination efficacy against serious disease was estimated at 100% as there were two unvaccinated severe cases in the case group, which may have been overestimated due to small samples.

Jara et al. (2021) investigated the efficacy of an inactivated SARS-COV-2 vaccine in Chile between February 2 and May 1, 2021. 65.9% in preventing COVID-19, 87.5% in preventing hospitalizations due to COVID-19, and ICU it was found to be 90.3% successful in preventing hospitalization.

When the literature is examined, there is no application such as 3 doses of Sinovac, 1 reminder dose of Biontech on 2 doses of Sinovac, or 2 doses of Biontech over 2 doses of Sinovac in the vaccine program of any country other than Türkiye. In our study, it was seen that reminder doses are of great importance in the fight against peak waves experienced during the pandemic.

5. Conclusion

About half of those hospitalized and the majority of those admitted to the intensive care unit are unvaccinated, and vaccination reduces hospitalizations. Hospitalization rates are high for those 6 months or more after inactive vaccination, it is observed that the effectiveness of the vaccines decreases over time, and it is important to give reminder doses to maintain immunity. Intensive care admissions are common in unvaccinated individuals over the age of 65.

Vaccination studies of unvaccinated individuals, reminder doses to vaccinated individuals, and vaccination of risk groups such as 65 years and older should be given importance. It is recommended to contribute to the literature with similar studies in order to draw attention to preventive medicine studies such as vaccination in order to contribute to the early end of the pandemic.

Limitations

We could not reach to the patients' files, because of this reason, we do not have any information about what the physical, sociodemographic, and clinical characteristics (comorbid illness, risk groups etc.) of subjects are. We have only mean age and sex of subjects. And also, since the study was retrospective, there was no question of obtaining informed consent.

Author Contributions

Percentages of the author(s) contributions is present below. All authors reviewed and approved final version of the manuscript.

%	E.Ö.	B.Y.	M.B.	M.A.O
C	25	25	25	25
D	25	25	25	25
S	25	25	25	25
DCP	25	25	25	25
DAI	25	25	25	25
L	25	25	25	25
W	25	25	25	25
CR	25	25	25	25
SR	25	25	25	25
PM	25	25	25	25
FA	25	25	25	25

C= concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval/Informed Consent

In order to carry out the study, ethics committee approval numbered 2021/17/1 was obtained from Samsun Educational Research Hospital Non-Interventional Clinical Research and Ethics Committee at the meeting dated 20.10.2021. The study was carried out in accordance with the principles of the Declaration of Helsinki.

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