

Covid-19 infection in vaccinated individuals and its predictors in Karbala /Iraq

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Abstract

Background: Coronavirus disease 2019 (COVID-19) is a serious disease that has resulted in morbidity and mortality all over the world.

Objectives; This study aimed to assess clinical characteristics, severity and risk factors of breakthrough SARS-CoV-2 infection among vaccinated individuals in Karbala.

Methods: A cross sectional study was conducted for three-months starting from March to May 2023 among 419 patients with SARS-CoV-2 infection who had vaccinated before the episode of the infection. Confirmed diagnosis was obtained from the database of the hospitals, PHCCs and private clinics. -Collection of the various epidemiological and clinical data through direct interview or via telephonic call interviews with the patients using a structured validated questionnaire. SPSS was used for data statistical analysis, p-value less than 0.05 was considered statistically significant.

Results: Among total 419 persons, two thirds were living in urban areas. The mean age was 35.5 ± 15.83 years, about 45% of them were in the age category of (25-50 years), nearly no sex difference, most of them were not smoker. majority of the sample received the primary series of the vaccine and only 12.4% took the booster dose. post vaccination infection was more among people in urban area than rural. Most of the sample received Pfizer vaccine and 4.8% mixed types of vaccine. post vaccination illness was mild in most patients. On applying binary logistic regression analysis. Adherence to preventive measures, Post vaccination time more than 6 months, Prior infection and vaccination status were the sole factors significantly associated with increased odds of breakthrough severe acute respiratory syndrome coronavirus.

Keywords: Vaccine; Coronavirus; Telephonic call interviews; Booster dose

1. Introduction

Coronavirus disease 2019 (COVID-19) is a serious disease that has resulted in morbidity and mortality all over the world, is characterized mainly by fever and cough and the disease can progress to severe symptoms resulting in unprecedented burden on public health services and causing more than four million deaths,[1]

It was found firstly in China in 2019 and then became pandemic in the next year. To prevent and interrupt outbreaks of the disease many countries started a vaccination programme against SARS-CoV-2 at the end of 2020. [2] Breakthrough was occurred due to failure of the vaccine to provide complete immunity against SARS-CoV-2, some individuals who were vaccinated infected with COVID-19 in USA and other countries. The breakthrough phenomenon was reported with many other vaccines.[3,4, 5] Regarding underlying causes and characteristics of SARS-CoV-2 infections, the vaccination and prior infection did not prevent infection specially in the patients who had immunosuppressed diseases, may be due to the decrease of their capacity to produce antibodies. Vaccination status of the individuals, type of the vaccine, time after taking the vaccine, duration of immunity after taking full vaccination, all

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these factors play important role in prevention of newly SARS- cov-2 infection .[6,7,8] IgG antibodies in individuals with SARS-CoV-2 infection appear at the fourth day after symptom onset, and reach the peak the levels in the second and third week of the illness [9], and then an antibodies start to decline from 9 to 11 months after the infection [10]. In vaccinated individuals mRNA-1273 vaccine showed that antibodies lasting up to three to five months and then decline after the second dose. [11,12]

Immune memory which is produced from either primary infection or immunization, is the source of immunity to prevent subsequent infection. [13] and according to many studies conducted in acute and convalescent COVID-19 patients found that reduced disease is related to response of T-cell. [4] vaccinated health care workers, advanced age and having BMI more than 25 person , were considered at higher risk to get breakthrough SARS-CoV-2 infection. The patients who had immunosuppression and chronic diseases of the heart, lung , kidney, diabetes mellitus, and cancer were associated with serious outcomes of COVID-19 infection. [14,15,16.] This study aimed to assess clinical characteristics, severity and risk factors of breakthrough SARS- CoV-2 infection among vaccinated individuals.

1.1. Patients and Methods

A cross sectional study was conducted for three-months starting from March to May 2023 among 419 patients with SARS-CoV-2 infection who had vaccinated before the episode of the infection. Confirmed diagnosis was obtained from the date base of the hospitals ,PHCCs and private clinics . Collection of the various epidemiological and clinical data through direct interview or via 10-minutes telephonic call interviews with the patients using a structured validated questionnaire consisting of 2 parts. Part1 included the Socio-demographic characteristics like age, residence and occupation, history of smoking and alcohol intake and Part 2 consisted of medical history, preventive measure adherence , symptoms , Prior infection , Vaccination status and types of the vaccines, complications of the disease including (oxygen use, hospitalization and death) ,comorbidities and body mass index (BMI) using the following equation, weight in kilogram divided by the square of height in meters.

1.1.1. Sample size

An appropriate sample size was calculated according to the sample size equation. The following sample equation was applied

$$N = Z^2 \times pq / d^2$$

Where N = Sample size. Z = statistical for a level of confidence 95%. P = expected proportion. q = 1 – p. d = absolute precision. Using the proportion of 50% to achieve the maximum sample size, and d=0.05, and z=1.96, the estimated sample size will be 384 students p= 0.50, q= 1-p =0.50 , z =1.96, d=0.05 . N = 384

We will add 10% for non-response, so the sample size is = 422

1.2. Statistical analysis

Statistical Package for Social Sciences version 22 (SPSS -22) was used for data statistical analysis. The frequency data was viewed in suitable tables and figures. Statistical association was done by chi-square test of independence, and logistic regression analysis was used to identify the significant independent determinants and when p-value less than 0.05 , it was considered statistically significant.

Ethical consideration: Confidentiality the data was kept and held for research purpose in a password computer throughout the study. Written consents were obtained from all patients.

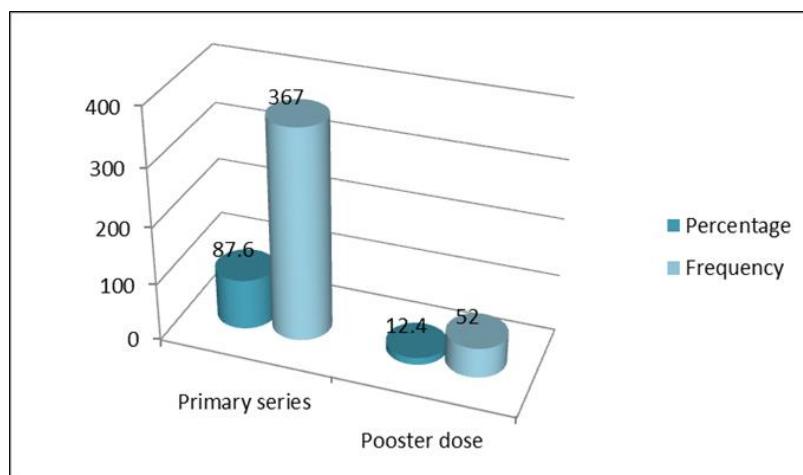
2. Results

As shown in table 1 below, this study included a total of 419 persons, providing 99% response rate, nearly no sex difference was found in the sample, about two thirds of them were living in urban areas. The mean age was 35.5 years, with standard deviation of ± 15.83 and about 45% of the clients were in the age category of (25-50 years) .About 80% Of the sample were not smoking and two of them were alcoholic.

Table 1 Distribution of the sample according to sociodemographic characteristic

Variable		Frequency (419)	Percent 100%
Gender	Male	204	51.3
	Female	215	48.7
Age groups	< 25 yrs	147	35.1
	25-50	187	44.6
	>50	85	20.3
Residence	Urban	286	68.3
	Rural	133	31.7
Occupation	jobless	39	9.3
	employed	126	30.1
	self employed	34	8.1
	student	155	37.0
	house wife	65	15.5
BMI	Normal	248	59.2
	Over	95	22.7
	Obesity	34	8.1
	Under	42	10.0
Smoking	Yes	87	20.8
	No	332	79.2
Alkohol	Yes	2	0.5
	No	417	99.5

Figure (1) revealed vaccination status of the sample in which majority of the sample received only the primary series of the vaccine and only 12.4% of them took 2nd dose of the vaccine.

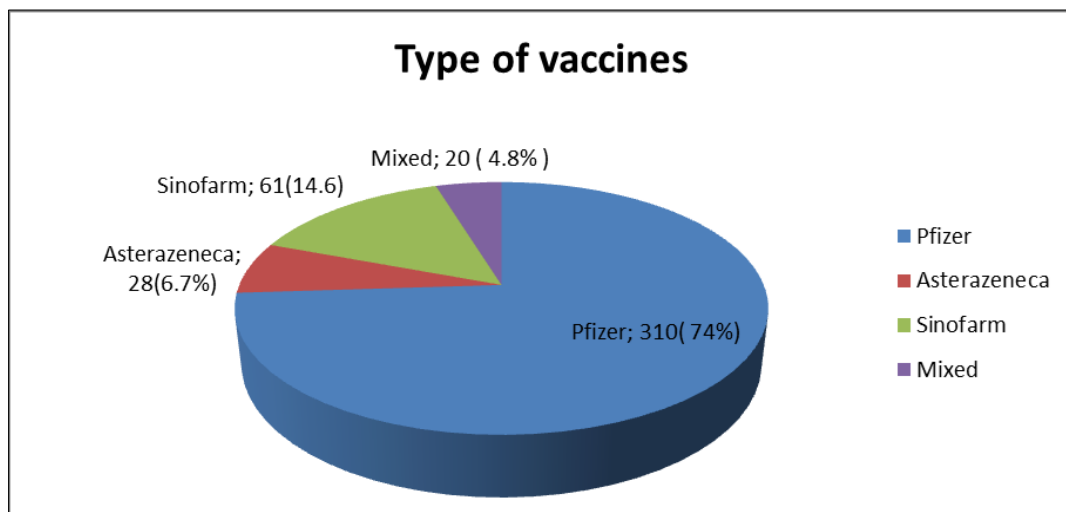
**Figure 1** Vaccination status of the sample

In table 2 there was a statistically significant association between the post vaccination infection and the residence ($P=0.049$), and about one third of those who lived in urban area had post vaccination infection in front of 25% of those who lived in rural area.

Table 2 Association between Post vaccination inf and sociodemographic characters

Variables		Post vaccination inf.				Total		P value
		-Ve No. %		+Ve No. %		No.419	%100	
Age in groups	< 25 years	108	75.5	39	26.5	147	100	0.166
	25- 50	121	64.7	66	35.3	187	100	
	>50	62	72.9	23	27.1	85	100	
Gender	Female	150	69.8	65	30.2	215	100	0.885
	Male	141	69.1	63	30.9	204	100	
Residence	Urban	190	66.4	96	33.6	286	100	0.049
	Rural	101	75.9	32	24.1	133	100	
Occupation	Jobless	26	66.7	13	33.3	39	100	0.55
	Employed	79	62.7	47	37.3	126	100	
	Self employed	28	82.4	6	17.6	34	100	
	Student	109	70.3	46	29.7	155	100	
	House wife	49	75.4	16	24.6	65	100	
Smoking	No	234	70.5	98	29.5	332	100	0.347
	Yes	57	65.5	30	34.5	87	100	
BMI	Under	31	73.8	11	26.2	42	100	0.289
	Normal	169	68.1	79	31.9	248	100	
	Over weight	63	66.3	32	33.7	95	100	
	Obese	28	82.4	6	17.6	34	100	

In figure 2 about three quarters of the sample received Pfizer vaccine and 4.8% received other type of vaccine as a booster dose (mainly Pfizer).

**Figure 2** Distribution of the sample according to the type of vaccines in Iraq.

In figure 3 the illness was mild in most patients and only 6 patient admitted to the respiratory care unit.

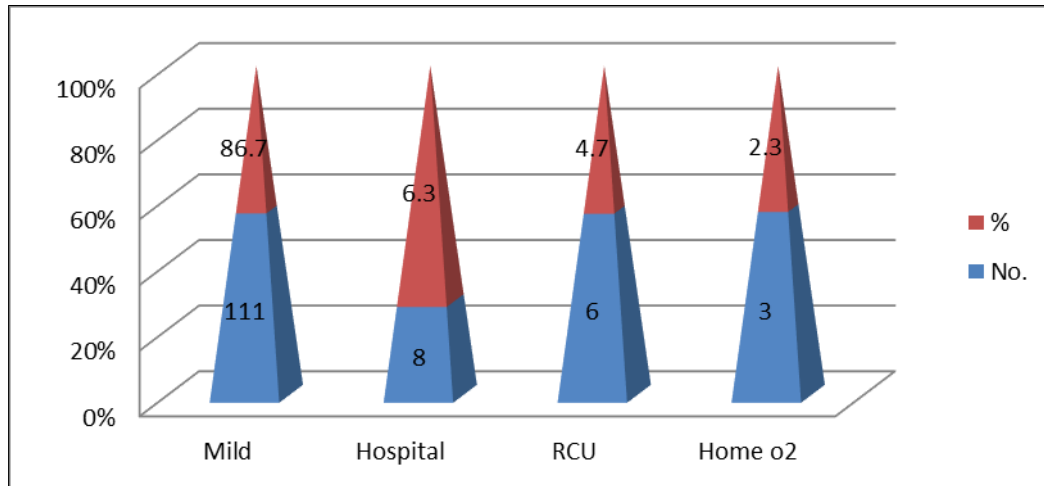


Figure 3 Distribution of the sample according to the type of vaccines

table 3 revealed the post vaccination infection was more among participants who had prior infection, no or sometimes adherent to preventive measure , after 5months of getting vaccines and among those who received only primary series of vaccines , the association was significant (p value ≤ 0.05).

Table 3 Association between Post vaccination infection with Adherence to preventive measures, vaccination characteristics and comorbidity

Variables		Post vaccination inf.				Total		P value
		-Ve No.	%	+Ve No.	%	No.	%	
Adherence to preventive measures	No or Some times	203	69.8	102	79.7	305	72.8	0.035
	Always	88	30.2	26	20.3	114	27.2	
Prior infection	No	106	62.4	64	37.6	170	100	0.009
	Yes	185	74.3	64	25.7	249	100	
Vaccination status	Primary series	248	67.4	120	32.6	368	100	0.014
	booster dose	43	84.3	8	15.7	51	100	
Type of the vaccine	Pfizer	217	70	93	30	310	100	0.722
	AstraZeneca	21	75	7	25	28	100	
	Sinofarm	39	63.9	22	36.1	61	100	
	Mixed	14	70	6	30	20	100	
Post vaccination time	4 or less months	14	53.8	12	46.2	26	100	0.000
	5-12 months	18	18.6	79	81.4	97	100	
	>12 months	259	87.5	37	12.5	296	100	
Comorbid illness	No	180	68.7	82	31.3	262	100	0.667
	Yes	111	70.7	46	29.3	157	100	
Total		291	69.5	128	30.5	419	100	

Table 4 revealed that although the infection was more in those with sever previous infection, need o₂ at home or admitted to the respiratory care unit than those without prior sign and symptoms but the association was not significant (P = 0.381).

Table 4 Association between post vaccination infection and clinical features of Prior infection

Variables		Post vaccination inf.				Total		P value
		-Ve No. %		+Ve No. %		No.	%	
Clinical features of Prior infection	No prior infection	115	74.2	40	25.8	155	100	0.381
	Home o ₂	11	64.7	6	35.3	17	100	
	Mild	89	70.1	38	29.9	127	100	
	Severe	69	62.7	41	37.3	117	100	
	R.C.U.	7	63.6	4	36.4	11	100	
Total		291	69.5	128	30.5	419	100	

On applying binary logistic regression analysis, , Poor adherence to preventive measures , post vaccination time more than 6 months, Prior infection and vaccination status were the major factors significantly associated with increased probability of reinfections after vaccination ($p \leq 0.05$)

Table 5 Logistic regression analysis (OR with 95% CI) for factors related to Breakthrough SARS-CoV-2 infections

Variables	P	OR	95% CI	
			Lower	Upper
Residence	.161	.708	.437	1.148
Adherence to preventive measures	.006	.691	.530	.901
Vaccination status	.013	2.171	1.176	4.011
Post vaccination time	.005	.538	.349	.830
Prior infection	.009	.558	.359	.866

3. Discussion

All over the world reinfection of COVID-19 have been occurred in vaccinated individuals [4] In the current study among all the participants about 30.5% of them had post vaccination infection. The infection was more in those lived in urban areas, other study in Egypt, infection was more in urban areas with no significant differences.[17] It was not in agreement with another study which found the infection was more in the rural area.[18] The variation may be due to the overcrowding in the urban area, while the cause in the rural area was that the increased number of individuals who were not fully vaccinated. Because the illness was mild in most patients, particularly in fully vaccinated individuals , the patients were rarely required admission to the hospital, same finding was found in other studies.[19,20] There is no significant association between breakthrough COVID19 infections after vaccinations and presence of comorbidities such as chronic lung and renal diseases, diabetes mellitus and immunocompromising conditions, inconsistent with other studies found that higher risk of severe infection which may need hospitalization in people with any of these comorbidities.[12,22,23] Breakthrough covid-19 infections occur among all ages and both sexes without significant difference , same results was found in other study [24] and differ from other study found that younger age, male and young age had higher risk to develop breakthrough covid-19 infections. [25,26] There is no significant difference in the occurrence of the breakthrough in obese versus normal BMI individuals , while other study concluded that individuals with grade III obesity had more chance to get breakthrough could be due to immune dysfunction associated with obesity.[27] Poor adherence to preventive measures associated with increased risk to develop COVID-19 vaccine breakthrough , although in some patients with high adherence to preventive had severe cases of the infection. Same finding was reported in other study.[28] Risk for reinfection of the vaccinated persons is remain possible particularly among people who had poor adherence to preventive measures.[28] In the current study the post vaccination infection

occurred nearly 4 months after vaccination, other studies mentioned that anti-SARS-CoV-2 antibodies, persisted three to five months following the primary infection. [8 , 9] However, studies about the duration of the immunity against SARS-CoV-2 induced by the vaccine are scarce[10]. Regarding the vaccine status of the patients and its association with reinfection covid-19 , the breakthrough infection was less in those individual received booster dose of the vaccine and other studies found sever COVID-19 illness was more in patient who received only one dose of the vaccine and they were more likely to have subsequent admission to the hospital compared with fully vaccinated individuals.[29,30] Other studies showed after a third dose of the vaccine a significant increase in both IgG antibody levels and cellular immunity, which is in line with results of the current study.[31,32] No significant association between Type of the vaccine and the post-vaccination COVID-19 infection .Other study found that vaccination with inactivated whole virus vaccine (Sinopharm), and not obtaining a booster dose were all linked with an elevated risk of COVID-19 breakthrough infection.[26] the variation in the results of the current study because of that about two thirds of individuals were received Pfizer vaccine.

4. Conclusion

- Prevalence of breakthrough infection 30.5%
- Post vaccination occurred nearly 4 months after vaccination.
- The post-vaccination COVID-19 infection in fully vaccinated individuals was mild and usually not required admission to the hospital or the intensive care unit (ICU).
- There was a significant association between adherence to preventive measures and breakthrough COVID19 infection.

Recommendations

- The importance of maintaining preventive measures for all people including vaccinated individuals.
- More studies are required with larger sample size and longer duration to assess the efficacy of this vaccine.

Compliance with ethical standards

Statement of ethical approval

Confidentiality the data was kept and held for research purpose in a password computer throughout the study.

Statement of informed consent

Written consents were obtained from all patients.

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