Estimating the Effectiveness of Pfizer and Sinopharm Vaccines and their Relationship to Occupation, Residence, Smoking, and Body Mass Index during Pregnancy Smoking

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Abstract

Severe acute respiratory syndrome coronavirus *2* (*SARS-CoV-2*) caused a rapid global demand for the development of several vaccines by the scientific community. Vaccination contributes to preventing infection associated with symptoms and reduces the risk of infection by stimulating the immune system to produce antibodies. This study aimed to determine the effectiveness of Pfizer and Sinopharm vaccines and their relationship to occupation, residence, pregnancy, mass index, and smoking. This study was conducted in Diyala Province, Iraq, for the period from April 2022 to May 2023. A total of 266 blood samples were collected. Written consent was obtained by the Research Ethics Committee in the Diyala Health Department (DHD/No-39072/Date-31/8/2022). The researchers collected the data using a specific questionnaire they created after conducting a brief interview with the participants. The ELISA technique was used to detect IgG titers. The rate of positivity for IgG antibodies among study participants vaccinated in Diyala province was 53.8%, and the Mean±SD for those vaccinated with the Pfizer vaccine was higher compared to the Mean±SD for those vaccinated with the Sinopharm vaccine, and the statistical difference was significant. Despite the higher antibody titer among participants residing in Khanaqin compared to those from other locations, the current results indicate no significant differences in antibody titer based on the participants' place of residence (P = 0.474). The study revealed no statistically significant influence of mass weight, blood groups, and rhesus factor on antibody titres. As for smoking, the study participants who smoked had a lower titer compared with non-smokers, with a statistically significant difference (P = 0025). The study concluded that the overall protective rate of SARS-CoV-2 vaccines among participants in Diyala Governorate after twelve to seventeen

months of vaccination was good, and that the Pfizer mRNA vaccine had a better outcome compared to the inactivated Sinopharm vaccine.

Keywords: Pfizer vaccine, Sinopharm vaccine, SARS-CoV-2, COVID-19.

1. Introduction

SARS-CoV-2 is the cause of COVID-19, a new worldwide infectious disease (1). It is a member of the Coronaviridae family within the Nidovirales order. The virus, known as SARS-COV-2, possesses a single-stranded, positive-sense RNA and envelopes the largest viral genome, measuring 26 to 32 kilobases in length (2, 3). Its spherical shape and corona-like crust give it its name (4). People exposed to the seafood market in Wuhan, China, first reported the origin of the SARS-COV-2 virus in December 2019, after which it spread to various parts of the world and caused severe respiratory disease events. The first suggestion was that the infection originated from a zoonotic source (5). The transmission of SARS-CoV-2 occurs via respiratory droplets through direct contact with an infected person (6), or it may occur through indirect contact or in the pre-symptomatic incubation period (7). Fever, sore throat, fatigue, headache, dry cough, and loss of smell are among the symptoms of infection, which can progress to hypoxia if left untreated (8). The lack of a suitable treatment during the virus's fierce attack necessitated the urgent and necessary development of various vaccines through scientific institutions, and the only way out of the epidemic crisis was vaccination with effective vaccines (9). Iraq received its first Sinopharm vaccine from China, and the majority of its population received it (6). Regarding the vaccine's status in Iraq, 441,121 people had received it by May 10 th, with an average of 15,000 doses per day (10). Vaccination contributes to preventing asymptomatic infections and reduces the risk of infection by stimulating the host immune system to produce antibodies (11, 12, 13). In general, COVID-19 vaccines stimulate, through various mechanisms, innate and adaptive immune responses. Pfizer-Biotech Vaccine Developed by BioTech and distributed by Pfizer and Fosun Pharmaceutical, it is the first EU-approved vaccine for emergency use. Researchers have conducted several clinical trials, reporting more than 95% success (14). The WHO officially approved the Sinopharm vaccine (BBIBP-CorV) in May 2021. The National Medical Products Administration of China announced a prior approval of the Sinopharm vaccine (BBIBP-CorV) in January 2020, which showed 79% effectiveness against symptomatic disease in the Phase 3 trial (15). The inactivated virus-based Sinovac vaccine worked between 59 and 65% of the time against alpha, beta, and kama virus variants (16, 18, 19), as well as against people who were older, had cancer, or had a transplant, were pregnant, or had other health problems, compared to people who were not infected (20).

2. Materials and Methods

The researchers used a specific questionnaire to gather data for this study. A sample of 266 participants filled out the questionnaire. They agreed to participate in this research project. They represented both sexes and ranged in age from 18 to 77. The obtained data had variables including age, sex, height, occupation, residence, weight, number of doses, type of vaccine, date of last vaccination, symptoms, side effects of the vaccine, and exposure to SARS-CoV-2. We collected

samples from the seemingly healthy volunteers. We conducted this cross-sectional study after the last dose of the vaccine, ensuring a duration of at least 3 months. The number of doses varied from one to three. Diyala Province, Iraq, was the investigated area for the period from April 2022 to May 2023. The study included participants from the general community, specifically outpatients from the consultation clinic at Baquba General Teaching Hospital and Blood Transfusion Center, and received official consent from the Research Ethics Committee of the Diyala Health Department (DHD/No-39072/Date-31/8/2022). We used the ELISA technique to detect IgG titers, and used a diagnostic kit (DIA PROI Italy) to coat the wells of the plate with spike protein and nucleocapsid of SARS-CoV-2, which target specific antibodies for this virus. The optical signal or color change is proportional to the amount of anti-SARS-CoV-2 IgG antibodies present in the sample. Through the positive control, whose IgG content is measured in WHO IU/mL units, the cut-off value can be used to turn the optical density into negative and positive results for IgG antibodies against the SARS-CoV-2 virus. SPSS version 28 carried out the data analysis. Statistical significance was considered whenever the P value was equal to or less than 0.05.

3. Results

The results of Table 1 showed that the highest mean±SD of pfizer vaccinators were among the study participants from (Baquba, Al-Khalis, Khanaqin, and Muqdadiya) with a non-significant statistical difference (P = 0.474), while the mean±SD of the sinopharm vaccinators were higher among the residents of the city of Khalis and Baquba, with a statistically significant difference (043.P = 0). The current study also revealed that the antibodies under study had the highest mean SD concentrations among the retired and for both vaccines, with a statistically significant difference (P = 0.0001) for Pfizer and a non-significant difference (P = 0.234) for Sinopharm.

Table 1. The effect of residence and occupation variables on the mean±SD of antibody concentration.

Variables		Titer of Ab concentration(IU\ml)				P value
		Pfizer		Sinopharm		
		No	Mean±SD	No	Mean±SD	
Residence	Baquba	172	68.21±2641.	50	58.36±19.44	0015.#
	Khalis	20	63.97 ±21.86	5	33.88± 25.65	0014.#
	Mukdadia	11	56.24± 19.89	-	-	-
	AKhanaqin	2	78.55±28.21	3	44.83±5.62	0.117
	Mendyli	2	53.60±1.56	1	39.20±	0.084
P value		0.474		0.043^		
Occupation	Student	24	5378. ±969.	9	4650. ±12.28	0.084
	Clerk	63	61.52±25.06	21	5462. ± 22.73	0.267
	Worker	22	68.74±22.53	11	52.31±20.70	0.051
	Military	23	65.66± 25.44	3	55.17±0.98	0489.
	Housekeeper	59	73.17± 26.63	11	58.62±19.45	0.089
	Retired	16	8673. ±30.17	4	7747.±26.22	0.582
P value		0.0001^		0.234		

^Significant difference among more than two independent means using Fisher's exact test and ANOVA-test and at 0.05

Table 2 displays the mean standard deviation and standard deviation of study participants who received vaccinations from Pfizer and Sinopharm for pregnancy, with the Pfizer vaccine showing the highest mean standard deviation for pregnant women. However, the statistical difference was not significant (0.518). For each weight group, the table also displayed the mean, standard deviation, and titer of Ab concentration in participants vaccinated with Pfizer and sinopharm. The participants vaccinated with the Pfizer vaccine, whose weight mass exceeded 30, had the highest mean and standard deviation, indicating a non-significant statistical difference (P = 0.077).

Table 2. The effect of pregnancy and weight-mass index with the mean±SD antibody concentration after vaccination.

Variables		Titer of Ab concentration(IU\ml)				P value
		Pfizer		Sinopharm		
		No	Mean±SD	No	Mean±SD	
Pregnant	Pregnant	12	7750. ±26.79	3	6117. ±12.11	0.332
	Not pregnant	93	6633. ±25.83	23	5327. ±2014.	0.026
	P value		0.163		0.518	
BMI	(18.5-249.)	62	6123. ±23.30	15	50.97±9.31	0.100
	(25-29.9)	78	68.32± 26.22	24	60.71±21. 73	0.200
	>30	67	71.17± 26.40	20	51.97± 24.37	0.005#
	P value		0.077		0.245	

significant difference between two independent means using Students-t-test at 0.05 level.

Table 3 showed the differences in mean±SD of the antibody titer of the participants and blood groups, where the highest mean and standard deviation of titer of Ab concentration were among Pfizer vaccinators with blood type AB. However, the statistical difference was not significant (P = 0.474). The table's results also revealed the average and standard deviation of the rhesus factor-vaccinated participants, indicating that those who received Pfizer's vaccine with a positive rhesus factor had the highest titer of Ab concentration. Consequently, the statistical difference for the same vaccine was not significant (P = 0.867).

Table 3. The effect of blood group variables and the rhesus factor mean±SD on antibody concentration.

Variables	Titer of Ab concentration				P value
	Pfizer		Sinopharm		
	No	Mean±SD	No	Mean±SD	
A	40	61.66±22.33	16	54.08±16.66	0.225
B	41	65.85± 24.28	11	51.05±624.	0.052
AB	10	69.55±21.73	3	76.20±26.70	0.662
O	116	69.24±27.40	29	55.37±2470.	0014.#
P value		0.427		0.311	
Rh+	184	67.23±25.92	52	54.75±21.43	0002. #
Rh-	23	6627. ±23.77	7	59.12±1312.	0.456
P value		0.867		0.603	

significant difference between two independent means using Students-t-test at 0.05 level.

Table 4 displays the mean±SD titer of Ab concentration of people who were vaccinated with the Pfizer and sinopharm vaccines based on their smoking status. The nonsmokers who got the Pfizer vaccine had the highest mean±SD, so the statistical difference was not significant (P = 0.944).

Table 4. The effect of the smoking mean±SD on antibody concentration.

Variables		Titer of Ab concentration(IU\ml)				P value
		Pfizer		Sinopharm		
		No	Mean±SD	No	Mean±SD	
Smoking	Yes	48	5988. ±18.74	15	59.51±15.78	0944.
	No	146	69.30±27.05	44	5383. ±21.95	0.001
	P value	0.025#		0.361		

significant difference between two independent means using Students-t-test at 0.05 level.

4. Discussion

The results of the current study revealed that the study participants from Baquba, Khalis, Khanaqin, and Al-Maqdiya who received the Pfizer vaccine had the highest titers of antibody concentrations, and the statistical difference was non-significant. As for the sinopharm vacciners, the difference was significant for Khalis and Baquba. There are no studies evaluating the relationship between residence and IgG antibody levels, but it's possible that people who live in densely populated areas are susceptible to the virus due to population density. Furthermore, process exposure and natural infection may increase the vaccine's protection and efficiency in terms of IgG antibody levels. The current study's results revealed a statistically significant difference in antibody titers between retired individuals and those in other studies. Previous research on Italian healthcare workers confirmed that there were no statistically significant differences between health workers and non-workers. However, when comparing occupation categories based on risk, it was found that workers in dangerous jobs had much higher concentrations of antibodies than workers in medium or low risk jobs. This is not consistent with the results of this study (21). The protective efficacy of study participants with SARS-CoV-2 vaccines was moderate compared to other studies. This study reported a persistent decrease in antibody levels to approximately 40% by 20-34 weeks after the initial vaccination series for individuals who received the Pfizer vaccine, with high concentrations of IgG antibodies ranging from 81%-90%. The second dose was administered 1-5 weeks after the first one (22). And this may be due to the long period, which is 12–17 months after the last dose between the time of drawing the sample and the date of the dose, or that the Iraqi citizens in general of Diyala province in particular preferred to be vaccinated with the Sinopharm vaccine due to fewer side effects compared with the Pfizer vaccine.

Table 2 of the current study revealed that pregnant women had a higher IgG antibody titer than non-pregnant women, although the statistical difference was not significant. In a previous study evaluating the effectiveness of vaccination in pregnant women in England, the Pfizer vaccine administered during pregnancy elicited a good immune response. High levels of IgG antibodies

are similar to those found in non-pregnant women (23, 24). In contrast, it is consistent with your study since this study also found that there were no significant differences between pregnant and non-pregnant women regarding Ab titers after vaccination. Pregnancy is also a state of immune tolerance to prevent the body from rejecting the foreign body, which is the fetus. Thus, their immune response is less active compared to non-pregnant women, pregnant women are more likely to contract many diseases, including COVID-19. Regarding the weight-mass index, a previous study conducted on residents in a city in England examined the relationship between body mass index (BMI) and the effectiveness of SARS-CoV-2 vaccines. The results showed that the vaccine was more effective for individuals who were overweight or of a healthy weight, compared to those who experienced a decrease in their weight-mass index (25). This study roughly aligns with the results of the current study for participants who received the Pfizer vaccine, but it differs slightly for those who received the Sinopharm vaccine. The difference in results with different outcomes with this vaccine might be because European countries mostly used the Pfizer vaccine and not the Sinopharm vaccine. Alternatively, the people in this study may have weak immune systems or have chronic diseases that make it harder for their bodies to respond to this vaccine, which lowers their levels of antibodies compared to people of other weights. Fictiveness of SARS-CoV vaccines with weight-mass index found that obese people were significantly associated with low antibody titers (26). This study is not consistent with the current study's results. The reason could be that the age groups of vaccinated individuals suffering from obesity differ between this study and the current study. Adipose tissue plays a role in the ability to absorb the titer of antibodies based on the date of the last vaccination and the previous infection with SARS-CoV-2. In an Iranian study evaluating antibodies to Sinopharm vaccine with weight-mass index, IgG antibody levels were significantly lower in obese subjects compared to other groups (27), and this is almost in agreement with the current study's results. The results presented in Table 3 of the current study show that study participants with type AB had a higher titer of IgG antibodies compared to those who received the Pfizer vaccine. However, this statistical difference was not significant. In comparison to other studies, previous studies have reported no significant effect of blood types on the concentration of immunoglobulin IgG (28, 29). The main factor affecting IgG antibody level was prior natural immunization as a result of SARS-CoV-2 infection. The results of some studies also showed significant differences in the type of vaccine and the previous infection. Specifically, the antibody levels for SARS-COV-2 were significantly lower in individuals without a natural infection to the virus compared to those suffering from an infection, with a statistically significant difference (greater than 001). However, the type of vaccine was found to have the highest concentration of IgG antibodies (30). The Pfizer vaccine was administered to those individuals (30). Studies have not directly linked the effectiveness of vaccination with different blood groups ABO, but a December study found that individuals with blood type A experienced more severe side effects than those with type O blood, suggesting a stronger immune response. Particularly, individuals under the age of 55, females, and those with a history of COVID-19 infection are more likely to experience negative side effects after vaccination compared to other groups (31). It may be the reason for the insufficiency of studies related to this regard and that this study did not confirm the actual association between vaccine efficacy and ABO blood groups. Since vaccination

is a process that mimics infection naturally, it may be possible to rely on the relationship between ABO blood groups and infection with COVID-19. A study was conducted in China at Wuhan Central Hospital to evaluate the relationship between ABO blood groups and susceptibility to infection with COVID-19, where the incidence of COVID-19 for people with blood group A was higher compared to those with blood group O (32). There are no previous studies in the international literature that demonstrate the actual association between ABO blood groups and the Rh factor with the titer of IgG antibodies. The current study found no significant differences in the mean of the Ab titer between the different ABO groups or between the different Rh factors in both vaccinated patients from Pfizer and Sinopharm. **Table 4** shows that the level of IgG antibody was higher in people who did not smoke. This difference was significant in a previous study that looked at how smoking affected people who got the SARS-CoV-2 vaccine. That study found that the level of IgG antibody dropped faster in vaccinated smokers than in vaccinated non-smokers (33, 34). This is consistent with the results of the current study. In a previous study of healthcare workers at the National Hospital in Japan to assess IgG antibody titers, smokers had lower antibody levels compared to non-smoker participants, indicating that smoking cessation will reduce the risk of antibody loss (35). This study is consistent with the current study's findings.

5. Conclusion

The study concluded that the effect of the housing factor was significant for study participants who received Sinopharm vaccine and insignificant for Pfizer vaccinators, while the effect of occupation and smoking was significant for Pfizer vaccinators and insignificant for Sinopharm vaccinators. The study also found significant effects on antibody titer levels among study participants in Diyala province. Therefore, the study recommends the necessity of vaccination with a preventive dose, not neglecting vaccination schedules, and periodic examinations to ensure safety from COVID-19.

Conflict of interest

The authors declare no conflicts of interest.

Ethical Clearance

Approval Scientific approval has been obtained from Diyala Health Department, in letter No. 2790 dated 8/2/2022, and the procedures were Complies with ethical standards and follows the institution's health guidelines.

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