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RETROSPECTIVE ANALYSİS OF COVID-19 VACCİNATİON IN A UNİVERSITY HOSPİTAL DURİNG THE COVID-19 PANDEMİC AND THE RELATİONSHİP WİTH THE EPİDEMİC RATE

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ABSTRACT

The Covid-19 vaccine has changed the course of the pandemic. In total, 162 doses have been given to every 100 people around the world since September 2022, according to the World Health Organization. This research aims to make a retrospective analysis of the vaccines administered in the vaccine unit of our hospital since the beginning of the pandemic, to analyze the distribution of vaccine brands and vaccine doses by the time, and to examine the relationship between the epidemic rate and vaccination rates. The study was carried out retrospectively from the vaccination records applied in the vaccination unit, from the start of the first day of vaccination in our country January 14, 2021, to July 1, 2022. A total of 75079 (100%) vaccines were administered, 59386 (79%) were Biontech, and 15693 (21%) were Sinovac vaccines. July 2021 was the month with the highest vaccination rate (n=15775), 92% Biontech and 8% Sinovac. An inverse correlation was found between the peak points of the epidemic and vaccine. As in the rest of the world, Biontech was found to be the most preferred vaccine by individuals against COVID-19 in this study.

Keywords: Adult; Epidemiology; Vaccine

INTRODUCTION

The Coronavirus disease 2019 (COVID-19) pandemic resulted in more than 574 million cases and more than 6,3 million deaths as of July 31, 2022.[1] Therefore, the rapid development of a vaccine against SARS-COV-2 has become a global goal to end the COVID-19 pandemic. Using new technologies that have never been licensed before, different brands of vaccines such as BNT162b2 mRNA COVID-19 vaccine (BioNTech/Pfizer), mRNA-1273 (Moderna), ChAdOx1 nCoV-19 (Oxford/ AstraZeneca), Ad26.COV2.S (Janssen) and Sinovac for COVID-19 were developed and distributed globally.

As of July 5, 2022, approximately 68.5% of the global population had received at least one dose of a COVID-19 vaccine.[2] Real-world studies conducted in multiple countries showed that COVID-19 vaccines, such as BNT162b2 (Pfizer/BioNTech), mRNA-1273 (Moderna), Ad26.COV2.S (Janssen), and ChAdOx1 nCoV-19 (Oxford/ AstraZeneca), are effective against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.[3]

Sinovac is an inactivated vaccine containing inactivated SARSCoV-2. Multiple phase-3 trials were conducted in countries such as Brazil, Indonesia, and Turkey to determine the effectiveness of Sinovac.[4] World Health Organization proposed the Sinovac vaccine efficacious reach a protection level of at least 50%. According to the phase-3 Sinovac study conducted in Chile, the effectiveness of the Sinovac vaccine rolled out to the general

population aged ≥16 years is 16.13% after the first dose and 66.96% after the second dose.[5]

The BNT162b2 COVID-19 vaccine developed by BioNTech and Pfizer is the first vaccine approved by the US Food and Drug Association (FDA). It is a lipid nanoparticle-formulated, nucleoside-modified RNA vaccine and is safe and effective against COVID-19. The effectiveness of the BNT162b2 vaccine is detected at 92% after the second dose in Israel after nationwide mass vaccination.[4,6]

Vaccines registered and put into use by countries differ according to national policies. Public instilled with BioNTech/ Pfizer, Sinovac, and Turkovac vaccines against to COVID-19 in Turkey. The COVID-19 vaccination program was launched across the country on January 14, 2021, with Sinovac. From January 14 to April 2, 2021, Sinovac was the only COVID-19 vaccine available in our country. Messenger RNA BNT162b2 (BioNTech) mass vaccination started to be implemented nationwide on April 2, 2021.

Public and health workers have been vaccinated with BioNTech/Pfizer and Sinovac vaccines in our hospital. Sinovac rolled out on January 14, 2021, and BioNTech/ Pfizer on June 9, 2021.

In this study, it was aimed to analyze retrospectively the vaccination records enrolled in the vaccination unit of our hospital between January 2021 to July 2022 and to examine the relationship between the epidemic rate and the rate of vaccination

MATERIAL AND METHODS

The study was carried out retrospectively from the vaccination records applied in the COVID-19 vaccination unit of a university health practice and research hospital from the first day of vaccination in our country January 14, 2021, to July 1, 2022. In addition, epidemic data of the country was obtained from the website of the Ministry of Health's COVID-19 information platform. The data was first transferred to Microsoft Excel and then to the JMP software statistical discovery program, providing necessary control and analysis. The R-Studio statistical program checked whether the distribution of the variables was in accordance with the normal distribution. Figures and tables were created with the data obtained by the created giant chart.

RESULTS

In the 18-month period, a total of 75079 (100%) vaccines in, of which 60 480 Biontech (81%) vaccines and 14599 (19%) Sinovac vaccines were received by 68755 (92%) public and 6324 (8%) healthcare workers (HCWs). A total of five doses of vaccines were administered to individuals, likely through the national vaccination campaign. The month with the highest vaccination rate was July 2021, with the highest number of vaccines applied (n=15775), 92% of which were Biontech and 8% of Sinovac. It is followed by December and June 2021, respectively (Table 1).

At the end of the first year, 65836 people were vaccinated, of which 5823 (9%) were HCWs. Since the HCWs struggled with the epidemic face to face, they were vaccinated only with the Sinovac vaccine in the first five months, and at the end of the first year, 62% were vaccinated with Sinovac and 38% with Biontech. On the contrary, in 2022, the percentage of healthcare personnel vaccinated with Biontech was 94%, and Sinovac remained at 6%. In the total study period, 6324 (8%) vaccines were administered to HCWs, and 3377 (53%) of them were administered in the first five months when only Sinovac was available. At the end of 18 months vaccination period, out of 60 480 Biontech vaccines, 2700 (4.5%) were given to HCWs, and 57780 (95.5%) vaccines were given to the public (Table 2).

At the end of 2021, the public vaccination rate with Biontech was 83%, while it was 38% in HCWs. In the first six months of the following year, 9243 individuals were vaccinated, of which 501 (5%) were HCWs, and 91% of the public was vaccinated with Biontech, while this rate was 94% among HCWs (Table 2). With the start of the Biontech vaccination on June 10, 619 individuals (14.1%) received the vaccine, meaning there has been a noticeable increase in the vaccination rate compared to the previous months. Individuals often preferred the

Biontech vaccine. In June 2021, only 10% of the vaccines given to individuals were Sinovac, and 90% were Biontech. In the following period, at least 79% of vaccines were carried out with the Biontech vaccine each month (Table 1). According to the distribution of vaccination by months in the Figure, it is determined that Sinovac vaccination peaks in the second (February 2021) and sixth (June 2021) months, and Biontech vaccination peaks in the seventh (July 2021) and 12th months (December 2021). Sinovac vaccination peaks remain well below the Biontech peaks.

For the result which was created with the data obtained from the Ministry of Health's COVID-19 Information Platform website, it was observed that the nationwide daily number of cases peaked in February 2022.[7] Since the start of COVID-19 vaccination across the country, the first three months with the highest daily number of COVID-19 infected cases were February, January 2022 and April 2021 respectively. Vaccination peaked in July 2021 (21%) and watched high in December 2021 (18%) and June 2021 (14%), respectively, when the monthly number of COVID-19 infected cases was low (Table 1).

In the months when the number of cases was low across the country, vaccination rates were high in our hospital (July, December, and June 2021). However, in February 2022, when the number of monthly cases across the country was the highest, it was noteworthy that the vaccination rate remained as low as 2% in the hospital (Table 1).

During 18 months, a total of five doses of vaccines were received by the public and HCWs in the vaccination unit of our hospital. The vaccines brand that the public and HCWs preferred at each dose were shown in a table (Table 2). It was observed that the first three dose vaccination rates were high, the fourth and fifth dose vaccination rates were low, and Biontech was clearly preferred for each vaccine dose. In addition, when the arm of those who had the Sinovac vaccine was examined, it was seen that each dose of the Sinovac vaccination declined from the first dose (Table 3).

When Sinovac and Biontech vaccine arms were examined separately, it was seen that each Biontech vaccine doses received by individuals were remarkably higher than Sinovac (Figure 3).

Table 1. Vaccination Distribution by Months

		SINOVAC		BIONTECH		TOTAL	
		n	%	n	%	n	%
2021	January	1627	100	0	0	1627	2,17
	February	2735	100	0	0	2735	3,64
	March	1734	100	0	0	1734	2,31
	April	831	100	0	0	831	1,11
	May	1330	100	0	0	1330	1,77
	June	1053	10	9566	90	10619	14,14
	July	1287	8	14488	92	15775	21,01
	August	858	11	6840	89	7698	10,25
	September	745	15	4374	85	5119	6,82
	October	510	17	2424	83	2934	3,91
	November	316	15	1752	85	2068	2,75
	December	718	5	12648	95	13366	17,8
2022	January	465	7	5910	93	6375	8,49
	February	160	11	1344	89	1504	2
	March	124	15	685	85	809	1,08
	April	71	19	300	81	371	0,49
	May	27	21	101	79	128	0,17
	June	8	14	48	86	56	0,07
Total		15963	21	59386	79	75079	100

Table 2. Vaccination Dashboard of Public and HcWs

YEAR		Public					HCWs					
		Sinovac		Biontech		Total	Sinovac		Biontech		Total	Grand Total
		n	%	n	%	n	n	%	n	%	n	n
2021	January	85	5	0	0	85	1542	95	0	0	1542	1627
	February	1062	39	0	0	1062	1673	61	0	0	1673	2735
	March	1624	94	0	0	1624	110	6	0	0	110	1734
	April	797	96	0	0	797	34	4	0	0	34	831
	May	1312	99	0	0	1312	18	1	0	0	18	1330
	June	1048	10	9544	90	10592	5	0	22	0,2	27	10619
	July	1191	8	13485	85	14676	96	1	1003	6	1099	15775
	August	813	11	6476	84	7289	45	1	364	5	409	7698
	September	718	14	4052	79	4770	27	1	322	6	349	5119
	October	501	17	2312	79	2813	9	0	112	4	121	2934
	November	306	15	1614	78	1920	10	0	138	7	148	2068
	December	693	5	12380	93	13073	25	0	268	2	293	13366
	Total 2021	10150	17	49863	83	60013	3594	62	2229	38	5823	65836
2022	January	444	7	5560	87	6004	21	0	350	5	371	6375
	February	157	10	1277	85	1434	3	0	67	4	70	1504
	March	119	15	669	83	788	5	1	16	2	21	809
	April	71	19	277	75	348	0	0	23	6	23	371
	May	26	20	94	73	120	1	1	7	5	8	128
	June	8	14	40	71	48	0	0	8	14	8	56
	Total 2022	825	9	7917	91	8742	30	6	471	94	501	9243

Table 3. Vaccine Brands Received at Each Dose

		1.Dose		2.Dose		3.Dose		4.Dose		5.Dose		Total
		n	%	n	%	n	%	n	%	n	%	n
Sinovac		7416	33	5778	25	1757	8	628	12	114	7	15693
Biontech		15099	67	17785	75	20127	92	4822	88	1553	93	59386
Total		22515	100	23563	100	21884	100	5450	100	1667	100	75079

DISCUSSION

COVID-19 vaccination is important to reduce mortality and stress on healthcare systems by reducing the cases of admitted patients. Vaccines are safe, efficacious and various countries have already instilled individuals with specific COVID-19 vaccines such as mRNA-based vaccines (Moderna and Pfizer/BioNTech), inactivated virus vector vaccines (Sinovac-Coronavac) and viral vector (Adenovirus) vaccines, (Astra Zeneca, Gamaleya).

The effectiveness of the Pfizer/BioNTech and Sinovac vaccine, according to the synthesized evidence from different study settings, showed 91.2% and 65.7% rates, respectively.[8] In February 2021, Colombia did mass vaccination against COVID-19 using mainly BNT162b2 and Coronavac vaccines. Caicedo et al. found COVID-19 mortality risk reduction at a 93.5% rate in vaccinated people with two doses of BNT162b and 55.7% Coronavac between 40 and 79 years of age. Their evaluation of the effectiveness of BNT162b2 was similar to previous studies showing stronger effectiveness for BioNTech/Pfizer vaccine to Coronavac vaccine.[9] The reason why the Biontech vaccine was more preferred and accepted in public can be associated with the greater number of studies of mRNA vaccines and the data obtained from scientific results.

In the analysis of Akpolat T et al., during the period from mid-January 2021 to April 2021, in which the only Sinovac vaccine was available in our country, it was observed that the ratio of the death of selected HCWs to all residents decreased after vaccination.[10]

BioNTech/Pfizer, Sinovac, and Turkovac (only in phase 3 clinical study) vaccine brands were carried out in Turkey against the COVID-19 epidemic. The government let the choice of vaccine brand to the people unless a contraindication was put by the doctor and also offered two different types of vaccine (mRNA or inactivated) as a booster dose. In this study, out of a total of 75079 vaccines administered, 60480 were Biontech (81%) vaccines, and 14599 (19%) were Sinovac. The results suggest that the Biontech vaccine was mostly preferred over the Sinovac vaccine by individuals in vaccination and reveals real data on vaccine preferences in the vaccinated people at our hospital.

A nationwide mass vaccination began in Turkey in mid-January 2021, and Sinovac was the only vaccine option until April 2021. As of June 9, 2021, Sinovac was the only COVID-19 vaccine available in our hospital. Only 8257 (%11) individuals were vaccinated in five months. When vaccination with the Biontech vaccine was added, 9566 people only received the Biontech vaccine in the first month, and so July 2021 was the month with the highest vaccination. At the beginning of July 2021, the government offered a third booster dose to HCWs and individuals >50 years who had been previously vaccinated with two doses of Sinovac.[11] For this reason, we may have seen a peak in vaccination rates in our hospital in July 2021.

In the study of Aw et al., factors associated with vaccine hesitancy were grouped into four themes that are vaccine specifics and individuals groups; contextually related factors; common vaccine-specific factors associated with increased vaccine hesitancy were beliefs that vaccines are not safe/effective; and concerns about the rapid development of COVID-19 vaccines.[12] While 1330 Sinovac vaccinations were made in May, it was observed that 10 619 individuals were vaccinated with the beginning of Biontech vaccination in our hospital in June, and 9 566 (%90) of them were Biontech vaccines. Similar to our study, Uzun et al. pointed most people (>90%) preferred Biontech as their third dose in Turkey[11]. High vaccination rates after May show that vaccine hesitancy decreased with the start of vaccination with Biontech vaccines.

Vaccine brands are highly associated with vaccine hesitancy of individuals in this study.

Although the only Sinovac vaccine was administered in the first five months of vaccination, the rate of vaccination with Sinovac among the public remained at 17% at the end of the first year, while the rate of vaccination with Biontech was 83%. While the nationwide mass vaccination set in Turkey, there were only 85 (%5) individuals were vaccinated with Sinovac, although 1542 (%95) HCWs were vaccinated in the vaccine unit of our hospital in the first month (Table 2). In June, when the first dose of the Biontech vaccine started to be administered, 90% (n=9544) of the public were vaccinated with Biontech, while 10% (n=1048) were vaccinated with Sinovac. In this study, statistical data obtained showed the high confidence of individuals in the Biontech vaccine compared to the Sinovac vaccine.

On April 4, travel restrictions were imposed on 30 metropolitan cities and Zonguldak. As of 2021 September 6, a negative PCR test result is required from non-vaccinated or unvaccinated persons for concerts, cinemas, theaters, and intercity travels by plane, bus, train, or other public transportation vehicles in our country. It was observed that the vaccination rate was 6.82% in September, and there was no parallelism when a negative PCR or vaccination requirement was sought in travels. Individuals were mostly vaccinated in July, December, and June 2021. Also, a low number of monthly cases across the country can be considered an indicator of the effectiveness of vaccination in the months when vaccination rates are highest in our center. This study is the first one that compares a vaccination center's vaccination rates with the number of cases in our country.

The vaccination program in Turkey began with the Sinovac vaccine, two doses of 3 mcg, 28 days apart. Since the HCWs struggled with the epidemic face to face, they were vaccinated only with the Sinovac vaccine during the first five months. More than one million HCWs received their first dose within one week in mid-January. HCWs got their second shots in mid-February.

In this hospital, where 1625 HCWs are employed, the highest vaccination rates among healthcare professionals occurred in the first months of vaccination, February (n= 673) and January (n=1542) 2021, respectively. Of the 8 257 Sinovac vaccines administered in the first five months, 3377 (%41) were administered to HCWs and 4 880 (%59) to the public. The number of vaccines administered to the HCW was approximately four times the number of employees (n=6324) of our hospital, with 1625 healthcare professional workers. Notably, the vaccination rate in the second year declined more than ten times. Considering the vaccines preferred by healthcare professionals, it was seen that the Sinovac vaccine was received at a rate of one or zero percent after May 2021 for each month (Table 2).

Table 2 shows that there is a hesitation in the public against the Sinovac vaccine, with low vaccination rates, and with the start of Biontech vaccination in June, 90% of people were vaccinated with the Biontech vaccine. It was observed that the Sinovac vaccine was accepted in HCWs at the beginning of the vaccination in January and February 2021. The three months which has the highest vaccination rate among healthcare professionals were February (n=1673), January (n=1542), and July 2021 (n=1099), respectively. The vast majority of HCWs did two-dose primary vaccination schedules with the Sinovac vaccine in January and February 2021, though they mostly (n=1099) had their booster dose with the Biontech vaccine in July, which means they proactively adopted heterologous vaccination schedules.

Randomized controlled trials almost solely evaluated homologous schedules [13,14,15], and a few vaccine effectiveness data came out for heterologous booster schedules.[16,17]

Chiang Mai University team conducted a test-negative case-control study to assess the vaccine effectiveness of heterologous third (ChAdOx1 and BNT162b2) and fourth (ChAdOx1, BNT162b2 and mRNA-1273) dose schedules against SARS-CoV-2 infection during delta-predominant and omicron-predominant periods even used over 95% of priming schedules with inactivated vaccines.

They suggested heterologous boosting schedules have the potential to provide very high levels of protection across a diverse range of variants, including Omicron.[13] In this study, vaccination schedules started with the Sinovac vaccine and declined in booster doses. Table 3 shows that the number of individuals who received the first dose of the Sinovac vaccine decreased with repeated doses. On the contrary, the number of those vaccinated with Biontech gradually increased in the first three doses of vaccination schedules. This made us think that individuals vaccinated with the Sinovac vaccine had booster vaccine doses with Biontech and mostly preferred heterologous vaccination by their own requests.

In the twitter-based study of Ying You et al., the USA was the country with the highest vaccination rate (with 56.4%), and BioNTech/Pfizer was the most preferred vaccine brand reported globally.[18] Similarly, in this study, after BioNTech/Pfizer was added to the vaccination schedule, BioNTech/Pfizer vaccination rates were higher than Sinovac vaccinations per month (Figure 1). When we examine the primary two doses of vaccines and booster shots, the number of those vaccinated with BioNTech/Pfizer remained far ahead of those vaccinated with Sinovac in vaccination per each vaccine dose (Figure 3).

CONCLUSION

As a result, it was thought that the higher number of Biontech vaccination compared to Sinovac vaccination against COVID-19 might have a role in the real-life data that emerged due to the fact that it is the most preferred vaccine brand in the world.

Conflict of Interest:

No conflict of interest was declared by the authors.

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