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Research Article

Immune Response among Different Types of SARS-CoV-2 Vaccines in Iraq

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A B S T R A C T

Introduction: COVID-19 vaccine have been indicated to successfully decrease the hazard for symptomatic severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection furthermore associated hospitalisations.

Objective: To study the immune response among different types of SARS-CoV-2 vaccines.

Methods: This study includes 100 vaccinated individuals (43 Sinopharm, 30 AstraZeneca and 27 Pfizer) with one or two doses from different health centres in Baghdad. During the period from April 2021 to the end of May 2021, SARS-CoV-2 IgG and SARS-CoV-2 IgM levels were detected using AFIAS-6 device depending on FIA (Fluorescence Immunoassay) technique.

Results: 93% of the cases were positive for IgG levels, and negative in 7% cases. Coronavirus IgM concentrations for all individuals were negative. The highest IgG mean level was seen in vaccinated persons with Pfizer than AstraZeneca (34.41, 26.29 respectively) and the lowest mean value was detected in Sinopharm (23.76). There was a significant elevation in IgG levels in the previously infected group in comparison with non-infected individuals. IgG levels decrease in antibody responses to SARS-CoV-2 in older individuals compared to younger participants. Also, results reported that SARS-CoV-2 IgG levels increased in males who were vaccinated with Pfizer and AstraZeneca more than females, while there is a significant decrease in IgG levels in vaccinated males with Sinopharm as compared to females.

Conclusion: Different vaccines against SARS-CoV-2 produce different levels of IgG.

Keywords: COVID-19, SARS-CoV-2, IgG, IgM, Vaccination, Pfizer, AstraZeneca, Sinopharm

Introduction

Coronavirus new trending strain was recognised as the reason for a progression of pneumonia-like cases in Wuhan, China, toward the finish of 2019. The infection propagates quickly everywhere, causing a worldwide proceed pandemic.[1] As of 21 May 2021, there have been more than 165 million confirmed cases of COVID-19, including 3 million

deaths, reported by World Health Organization (WHO), and more than one and a half billion vaccine doses have been administered.[2] COVID-19 vaccines have been indicated to successfully decrease the hazard for symptomatic severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection furthermore associated hospitalisations.[3] In Iraq, vaccination started in the beginning of March 2021, with the first obtainable doses of inactivated SARS-CoV-2 vaccine, BIBP CorV (Sinopharm) being delivered to healthcare workers. This vaccine was offered to all individuals on a voluntary basis, whether the individual had prior COVID-19 infection or not with another type of vaccine: the ChAdOx1-S/nCoV-19 (Oxford AstraZeneca vaccine) which started in the end of March 2021 and BNT162b2 mRNA COVID-19 vaccines (Pfizer/ BioNTech) in the middle of April 2021.

Inactivated SARS-CoV-2 vaccine developed by Sinopharm taken intramuscularly as two doses (0.5 mL). WHO recommends an interval of three to four weeks between the first and second dose.[4] The Oxford University and Astra Zeneca have embraced a recombinant vaccine by engineering a chimpanzee adenovirus to carry DNA for the spike antigen.[5] WHO recommended giving it intramuscularly (0.5 mL) in two doses with an interval of eight to twelve weeks.[6] Pfizer (BioNTech) adapted nucleoside modified mRNA for the vaccine, its protection begins to develop twelve days after the first dose, but full protection needs 2 doses which World Health Organization recommends be administered with a 21 to 28 day interval.[7]

In spite of COVID-19 infected individuals showing an obvious decline in antibody concentrations, the immune memory, which include: B-cells, Helper T-cell, Cytotoxic T-cell and antibodies may prolong for months and even elevate with time in memory B-cell case against the spike protein of the virus.[8,9]

In the current study, we aimed to examine the effectiveness and the efficiency of three types of COVID-19 vaccines (Pfizer, AstraZeneca and Sinopharm) by comparing serum IgG and IgM specific antibodies titer against SARS-CoV-2 and determining the vaccine that gives the highest immune response and the best duration after the first and second dose or the first dose only. Also, the study used to observe the differences in antibodies response between individuals that have a post COVID-19 infection and non-infected ones.

Method

This study was performed in the Department of Biology, Madenat Al-Elem University College. It included 100 vaccinated individuals (43 Sinopharm, 30 AstraZeneca and 27 Pfizer) with one or two doses from different health centres in Baghdad. 66 of them were male and 43 were females. During the period from April 2021 to the end of May 2021, blood samples were collected from them and then separate serum detection was done for SARS-CoV-2 IgG and IgM levels using AFIAS-6 (Boditech Med Inc., South Korea) device depending on FIA (Automated Fluorescence Immunoassay) technique. The unit of measurement was cutoff index value (COI). Blood samples from vaccinated infected peoples were compared with vaccinated and non-infected once for IgG titer as well.

Statistical Analysis

The Statistical Analysis System-SAS (2012) programme was used to detect the effect of different factors on parameter vaccines impact on the immune system. Least significant difference (LSD) test was performed to significantly compare means in the current study.[10]

Results

The mean age for persons in the current study was 41.61 ± 1.27 years ranging from 19 to 71 years. 66% (n = 66) of the cases were male and 34% (n = 34) were female. It was reported that 21% (n = 21) of the cases had a prior infection of COVID-19. The duration of having the virus infection ranged from 3-10 months prior to vaccination, with an average of 5.28 ± 0.42 months. It was observed that 93% (n = 93) of the cases of SARS-CoV-2 IgG were positive and 7% (n = 7) cases were negative. The negative values appeared in Sinopharm and AstraZeneca only (4 and 3 cases respectively). The cut off index more than 1.1 for positive and less than 0.9 for negative. COVID-19 IgM levels for all individuals were negative (less than 0.9 cut-off index). The highest mean COVID-19 IgG level was seen in vaccinated persons with Pfizer (34.41 ± 1.86) followed by AstraZeneca with a mean value of 26.29 ± 1.57 and the lowest mean value was detected in persons vaccinated with Sinopharm (23.76 ± 0.85) (Table 1).

Table 1.Serum SARS-CoV-2 IgG and IgM Concentration (Cutoff Index Value, COI) among different Vaccinated Groups

Type	IgG**	IgM**
All vaccine	27.40 ± 1.07	0.36 ± 0.07
Pfizer	34.41 ± 1.86	0.23 ± 0.04
Sinopharm	23.76 ± 0.85	0.50 ± 0.07
AstraZeneca	26.29 ± 1.57	0.24 ± 0.03
LSD value	4.58*	0.194*
* ($P \leq 0.05$), **(Mean ± SE).		

According to the history of COVID-19, the statistical analysis shows a significant increase in IgG mean levels (53.59 ± 2.74) of previously infected group comparison with mean IgG level (19.92 ± 0.85) of non-infected individuals for all types of vaccine with the highest LSD value for AstraZeneca (7.01) then Pfizer (6.44) and Sinopharm (5.92) respectively.

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Astra Zeneca vaccine showed the highest IgG in previously infected patients (75.03 ± 3.64) followed by Pfizer and the lowest once is Sinopharm. Almost the same pattern was found in non-infected patients, their exception that Sinopharm showed the highest titer than AstraZeneca in non-infected once (Table 2).

Table 2.Comparison of IgG Levels between different Vaccinated Groups depending on History of Presence of COVID-19

Type	IgG (None infected) **	IgG (Previously infected) **	LSD Value
All vaccine	19.92 ± 0.85	53.59 ± 2.74	6.05*
Pfizer	25.90 ± 0.96	51.45 ± 2.06	6.44*
Sinopharm	18.84 ± 0.62	45.28 ± 2.06	5.92*
AstraZeneca	17.22 ± 0.59	75.03 ± 3.64	7.01*
LSD value	3.48*	6.71*	---
* (P ≤ 0.05), **Mean ± SE.			

It was found that the second dose of vaccine caused a significant higher increase in the mean levels of SARS-CoV-2 IgG (29.08 ± 2.37) as compared to the mean levels (23.42 ± 1.25) of those who were administered the first dose only in all types of vaccine. The highest levels of IgG (35.56 ± 2.06) were produced in people vaccinated with the second dose of Pfizer, followed by AstraZeneca (30.09 ± 1.76) ;While Sinopharm show non significant differences (Table 3).

Table 3.Comparison in IgG Levels between Different Groups according to Vaccine Doses

Type	IgG (1st Dose)**	IgG (2nd Dose)**	LSD Value
All vaccine	23.42 ± 1.25	29.08 ± 2.37	3.29*
Pfizer	31.14 ± 1.57	35.56 ± 2.06	3.97*
Sinopharm	21.84 ± 1.08	24.51 ± 1.22	3.22 NS
AstraZeneca	21.48 ± 0.96	30.09 ± 1.76	4.73*
LSD value	4.62*	5.08*	---
* (P ≤ 0.05), NS: Non-significant, ** Mean ± SE.			

Table 4 shows a significant increase in the mean levels of SARS-CoV-2 IgG for 2 weeks of vaccination with Pfizer and Sinopharm and then a gradual decrease for the third and fourth weeks, while SARS-CoV-2 IgG mean concentration increased gradually and reached the peak at the fourth week in persons vaccinated with AstraZeneca.

This study reported that SARS-CoV-2 IgG levels increased in males who were vaccinated with Pfizer and AstraZeneca (38.63 ± 2.55 and 32.25 ± 2.18 respectively) as compared to females (29.89 ± 2.08 and 15.36 ± 0.47 respectively), while there was a significant decrease in SARS-CoV-2 IgG mean levels in males vaccinated with Sinopharm (21.71 ± 0.92) as compared to females (32.76 ± 2.66) (Table 5). However, the mean value for all vaccines showed no significancy in IgG titer for vaccinated males and females.

Table 4.Alteration of SARS-CoV-2 IgG Levels in different Periods among Vaccinated Groups

Type	IgG** 1st week	IgG** 2nd week	IgG** 3rd week	IgG** 4th week	LSD Value
All vaccine	14.42 ± 0.52	34.28 ± 1.47	29.64 ± 1.68	20.76 ± 0.86	5.28*
Pfizer	30.58 ± 1.38	50.87 ± 2.06	33.99 ± 1.50	19.90 ± 0.61	6.77*
Sinopharm	9.95 ± 0.62	33.92 ± 1.85	25.56 ± 1.07	9.72 ± 0.63	5.04*
AstraZeneca	6.10 ± 0.37	20.04 ± 0.88	31.28 ± 1.75	34.49	6.98*
LSD value	4.85*	5.79*	4.02*	5.66*	---
* (P ≤ 0.05), ** Mean ± SE.					

Cases were divided in this study according to age into 3 groups (less than 30 years, 30-50 years, and more than 50 years). The statistical analysis shows a significant decrease in IgG levels of individuals vaccinated with Pfizer and Sinopharm of ages above 50 years, this decrease in IgG did not appear in people vaccinated with AstraZeneca. (Table 6).

Table 5.SARS-CoV-2 IgG Total Levels in Males and Females among Vaccinated Groups

Type	IgG** (Male)	IgG** (Female)	LSD Value
All vaccine	28.01 ± 1.79	25.01 ± 1.27	3.26 NS
Pfizer	38.63 ± 2.55	29.89 ± 2.08	5.61*
Sinopharm	21.71 ± 0.92	32.76 ± 2.66	5.47*
AstraZeneca	32.25 ± 2.18	15.36 ± 0.47	5.38*
LSD value	5.72*	4.88*	---
*(P ≤ 0.05), **Mean ± SE, NS: Non-significant.			

Table 6.Comparison in IgG Levels between different Groups according to Age Distribution

Type	IgG** < 30 years	IgG** 30-50 years	IgG** > 50 years	LSD Value
All vaccine	28.01 ± 1.28	28.15 ± 1.36	23.94 ± 1.15	3.96*
Pfizer	41.99 ± 2.66	40.14 ± 1.97	25.92 ± 1.50	4.63*

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Sinopharm	28.27 ± 1.41	24.40 ± 0.95	17.06 ± 0.79	4.08*
AstraZeneca	25.92 ± 1.07	22.17 ± 1.14	29.69 ± 1.76	4.12*
LSD value	4.59*	4.92*	4.02*	---
* (P ≤ 0.05), ** Mean ± SE.				

Discussion

The most important way to govern the pandemic Coronavirus disease (2019) is to provide a powerful vaccine. Presently, numerous vaccines have been created by using distinct strategies, which are used all around the globe with emergency use approval.[11] When the effectiveness of vaccines is studied; Pfizer, AstraZeneca and Sinopharm declared the efficacy of the vaccine as 95%, 81%, 79% respectively.[12,13] This explains the difference in IgG levels acquired after immunisation with the three types of vaccines in Iraq. Bauer G proposed that vaccines elicit specific qualities of IgG in order to initiate intact immunity. Sufficiently, high level and long-lasting IgG readings mainly target viral systems that are applicable for binding to cellular receptors, RBD (receptor-binding domain); Neutralising IgG that have completed avidity maturation in the direction of COVID-19 virus and the potential of these antibodies to block the engagement of the virus to the cells.[14] Several studies reported rapid immune response and increase of SARS-CoV-2 neutralising antibodies after the first dose of vaccine in a group of previously infected persons and reached high titers similar to seronegative participants who received two vaccinations.[15-18] Blain H et al. suggested that a single dose of AstraZeneca vaccine may be enough to obtain a high concentration of S-protein IgG antibodies in nursing home residents previously infected with SARS-CoV-2.[19]

Lombardi A et al. showed how Pfizer can elicit specific antibodies titers and neutralising antibodies levels over those observed among previously infected cases serum in the first 100 days after vaccination.[20]

Immunoglobulin type G to spike antigen was stable over six months. B-cells reminiscence spike-specific had been more considerable at 6 months than at one-month symptoms appearance. SARS-CoV-2 specific Helper T-cells and Cytotoxic T-cells depleted with a 1/2-life of three to five months. By studying antibody, memory B-cell, helper T-cell, and Cytotoxic T-cell memory to COVID-19 virus in an included situation, each factor of COVID-19 immune memory demonstrated awesome kinetics.[21]

Muller L et al. described differences between the antibody responses raised after the first and second Pfizer/ BioNTech vaccination, in particular lower frequencies of neutralizing antibodies in the elderly group.[22] Other studies reported decrease in both antibody responses to SARS-CoV-2 and mild to moderate reverse events in well older individuals compared to younger participants.[23,24] Age-associated immune system especially adaptive immune responses decline in older peoples known as immunosenescence. The impact of ageing on immunity is linked with an enhanced susceptibility to both infectious and non-infectious illnesses and a substantial elevation in disease severity and mortality. Immunosenescence can also respond less to vaccination, mainly due to a decline in cellular as well as humoral immunity. For vaccinations including the influenza vaccine, this limitation is bypassed by increasing the vaccine doses.[22,25]

Men and women display variations in immune responses to several viral vaccines. In general, women develop significant higher concentrations of humoral immunity than men.[26] World Health Organization (WHO) reported that females generate stronger cellular and humoral immune responses to antigenic stimulation, infections and vaccination than males. Studies also indicate that cross reactions to vaccines may be more prevalent among females compared to males. In this study, Sinopharm vaccine only generated high IgG antibodies in females, while Pfizer and AstraZeneca produced high antibodies in males rather than females. To what range these findings contribute to recognised greater vaccine hesitancy among females remains to be investigated.[27]

Conclusion

- All types of vaccines produce IgG antibodies which protect persons from infection for at least one month
- Second dose is important for all three vaccines
- Previously infection give more protection against COVID-19, with recommended one dose for them
- AstraZeneca protects old aged people from infection better than Pfizer and Sinopharm
- Sinopharm is more effective on females than males

Source of Funding: Self

Conflict of Interest

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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