Original Research

Comparison Of Four Types Of Vaccines Sinopharm, Astrazeneca, Sputnik V, And Covaxin In Terms Of Morbidity And Severity Of Covid-19 In Vaccinated Personnel

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Abstract:

Background: The main purpose of the present study was to compare four vaccines: Sinopharm, AstraZeneca, Sputnik V, and Covaxin, in terms of morbidity and severity of COVID-19 after vaccination in healthcare workers working in selected medical centers in Tehran, Iran.

Materials and Methods: This descriptive-analytical cross-sectional study was conducted among 1474 students, staff of a medical university, and seven selected hospitals in Tehran for two months between June to August 2021; Data were collected by a questionnaire, Participants had received one or two doses of mentioned vaccines and at least twenty days had passed since they received their first dose of the vaccine. Incomplete questionnaires were excluded from statistical analysis.

Results: 35.9% (n=531) of participants had a history of COVID-19 before vaccination. There was no significant relationship between the history of the previous infection with COVID-19 before vaccination and the occurrence of COVID-19 after vaccination in any of the vaccines. For all four vaccines, the occurrence of the disease after receiving the second dose was less than 10% (Sinopharm 3.1%, AstraZeneca 6.4%, Sputnik V 6.4%, Covaxin 6.8%),. There was a statistically significant difference among all vaccines mentioned above in terms of COVID-19 infection after receiving the second dose ($p = 0.042$) for all four vaccines. The severe form of the disease, which requires referral to medical centers, was less than 10% among patients with the disease after vaccination. There was no significant difference between the vaccines regarding disease severity in patients.

Conclusion: The severity of COVID-19 was not significantly different in the infected patients after the first or second dose. Also, the previous infection with COVID-19 before vaccination was not associated with the occurrence of COVID-19 after vaccination in any of the four vaccines. To sum up, this finding can be applied by policymakers to have a better vision.

Keywords: Vaccination, COVID-19, Severity, Morbidity, Immunity

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Introduction

Today, COVID-19 is the main culprit of millions of deaths(1) and major economic and social disruptions worldwide (2, 3). As of September 14, 2021, the number of reported cases worldwide was close to 224 million, and the number of virus-related deaths was close to 4.6 million (4). Hence, recommended measures to minimize the prevalence of the disease further include quarantine and social distance, vaccination, and injection of antibodies from the recovered patients to the infected counterparts(5).

Luckily, several vaccines have been developed that significantly alter the occurrence and mortality of COVID-19(6). The most important and conventional ones are viral-vector vaccines such as AstraZeneca and Sputnik V, mRNA-based vaccines such as the Pfizer-BioNTech and Modern vaccines, and inactivated virus vaccines such as the Covaxin and Sinopharm vaccines. These vaccines appear to be effective against coronavirus infection (7).

Voysey et al. (2021) carried out their studies in the United Kingdom, Brazil, and South Africa. They concluded that the occurrence of COVID-19 was significantly reduced after receiving two doses of the AstraZeneca vaccine (8). Similarly, another study in Argentina found that a single dose of the Sputnik V vaccine was effective in diminishing the occurrence, severity, and mortality of COVID-19 patients (9).

Also, Studies in Bahrain (10), Jordan(11) and Turkey(12) have also shown that vaccination with the h Sinopharm vaccine significantly minimizes the occurrence of COVID-19 infection. However, what is ambiguous is the lack of information on the extent and severity of the disease after receiving the available vaccines.

The present study aimed to compare Sinopharm, AstraZeneca, Sputnik V, and Covaxin vaccines in terms of frequency and severity of COVID-19 after vaccination in healthcare workers in medical centers in Tehran Iran.

Methods and material

Sample size determination

This cross-sectional study was performed on 1474 students, staff, and employees of the university and medical centers of seven selected hospitals in Tehran who enrolled in the study for two months between June and August 2021 and were all vaccinated (91.7%) with two doses, 8.3% one dose) with one of four vaccines: Sputnik V, Covaxin, AstraZeneca, and Sinopharm.

Procedure: having coordinated with the officials of these centers, the researcher administered the questionnaires to the students, staff and university professors, and employees of the selected medical centers. The study sample included students or staff working in university centers and seven medical centers in Tehran which had received one or two doses of one of the four types of vaccine and at least twenty days had passed since they received their first dose of the vaccine. Before administering the questionnaire, the study's objectives were thoroughly explained to the participants; it was ensured that all information would remain confidential. Afterward, participants signed an informed and written consent form followed by the questionnaire administration. (Ethics code: IR.AJAUMS.REC.1400.163.)

Measures

It should be noted that all statistical populations were regarded as the study sample. Additionally, data were collected by a researcher-made questionnaire. The related questions encompassed demographic information such as age, sex, height, weight, and marital status, as well as questions about underlying conditions such as hypertension, hyperthyroidism or hypothyroidism, kidney, heart, lung, and skin diseases, and diabetes. Also, previous history of Covid-19 before

Table 1. Demographic information of the respondents (n=1474)

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Variables	Sputnik Number (%)	Bharat Number (%)	AstraZeneca Number (%)	Sinopharm Number (%)
Gender				
Male	132 (61.68)	27(44.26)	193(62.45)	688(77.30)
Female	82 (38.31)	34(55.37)	116(37.54)	202(22.69)
Marital status				
Single	80(37.38)	20(32.78)	128(41.42)	802(90.11)
Married	134(62.61)	41(67.21)	181(58.57)	88(9.88)
Vaccine doses received				
One dose	22(10.28)	1(1.63)	85(27.50)	15(1.68)
Two doses	192(89.71)	60(98.36)	224(72.49)	875(98.31)
History of flu vaccine allergy	12(5.60)	3(4.91)	6(1.94)	7(0.78)
History of COVID-19 infection	95(44.39)	18(29.50)	106(34.30)	311(34.94)
COVID-19 infection period				
No COVID-19 infection	119(55.60)	43(70.49)	204(66.01)	561(63.03)
One month before vaccination	9(4.20)	0(0)	5(1.61)	12(1.34)
Two months before vaccination	14(6.54)	1(1.63)	13(4.20)	71(7.97)
Four months before vaccination	29(13.55)	7(11.47)	33(10.67)	90(10.11)
More than six months before vaccination	43(20.09)	10(16.39)	54(17.47)	156(17.52)
Age				
Less than 20 years	16(7.47)	0(0)	1(0.5)	140(15.73)
20-29 years	64(29.90)	24(39.34)	122(39.48)	673(75.39)
30-39 years	76(35.51)	21(34.42)	82(26.53)	39(4.38)
40-49 years	44(20.56)	7(11.47)	86(27.83)	27(3.14)
50-59 years	12(5.60)	9(14.75)	13(4.20)	10(1.23)
Greater than 60 years	2(0.93)	0(0)	5(1.6)	1(0.11)
BMI				
Thin	8(3.73)	2(3.27)	8(2.58)	35(4.04)
Normal	110(51.40)	41(67.21)	170(54.69)	665(74.60)
Overweight	79(36.91)	16(26.22)	91(29.77)	164(18.42)
Fat	17(7.94)	2(3.27)	40(13)	26(3)

Table 2. Comparison between Different vaccines in terms of COVID-19 severity after vaccination

	Sputnik V		Covaxin		AstraZeneca		Sinopharm		Total	
	First dose	Second dose	First dose	Second dose	First dose	Second dose	First dose	Second dose		
Mild infection	2 (50%)	8 (66.7%)	1 (100%)	2 (50%)	8 (66.7%)	8 (57.1%)	5 (50%)	15 (55.6%)	49 (58.3%)	P=0.957
Moderate infection	2 (50%)	4 (33.3%)	0 (0%)	2 (50%)	4 (33.3%)	4 (28.6%)	3 (30%)	11 (40.7%)	30 (35.7%)	
Severe infection	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (14.3%)	2 (20%)	1 (3.7%)	5 (6%)	
No infection	198 (92.5%)		56 (91.8%)		283 (91.6%)		853 (95.8%)		84 (100%)	
	P=0.489		P=0.600		P=0.685		P=0.319			

vaccination, the time elapsed since the last COVID-19 infection, type of vaccine received, number of doses of vaccine received, COVID-19 infection after the first or second dose, as well as the interval between vaccination and the disease, and the severity of the infection was taken into account.

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Table 3. Comparison of post-vaccination morbidity in participants who were vaccinated with two doses of Covaxin, Sputnik V, AstraZeneca, and Sinopharm vaccines

	Sputnik V	Covaxin	AstraZeneca	Sinopharm	Total
	Number (%)				
Positive post-vaccination COVID-19	12 (6.38%)	4 (6.77%)	14 (6.42%)	27 (3.12%)	57 (4.28%)
Negative post-vaccination COVID-19	176(93.61%)	55 (93.22%)	204 (93.57%)	838 (96.87%)	1273 (95.71%)
Total	188 (100%)	59 (100%)	218 (100%)	865 (100%)	1330 (100%)
	P=0.042				

The severity of COVID-19 in this study was characterized by those who needed hospitalization and special care in the intensive care unit thanks to COVID-19 after vaccination (severe form), people who needed quarantine and received prescription drugs at home (moderate form), and people with mild symptoms or people who were asymptomatic and found out about their disease via PCR (mild form).

Analytic approach

The questions were prepared based on previous and valid documents from WHO, CDC, and articles published from 2019 to 2021. Afterward, ten faculty members and clinical specialists in infectious diseases validated this research tool, and necessary corrections were made based on their recommendations accordingly. To ensure the validity of the designed questionnaire, questions were evaluated and confirmed with Content Validity Index. Also, using Cronbach's alpha coefficient, the internal consistency of the questions was calculated and validated as acceptable (α=0.86).

It should be noted that central and dispersion indices such as mean and standard deviation were used for descriptive analysis. Also, the Chi-squared test and Fisher Exact test were used with significance levels less than 0.05. After completing and collecting all the questionnaires, the data were analyzed using SPSS 16.0.

Results

Demographic characteristics

The findings showed that the mean age of the subjects was 26.1 ± 9. The number of people over 50 in this study was 42 (2.84%). Also, 530 (36%) people reported a previous history of COVID-19 before vaccination, of whom 275 (51.88%) experienced COVID-19 in the past six months. In addition, less than 10% of the subjects reported an underlying disease. Meanwhile, participants' mean BMI was 23.5 ± 3.4, 1024 (69.47%) had normal BMI, and 399 (27.06%) were overweight or obese. Besides, 890 (60.37%), 309 (20.96%), 214 (14.51%) and 61 patients (4.13%) had received Sinopharm, AstraZeneca, Sputnik V and Covaxin vaccines, respectively. It should be stated that only 8.3% had received one dose of vaccines (Table 1).

Prevalence of COVID-19

In this study, we examined the prevalence of COVID-19 among the study sample who had been vaccinated with one of four types of

Table 4. The odds ratio of vaccines AstraZeneca, Sputnik V, and Covaxin in

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morbidity of COVID-19 after vaccination compared to Sinopharm vaccine

Vaccine type	B	OR	95% CI for OR		P-value
			Lower	Upper	
Sputnik	1.20	3.33	1.14	9.67	0.027
Covaxin	2.06	7.89	2.18	28.59	0.002
AstraZeneca	1.82	6.21	2.72	14.15	<0.001

mentioned vaccines and found out that 95.84% of those immunized with Sinopharm, 92.52% of whom were vaccinated with Sputnik V vaccine, and 91.80% of those immunized with Covaxin vaccine and Also 91.58% of those vaccinated with AstraZeneca vaccine did not develop COVID-19 (Table 2). Reportedly, People with COVID-19, on average, developed the disease 27 days after receiving the second dose (Table 2).

Form of infection

Furthermore, it was found that among the people infected with COVID-19 after vaccination, 6% developed severe COVID-19, and the severity of the disease was such that it required hospitalization and intensive care. Also, 35.71% of participants exhibited a moderate form of the disease. The severity of the disease was such that they recovered only with medication and quarantine at home. However, 58.33% presented a mild form, with mild or insignificant symptoms which were only confirmed via PCR.

None of the Sputnik V or Covaxin vaccine recipients experienced a severe form of COVID-19. The prevalence of a severe form of COVID-19 after receiving AstraZeneca and Sinopharm vaccines were 7.6% and 8.1%, respectively. It should be noted that none of the vaccines revealed a significant difference between the severity of COVID-19 in patients who became infected after the first dose and the second dose. Additionally, no significant difference was noticed in the vaccines in terms of disease severity among patients (p=0.957) (Table 2).

Comparison

The prevalence of COVID-19 among those who received two doses of their vaccine and did not develop COVID-19 after the first dose was ranked as: 3.19% for the Sinopharm vaccine, 6.4% for the AstraZeneca and Sputnik V vaccines, and 6.8% for the Covaxin vaccine. There was also a significant difference among the vaccines (p=0.042) (Table 3).

Table 5. Comparison of post-vaccination morbidity according to the history of COVID-19 infection before vaccination

	Sputnik V		Covaxin		AstraZeneca		Sinopharm	
	Previous COVID-19 infection status							
	Yes	No	Yes	No	Yes	No	Yes	No
Positive post-vaccination COVID-19	7 (7.36%)	10 (8.40%)	0 (0%)	5 (11.62%)	12 (11.32%)	14 (6.89%)	15 (4.82%)	22 (3.79%)
Negative post-vaccination COVID-19	88 (92.63%)	109 (91.59%)	18 (100%)	38 (88.37%)	94 (88.67%)	189 (93.10%)	296 (95.17%)	557 (96.20%)
Total	95 (100%)	119 (100%)	18 (100%)	43 (100%)	106 (100%)	203 (100%)	311 (100%)	579 (100%)
P-Value	P=0.781		P=0.309		P=0.309		P=0.466	

Also, we examined the vaccines in terms of

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COVID-19 infection in pairs. We found a significant difference between Sinopharm and AstraZeneca (p=0.023), Sinopharm, and Sputnik V vaccines (p=0.03). There was no significant difference between Sinopharm and Covaxin vaccines (p=0.013), and also, there was no significant difference between other vaccines.

Logistic regression model

We conducted a logistic regression model to compare four types of COVID-19 vaccines after adjusting the effect of other variables. The model included age, gender, marital status, BMI, past medical history, time of COVID-19 infection prior to vaccination, and vaccine type. Sinopharm vaccine, which had the lowest morbidity of COVID-19 after vaccination in the univariate analysis, was selected as the reference group. None of the variables entered in the model except vaccine type had a significant relationship with morbidity of COVID-19 after vaccination. Table 4 shows the odds ratio of vaccines AstraZeneca, Sputnik V, and Covaxin in morbidity of COVID-19 after vaccination compared to Sinopharm (Table 4).

Previous history of COVID-19

Does a previous history of COVID-19 prior to vaccination affect a person's occurrence of COVID-19 after receiving the vaccine? To answer this question, we assigned people who had a history of COVID-19 before vaccination to a specific group and compared them with those who did not have a history of the disease before receiving the vaccine. The findings suggested no significant relationship between the history of previous COVID-19 before vaccination and COVID-19 after vaccination in none of the vaccines (Table 5).

Discussion

We compared four vaccines, Sinopharm, AstraZeneca, Sputnik V, and Covaxin, in terms of morbidity and severity of COVID-19 after vaccination. We found out 93.2%, 93.6%,93.6,% and 96.9% of the samples did not develop COVID-19 after receiving the second dose of Covaxin, Sputnik V, and AstraZeneca and Sinopharm vaccines, respectively. This is in line with the results of previous studies in which receiving Covaxin (13), Sputnik V(9), AstraZeneca(14) and Sinopharm(15) vaccines reduced the occurrence of hospitalization and resulted in mortality from COVID-19.

Besides, there was a significant difference among the vaccines in terms of the frequency of COVID-19 after receiving the second dose of the vaccine (p=0.042). We did not notice any severe form of the COVID-19 after Sputnik V and Covaxin vaccination; however, a few cases of a severe form of the disease were reported after AstraZeneca and Sinopharm vaccination, which was not possible to analyze statistically due to their small number.

After receiving the vaccine, there was no significant difference among the vaccines in the terms of severity (mild, moderate, and severe) of the disease in patients. There was no significant difference between the severity of the disease in people who developed COVID-19 after the first or second dose; none of the vaccines showed a significant association between a history of previous COVID-19 prior to vaccination and COVID-19 occurrence after receiving a second dose of the vaccine, as well. This result could confirm the results of Cavanaugh et al.`s study, which concluded that vaccinating people with a history of COVID-19 dramatically reduces the risk of disease, and not vaccinating is associated with a higher risk re-infection (16). It also confirms Stamatatos et al. findings which indicated that sera collected from people infected with COVID-19 before vaccination represented fewer and weaker antibodies than those vaccinated. In some cases, antibodies and immunity were not present despite their previous disease. Nevertheless, they exhibited significantly higher levels of antibodies and better immunity after vaccination (17).

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Limitations in this study include the lack of racial and ethnic diversity, lower participation rate of older adults, and lack of research on other vaccines, such as mRNA-based vaccines. Meanwhile, a small number of injections of the Covaxin vaccine makes it difficult to draw a comprehensive conclusion about it.

In a recent study, it was concluded that the BBIBP-CorV (Sinopharm) vaccine was safe and well-tolerated in participants aged 3–17 years, and it elicited great immunity against SARS-CoV-2 infection after two shots (18).

One of the strengths of the present study is the statistical population relative to the high and realistic population compared to clinical and laboratory trials, the availability of sufficient and accurate information about the participants, and the very limited missing data. Also, participants' information was collected accurately through a comprehensive questionnaire. To summarize, given the prevalence of delta strains of the virus and the potential ineffectiveness of vaccines in protecting against different variants even after two doses, it is now time to do more research on the third dose or booster shot which is beneficial for public health policy (19,20). In this study, we were not able to assess the duration of vaccine protection against the disease. Therefore, further evidence and studies are needed to determine the duration of protection and the need for vaccine booster doses. In a recent study, COVID-19 vaccines (AstraZeneca and Pfizer–BioNTech and Moderna-mRNA-1273 Janssen-Ad26) efficacy or effectiveness was evaluated and the immunity did decrease by six months after full vaccination. (21) This decrease is likely to be caused by waning immunity, which is concerning among the health care systems worldwide. More extensive investigations are needed to learn more about it.

Conclusion

According to the findings, the disease occurrence after receiving the vaccine was less than ten percent. There was a statistically significant difference among all vaccines mentioned above in terms of COVID-19 infection after receiving the second dose (p=0.042). There was a significant difference between Sinopharm and AstraZeneca vaccines (p=0.023), and Sinopharm and Sputnik V vaccines (p=0.03). There was also no significant difference between the vaccines regarding disease severity among patients with COVID-19 after receiving the vaccine. Also, there was no significant difference among the severity degrees of the disease (mild, moderate, and severe) in infected people after receiving the first or second dose of the vaccines.

This study showed that there is no significant relationship between the history of the previous infection with COVID-19 before vaccination and COVID-19 infection after receiving the second dose of vaccines in none of the vaccines.

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Authors' Contributions

The authors thank IN, and AA designed the study and concept. FK, AA, and MN contributed to data acquisition and the creation of data resources. FKZ and AA checked and verified the dataset and prepared it for analysis. FKZ did the statistical analysis with support from FK, MN, AA, MF, and MS.

FK, AA, FKZ, MN, and MF, MS wrote the manuscript. FK, MN, and FKZ reviewed and edited the manuscript. IN and FK supervised the work. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication. the manuscript has been read and approved by all

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the authors, the requirements for authorship as stated earlier in this document have been met, and each author believes that the manuscript represents honest work

Ethics approval

This study was reviewed and granted approval by the ethics committee of Aja University of Medical Sciences based on the ethics code IR.AJAUMS.REC.1400.163. Also, the principles of the Helsinki Convention were fully observed

Conflict of interests

None declared

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Tables

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