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The Effectiveness of Covid-19 Vaccines Currently Available in Iraq

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Abstract

Coronavirus disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China in December 2019. The disease has since spread worldwide, leading to an ongoing pandemic. It has had a devastating effect on the world's demographics resulting in the death of millions worldwide.

As the coronavirus continues to cause illness and death around the world, vaccines are seen as one of the best ways to stop it.

This study aimed to evaluate the effectiveness of the currently available corona vaccines in Iraq (Pfizer, AstraZeneca and Sinopharm) and the protection provided by existing antibodies which formed due to vaccination.

This cross-sectional study was done on Iraqi individuals attending Coronavirus vaccination center in Baghdad.

206 asymptomatic Iraqi individuals, 86 (42%) males and 120 (58%) females, aged 16-80 year, were willing to participate. The participants were tested, before vaccination, by real-time reverse transcriptase-polymerase chain reaction (rRT-PCR), and were enrolled in this study when tested negative.

Each participant had one of the three currently available vaccines in Iraq (Pfizer, AstraZeneca and Sinopharm).

Data including age, sex and type of vaccines were recorded for each participant. The participants were followed up for nearly a year (from 6 February to 17 December 2022) to check for covid-19 infection and antibody existance.

In this study, Pfizer vaccine was found to be 73% effective against infection, as 27% of the vaccinated participants were infected with coronavirus; 19 male and 16 females.

AstraZeneca vaccine was found to be 64% effective against infection as 36% of the vaccinated participants were infected with coronavirus; 7 male and 4 females Sinopharm vaccine was found to be 78% effective against infection as 22% of the vaccinated participants were infected with coronavirus; 6 males and 4 females.

The results of this study indicate that Sinopharm vaccine was more effective than Pfizer and AstraZeneca vaccines, as the infection rate was lower and the period of infection after vaccination was longer.

Most of the infected patients had antibody titer at time of infection, which indicates that existing antibody did not provide complete protection against infection.

Although females were the most participants, in this study, males were the most infected.

The age of the participants did not affect the rate of infection.

Keywords: Vaccines, Pfizer, AstraZeneca, Sinopharm, Corona

1. Introduction

COVID-19 is the disease caused by an infection of the SARS-CoV-2 virus. COVID-19 was previously known as 2019 Novel Coronavirus (2019-nCoV) respiratory disease before the World Health Organization (WHO) declared the official name as COVID-19 in February 2020 (Zhu *et al.*, 2020; Coronavirus, n.d.).

The SARS-CoV-2 virus belongs to the family of viruses called coronaviruses, which also includes the viruses that cause the common cold, and the viruses that cause more serious infections such as severe acute respiratory syndrome (SARS). Coronaviruses are a

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group of related RNA viruses. In humans, they cause respiratory tract infections that can range from mild to lethal (Jonathan *et al.*, xxxx).

The appearance of this virus under microscope shows the virus's outer layers are covered with spike proteins that surround them like a crown (Merriam-Webster, n.d.). The name "coronavirus" is derived from Latin "corona", meaning "crown" (Coronavirus, n.d.).

As the coronavirus continues to cause illness and death around the world, vaccines are seen as one of the best ways to stop it.

A vaccine is a biological preparation that provides active acquired immunity to a particular infection. The safety and effectiveness of vaccines has been widely studied and verified (Sumirtanurdin & Barliana, 2021; A brief history of vaccination, n.d.).

A vaccine typically contains an agent that resembles a disease-causing microorganism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins. The agent stimulates the body's immune system to recognize the agent as a threat, destroy it, and to further recognize and destroy any of the microorganisms associated with that agent that it may encounter in the future (Vaccination, n.d.; Kathy, 2023).

The virus that causes COVID-19 only surfaced in late 2019. WHO had to approved all COVID-19 vaccines for emergency use listing have been through randomized clinical trials to test their quality, safety and efficacy. To be approved, vaccines are required to have a high efficacy rate of 50% or above. After approval, they continue to be monitored for ongoing safety and effectiveness (Francesco *et al.*, 2022; Maria *et al.*, 2021; Olliaro *et al.*, 2021; Hind *et al.*, n.d.; Omeed *et al.*, 2022).

In Iraq, from 3 January 2020 to 10:11am CEST, 12 April 2023, there have been (2,465,545) confirmed cases of COVID-19 with (25,375) deaths, reported to WHO (covid19.who.int, n.d.).

As of 1 January 2023, a total of (19,557,364) vaccine doses have been administered. Iraq received almost 3 million doses of the COVID-19 vaccine through COVAX (covax, n.d.).

The Pfizer vaccine (Comirnaty, also known as tozinameran or BNT162b2) was the first-ever approved corona vaccine and it was fully approved by the FDA, WHO, EMA, and almost all international health authorities. It was produced by a collaboration between the American pharmaceutical giant, Pfizer, and an innovative German biotechnology firm, BioNTech. The Pfizer/BioNTech vaccine introduced a new technology to the vaccine market; mRNA vaccines. These vaccines are based on genetic mRNA molecules. The mRNA (messenger RNA) carries the genetic code for the "spike" protein, an antigen specific for the SARS-CoV-2. Once injected, the mRNA enters the body cells, making them produce the spike protein themselves and that will allow the immune system to prepare to combat the actual infection if it happens (Kathy, 2023; Mersad, 2022).

The vaccine is given in 2 doses 3 weeks apart. A third booster dose with the same vaccine is now recommended after 5-6 months. The original trial by Pfizer showed that the 2 shots of the vaccine were 95% protective against COVID-19. However, scientists observed that immunity wanes with time, and that a 3rd dose re-boosts protection against the coronavirus. This is why now, the term "fully vaccinated" means 3 jabs and not just two (Mersad, 2022; Zimmer *et al.*, 2021; Knoll & Wonodi, 2021; Syed *et al.*, 2021; Sinopharm, 2021; COVID-19, 2021).

Pfizer-BioNTech COVID-19 Vaccine may not provide protection in every person (Kathy, 2023). BNT162b2 effectiveness (VE) was found, for the total population group for infection, hospitalization and mortality, with adjusted VE of 93·0% (CI:92·6–93·4%), 93·4% (CI:91·9-94·7%) and 91·1% (CI:86·5-94·1%) respectively (Yaki *et al.*, 2022).

The Oxford/AstraZeneca vaccine was the first traditional vaccine against corona to be approved worldwide. known as ChAdOx1 nCoV-19 or AZD1222. It was well accepted by health authorities, but seems to have slightly less effectiveness compared to the mRNA vaccines (Pfizer). This vaccine was developed by the British laboratory AstraZeneca and Oxford University "AstraZeneca-Oxford". The AstraZeneca vaccine, also called Vaxzevria, is produced using a traditional method of vaccine production (a vector-based vaccine) (Mersad, 2022; Zimmer *et al.*, 2021; COVID-19, 2021; Jonathan & Carl, 2021). The harmless modified virus "infects" cells, and presents the spike protein to the immune system. So Immune cells and antibodies will be produced to fight any future infection with COVID-19 shall it occur. The vaccine is given in 2 doses, 28 days apart. A third booster dose is recommended after 4–6 months. The original efficacy studies showed that 2 doses of AstraZeneca were at around 74% against symptomatic illness and 100% against hospitalization and critical illness. One study, however, showed that the vaccine protection got down to 47% after 5 months of the second dose. This is why a third booster dose is now recommended, as with all other vaccines (Mersad, 2022; Zimmer *et al.*, 2021; COVID-19, 2021; Jonathan & Carl, 2021).

The first Chinese corona vaccine, BBIBP-CorV, is now one of the 10 WHO-approved vaccines. It's

currently being administered in China, South America, Central Asia, the UAE, and other countries around the world (Jonathan & Carl, 2021).

It was developed by Sinopharm and the Beijing Institute of Biological Products Co. The Sinopharm vaccine is produced using traditional vaccine-producing technology. Nevertheless, it's different from the methods used to produce AstraZeneca vaccine. Researchers at the institute produced BBIP-CorV by growing live coronaviruses in cells and then dousing them with chemicals to inactivate them. Injected into the body, these inactivated viruses cannot infect cells, but they can draw the attention of the immune system. On Dec. 30, Sinopharm announced that the vaccine had an efficacy of 79.34 percent, leading the Chinese government to give it approval. On May 7, 2021, the World Health Organization put forward a similar efficacy estimate of 78.1 percent and gave the vaccine emergency use authorization. Sinopharm is an inactivated vaccine. This means that the shot contains an inactivated and harmless version of the original coronavirus (incapable of disease-producing). Then after you receive the vaccine, your body will produce immune cells and antibodies to combat any future corona infections. The vaccine is given in 2 doses, 3 weeks apart. A third booster dose as with AstraZeneca, or Pfizer is recommended. It has proven to be 79% effective in preventing symptomatic infection and hospitalization of SARS-CoV-2 (Mersad, 2022; Knoll & Wonodi, 2021; Syed *et al.*, 2021; Sinopharm, 2021; COVID-19, 2021; Jonathan & Carl, 2021).

A study comparing different corona vaccines was published by Hungarian researchers who compared the efficacy of five different covid vaccine types : Moderna, Pfizer, Sputnik V, AstraZeneca, and Sinopharm. The study reviewed data from 3.7 million vaccinated patients since early 2021. Two endpoints were compared: protection against infection and protection against death.

Pfizer/BioNTech was found to be 83.3% effective against infection. AstraZeneca and Sinopharm fell a bit short compared to other corona vaccines, with 71.5% and 68% effectiveness against infection respectively (Zoltán *et al.*, 2021).

COVID-19 is now in its fourth year, and the Omicron variant and its subvariants are still driving infections in cases in the United States. So, as the SARS-CoV-2 virus mutates and new variants continue to emerge, it's important to keep up with how well vaccines are performing (Kathy, 2023).

AIM(s): This cross-sectional study aimed to evaluate the effectiveness of COVID-19 vaccines currently available in Iraq (Pfizer, AstraZeneca and Sinopharma) and the protection provided by existing antibodies which formed due to vaccination.

2. Material and methods

This study was done among Iraqi individuals attending Corona virus vaccination center in Baghdad. 206 Iraqi asymptomatic individuals, 86 males and 120 females, aged 16-80 years were willing to participate in this study.

The asymptomatic individuals were tested, before vaccination, by real-time reverse transcriptase-polymerase chain reaction (rRT-PCR) (Shannon *et al.*, 2004).

Participants were enrolled in this study when tested negative. Individuals were vaccinated by one of the three currently available vaccines in Iraq namely: Pfizer, AstraZeneca and Sinopharm. Data including age, sex and type of vaccines were recorded for each participant. The participants were followed up for nearly a year (from 6 February 2022 to 17 Decembre 2022) to check for covid-19 infection.

Antibody titer was tested at time of infection, using AFIAS COVID-19 Ab method (Immunostics, n.d.; Oh *et al.*, 2020).

Statistical analysis was done using IBM SPSS version 27.0. The Data are reported as mean standard deviation (SD) or number of participants (N) (percent) and the P-values of less than 0.05 were considered significant.

3. Results

A total of 206 Iraqi asymptomatic individuals participated in this study:120 Females (58%) and 86 Males (42%) (Fig. 1)

Among all vaccinated individuals, 56 out of 206 (27%) were infected with coronavirus after different periods of time; 32 (57%) males and 24 (43%) females (Fig. 2).

132 of the 206 participants (64%) choose to be vaccinated by Pfizer, 30 of the 206 participants (16%) choose to be vaccinated by AstraZeneca and 44 of the 206 participants (21%) choose to be vaccinated by Sinopharm (Fig. 3).

In this study, Pfizer vaccine was found to be 73% effective against infection, as among vaccinated individuals, 35 out of 132 (27%) were infected with coronavirus (confirmed by PCR); 19 male and16 females (Table 1 and Fig. 4).

AstraZeneca vaccine was found to be 64% effective against infection as among vaccinated individuals,11 out of 30 (36%) were infected with coronavirus (confirmed by PCR); 7 male and 4 females (Table 1 and Fig. 4).

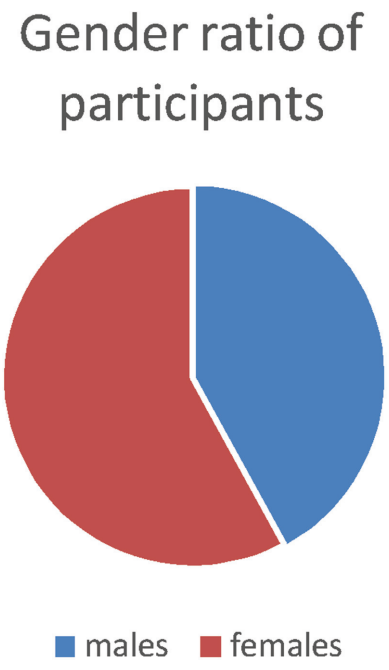

Fig. 1. Gender ratio of participants.

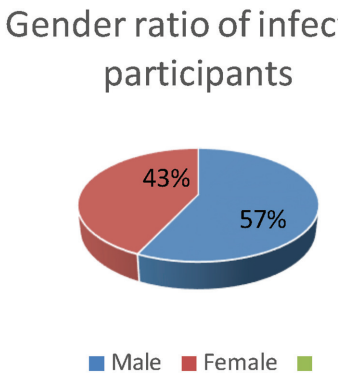

Fig. 2. Gender ratio of infected participants.

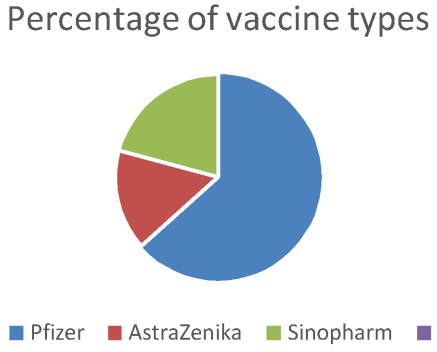

Fig. 3. Percentage of vaccine types.

Sinopharm vaccine was found to be 78% effective against infection as among vaccinated individuals, 10 out of 44 (22%) were infected with coronavirus (confirmed by PCR); 6 males and 4 females (Table 1 and Fig. 4).

Table 1. Number (N0.) and percentage (%) of infected participants.

Vaccines	No. of infected participants & (%) Males	Females	Total no. infected
Pfizer	19 (54.3%)	16 (45.7%)	35
AstraZeneca	7 (63.2%)	4 (36.8%)	11
Sinopharm	6 (60.0%)	4 (40.0%)	10
Total	32 (57%)	24(43%)	56 (27%)

Table 2. Age of the infected partipants by each of the three vaccines.

Groups	Age mean ± SE (Years)
Pfizer	38.06 ± 2.29
AstraZeneca	30.95 ± 1.85
Sinopharm	33.80 ± 2.73
$P > 0.05$	

Table 3. No. of doses of vaccines received by participants.

Groups	Number of doses 1	2	3
Pfizer	5 (14.3)	29 (82.9)	1 (2.9)
AstraZeneca	2 (10.5)	9 (89.5)	0 (0.0)
Sinopharm	0 (0.0)	8 (80.0)	2 (20.0)
Probability	$P > 0.05$		

Age of the infected participants vaccinated by Pfizer :16-70 years.

Age of the infected participants vaccinated by AstraZeneca: 20-48 years. Age of the infected participants vaccinated by Sinopharm: 25-52 years

The age of the infected partipants by each of the three vaccines is presented in Table 2.

The majority of infected participants received 2 doses of vaccines. Only 5 participants received 1 dose and 1 received 3 doses of Pfizer vaccine, 2 participants received 1 dose of AstraZeneca vaccine and 2 participants received 3 doses of Sinopharm vaccine (Table 3 and Fig. 5).

The period during which infection occurred after vaccination by Pfizer was between 1 weeks to 8 months (Table 4 and Fig. 6).

The period during which infection occurred after vaccination by AstraZeneca was between 1 weeks to 5 months (Table 4 and Fig. 6).

The period during which infection occurred after vaccination by Sinopharm was between 5 to 8 months (Table 4 and Fig. 6).

In this study, the 3 vaccines produced immunity in a slightly different way.

Anti COVID-19 IgM antibody titer of the infected patients at time of infection is presented in Table 5 and Fig. 7.

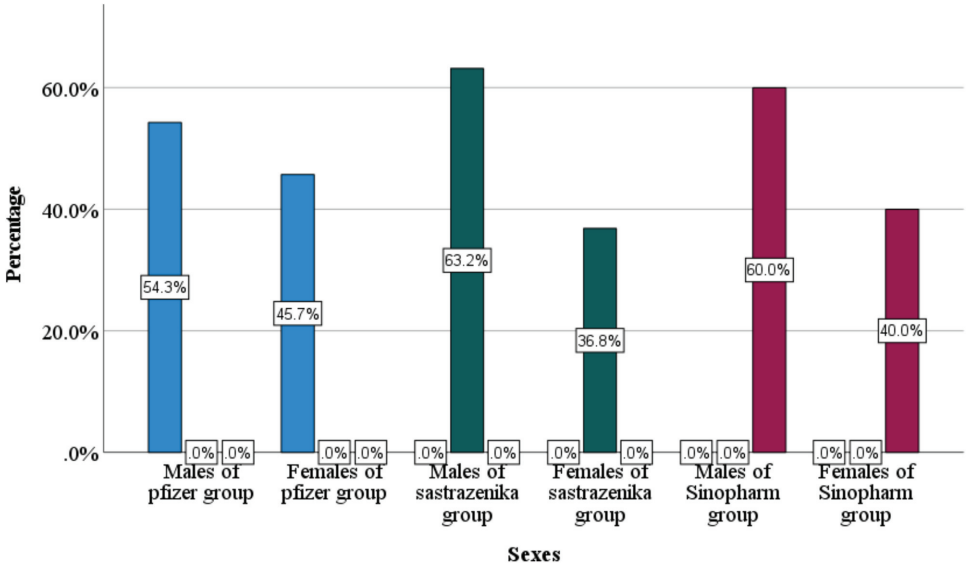

Fig. 4. Number (N0.) and percentage (%) of infected participants.

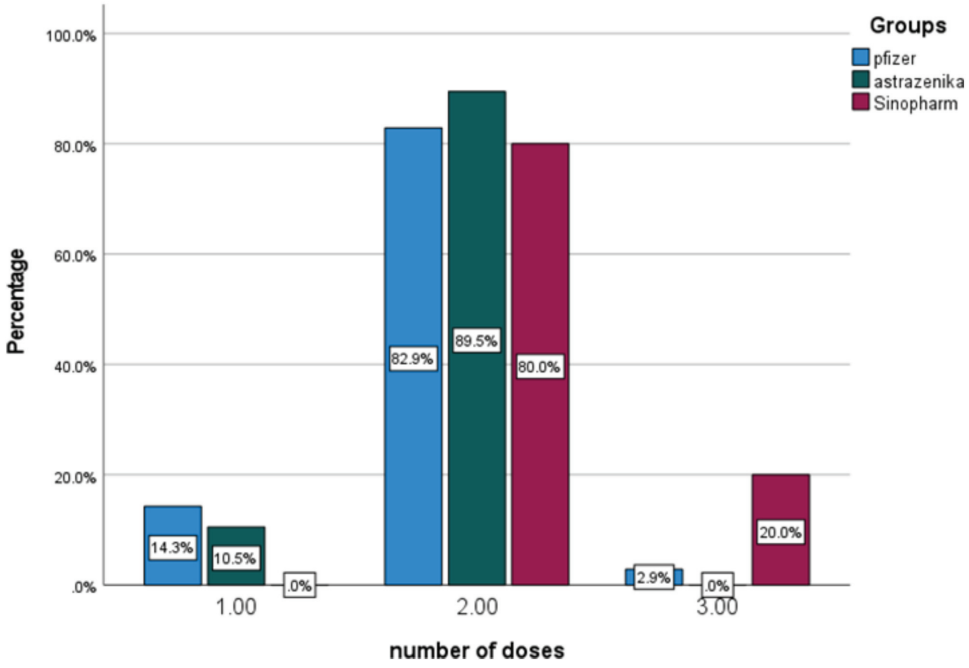

Fig. 5. No. of doses of vaccines received by participants.

Table 4. The period during which infection occurred after vaccination by the three types of vaccine.

Groups	Date of infections after vaccination mean ± SE (Weeks)
Pfizer	11.29 ± 1.33
AstraZeneca	9.74 ± 1.12
Sinopharm	27.60 ± 1.26
P > 0.05	

Table 5. Anti COVID-19 IgM antibody titer of the infected patients at time of infection.

Groups	Anti-COVID-19 IgM antibody mean ± SE (Unit)
Pfizer	1.60 ± 0.35
AstraZeneca	4.40 ± 0.79
Sinopharm	0.69 ± 0.24
($P > 0.05$)	

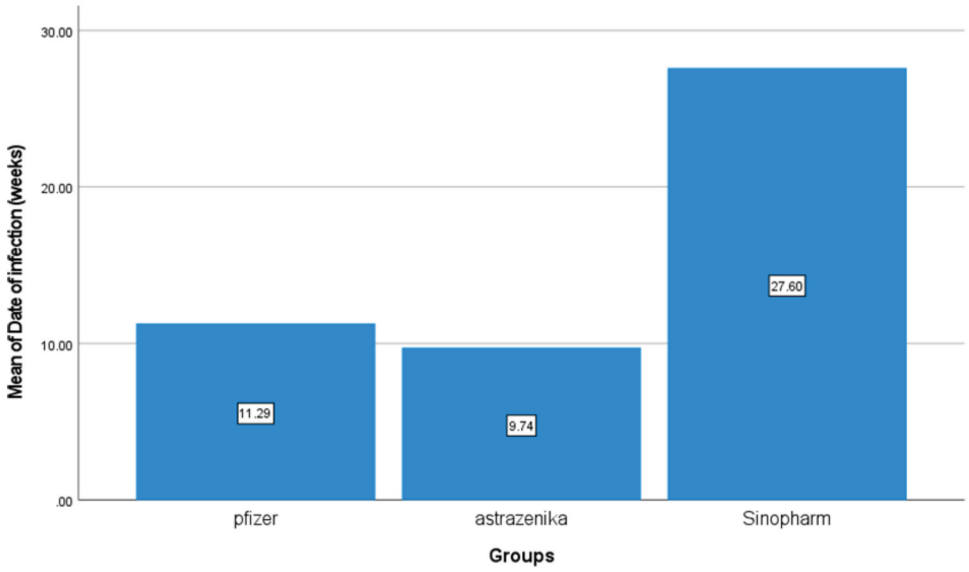

Fig. 6. The period during which infection occurred after vaccination by the three types of vaccine.

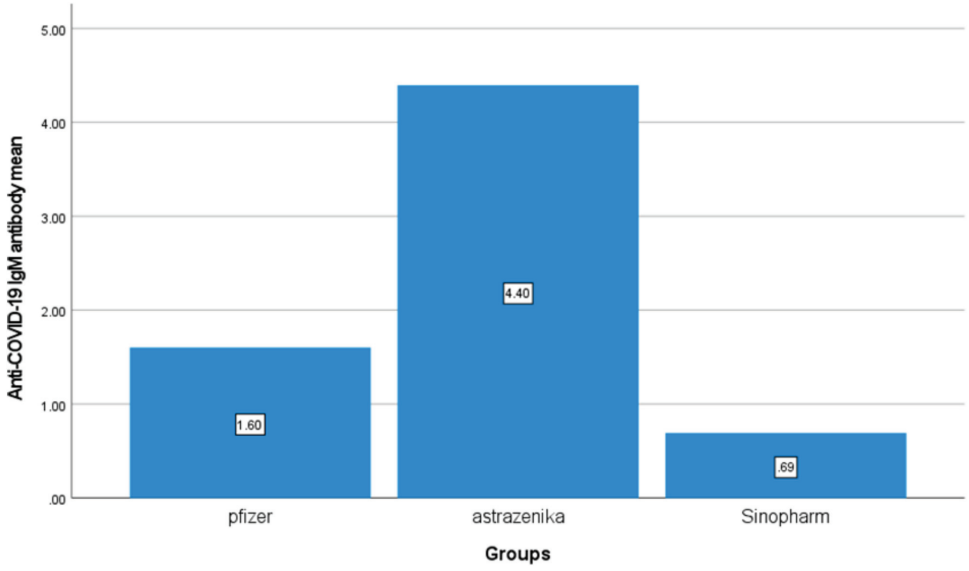

Fig. 7. Anti COVID-19 IgM antibody titer of the infected patients at time of infection.

Table 6. Anti COVID-19 IgG antibody titer of the infected patients at time of infection.

Groups	Anti-COVID-19 IgG antibody mean ± SE (Unit)
Pfizer	0.94 ± 0.17
AstraZeneca	1.04 ± 0.27
Sinopharm	4.08 ± 3.01
($P > 0.05$)	

Anti COVID-19 IgG antibody titer of the infected patients at time of infection is presented in the following Table 6 and Fig. 8.

4. Discussion

Vaccine effectiveness is a measure of how well vaccination works under real-world conditions to protect people against health outcomes such as infection, symptomatic illness, hospitalization, and death (Vaccine, n.d.; COVID-19, n.d.).

This cross-sectional study aimed to evaluate the effectiveness of COVID-19 vaccines available in Iraq (Pfizer Vaccine, AstraZeneca Vaccine and Sinopharm Vaccine) in protecting individuals against COVID-19 infection.

206 asymptomatic individuals were willing to participate in this study; 120 (58%) females and 86 (42%)

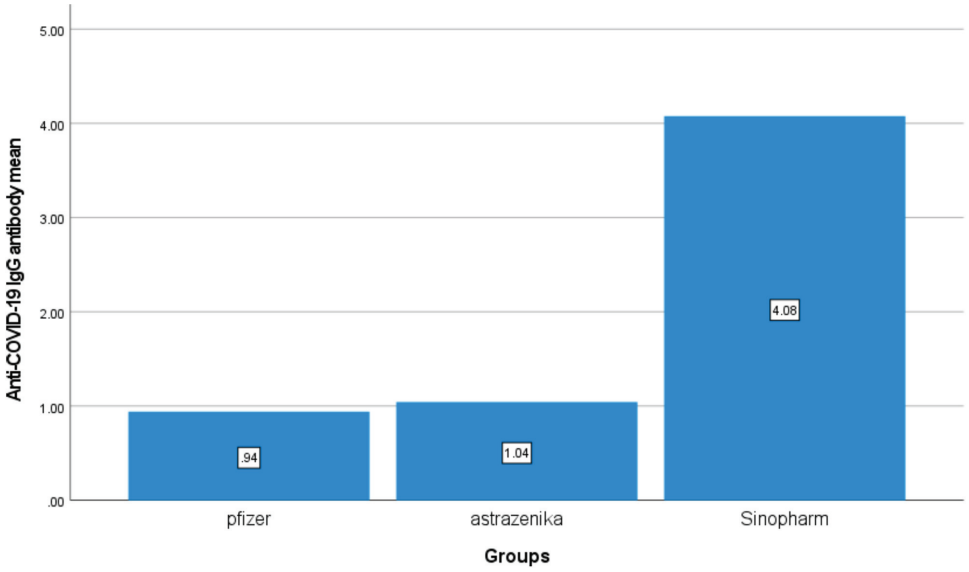

Fig. 8. Anti COVID-19 IgG antibody titer of the infected patients at time of infection.

males. Among all vaccinated individuals with different vaccines; 27% (56 out of 206) of the participants infected with coronavirus after different periods of time; 32 (57%) males and 24 (43%) females.

Some people may still become infected even though they have been vaccinated, but the goal of the vaccines may be is to prevent severe disease, hospitalization and death. Research has suggested that people who are infected after vaccination also are less likely to report long COVID (defined as signs, symptoms, and conditions that continue or develop after acute COVID infection), compared to those who were not vaccinated (Kathy, 2023).

Although females were the most participants in this study, males were the most infected. This result is in agreement with a study by Maha Al-Alousi *et al.*, (Maha *et al.*, 2022) who found that infection rates of COVID-19 in males (44%) higher than that of females (39%) and by Yahya *et al.* (Bayda *et al.*, 2022), Dutta (COVID-19, n.d.) and by George M.B. (2020) who concluded that "Generally, females are more resistant to infections than men, and this is possibly mediated by several factors including sex hormones and high expression of coronavirus receptors (ACE 2) in men, also life style, such as higher levels of smoking and drinking among men as compared to women."

This study found No effect of age on rate of infection as the infected participants were of all age groups (16-70 years), old participants were not found more vulnerable to infection.

Older people were reported to be more vulnerable to becoming severely ill with the virus, not for being vulnerable to Covid-19 infection (Karla *et al.*, 2021).

No studies have been done to examine the response of this category of individuals to all COVID-19 vaccines. Vaccines developed by the University of Oxford/AstraZeneca (ChAdOx1) was found to be better tolerated by older than younger people, and after the second dose, it has similar immunogenicity across all ages (Bayda *et al.*, 2022).

Three types of vaccines evaluated in this study: whole virus, viral vector and nucleic acid (RNA), each of which was found to protect vaccinated people, but found to have different effectiveness.

In this study, Pfizer vaccine was found to be the most trusted vaccine as the majority (64%) of participants choose to be vaccinated by it. However, 27% of the participants vaccinated by Pfizer vaccine, infected with coronavirus (i.e.73% effectiveness against infection), which is less than the protection provided by Sinopharm (78%) in this study.

Ever since the Pfizer/BioNTech vaccine got approved in December 2020, there have been many studies to assess its effectiveness.

The original trial by Pfizer showed that the 2 shots of the vaccine were 95% protective against COVID-19. However, scientists observed that immunity wanes with time (Kathy, 2023; Mersad, 2022).

In another study, Pfizer/BioNTech was found to be 83.3% effective against infection, slightly higher than the protection provided by AstraZeneca and Sinopharm vaccines, with 71.5% and 68% effectiveness against infection respectively (Zoltán *et al.*, 2021).

In this study, AstraZeneca fell short compared to other corona vaccines, with 64% effectiveness against infection.

The results of this study indicate that Sinopharm vaccine was more effective than Pfizer and AstraZeneca vaccines, as the infection rate was lower and the period of infection after vaccination was longer.

This variability could be due to different study designs, sample size variations, methodology, and quality. Thus, may be these factors which have generated different findings.

Generally, our vaccine effectiveness findings regarding Sinopharm are consistent with a multi-country trial study, which found that Sinopharm's COVID-19 vaccine proved 79% effective in preventing symptomatic infection of SARS-CoV-2 (COVID-19, 2021).

This study also aimed to investigate the protection by existing antibodies due to vaccination. Three types of vaccines investigated in this study, each of which produced immunity in a slightly different way. Generally, the serum antibody level is one of the important indicators of COVID-19 infection, but the protective concentration of COVID-19 antibody is unknown at present (Fengling *et al.*, 2020).

Previous studies have revealed that those who could generate the immune response after vaccination (IgM/IgG) may still be infected with SARS-Cov-2. Nevertheless, they can rapidly produce a large number of IgG that perform a protective function after infection in comparison to those who had not been vaccinated Jonathan *et al.*, 2020).

In this study, we found a high level of IgG in vaccinated people by Sinopharm compared to other vaccines. Perhaps the reason is that the people took the vaccine a long time ago, 5-8 months which led to the decline of the IgM and the existence of the IgG. In a study by Fengling Chen et al (Fengling *et al.*, 2020) to evaluate the dynamic changes of antibody levels in different groups after inoculation with the coronavirus disease 2019 (COVID-19) vaccine, IgG level remained at a high level without turning negative during 25-weeks observation period, indicating that IgG could exist for a longer period and exhibiting positive SARS-CoV-2-defending effect.

IgM was found to be high in AstraZeneca vaccinated individuals indicating that most of the infected participants may have a recent infection as the duration was very short (weeks) in some of them. IgM is secreted at first in the early stage of infection with pathogens, but it exists for a short time and can be used as an indicator of acute infection.

One of the possible reasons that those vaccinated and having antibodies against the COVID-19 vaccine were infected by SARS-Cov-2 is that some IgG are not neutralizing antibodies and play a limited protective role (Fengling *et al.*, 2020). Second, there may be an immune escape reaction because of the mutation of the virus (Christopher *et al.*, 2020). Third, the protective titer of antibody gradually attenuates at a lower level than the protective level to be subject to the virus. Although may be vaccinated individuals were (re)-infected by the emerging variants, antibodies are a marker for protection and often help prevent infections, however, individuals with antibodies in this study became infected, which indicate that existing antibody did not provide complete protection against infection. In these cases, antibodies may played a role in preventing severe disease (hospitalization, and death).

Collectively, our data indicate that none of the vaccines used ensure complete protection against SARS-CoV-2 infection nor the existence of antibodies.

However, emerging variants could (re)-infect naturally infected or vaccinated individuals. Therefore, along with vaccination, other non-pharmaceutical interventions and protective measures need to be implemented for infection control. More studies are required to prove the effectiveness of vaccines against COVID-19 variants.

This study has several potential limitations:

- Small number of participants.
- Only the three COVID-19 vaccines available in Iraq were included in this study, which do not represent all vaccines. As such, the findings are unlikely to be generalizable to some other countries.
- Participants in this study were all asymptomatic. Previous research has suggested that vaccine effectiveness of COVID-19 vaccines for symptomatic infections might be higher than for asymptomatic infections (Madhura *et al.*, 2023). This study conducted on select categories of individuals (asymptomatic, corona free). Therefore, these results unlikely to be generalizable to symptomatic people, especially those with comorbidities, such as hypertension, obesity and diabetes mellitus.

5. Conclusion

The results of this study indicate that Sinopharm vaccine was more effective than Pfizer and AstraZeneca vaccines, as the infection rate was lower and the period of infection after vaccination was longer.

All infected patients have antibody titer at time of infection, which indicate that existing antibody did not provide complete protection against infection.

In summary, our data indicate that none of the vaccine used ensure complete protection against SARS-CoV-2 infections nor antibody titer.

In this study, it was found that the Pfizer vaccine is the most trusted vaccine among Iraqis. Although females were the most participants, in this study, males were the most infected. The age of the participants did not affect the rate of infection.

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