A Comparison of the COVID-19 Vaccinations Used During Various Time Periods in Iraq

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Abstract
The sole means of preventing the COVID-19 pandemic are vaccines against the SARS-CoV2 virus (severe acute respiratory syndrome). By examining people's IgG levels and the times during which they survived at high levels, the study sought to evaluate the efficacy of the three vaccination types utilized in the Nineveh governorate. IgM appeared in 82.5% of the positive control samples and in 30% of the negative control samples, reflecting the presence of recent cases of infection in vaccine recipients after vaccination. IgM appeared in 46% of those who received the Sinopharm vaccine, 39.1% of those who received the Pfizer vaccine, and 13.9% of those who received the AstraZeneca vaccine. For the first time period following the immunization (less than 8 months) and for the three different vaccine types, the rate of IgG occurred at a high level. It was highest among individuals who received vaccines from Sinopharm, AstraZeneca, and Pfizer, and its rate started to fall as the amount of time passed after the shots for all three vaccine kinds. there are no obvious substantial differences, the rate of IgG appeared among individuals with a positive IgM at the highest level in the third time period when vaccinated with the Pfizer and Sinopharm vaccines, and in the second time period when vaccinated with the Astrazeneca vaccine. As its rate increased generally with the increase in the period of the vaccine, this reflects the role of post-vaccination infection. The body's IgG levels rise as a result of (IgM+).
Keywords: COVID-19, Sinopharm, IgG levels, AstraZeneca, Pfizer

1. Introduction

Two vaccines against the 2019 coronavirus disease (COVID-19) have received approval for use in the USA. The Pfizer BioNTech COVID-19 vaccine and the Moderna COVID-19 vaccine both received Emergency Use Authorizations from the Food and Drug Administration (FDA) on December 11, 2020, and December 18, 2020, respectively; both must be administered in a two-dose sequence [1,2]. According to recent estimates, there have been more than 187 million cases diagnosed and more than 4 million fatalities in the coronavirus disease 2019 (Covid-19) pandemic [3.] The severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) full-length spike glycoprotein is encoded by BNT162b2, a lipid nanoparticle-formulated, nucleoside-modified RNA in a prefusion stabilized conformation[4,5,6]. Despite a gradual decline in vaccine effectiveness throughout the follow-up period of six months, BNT162b2 had a good safety profile and was very effective at preventing Covid-19 [7]. One of six Covid-19 vaccines based on various platforms that have been approved for emergency use is ChAdOx1 to-19, a replication-deficient chimpanzee adenoviral vector containing the sequence for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) structural surface glycoprotein antigen [8,3,9,10]. The first Chinese COVID-19 vaccine that the WHO has authorized for use urgently is the Sinopharm COVID-19 vaccine, an inactivated coronavirus vaccine created by the Beijing Bio-Institute of Biological Products (BBIBP) [11]. Numerous studies have demonstrated the safety and tolerability of Sinopharm, and 100% of patients who received the vaccination reported a positive humoral immune response [12,13]. Within 28 days of vaccination, some mild to severe adverse reactions but no serious adverse events occurred. Additionally, compared to a single 4 or 8 uL dose, a 2-dose vaccination given one-month apart results in higher neutralizing antibody titers [14]. Following vaccination, people's antibody levels go through a dynamic process, and how long they remain steady is directly related to how resistant they are to contracting the virus. It's important to remember that higher doses of the vaccine or monoclonal antibodies are required for the population at higher risk, such as the elderly and those with immunodeficiencies who have low antibody levels [15,16.] Over 10 billion vaccine doses have been given in total, but more research is still needed to determine how long the high antibody levels in the serum last. The most important intervention strategy to stop the spread of COVID-19 is a large-scale vaccination program that is both safe and effective, and antibody detection serves as a gauge of the vaccine's efficacy [17,18,19].

2. Materials and Method

This study is being conducted in Nineveh Governorate on healthy, uninfected, infected, and vaccinated people. From June to September, a total of 281 blood samples were taken, with (134 (47.7%) males and 147 (52.3%) females) ranging in age from (20-87) Each person's information was recorded on a specific form that included questions regarding age, gender, date of vaccination, number of doses,

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vaccine symptoms, comorbidities, the date of the previous infection with the virus, disease after vaccination and its date, and work.

1-Using the indirect ELISA technique, determine the levels of IgM.

This kit was created using the indirect enzyme-linked immune-sorbent assay technique. The 96-well plates were pre-coated with recombinant nucleocapsid protein. The HRP-conjugated antibody was utilized as the detecting antibody. After that, the standards, test samples, and HRP conjugated detection antibody were added to the wells and rinsed with a wash buffer. TMB substrates were utilized to visualize the HRP enzymatic process. HRP catalyzed TMB to yield a blue product that turned yellow after adding an acidic stop solution. The density of yellow is related to the amount of sample collected on the plate. Read the O.D. absorbance at 450nm in a microplate reader to compute the target concentration.

2-Use the indirect ELISA technique to determine the levels of IgG.

The indirect enzyme-linked immune-sorbent assay methodology was used in this kit. Pre-coated 96-well plates were pre-coated with recombinant Nucleocapsid protein. The detecting antibody was the HRP-conjugated antibody. Following that, the wells were washed with wash buffer and the standards, test samples, and HRP conjugated detection antibody were added. The HRP enzymatic process was seen using TMB substrates. HRP catalyzed TMB to yield a blue product that became yellow when an acidic stop solution was added. The density of yellow in the plate is related to the amount of sample taken. In a microplate reader, read the O.D. absorbance at 450nm, and then compute the target concentration.

3. Statistical Analysis

Data were analyzed according to a simple experiment system using a completely randomized design. Significantly different coefficients were distinguished, with different letters of the alphabet, using Duncan's multiple range test at a 1% probability level.

4. Results and Discussion

1-Individuals under investigation as a group

The vaccinated individuals were separated into two groups (infected and non-infected after receiving the vaccination) based on the positivity of the IgM test for the three vaccines and comparison with positive and negative controls, as shown in the table below.

Table(1). IgG and IgM averages and percentages for the various vaccinations used

		IgM – (4-14.15) ng/ml						IgM+(4-14.15) ng/ml					
Type of vaccine	Total	Number	Percentage %	Mean IgG ((43.85-429.05) ng/ml	S. D	Mean IgM ng/ml	S. D	Number	Percentage %	Mean IgG(43.85-429.05) ng/ml	S. D	Mean IgM ng/ml	S. D
Pfizer	92	56	60.9	937.12 c ±53.52	262.22	9.13a ±0.5	2.4	36	39.1	1189.74 b ±85.66	514	32.38 a±7.77	46.66
Sinopharm	74	40	54	828.44 a ±102.34	630.88	8.06 a ±0.37	2.39	34	46	1293.24 a ±159.85	932.11	30.66 a±6.16	35.96
Astrazeneca	65	56	86.1	804.35 b ±66.2	495.42	7.46 a±0.37	2.8	9	13.9	957.10 c ±97.83	293.5	17.63 b±3.13	9.39
CO +	40	7	17.5	582.2 d ±125.76	332.74	8.11 a±2.3	4.6	33	82.5	765.5 d ±105.16	604.15	15.64 b±1.32	7.16
CO -	10	7	70	449.57 e ±127.13	336.36	7.31 a±1.61	3.94	3	30	704.6 d ±275.57	389.72	14.15 b±	-
Total	281	-	-	-	-	-	-	-	-	-	-	-	-

* Similar letters refer that there are no significant differences at the probability level of ($p \leq 0.05$) according to Duncan Test.**Mean ± standard error. SD. Standard deviation.

Pfizer vaccinated 60.9% of those who tested IgM-, whereas 39.1% tested positive for IgM at a rate of 32.38 ng/ml. 54% of individuals vaccinated by Sinopharm have IgM-, and 46% have IgM+ with a rate of 30.66 ng/ml after taking the vaccine. AstraZeneca immunized 86.1% of the patients, whereas 13.9% were infected after receiving the vaccine at a rate of 17.63 ng/ml to IgM+.

Rates of all persons who were positive for IgM were higher in comparison to those who were negative for IgM for all types of vaccines, and this is considered normal because these individuals were infected after the vaccine, which is considered an enhancing dose that increases the immune response against the virus protein and thus the concentration of IgG in blood increases, as evidenced by the increase in IgM rates in infected individuals in comparison to those who were negative to IgM.

Positive control samples (infected and unvaccinated people) were used to determine the effect of the vaccine on the body's immune response and the production of IgG, as well as the vaccine's effectiveness against the disease and obtaining the necessary immunity for protection against the virus infection a second time.

Because the majority of the vaccinated people were infected before receiving the vaccine, and they have immunity that was acquired during the first infection, but this immunity is weakened over time, especially if unvaccinated, it was observed that the rates of IgG for the three vaccines were high in comparison to the

positive control samples, confirming the effectiveness of the vaccine and stimulating the body's immunity response, as a result. Additionally, negative control samples (non-infected and non-vaccinated individuals) are used to identify the rate of IgM as a normal one, compare it to other study participants, and separate recently infected individuals from previously infected individuals because the values of the negative control samples are thought to be the ideal measure in such studies. The individuals were recognized as negative control samples based on the data that had been recorded, demonstrating that they had not displayed any symptoms and had not been exposed to the virus. In reality, there may have been cases of infection without obvious symptoms in the patient; these cases were known as "carriers of the disease," which explains why the antibodies' results appeared to be negative. These individuals were also all negative on the IgM test, confirming that they had not recently contracted the infection. As a result, they were used as negative control samples. Even though the IgM rates were greater in the infected and immunized individuals, these rates were still within the normal range. Comparing those who received the Pfizer vaccine to those who received other vaccines, higher rates of IgG were found, indicating that the Pfizer vaccine is more effective than the others. While those who received the AstraZeneca vaccine and those who were not sick showed the lowest rates of IgG. The IgG rates for the infected individuals varied across vaccines because each member of this group contracted the illness at a different time, and the more recent the infection, the higher the number of antibodies. The high levels of IgM in people who were vaccinated and then infected following the vaccination, especially in those who were vaccinated by Pfizer and Sinopharm, make this obvious. The findings demonstrated that non-infected individuals' IgG rates differ significantly from those of CO+ and CO-. In comparison to CO+ and CO-, the IgM rates for the three vaccines did not differ significantly. Additionally, it was noted that the IgG rates for the three vaccines in comparison to CO- varied significantly. Additionally, it was noted that Pfizer and Sinopharm's IgM samples significantly differed from the CO+ and CO- samples in comparison, although AstraZeneca's samples did not. It was demonstrated in research on those who had received vaccinations vs those who hadn't that the virus cleared more quickly and that the period of infectivity was shorter[20]. The results of the current study are in line with past research that demonstrated the Pfizer vaccine's advantage over those made by AstraZeneca and Sinopharm when compared to the control group [21]. Recent studies have shown that vaccination protects against serious hospitalization and death outcomes for a longer period than symptomatic and asymptomatic infection [22,23].

According to recent studies [24,25,10] complete vaccination was effective against SARS-CoV-2 even for recently evolving variations, and infection rates were much lower in the vaccine group than in the non-vaccinated group. Contrarily, many studies revealed that vaccination against the Wuhan (B.1) or Alpha (B.1.1.7) variants was less successful than vaccination against the Delta (B.1.617.2) variation [26,27,28]. Another study conducted in a Massachusetts town discovered that 74% of the 469 cases, the majority of which were infected with the Delta strain, had gotten all advised immunizations [29]. While another study discovered that the majority of vaccine breakthrough infections occurred outside of the USA [30]. Spike protein antibodies successfully stopped SARS-CoV from entering the host cell, but changes in the region of the S-receptor-binding protein allow them to get beyond host defenses and lead to the development of new variations[31,32]. The ability to evade immunity and cause reinfection are all characteristics of emerging new variants, together with greater transmissibility, severity, and mortality [33,34].

2-The duration of the vaccination

2-1The period after receiving the vaccine that is required for non-infected individuals

The time between the date the vaccination was administered and the date a sample was taken from the administered vaccines was identified as the duration of time for each vaccine. According to the information obtained from the subjects, the time was separated into three periods: the first included 8 months or less, the second included 8–12 months, and the third included 13–16 months. The rate of IgG for each period was identified as shown in the following table:

Table (2). The duration of the vaccines being studied

	The duration of time of the vaccine	Number	Percentage %	Mean IgG(43.85-429.05) ng/ml	S.D
Pfizer	Less than 8 months	24	42.8	985.95 a ±81.76	283.24
	8-12	29	51.8	719.46 a ±35.24	145.31
	13-16	3	5.4	818.98 a ±43.77	61.9
	Total	56	100		
Sinopharm	Less than 8 months	7	17.5	1344.8±505.79	1338.21
	8-12	28	70	804.36±112.53	595.46
	13-16	5	12.5	354.05 ±35.32	61.18
	Total	40	100		
AstraZeneca	Less than 8 months	4	7.1	1282.0 a ±629.414	1090.17
	8-12	25	44.7	869.26 b ±65.69	270.84
	13-16	27	48.2	722.92 b ±64.94	275.55

* Similar letters refer that there are no significant differences at the probability level of ($p \leq 0.05$) according to Duncan Test.**Mean ± standard error. SD. Standard deviation.

In each of the three time periods, Pfizer vaccine recipients had IgG levels that were (985.95ng/ml), 719.46ng/ml, and 818.98ng/ml, respectively. During each of the three time periods, the rate of IgG in individuals who received the Sinopharm vaccine was (1344.8 ng/ml, 804.36 ng/ml, and 354.05 ng/ml, respectively). In individuals who had an AstraZeneca vaccination, the rates of IgG were, respectively, 1282.0 ng/ml, 869.26 ng/ml, and 722.92 ng/ml for the three time periods. The duration of effectiveness of Pfizer is longer than that of AstraZeneca, which is itself longer than Sinopharm. In general, the rate of IgG was reduced with the elongation of time in the three types of vaccines; the lowest rate of IgG was during the period of 13 months for the Sinopharm vaccine, while it was the least reduced during 13-16 months for Pfizer. When compared to other vaccines, AstraZeneca showed significant differences over the periods of (8-12) and (13-16), respectively, but not for the three vaccines during the first eight months.

2-2The time after vaccination for those with positive IgM

For each vaccine, the length of time for the sick individuals was determined, and for each vaccine, the rate of IgG during the lengths of time in the vaccinated individuals with positive IgM after the vaccine was determined.

Table(3). The lengths of time that infected people received the vaccines under study

	The duration of time of the vaccine	Number	Percentage %	Mean IgG (43.85-429.05) ng/ml	S. D	Mean IgM (4.4-9.85) ng/ml	S. D
Pfizer	Less than 8 months	15	41.7	1032.89 b ±124.51	482.25	43.71 a ±18.1	70.13
	8-12	18	50	1215.44 b ±33.61	142.61	23.15 a ± 3.36	14.26
	13-16	3	8.3	1819.68 a ±209	362.15	31.06a ± 8.59	14.89
	Total	36	100				
Sinopharm	Less than 8 months	18	52.9	1321.32 a ±203.1	952.66	31.77a ± 21.61	48.32
	8-12	9	26.5	1067 a ±201.55	450.69	21.4a ± 2.7	12.7
	13-16	7	20.6	1365.91 a ± 449.65	1189.68	45.95a ±24.18	63.99
	Total	34	100				
AstraZeneca	Less than 8 months	1	11.1	750 b	0	13.75 a	0
	8-12	2	22.2	1395.2a ±78.3	110.73	14.48 a ± 1.12	1.59
	13-16	6	66.7	845.58 b ±76.49	187.37	19.34 a ± 4.65	11.4
	Total	9	100				

* Similar letters refer that there are no significant differences at the probability level of ($p \leq 0.05$) according to Duncan Test.**Mean ± standard error. SD. Standard deviation.

Because the infection happened after the vaccination, which was regarded as an enhancing dose, the rate of IgG increased. This is demonstrated by the high rates of IgM, for the three vaccines, in individuals who acquired the infection after the vaccination, in comparison to the control samples. The three vaccines' IgG rates varied, as did their duration of response, and this was related to the dates on which the immunizations were administered, and samples were collected. The elevated IgM rate in all three periods indicates that there was a recent infection by the same virus after the vaccine, as indicated by the fact that the rate of IgG in individuals who became ill after receiving the Pfizer vaccine was high during the first period and increased with time after taking the vaccine. Regarding Sinopharm, the IgG rate decreased during the second period, increased during the third, and was accompanied by an increase in the IgM rate during the third period. This indicates that there was a recent infection in people who received the vaccine and within a short period before the date, the sample was taken. The second period saw the highest IgG prevalence among AstraZeneca vaccine recipients. Because there were no clear symptoms in the individuals who became infected after receiving the vaccine, their infection was only discovered through the high level of IgM, we were unable to conclusively demonstrate the irregularity of the rates of IgG (low and high rates) during the durations of time for the three vaccines due to the date of the infection after the vaccine. The outcomes also demonstrated that Sinopharm benefited much more during the first period as compared to Pfizer and AstraZeneca. Additionally, it was noted that Pfizer significantly differed from AstraZeneca and Sinopharm for the benefit of IgG during the second term. Additionally, there are notable variances for AstraZeneca in the third period when compared to Pfizer and Sinopharm. For all of the vaccines under investigation, there are no appreciable variations in IgM rates. The results of the present study are comparable with those of earlier research, which showed that the three types of immunizations vary significantly in antibody levels and their persistence for weeks after inoculation, with the Pfizer vaccine having the greatest levels[35]. According to the results of the American experiment, BNT162b2's ability to prevent SARS-CoV-2 infections started to wane after six months [36]. The effectiveness against infection steadily declines in the months after receiving the second dose. An increase in infections 6–12 months following the second treatment, as well as the potential need for booster doses, were predicted given that immunogenicity trials conducted during this period had shown decreasing neutralizing antibody titers [37]. According to a different study, AZD1222 can offer security for up to six months [38] In contrast, AstraZeneca and Sinopharm's vaccines produced antibodies whose levels were significantly lower and whose mean stability persisted for 120 days [39]. According to a

different study, the immune response began to wane 6 and 12 weeks after vaccination as antibody levels dropped [40]. Both declining immunity and the emergence of the variation contributed to the decrease in infection resistance over time [41].

Conclusion

IgM appeared in 82.5% of the positive control samples and in 30% of the negative control samples, reflecting the presence of recent cases of infection in vaccine recipients after vaccination. For the first period the rate of IgG occurred at a high level. It was highest among individuals who received vaccines from Sinopharm, AstraZeneca, and Pfizer, and its rate started to fall as the amount of time passed after the shots for all three vaccine kinds.

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