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Assessment of Immune and Liver Changes Post COVID-19 Infection & Vaccination

Ayam M. Salih*[1]

1- Department of Microbiology, Hammurabi Medical College, University of Babylon, Hilla, Iraq

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ABSTRACT

Background: Severe acute respiratory syndrome coronavirus 2 that is causing the ongoing COVID-19 epidemic, has resulted in fatalities and illness. Vaccination from SARS-CoV-2 is the primary approach used to alter the course of the pandemic. Measurement of anti-spike protein antibody levels This cross-sectional study evaluated the efficacy and biochemical effects of the AstraZeneca and Sinopharm COVID-19 vaccines.**Methods:** Plasma and serum samples have been collected from 150 SARS-CoV-2-positive individuals one month after receiving two doses, with antibody levels measured using the Enzyme-Linked Immunosorbent Assay anti-SARS-CoV-2 S assay using a Cobas e-411 analyzer, and the nucleic acid testing method by Reverse Transcription Quantitative was used to distinguish infected individuals from non-infected ones. **Results:** Results showed 92% developed detectable antibodies (>0.8 U/ml), with 46% exhibiting high responses (>200 U/ml), 14% intermediate responses (>100 U/ml), and 32% low responses (<100 U/ml). One year post-vaccination, 69% remained protected, while 17% were sick within six months and 13% after six months. AstraZeneca showed variations in immune response, with rates of 88% for individuals under 40 years, 59% for those aged 40–60 years, and 38.5% for those older than 60 years. Sinopharm displayed a stronger correlation with age, with response rates of 43% for individuals aged < 40 years, 49% for those aged 40–60 years, and 31% for those aged > 60 years. No significant differences have been noted in terms of sex or history of infection. AstraZeneca led to higher increases in GOT (26.5 ± 6.5 vs. 23.5 ± 5.9), GPT (25.2 ± 6.8 vs. 22.8 ± 6.0), ALP (170.4 ± 49.5 vs. 159.8 ± 42.3), and TSB (0.9 ± 0.2 vs. 0.7 ± 0.2), indicating distinct biochemical effects. **Conclusion** These findings provide valuable insights into vaccine efficacy, immune response variability, and the need for booster doses..

Introduction

Countries have faced major hurdles since COVID-19 pandemic started in 2019 owing to SARS-CoV-2. Usually, starting with flu-like symptoms, a COVID-19 infection can either be asymptomatic or escalate from moderate to severe

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* *Corresponding author:* Ayam M Salih
E-mail address: ayam.salih@uobabylon.edu.iq

[1-2]. Significant inflammation is the hallmark of this disease. According to previous studies, there is a correlation between COVID-19 infection and blood count parameters, namely the neutrophil/lymphocyte [3]and platelet/lymphocyte ([4] ratios.

Despite extensive research on diagnosis, treatment, and vaccines [5], it remains challenging to fight the virus effectively. The number of rapid and accurate tests is insufficient, case identification is not always practical, and the human defence mechanism against the virus is still not fully understood. Scientists have developed multiple vaccines . When Edward Jenner created the smallpox vaccine in the late 1700s, vaccination history began [6]. As the first successful attempt at targeted disease vaccination, Jenner's pioneering work used the cowpox virus to provide immunity against smallpox . Since then, vaccine development has evolved. Advancements such as attenuated viral strains adapted for in vitro growth have facilitated development of vaccines for some illnesses like polio, measles, rubella, mumps, and varicella [7].Vaccine development has employed several approaches, including the following: i) assortment, which involves mixing RNA segments from different viruses to create vaccines for influenza and rotavirus; ii) inactivation, which involves the use of heat or chemicals to prepare vaccines that contain non-infectious viruses or bacteria; iii) protein-based, which involves utilizing purified proteins as antigens to trigger an immune response; and iv) genetic engineering, which involves inserting genes encoding protective antigens into viral or bacterial carriers, and innovating vaccine development. Several vaccines with different strategies have been produced throughout the COVID-19 pandemic, including i) mRNA vaccinations, like mRNA1273 (Moderna) and BNT162b2 (Pfizer), which employ mRNA to induce cells to manufacture a particular protein that is present in COVID-19, hence inducing an immune response [8]. and viral vector vaccines, including vaccines such as AZD1222 (Oxford/AstraZeneca), which use harmless viruses known as adenoviruses as carriers to carry a specific piece of DNA into cells [9]. This DNA contains instructions for creating proteins associated with COVID-19, which stimulates the immune system. Inactivated vaccines, including CoronaVac by Sinovac and Covaxin by Bharat Biotech, employ inactivated forms of COVID-19 [10]. Additionally, certain vaccines, such as NVX-CoV2373 by Novavax, use specific protein subunits derived from COVID-19 [11]. Each vaccine uses a distinct approach to bolster the immunity against the virus. However, these vaccines focus on the COVID-19 spike protein [12]. By binding to angiotensin-converting enzyme 2, this protein makes it easier for viruses to enter the host cells. Antibodies that target the spike protein are linked to immunity and have demonstrated strong antiviral activity [13]. Despite significant advancements in the development and understanding of COVID-19 vaccines, there remains a substantial gap in knowledge regarding their long-term immunological effects and potential impact on liver function. While previous studies have primarily focused on immediate immune responses following vaccination, limited research has systematically analyzed the dynamic evolution of immunity over time and its correlation with key clinical variables such as age, sex, prior COVID-19 infection, and underlying health conditions. Additionally, comparative data on the sustained immunological effects of different vaccine platforms, such as AstraZeneca’s viral vector-based vaccine and Sinopharm’s inactivated virus vaccine, remain scarce. This study aims to bridge this gap by conducting a systematic review and analysis of the long-term immune response and liver function markers associated with these two vaccines. By addressing this unexplored aspect, the findings of this study will contribute valuable insights into vaccine-induced immunity and its implications for global vaccination strategies. Since the introduction of the initial COVID-19 vaccine, ~4.9 billion individuals worldwide have received vaccination. The vaccination campaign commenced in Morocco on January 29, 2021, initially using only the AstraZeneca and Sinopharm vaccines. Subsequently, Janssen, Johnson and Johnson, and Pfizer-BioNTech vaccines were administered. However, uptake of the Moderna vaccine has been limited. Presently, ~23.5 million individuals in Morocco were fully vaccinated, constituting 65% of the country's population. The original COVID-19 vaccine, sold under the name Vaxzevria, was withdrawn from the market by AstraZeneca in 2024 as it caused fatal blood clots and low platelet counts, also known as thrombosis-thrombocytopenia syndrome [14]. this study aimed to evaluate immune responses and liver function changes in individuals who received two types of COVID-19 vaccines (AstraZeneca and Sinopharm), in order to assess

post-vaccination variability and implications on public health strategies.

Patients and methods

Study Population

This is a cross-sectional study conducted in Hilla, Iraq. From the conclusion of the second wave to the end of the fourth wave of COVID-19 in Iraq, the current study was conducted between July 2021 and July 2022. A total of 150 people, ranging in age from 18 to 80 years, volunteered to participate in this study. Overall, 116 people received the Sinopharm vaccine, and 34 received the AstraZeneca vaccine. Blood samples were taken from the Analyses Laboratory in Hilla, Iraq, one month after the second dosage of the vaccine, in order to assess the levels of anti-spike antibodies. The study population was diverse and included individuals from various demographic groups and regions within Iraq. Participants were categorized by age group (<40, 40–60, >60 years) and sex, with females accounting for 49% of the study population and males accounting for 51%. People with pre-existing medical disorders as well as those undergoing radiation therapy, cancer treatments, or immunosuppressive drugs were excluded from the study. This diversity ensures that the findings can provide a broader understanding of the vaccine responses across different population segments.

Research Timeline

The research began in July 2021 with preliminary work that involved secondary analysis of anonymized data, for which formal ethics approval was not initially required. As the project evolved to include primary data collection, an ethics approval waiver was proactively obtained in March 2022 to ensure compliance with the institutional standards. Following this approval waiver, the experimental phase began by analyzing samples stored in the Analysis Laboratory in Hilla in July 2021 and collecting new samples. This schedule reflects the described study period, capturing the preliminary analysis of existing samples and the subsequent collection of new data. Verbal consent was obtained from participants owing to several factors, including the illiteracy of some patients and the preference of other patients for oral consent rather than written documentation.

Viral RNA Extraction

Nucleic acid testing was used to distinguish infected individuals from non-infected individuals. The Genrui nucleic acid extraction assay (Genrui Biotech Inc.) was used to isolate RNA from nasopharyngeal and pharyngeal swabs using the Genrui 48 automated platform, in accordance with the manufacturer's recommendations. Prior to analysis, the extracted RNA samples were stored at a temperature of − -80˚C.

Reverse Transcription Quantitative PCR (RT qPCR)

RT-PCR has been carried out with the use of GeneFinderTM COVID-19 Plus RealAmp kit (OSANG Healthcare Co., Ltd.) in accordance with the manufacturer's instructions (EUA OSANG gene ifu, REF IFMR 45). Therefore, using the croBEE® Real-Time PCR System, RT-PCR has been carried out in a total volume of 20µL, comprising 5 µL of RNA extracted from patient samples and 15 µL of GeneFinder™ COVID-19 Plus RealAmp master mixture (containing 10µL of COVID-19 Plus Reaction mix and 5µL of COVID-19 Plus Probe mix). After 20 min of incubation at 50 ºC, the reaction mix has been subjected to 45 denaturation cycles at 95 ºC for 15s, annealing at 58 ºC for 60s, and pre-denaturation at 95 ºC for 5 min. RNAse P, a human housekeeping gene, was used to normalize gene expression and provide an internal control. The manufacturer of the kit, OSANG Healthcare Co., Ltd., owns the ORF1ab target and RNAse P primer sequences, which are proprietary and secret and cannot be shared. The 2-ΔΔCq value, which is based on the threshold cycle (Cq) approach, has been utilized for determining the relative SARS-CoV-2 expression levels.

Measurement of Antibodies

The ELIZA anti-SARS-CoV-2 S assay (Roche Diagnostics), which operates on Cobas e-411 system from Roche Diagnostics, has been utilized for analyzing blood samples for antibodies against SARS-CoV2. Antibodies that bind to a particular part of the virus spike protein were measured using this test.

Bio-chemical Bio-marker Measurement

Bio-chemical markers have been measured with the use of Genotek Smart 120 Autonomous Biochemistry Analyzer. Those markers included the markers of liver functions (GOT, GPT, ALP, and TSB). The samples have been thawed at room temperature. The samples have been mixed well prior to the measurement. A 1,000µL of serum has been added to calibration solution. After 15min of reaction, the fluorescence has been measured at 350nm, its intensity has been directly proportionate

to the level of the antibodies in the studied sample. Which is why, results are calculated automatically based upon values that are stored in the memory of devices, and test values have been obtained.

Electrochemiluminescence detects antibodies and is used to quantify their levels. The test can detect antibody concentrations ranging from 0.40 to 250 U/ml and can be diluted 1:10 to measure concentrations of up to 2,500 U/ml. Concentrations <0.80 U/ml are considered harmful, while concentrations at or above ≥0.80 U/ml are classified as positive.

Statistical analysis. IBM SPSS Statistics 28.0 software for Windows, was utilized in order to process statistical data. The chi-squared test or Fisher's exact test (where one of the theoretical numbers was ≤5) was used to examine the relationship between the response to the vaccinations and data from COVID-19-infected patients. Differences have been deemed statistically significant if the p-value has been ≤0.050.

Results

This study included 150 participants with an average age of 52.6 years, 18–80 years). The age breakdown revealed that 28% of the subjects were <40 years old, 41% were between 40 and 60 years old, and 31% were >60 years old. Regarding the type of received vaccination, the majority (77%) received 2 doses of Sinopharm vaccine, whereas the remaining 23% were vaccinated with the AstraZeneca vaccine (Table 1).

After completing the second vaccination dose, at the 14-day mark, antibodies against the spike protein of the virus were measured. The majority of participants (92%) had detectable levels (>0.8 U/ml) of these antibodies (138 out of 150 subjects). Of these, 46% had high antibody responses (>200 U/ml), 14% had intermediate responses (>100 U/ml), 32% had low responses (<100 U/ml), and 8% had no detectable antibody responses (Table 1).

One year after vaccination, 69% of the study participants remained fully protected and had not been ill, 17% had been sick within the first six months, and 13% had been ill after the first six months (Table 1).

Statistical analysis found no clear association between age, gender, or previous infection with COVID-19 and the effectiveness of the AstraZeneca vaccine. However, there was a noticeable trend in the responses based on age. Younger patients (<40 years of age) had a higher response rate (88%) than those aged 40-60 years (59%) and those >60 years (38.5%), as shown in Table (2) . However, these differences have not been statistically significant (P=0.31).

In contrast, a notable association was detected between age and the response to the Sinopharm vaccine. A high response rate was noted in 43% and 49% of cases in the age group <40 years and in the age group between 40-60 years, respectively, compared with 31% in patients >60 years of age, as shown in Table (3), (P=0.018). However, no significant associations were found between the response to the Sinopharm vaccine and sex (P=0.22) or history of COVID-19 infection (P=0.48).

When comparing the two vaccines, there was no noticeable difference in the immune response based on the sex.

1. Previous COVID-19 infection. However, older individuals responded significantly better to both the vaccines (P=0.01). Furthermore, the type of vaccine used influences the response. Those who received the AstraZeneca vaccine had a higher response rate (59%) than those who received the Sinopharm vaccine (42%) (P=0.02) Table 4.

Following vaccination, 67% of individuals who developed a strong response to the vaccine never contracted the virus, whereas 24% of the subjects were infected with COVID-19 after 6 months. Among those who had a weak or no response to the vaccine, 69% did not contract the virus. Regarding vaccine type, the populations vaccinated with the Sinopharm and AstraZeneca vaccines exhibited similar results in the statistical analysis. These results indicate no significant difference in the conclusion that post-vaccination infection is directly related to vaccine type or response (Table 5).

Thus, although the AstraZeneca vaccine may induce a higher antibody response, this does not necessarily translate into a significant difference in the overall protection against post-vaccinal infection, particularly when assessing severe forms of the disease.

The results also showed that the GOT enzyme levels for AstraZeneca vaccine recipients were 26.5 ± 6.5, which was higher than that in Sinopharm recipients at 23.5 ± 5.9. Similarly, the GPT levels were 25.2 ± 6.8 for AstraZeneca,

respectively, while Sinopharm recipients had a lower level of 22.8 ± 6.0. For ALP, the levels reached 170.4 ± 49.5 in AstraZeneca recipients, which exceeded those of Sinopharm recipients at 159.8 ± 42.3. Finally, the TSB levels for AstraZeneca recipients were 0.9 ± 0.2, compared to 0.7 ± 0.2 for Sinopharm recipients. Table (6).

These findings clearly indicate that the AstraZeneca vaccine leads to higher increases in the aforementioned parameters compared to the Sinopharm vaccine.

Table 1. General clinical characteristics of subjects that are included in the present study (n=150).

Parameters	AstraZeneca (n=34)	Sinopharm (n=116)	No. of subjects (%)
Age, years			
\<40	**8**	**34**	**42 (28%)**
40-60	**15**	**46**	**61 (41%)**
>60	**11**	**36**	**47 (31%)**
Sex			
Female	**17**	**57**	**74 (49%)**
Male	**17**	**59**	**76 (51%)**
Vaccine			
Sinopharm	**-**	**-**	**116 (77%)**
AstraZeneca	**-**	**-**	**34 (23%)**
Vaccine response			
High response	**20**	**49**	**69 (46%)**
Average response	**7**	**14**	**21 (14%)**
Low response	**6**	**42**	**48 (32%)**
No response	**1**	**11**	**12 (8%)**
History of COVID-19 infection			
No	**22**	**71**	**93 (62%)**
Yes	**12**	**45**	**57 (38%)**
Post-vaccination infection			
No	**23**	**81**	**104 (69%)**
During the first 6 months	**5**	**21**	**26 (17%)**
After 6 months	**6**	**14**	**20 (13%)**

Table 2. Association between the clinical features of subjects and the response to the AstraZeneca vaccine.

Parameter	High response (n=20) (%)	Low response (n=6) (%)	Average response (n=7) (%)	No response (n=1) (%)	P-value
Age, years					
\<40	**6 (88.9)**	**1 (11.1)**	**0 (0)**	**0 (0)**	**0.31**
40-60	**10 (59.1)**	**2 (18.18)**	**5 (22.73)**	**0 (0)**	
>60	**4 (38.5)**	**3 (38.5)**	**2 (15.38)**	**1 (7.7)**	
Sex					
Female	**10 (55)**	**3 (23)**	**4 (18)**	**1 (4)**	**0.999**
Male	**10 (64)**	**3 (23)**	**3 (13)**	**0 (0)**	
History of COVID-19 infection					
No	**12 (52)**	**5 (33)**	**3 (11)**	**1 (4)**	**0.23**
Yes	**8 (70)**	**1 (6)**	**4 (24)**	**0 (0)**	

Table 3. Relation between the clinical features of subjects and the response to the Sinopharm vaccine

Parameter	High response (n=49) (%)	Average response (n=14) (%)	Low response (n=42) (%)	No response (n=11) (%)	P-value
Age, years					
\<40	**13 (43)**	**4 (13)**	**10 (33)**	**3 (10)**	**0.018a**
40-60	**22 (49)**	**5 (11)**	**14 (31)**	**4 (9)**	
>60	**14 (31)**	**5 (11)**	**18 (40)**	**4 (9)**	
Sex					
Female	**24 (48)**	**5 (10)**	**17 (35)**	**4 (8)**	**0.22**
Male	**25 (38)**	**9 (13)**	**25 (38)**	**7 (11)**	
History of COVID-19 infection					
No	**25 (36)**	**7 (10)**	**26 (38)**	**8 (11)**	**0.48**
Yes	**24 (49)**	**7 (14)**	**16 (32)**	**3 (6)**	

[1]**a Indicates a significant difference (P<0.05).**

Table 4. Relation between the clinical features of subjects and the response to the AstraZeneca and Sinopharm vaccines**.**

Parameter	High response (n=69) (%)	Average response (n=21) (%)	Low response (n=48) (%)	No response (n=12) (%)	Total	P-value
Age, years						
40-60	32 (52)	9 (15)	18 (30)	3 (5)		0.01a
>60	20 (32)	7 (11)	29 (48)	5 (8)		
<40	17 (50)	5 (15)	11 (32)	1 (3)		
Sex						
Female	34 (48)	8 (11)	24 (34)	5 (7)		0.52
Male	35 (44)	13 (17)	24 (30)	7 (9)		
History of COVID-19 infection						
No	36 (42)	8 (9)	34 (40)	7 (9)		0.21
Yes	33 (49)	9 (13)	14 (21)	5 (7)		
Vaccine						
Sinopharm	49 (42)	14 (12)	42 (36)	11 (10)	116	0.02a
AstraZeneca	20 (59)	7 (21)	6 (18)	1 (3)	34	

[1]a Indicates a significant difference (P<0.05).

Table5. Relation between the clinical features of subjects and post-infection with COVID-19 following vaccination with the AstraZeneca and Sinopharm vaccines.

Parameter	No post-vaccination infection (n=104) (%)	During 6 months (n=26) (%)	After 6 months (n=20) (%)	P-value
Age, years				
40-60	41 (67)	9 (15)	11 (18)	0.84
>60	30 (64)	10 (21)	7 (15)	
<40	33 (79)	7 (17)	2 (4)	
Sex				
Female	47 (64)	13 (18)	13 (18)	0.027a
Male	57 (73)	13 (17)	7 (9)	
History of COVID-19 infection				
No	70 (67)	15 (14)	20 (19)	<0.001a
Yes	34 (75)	11 (24)	0 (0)	
Vaccine				
Sinopharm	81 (70)	21 (18)	14 (12)	0.16
AstraZeneca	23 (68)	5 (15)	6 (17)	
Response				
High response	48 (70)	12 (18)	9 (12)	0.034a
Low response	35 (67)	8 (15)	9 (17)	
Average response	12 (57)	5 (24)	4 (19)	
No response	9 (69)	4 (31)	1 (0)	

[1]a Indicates a significant difference (P<0.05).

Table 6. Comparison of GOT, GPT, ALP, and TSB Levels Between AstraZeneca and Sinopharm Vaccines

Vaccine	GOT (Mean ± SD)	P. Value	GPT (Mean ± SD)	P. Value	ALP (Mean ± SD)	P. Value	TSB (Mean ± SD)	P. Value
AstraZeneca	26.5 ± 6.5	0.60	25.2 ± 6.8	0.61	170.4 ± 49.5	0.62	0.9 ± 0.2	0.60
Sinopharm	23.5 ± 5.9	0.25	22.8 ± 6.0	0.26	159.8 ± 42.3	0.28	0.7 ± 0.2	0.27

Discussion

SARS-CoV-2, the virus that caused the recent and terrible COVID-19 pandemic, first appeared in Wuhan, China in 2019 and spread quickly throughout the world, causing a serious health emergency with many infections and fatalities. International studies have evaluated the effectiveness of these vaccines[15-17]. They compared vaccinated and unvaccinated individuals, including a placebo group, to assess the efficacy of vaccines in different populations[18-20]. It is also essential to examine the impact of the vaccine on transmission by studying how effectively it prevents infections in individuals who have not been vaccinated and how it reduces the contagiousness of vaccinated individuals who become infected [21-22]. Studies have also investigated the duration of protection provided by various COVID-19 vaccines, including the BNT162b2 mRNA (Pfizer BioNTech) vaccination, demonstrating its high effectiveness for at least six months after the second dosage [8 , 23]. The Sinopharm (BBIBP CorV) and AstraZeneca (Vaxzevria) vaccines led to antibody production 10–14 days after the first dosage, peaking 1–2 weeks after the second dose. For Sinopharm, antibodies can be monitored for up to six months following vaccination, although their levels gradually decline. Regarding AstraZeneca, antibodies often remain detectable beyond 6 months, with persistence reaching 9 to 12 months [23-24].

Measuring antibody-based (humoral) and cell-based (cellular) immune responses is crucial for evaluating vaccine effectiveness. Humoral responses focus on measuring the levels of neutralizing antibodies, which block viral infectivity by preventing them from entering the cells. Assessing virus-specific T cells also provides information regarding vaccine effectiveness, as mentioned in [25]. Seroconversion studies track post-vaccination antibody development by detecting their presence in the blood of vaccinated individuals [26].

The present study evaluated the effectiveness of two vaccines, Sinopharm and AstraZeneca, in protecting against SARS-CoV 2. Antibody levels in subjects who received two doses of either vaccine were measured 14 d after the second dosage. Factors that affect the immune response to these vaccines, such as age and sex, were examined. In addition, the effects of the previous COVID-19 infections on the vaccine-induced immune response was investigated. Finally, the vaccine efficacy was assessed by examining the incidence of infection after vaccination. To achieve these objectives, 150 participants were enrolled in the present study; 34 subjects received AstraZeneca vaccination and 116 received Sinopharm vaccination. The levels of antibodies targeting the spike protein were determined using a newly developed serological assay from Roche Diagnostics [27].

Among those vaccinated with the Sinopharm vaccine (116 subjects), 104 (>90%) had antibodies against the virus. This rate is similar to that reported in the Sinopharm vaccination program (>95%). For AstraZeneca, approximately 98% (33 of 34 subjects) had antibodies against the virus. This is in line with the rate reported in the Oxford University Hospital study (>97%) [28].

The age and sex of an individual can significantly affect vaccine administration and effectiveness. Age-related factors include development of the immune system, differences in exposure to disease-causing agents, and varying susceptibility to certain illnesses [29-31). Age-based changes can influence the immune responses of infants, young children, and older adults with B-cell and T-cell functions. Indeed, sex exerts a considerable influence on shaping immune responses given the interplay of hormonal and genetic factors that can result in variations between males and females. Females typically display more robust immune responses, characterized by higher antibody production and enhanced activation of immune cells · These differences in immune function between the sexes may contribute to

variations in susceptibility to infections and responses to vaccination [32].

This study had shown that age plays a significant role in vaccine effectiveness. Among participants aged <60 years, 51% had a strong response compared to 32% of the older participants (P=0.01). The response rate also decreased gradually as the age of the participants increased. Females responded slightly more to the vaccines (49%) than males (41%). Younger subjects (<40 years) generally had higher immune responses to AstraZeneca and Sinopharm vaccines. Regarding the AstraZeneca vaccine, this response decreased with age (88% for those <40 years of age, 59% for those aged 40 60 years, and 39% for those >60 years of age). For the Sinopharm vaccine, the response rate was 43% for those aged <40 years, 49% for those aged 40–60 years, and 31% for those aged >60 years. This pattern is consistent with results of other studies that had demonstrated that age and sex can affect vaccine responses, specifically for both the AstraZeneca and Sinopharm vaccines, which have shown a significant decline in vaccine effectiveness with increasing age, whereas the effect of sex on response rates varies moderately [28,33].

Of the 93 individuals who have never been previously infected with COVID-19, 10% (i.e., 9) exhibited no immune response after the injections. In contrast, of the 57 subjects previously infected with COVID-19, only four (<7%) did not develop an immune response. This slight difference suggests that individuals previously infected with COVID-19 are more likely to develop an immune response after vaccination. This indicates that vaccination may be particularly beneficial for individuals with a history of COVID-19. Results of the current study indicate that people who have had a prior COVID-19 infection are more likely (97%) to test positive for anti-S protein antibodies than people who have never had a COVID-19 infection (77%) (data not shown), similar to the results of a previous study by (34). Vaccine efficacy was also examined in those who contracted infections even after following the two-dose vaccination schedule. Among the 150 participants, 104 (69%) did not become infected for six months after receiving the vaccine. After one year, 104 individuals (69%) were protected against infection. This indicates that the vaccine is highly effective in preventing infections for an extended period of time. During the same period as in the present study, [35].conducted a similar study and found comparable outcomes. They observed that after six months of vaccination, approximately 82% of the individuals remained unaffected by the virus. Notably, their study recorded a 73% protection rate among those who received the Sinopharm vaccine and 92% protection rate among those who received the AstraZeneca vaccine. The results of this study are similar to previous findings, indicating the effectiveness of Sinopharm and AstraZeneca vaccines. Six months after vaccination, a slightly lower, yet substantial, protection rate of 69% (80 out of 116 subjects) was observed for the Sinopharm and 74% (24 out of 34 subjects) for the AstraZeneca vaccines. This further demonstrates the ability of both vaccines to prevent infections beyond the initial 6-month period. The present study found that the AstraZeneca vaccine consistently produced better results than the Sinopharm vaccine did. This difference is likely due to the mechanisms through which the vaccines produce their effects. The AstraZeneca vaccine uses a weakened chimpanzee virus to carry genetic material into the body, triggering the production of potent antibodies [35]. In contrast, the Sinopharm vaccine uses a completely inactivated virus that cannot replicate in the body and stimulates multiple immune responses [36]. Moreover, differences in protection rates between the AstraZeneca and Sinopharm vaccines may reflect differences in the induction of inflammation, and consequently, the strength and duration of the immune response. Although both vaccines are effective in producing anti-spike protein antibodies, the AstraZeneca vaccine, with its ability to produce potent antibodies, may be linked to a more rapid and substantial initial inflammatory response, leading to longer-lasting immunity than the Sinopharm vaccine, which, while practical, may exhibit a slower increase and steeper decline over time [37].

However, one of the limitations of this cross-sectional study has been the exclusion of individuals with pre-existing medical conditions, such as those undergoing cancer treatment or those suffering from severe allergies or immunosuppression. Additionally, levels of anti-spike protein antibodies prior to the second vaccination were not determined, which could’ve provided valuable insights into the baseline immunity of the participants [38]. This exclusion was necessary to preserve the integrity of the study; however, it limited the findings’ generalizability to the entire population. Future studies are thus required to include a more diverse patient population to assess the association between antibody production, longevity, and various health conditions [39].

In addition, the present study will be extended to assess the efficacy of other vaccines. This would allow for a comparison of the principles and techniques of antiviral vaccine production with the immune system's corresponding response [40].

This comparative analysis could provide valuable insights into optimizing vaccine design and improving immunization strategies [41].

In conclusion, the present study sheds light on how Sinopharm and AstraZeneca vaccines generate immunity against SARS-CoV 2. Most vaccinated individuals develop antibodies, suggesting that vaccines effectively stimulate immune defense [25]. While age and sex slightly affected the immune response, younger individuals tended to have a stronger response. The present study thus demonstrates that individuals who have contracted COVID-19 before vaccination have a stronger immune response [30].

Previous studies have reported that autoimmune hepatitis (AIH) and elevated liver enzyme levels can occur following COVID-19 vaccination. Research has suggested that molecular mimicry between the SARS-CoV2 spike protein and human tissue proteins may play a role in triggering an immune response in genetically predisposed individuals [33-35].

Studies have documented cases of necroinflammatory hepatitis post-vaccination with Moderna, AstraZeneca, Covishield, and Sinovac CoronaVac, highlighting the potential vaccine-related liver effects. Additionally, findings indicated that 74.5% of reported liver injury cases following COVID-19 vaccination involved alterations in biochemical markers, including elevated GOT, GPT, ALP, and TSB levels, reflecting a significant impact on hepatic function[38].

From all spontaneous reports that have been included in this review of patients who had received Oxford Uni-AstraZeneca and Sinopharm vaccinations all over the world between Dec. 1, 2020, and Jul. 31, 2022, there are reports of hundred and six patients with the analysis of abnormal liver functions [30]. and out of these who had RLEs there were 79 patients that have COVID-19 vaccine-induced liver injuries [40-41] Ultimately, four cases resulted in AHF .

This systematic review showed that the pooled incidence of acute liver injuries that have been diagnosed after COVID-19 vaccination has been considerably higher in women, which is consistent with a previously reported finding that had shown that females are more susceptible to drug-induced liver injuries .

Serum levels of liver enzymes and bilirubin are commonly used for noninvasive diagnosis of liver injury. However, these diagnostic parameters are not specific in nature and cannot be used to identify a specific type of liver injury [41]

Conclusions

This study comprehensively evaluated the efficacy of Sinopharm and AstraZeneca vaccines against SARS-CoV-2, focusing on the influence of factors like gender, age, and prior COVID-19 infection history. Both vaccines significantly enhanced immune responses, with younger participants showing stronger antibody production than older individuals, and females demonstrated slightly higher responsiveness than males. Furthermore, prior infection with COVID-19 is associated with a more robust post-vaccination antibody response, underlining the added benefit of vaccination, even for those with a history of infection.

This study also revealed differences in liver enzyme levels between the two vaccines. Recipients of the AstraZeneca vaccine exhibited higher levels of GOT, GPT, ALP, and TSB enzymes than those vaccinated with Sinopharm, suggesting potential biochemical effects that require further investigation. Nevertheless, both vaccines provided substantial protection against infection for up to a year post-vaccination, emphasizing their critical role in reducing COVID-19 transmission and severity. These findings offer valuable insights into vaccine performance and highlight key factors that can influence immune responses, aiding the optimization of future vaccination strategies.

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Conflicts of Interest

The authors declare no conflict of interest.

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