How to Cite:
Kamal, K., & Msibi, T. A. (2022). COVID-19 vaccine-related adverse effects and perceptions in Haryana State of India. *International Journal of Health Sciences*, *6*(S5), 1579–1610. https://doi.org/10.53730/ijhs.v6nS5.9008

COVID-19 vaccine-related adverse effects and perceptions in Haryana State of India

Dr. Kamal
Institute of Pharmaceutical Sciences/Kurukshetra University, Kurukshetra, India

Themba Andile Msibi*
Institute of Pharmaceutical Sciences/Kurukshetra University, Kurukshetra, India
*Corresponding Author

***Abstract*---**Background: The focus of this study was on any COVID-19 vaccines adverse effects, as well as perceptions about the vaccines. Among many, Covishield Covid-19 (ChAdOx1 nCoV-19) and Covaxin COVID-19 (BBV152) vaccines are some of the vaccines which have reached their advanced stages. These two brands are very common in India, and the majority of the already vaccinated populations in India comes from these two brands. Methods: It was a quantitative systemic randomized retrospective cohort kind of a study where only healthcare practitioners were targeted, especially the prescribers. Survey questionnaire was used as a tool of collecting the data from the voluntarily recruited participants. Results: Among the participants, males (106) were more than females (98). Different healthcare professionals: 100 (49.0%) were Physician/doctors; 36 (17.6%) were Pharmacists; 27 (13.2%) were Nurses; 23 (11.3%) were Medical Lab. Technicians and 18 (8.8%) were others. 123 participants reported not been affected by any side effects after taking the COVID-19 vaccines, in contrast, 81 participants reported to have experienced adverse effects after had taken the vaccines. Conclusion: This study showed that post-vaccination, of both first and second dose, adverse effects were mild to moderate, non-serious and non-life threatening. Noted was that adverse effects were more common with Covishield COVID-19 vaccine. It worth noting that, the scope of this study is not to assess vaccine effectiveness. This is beyond the scope of this resource.

***Keywords*---**COVID-19 vaccine, Covishield, Covaxin, Adverse effect, Perceptions.

Introduction

On the 11th of March, 2020, World Health Organization declared coronavirus disease to be a pandemic hence it had been identified as a public health emergency of international concern. Unexplained cluster of pneumonia cases were reported and shortly a causative virus was identified as a novel coronavirus. Which was first discovered in a large city, Wuhan, of approximately 11 million population in central China [V'kovski *et al.*, 2021; Li *et al.,* 2020; He *et al.,* 2020].

Etiology

Coronavirus (CoVs) are said to be a largely diverse enveloped positive-sense single-stranded RNA viruses that are believed to be belonging to a subfamily called *Coronavirinae* in the family of *Coronaviridae*. It is believed that they are in *Nidovirales*, off which they include the following four genera: *alphacoronavirus, betacoronavirus, gammacoronavirus* as well as *deltacoronavirus* [V'kovski *et al.*, 2021; Zhou *et al.*, 2020]. Since the Coronavirus had been identified, in the years 2003 and 2012 an outbreak of Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) were experienced. Scientist's eyebrows were then be raised and realized that coronaviruses were highly transmitted to humans and has a tendency of creating an outbreak [Zhou *et al.*, 2020]. These viruses can affect both humans and animals hence they are not a challenge for public health but also challenge veterinary as well [V'kovski *et al.*, 2021; He *et al.,* 2020].

The human coronavirus, of like HCoV-229E and HCoV-OC43, have been commonly circulating in the population and their symptoms have been seen by seasonal and commonly mild upper respiratory tract infections associated with symptoms of the so-called 'common cold'. Nevertheless, the SARS-CoV, MERS-CoV-2 and SARS-CoV-2, which have seen in the human population over the few decades, are highly pathogenic. These human coronaviruses have a tendency to develop into severe, life-threatening respiratory pathologies as well as lung injuries. Till up to date, there is no specific prophylactic or therapeutic treatment that has been approved [V'kovski *et al.*, 2021].

Many studies have suggested that the coronavirus (COVID-19) that was first identified in Wuhan belongs to genus *beta-coronavirus* (β-CoV). This virus is said to have ability to infect humans, bats and other wild animals. Concurrently, other studies have reported possibilities of cross transmission of the virus from bats to humans even though transmission intermediate host is not known [Lone & Ahmad, 2020]. According to current information, through pangolin the COVID-19 mighty have transmitted hence it is suspected that bats might initially host the virus or via other wild animals that might be sold at the Huanan seafood market. Then being spread through human-to-human transmission [Zhou *et al.*, 2020]. Close identity between COVID-19 and two bats-SARS-CoV, bat-SL-CoV ZC45 and bat-SL-CoV ZXc21, were established [Zhou *et al.*, 2020; Rauf *et al.*, 2020].

Virology of COVID-19

Covid-19 is the Coronavirus Disease 2019 that was first reported by Dr. Li Wenliang, who is an Ophthalmologist in Wuhan, China in the late December 2019 [Zhou *et al.*, 2020]. As coronavirus are enveloped but non-segmented, single-stranded RNA virus, belong to *Coronaviridae* family. Coronavirus diseases have been known as mild until the two previous outbreaks in the past few decades, which their prevalence was severe. These diseases were designated as SARS-CoV and MERS-CoV [Zhou *et al.*, 2020; Huang *et al.*, 2020].

According to the WHO, SARS-CoV-2 has been classified as a *β-Coronavirus*. It displayed more than 80% to MARS-CoV in its genetic sequence, both having their origins in bats [Rothan *et al.*, 2020]. Since the SARS-CoV-2 outbreak, transmission has been revealed to be from human-to-human, through direct contact on droplet expelled by coughing, also by sneezing from an infected individual at close range Li *et al.*, 2020; Rothan *et al.*, 2020]. SARS-CoV-2 has a virion of approximately 50-200 nm in diameter. At least four structural proteins are known. These include Spike (S) protein, Envelope (E) protein, Membrane (M) protein and Nucleocapsid (N) protein. All are requirements to assemble a complete viral particle. However, some studies, that were done recently, have shown that CoVs do not need all the four proteins to be an infectious virion, suggesting that other proteins with overlapping functionality may also be encoded [Yamamoto *et al.*, 2020].

The S protein, on the envelope, with its three segments form a crown-like structure. The S protein is responsible for promoting host attachment and virus-target cell membrane fusion during virus infection, according to [Schoeman D *et al.*, 2019]. A single-pass trans-membrane anchor, a short intracellular tail and a large ectodomain are the portions' constituents. They are said to consist of an S1 receptor-binding subunit S1 and a membrane-fusion subunit S2. The S1 portion binds to an ACE2 receptor and the serine protease TMPRSS2 on the host cell surface for viral attachment [Hoffman *et al.*, 2020]. While the S2 portion mediates the fusion of the host and viral membranes, hence permitting viral genomes to enter host cell [Yamamoto *et al.,* 2020; Lu *et al.*, 2020].

The E protein is said to be the smallest of the structural proteins. However, it is considered the most important structure for viral replication. The E protein is upregulated on the infected call endoplasmic reticulum, during replication. Only a small quantity is incorporated into the new virion envelope [Schoeman D *et al.*, 2019].

The N protein is made to be attached to the CoV-RNA genome and allowed to builds the nucleocapsid. A part of the viral structure. On another hand, the M protein is believed to be the most abundant structure protein in the viral envelop. This structure is interacting with all the major structural proteins in the CoV assembly process. What maintains the S protein in the endoplasmic reticulum or golgi complex for integration of S and M proteins. The M and E proteins combination consists to the structure of the viral envelope [Yamamoto *et al.*, 2020].

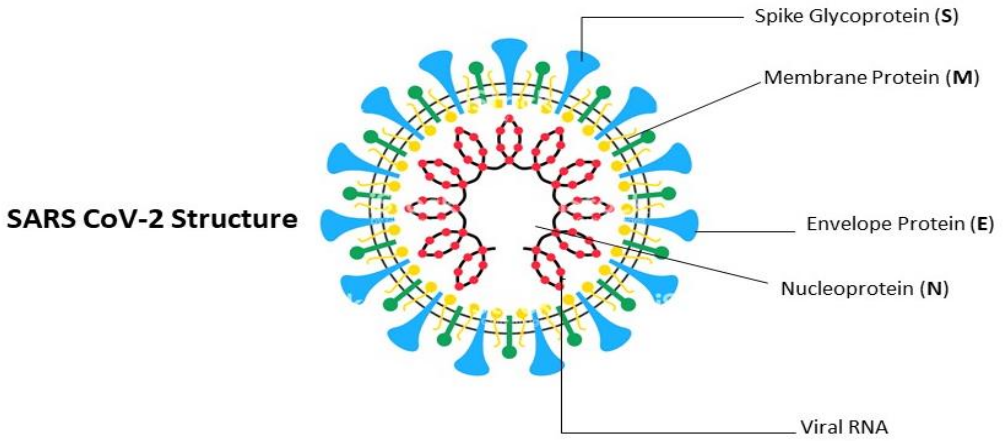

Fig. 1: Illustration of Covid-19 Structure

Clinical symptoms

The clinical symptoms of COVID-19 are said to range from asymptomatic or mild-to-severe disease to respiratory failure. The respiratory failure might be so severe such that requiring mechanical ventilation or as well as Intensive Care Unit support. COVID-19 can do affect many organs in the affected body [Yamamoto *et al.*, 2020].

With higher trend prevalence is Acute Respiratory Distress Syndrome (ARDS) in older age population. A relative high number of cases of heart, liver, and kidney function injuries were recorded among younger population, according to Liu K *et al.* Clinically presented of patient with COVID-19 includes multiple organ dysfunction, severe dyspnoea and hypoxemia, tachycardia, renal impairment with decreased urine output, and altered mental health [Lu *et al.*, 2020]. Moreover, according to Meng Di *et al.* revealed that recent studies reported that some COVID-19 patients also shown ocular manifestation, e.g., epiphora, conjunctival congestion and chemosis. Some other common laboratory findings presented cumphopenia, elevated cantate dehydrogenase and prolonged prothrombin time [Jiang *et al.*, 2020].

Different vaccine technology platforms

Currently, at least three major vaccine technology platforms have been exploited as far as the designing of safe and effective COVID-19 vaccines [Hadj Hassine, 2021].

The nucleic acid approaches

The nucleic acid kind of platforms employs genetic information. This genetic information can be either DNA or mRNA to direct cells to generate specific proteins, but not the entire virus as per se. However, there had been no gene-based vaccines approved before the outbreak of the so-called pandemic COVID-19 [Hadj Hassine, 2021].

The Whole-virus approach

1) Viral vector vaccines

The main principle of a viral vector vaccines is to stimulate the immune by delivering specific components of the virus-caused disease. While the component is being delivered is has to remain safe and harmless to the human body. Here the virus vector used can be either of replicating or non-replicating. A target viral protein is being carried in the virus vector to be deposited into the human body to trigger immune response enhancement. Typical example of such approach is Ad26.ZEBOV (Ebola vaccine) which is believed to be containing a human non-replicating adenovirus 26 vector, in it there is Ebola virus Mayinga glycoprotein variant [Hadj Hassine, 2021; Milligan *et al.*, 2016; Matz *et al.*, 2019].

2) Inactivated vaccines

A complete virus but killed by chemicals, heat or radiation is what makes inactivated vaccines. Specific laboratory facilities to grow such virus with safe means in development of this types of vaccines is required. Polio-Vaccine is a typical example of such kind of vaccines [Hadj Hassine, 2021; Badyopadhyay *et al.*, 2015; Keshavars *et al.*, 2019].

The subunit approaches

One or more purified antigens are used in a subunit vaccine kind of approach that is responsible to trigger immune system. A safe viral vector is not required. It is believed not to introduce the whole pathogen. For example, Heplisav-B vaccine produced by yeast **cell [Hadj Hassine, 2021].**

Table 1: A brief summary of SARS-CoV-2 vaccine technology platforms

Platform	DNA	RNA	Viral vector	Inactivated	Subunit
Vaccine candidate type	DNA of the virus causative disease delivered by means of electroporation	mRNA of a virus causative disease is encapsulated in a lipid nanoparticle	A harmless virus from the causative disease furnishes the cells with instructions for producing antigens	Disease-causing viral is inactivated either by heat, radiation or chemicals	One or more antigens of the virus causative disease
Immune response	Cellular & Humoral	Cellular & Humoral	Cellular & Humoral	Humoral mostly	Cellular & Humoral
Merits	-Easy to produce -A robust immune response is generated by electroporation -No live components, hence no risk of causing disease by the	-Relatively simple to produce -Fast in development -No risk of disease caused hence no live components	-Safe in use -Can be produced in a large-scale production -Technology is well established - Strong immunogenicity	-Less risk of causing disease, no live components -Technology is well established -Simple to manufacture	-Relatively stable -No live component Technology is well established

	vaccine -Relatively stable				
Demerits	-Been never approved in human -Electroporation is complicated -Different distribution system may be required	- Ultra-cold storage is required by the lipid nanoparticles -Has not been approved to be used in humans	-Complex in manufacturing -Pre-existing immunity to the vector could reduce the immune respond	-Booster shots may be required -Risk of vaccine-enhanced disease	-Adjuvants may be required -Relatively complex to produce -Time consuming in determining the best antigen

Mostly used vaccines in India

The researcher immensely looks on two brands of COVID-19 vaccines that were seen to be of most used in Indian. These vaccine brands are known as Covishield and Covaxin.

Covishield COVID-19 (ChAdOx1 nCoV-19) vaccine

Covishield COVID-19 (ChAdOx1 nCoV-19) vaccine being the far most gone vaccine in clinical trials not just only in India but it has been also acceptedly approved to be tested in various European Union countries [Mohfw.gov.in]. According to the Serum Institute, Covishield COVID-19 vaccine is a recombinant type of a vaccine, which is a replication-deficient chimpanzee adenovirus vector encoding the SARS-CoV-2 spike (S) glycoprotein. It is a regime that consists of two doses of 0.5ml each [www.schengenvisainfo.com; www.medicalnewstoday,com]. Side effects that one can expect after administering Covishield COVID-19 vaccine include, pain on the injection site and joints, headache, fever, itching as well as swelling and tenderness on the injection site [www.mpnre.org/covaxin-vs-covishield/].

Covaxin COVID-19 (BBV152) vaccine

This is another vaccine that has reached an advanced clinical trials stage in India. The manufacturer of Covaxin COVID-19 (BBV152) vaccine is an Indian company Bharat Biotech in partnership with the Indian Council of Medical Research (ICMR). Covaxin COVID-19 vaccine is an inactivated type of vaccine that has been developed using Whole-Virion Inactivated Vero Cell [www.bharatbiotech.com/covaxin.html]. Inactivated kind of a vaccine cannot replicate and thus unlikely to revert and cause pathological effects. The kind of a vaccine that actively contains dead virus that are incapable of infecting patients but still has an ability to stimulate the immune system response to mount a defensive reaction against an infection.

The Bharat Biotech BBV152 COVID-19 vaccine (Covaxin) has been formulated from a whole virion inactivated SARS-CoV-2 virus. Toxicity studies were

performed in compliance with the norms of Good Laboratory Practice (GLP) to access the safety of the COVID-19 vaccine (Covaxin). Mice, Rats, and Rabbits were three animal model used in evaluation of the immunogenicity and safety of the vaccine [www.bharatbiotech.com/covaxin.html; Bharat Biotech International, 2021].

Covaxin COVID-19 vaccine is a two doses regime too, but the second dose is being administered after a shorter period of time as compared to the one of Covishield COVID-19 vaccine. Common adverse effects that have been reported, which one may suffer from after taking this vaccine ranging from pain and swelling on the injection site, dizziness and weakness, rashes all over the body to increased heartbeat [www.mpnre.org/covaxin-vs-covishield/].

Materials and Methods

Study Area: This quantitative cross-sectional survey-based study was conducted in different health facilities across eleven districts of Haryana State. These facilities were said to be fully dedicated COVID-19 hospitals. Haryana State is found on the Northern part of India. A total number of 22 Government Hospitals/PHU/Clinics were visited and data was collected using survey questionnaires.

Duration of the Study: January 2022 to March 2022

Study design and participants: The researcher designed this study in such a way that data was collected using survey questionnaires that were distributed across Government Health Facilities. It was a quantitative systemic randomized retrospective cohort kind of a study where only healthcare practitioners were target, in particular the prescribers.

Subject and selection method: Population of this study was drawn from different Government owned Health Facilities that were dealing with COVID-19 patients. The study population were health practitioners of different fields, but mostly targeted were the prescribers, working in Haryana state. These healthcare workers were of age 18 years and above, with different durations of experiences.
Inclusion criteria:

1. Healthcare provider
2. Must be working in Government owned Health Facility in the Haryana State of India
3. Taken at least one dose (first dose) of any COVID-19 vaccines
4. Aged ≥18 years
5. Either sex

Exclusion criteria:

1. Non-medical practitioner
2. Working outside Haryana State

Sample size and sampling procedures
Sample size: 204 people participated.
Data collection: Firstly, a written informed consent was to be obtained, then a well-structured questionnaire was used to collect the data from the voluntarily

recruited participants. The questionnaire was comprised of three sections: (i) consisted of general demographic characteristics (i.e., age, gender, state of habitant, etc.); (ii) was about experiences after taking COVID-19 vaccine as well as perceptions about the vaccines; (iii) was generally about patients, from the public, who had presented COVID-19 vaccine related side effects, seen by the participants (if the participants was a prescriber).

Data processing and analysis

The Statistical Package for Social Science (SPSS) version 20.0 was used to process and analyze the data. From the SPSS software, primarily, descriptive statistics were derived including age (mean, median and standard deviation), gender, profession, duration of work experiences, COVID-19 vaccine related (brand and number of dose), adverse effects related (mild or severe, duration of disappearance and dose with more side effects). Chi-Square Tests were used in determining any significance differences among the variables. Furthermore, graphical presentation of the analyzed data was then extracted from the software.

Data quality assurance

Data was collected only from professionals who the researcher believes that are very well knowledgeable about the subject of the study and importance of data quality.

Results and Discussions

Results

As of March 16, 2022, 204 survey questionnaires were collected from 22 Hospitals/PHU/Clinics in Haryana State, on the Northern part of India, with median age of 35 and Std. Deviation of 11.353. Among them there were more males (106) than females (98). Approximately, 0.5% (1) were of age less than 20 years, 37.3% (76) were between 21 and 30 years, 26.0% (53) were of between 41 and 50 years, 13.7% (28) were ranging between 51 and 60 years, while 2.9% (6) were 60 years and older. For one to participate was supposed to be a healthcare provider working in one of the Government Health Institutions but under Haryana state and having taken at least one dose of COVID-19 vaccine.

Table 2: Showing Gender distribution of the participants among different Age groups.

Years * Gender Crosstabulation					
			Gender		Total
			Male	Female	
Age (Years)	Less than 20	Count	0	1	1
		% within Gender	0.0%	1.0%	0.5%
	21 to 30	Count	31	45	76
		% within Gender	29.2%	45.9%	37.3%

	31 to 40	Count	28	25	53
		% within Gender	26.4%	25.5%	26.0%
	41 to 50	Count	25	15	40
		% within Gender	23.6%	15.3%	19.6%
	51 to 60	Count	18	10	28
		% within Gender	17.0%	10.2%	13.7%
	60 & Above	Count	4	2	6
		% within Gender	3.8%	2.0%	2.9%
Total		Count	106	98	204
		% within Gender	100.0%	100.0%	100.0%

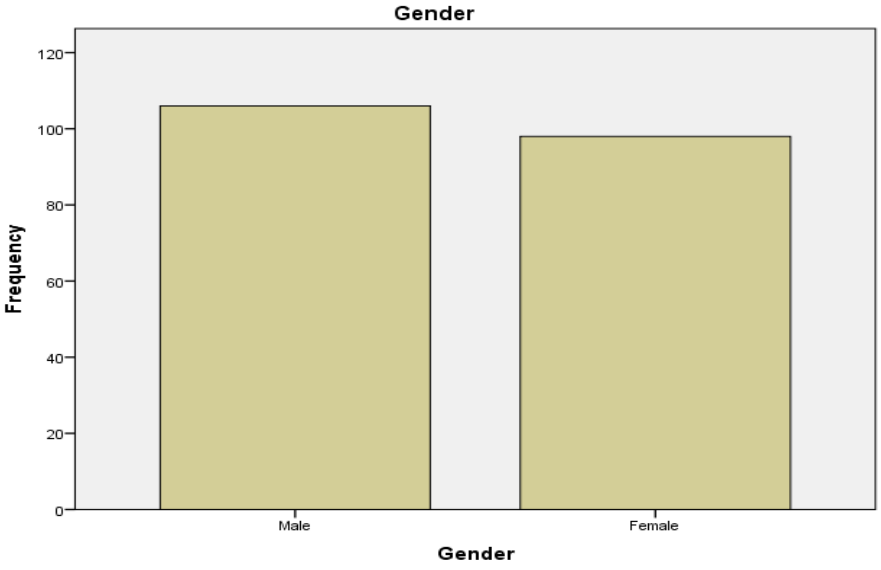

Fig. 2: A Graph illustrating gender distribution of the participants of this study

Even though the age among the participant were unevenly distributed, but the overall distribution shows that the participants were ranging between the ages of 19 to 63 years. The younger participant was of 19 years old while the older was 63 years old.

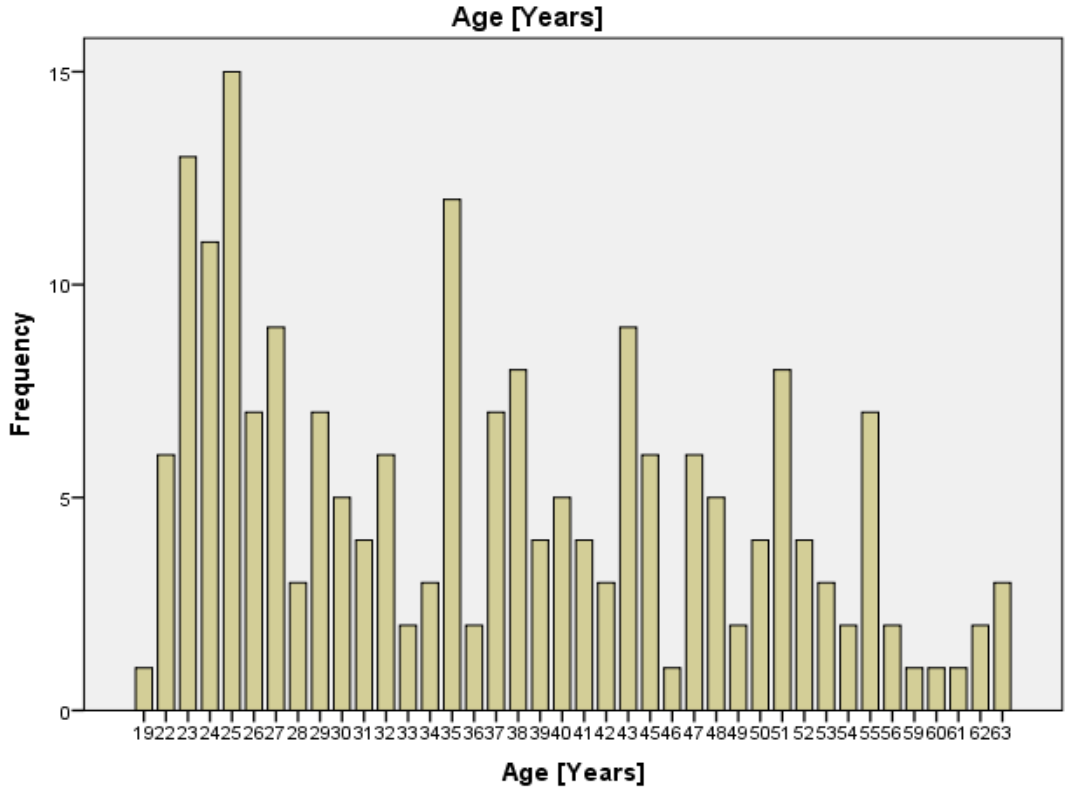

Fig. 3: A Graph showing Age distribution of the participants of the study.

The questionnaires were not evenly distributed among the different health care professions, however, 49.0% (100) were Physicians/doctors, 17.6% (36) were Pharmacists, 13.2% (27) were Nurses, 11.3% (23) were Medical Lab. Technicians and others were 8.8% (18). The participants were self-rating themselves as how knowledgeable were about drug adverse effects as well as their duration of experience in their fields. Out of the 204 participants, 120 had been in their field for more than five years, 12 for four years, 9 for three years, 19 for two years and 44 had only one year of experiences. To come to their knowledge level of adverse effects: 6.4% (13) rated Average, 55.4% (113) were Good, while 38.2% (78) claimed to be of Very good

.

Table 3: Showing statistics of Knowledge level of adverse effects and Duration of experiences of the participants among different Professions.

Profession * Knowledge level of adverse effects * Duration (years) Crosstabulation							
Duration of experience in a profession				Knowledge level of adverse effects			Total
				Average	Good	Very good	
1 Year	Profession	Physician/ Doctor	Count	6	21	1	28
			% within	21.4	75.0	3.6%	100.

			Profession	%	%		0%
			% within Knowledge level of adverse effects	75.0 %	67.7 %	20.0 %	63.6 %
		Pharmacist	Count	1	4	0	5
			% within Profession	20.0 %	80.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	12.5 %	12.9 %	0.0%	11.4 %
		Medical Lab. Techn	Count	0	5	2	7
			% within Profession	0.0%	71.4 %	28.6 %	100. 0%
			% within Knowledge level of adverse effects	0.0%	16.1 %	40.0 %	15.9 %
		Others	Count	1	1	2	4
			% within Profession	25.0 %	25.0 %	50.0 %	100. 0%
			% within Knowledge level of adverse effects	12.5 %	3.2%	40.0 %	9.1%
	Total		Count	8	31	5	44
			% within Profession	18.2 %	70.5 %	11.4 %	100. 0%
			% within Knowledge level of adverse effects	100.0 %	100.0 %	100.0 %	100. 0%
2 Years	Professi on	Physician/ Doctor	Count		5	2	7
			% within Profession		71.4 %	28.6 %	100. 0%
			% within Knowledge level of adverse effects		38.5 %	33.3 %	36.8 %
		Nurse	Count		5	0	5
			% within Profession		100.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects		38.5 %	0.0%	26.3 %
		Pharmacist	Count		2	4	6
			% within Profession		33.3 %	66.7 %	100. 0%
			% within Knowledge level of adverse effects		15.4 %	66.7 %	31.6 %
		Medical Lab. Techn	Count		1	0	1
			% within Profession		100.0 %	0.0%	100. 0%

			% within Knowledge level of adverse effects		7.7%	0.0%	5.3%
	Total		Count		13	6	19
			% within Profession		68.4 %	31.6 %	100. 0%
			% within Knowledge level of adverse effects		100.0 %	100.0 %	100. 0%
3 Years	Professi on	Physician/ Doctor	Count	0	2	0	2
			% within Profession	0.0%	100.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	0.0%	28.6 %	0.0%	22.2 %
		Nurse	Count	0	2	1	3
			% within Profession	0.0%	66.7 %	33.3 %	100. 0%
			% within Knowledge level of adverse effects	0.0%	28.6 %	100.0 %	33.3 %
		Pharmacist	Count	0	1	0	1
			% within Profession	0.0%	100.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	0.0%	14.3 %	0.0%	11.1 %
		Medical Lab. Techn	Count	1	1	0	2
			% within Profession	50.0 %	50.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	100.0 %	14.3 %	0.0%	22.2 %
		Others	Count	0	1	0	1
			% within Profession	0.0%	100.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	0.0%	14.3 %	0.0%	11.1 %
	Total		Count	1	7	1	9
			% within Profession	11.1 %	77.8 %	11.1 %	100. 0%
			% within Knowledge level of adverse effects	100.0 %	100.0 %	100.0 %	100. 0%
4 Years	Professi on	Physician/ Doctor	Count	1	0	0	1
			% within Profession	100.0 %	0.0%	0.0%	100. 0%
			% within	100.0	0.0%	0.0%	8.3%

			Knowledge level of adverse effects	%			
		Nurse	Count	0	2	3	5
			% within Profession	0.0%	40.0 %	60.0 %	100. 0%
			% within Knowledge level of adverse effects	0.0%	28.6 %	75.0 %	41.7 %
		Pharmacist	Count	0	2	1	3
			% within Profession	0.0%	66.7 %	33.3 %	100. 0%
			% within Knowledge level of adverse effects	0.0%	28.6 %	25.0 %	25.0 %
		Medical Lab. Techn	Count	0	1	0	1
			% within Profession	0.0%	100.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	0.0%	14.3 %	0.0%	8.3%
		Others	Count	0	2	0	2
			% within Profession	0.0%	100.0 %	0.0%	100. 0%
			% within Knowledge level of adverse effects	0.0%	28.6 %	0.0%	16.7 %
	Total		Count	1	7	4	12
			% within Profession	8.3%	58.3 %	33.3 %	100. 0%
			% within Knowledge level of adverse effects	100.0 %	100.0 %	100.0 %	100. 0%
5 Years	Professi on	Physician/ Doctor	Count	1	24	37	62
			% within Profession	1.6%	38.7 %	59.7 %	100. 0%
			% within Knowledge level of adverse effects	33.3 %	43.6 %	59.7 %	51.7 %
		Nurse	Count	2	4	8	14
			% within Profession	14.3 %	28.6 %	57.1 %	100. 0%
			% within Knowledge level of adverse effects	66.7 %	7.3%	12.9 %	11.7 %
		Pharmacist	Count	0	11	10	21
			% within Profession	0.0%	52.4 %	47.6 %	100. 0%
			% within Knowledge level	0.0%	20.0 %	16.1 %	17.5 %

			of adverse effects				
		Medical Lab. Techn	Count	0	10	2	12
			% within Profession	0.0%	83.3 %	16.7 %	100. 0%
			% within Knowledge level of adverse effects	0.0%	18.2 %	3.2%	10.0 %
		Others	Count	0	6	5	11
			% within Profession	0.0%	54.5 %	45.5 %	100. 0%
			% within Knowledge level of adverse effects	0.0%	10.9 %	8.1%	9.2%
	Total		Count	3	55	62	120
			% within Profession	2.5%	45.8 %	51.7 %	100. 0%
			% within Knowledge level of adverse effects	100.0 %	100.0 %	100.0 %	100. 0%
Total	Professi on	Physician/ Doctor	Count	8	52	40	100
			% within Profession	8.0%	52.0 %	40.0 %	100. 0%
			% within Knowledge level of adverse effects	61.5 %	46.0 %	51.3 %	49.0 %
		Nurse	Count	2	13	12	27
			% within Profession	7.4%	48.1 %	44.4 %	100. 0%
			% within Knowledge level of adverse effects	15.4 %	11.5 %	15.4 %	13.2 %
		Pharmacist	Count	1	20	15	36
			% within Profession	2.8%	55.6 %	41.7 %	100. 0%
			% within Knowledge level of adverse effects	7.7%	17.7 %	19.2 %	17.6 %
		Medical Lab. Techn	Count	1	18	4	23
			% within Profession	4.3%	78.3 %	17.4 %	100. 0%
			% within Knowledge level of adverse effects	7.7%	15.9 %	5.1%	11.3 %
		Others	Count	1	10	7	18
			% within Profession	5.6%	55.6 %	38.9 %	100. 0%
			% within Knowledge level of adverse effects	7.7%	8.8%	9.0%	8.8%

	Total	Count	13	113	78	204
		% within Profession	6.4%	55.4 %	38.2 %	100. 0%
		% within Knowledge level of adverse effects	100.0 %	100.0 %	100.0 %	100. 0%

The participants reported that 78.4% (160) had taken Covishield COVID-19 vaccine, while 21.1% (43) had administered Covaxin COVID-19 vaccine and 5% (1) had vaccinated with other vaccines (Sputnik V COVID-19 vaccine). Having the participants had taken at least one dose regardless of the brands, 91.2% (186) reported to have taken both jabs while 7.4% (15) had taken only the first dose and 1.5% (3) reported to had taken three doses of which the third dose is the booster dose. Among the subjects that took part in this study, 123 participants reported not been affected by any side effects after taking the COVID-19 vaccines, in contrast, 81 participants reported to have experienced vaccine adverse effects.

Table 4: Displaying distribution of the participants affected and not affected by vaccine adverse effects, vaccine Brand and Dose of the vaccines.

Dose# * Brand * Affected Crosstabulation							
Affected				Brand			Total
				Covishield	Covaxin	Others	
No	Dose #	First dose	Count	5	3		8
			% within Dose#	62.5%	37.5%		100.0 %
			% within Brand	5.6%	9.1%		6.5%
		Second dose	Count	83	30		113
			% within Dose#	73.5%	26.5%		100.0 %
			% within Brand	92.2%	90.9%		91.9%
		Booster dose	Count	2	0		2
			% within Dose#	100.0%	0.0%		100.0 %
			% within Brand	2.2%	0.0%		1.6%
	Total		Count	90	33		123
			% within Dose#	73.2%	26.8%		100.0 %
			% within Brand	100.0%	100.0%		100.0 %
Yes	Dose #	First dose	Count	6	1	0	7
			% within Dose#	85.7%	14.3%	0.0%	100.0 %
			% within Brand	8.6%	10.0%	0.0%	8.6%

		Second dose	Count	63	9	1	73
			% within Dose#	86.3%	12.3%	1.4%	100.0 %
			% within Brand	90.0%	90.0%	100.0 %	90.1%
		Booster dose	Count	1	0	0	1
			% within Dose#	100.0%	0.0%	0.0%	100.0 %
			% within Brand	1.4%	0.0%	0.0%	1.2%
	Total		Count	70	10	1	81
			% within Dose#	86.4%	12.3%	1.2%	100.0 %
			% within Brand	100.0%	100.0%	100.0 %	100.0 %
Total	Dose #	First dose	Count	11	4	0	15
			% within Dose#	73.3%	26.7%	0.0%	100.0 %
			% within Brand	6.9%	9.3%	0.0%	7.4%
		Second dose	Count	146	39	1	186
			% within Dose#	78.5%	21.0%	0.5%	100.0 %
			% within Brand	91.2%	90.7%	100.0 %	91.2%
		Booster dose	Count	3	0	0	3
			% within Dose#	100.0%	0.0%	0.0%	100.0 %
			% within Brand	1.9%	0.0%	0.0%	1.5%
	Total		**Count**	**160**	**43**	**1**	**204**
			% within Dose#	**78.4%**	**21.1%**	**0.5%**	**100.0 %**
			% within Brand	**100.0%**	**100.0%**	**100.0 %**	**100.0 %**

Table 5: Chi-Square Tests among the affected and not affected participants

Chi-Square Tests				
Affected by adverse effects		Value	df	Asymp. Sig. (2-sided)
No	Pearson Chi-Square	1.202[b]	2	.548
	Likelihood Ratio	1.687	2	.430
	Linear-by-Linear Association	1.006	1	.316
	N of Valid Cases	123		
Yes	Pearson Chi-Square	.276[c]	4	.991
	Likelihood Ratio	.496	4	.974

	Linear-by-Linear Association	.011	1	.918
	N of Valid Cases	81		
Total	Pearson Chi-Square	1.180[a]	4	.881
	Likelihood Ratio	1.870	4	.760
	Linear-by-Linear Association	.580	1	.446
	N of Valid Cases	204		
a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .01.				
b. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .54.				
c. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .01.				

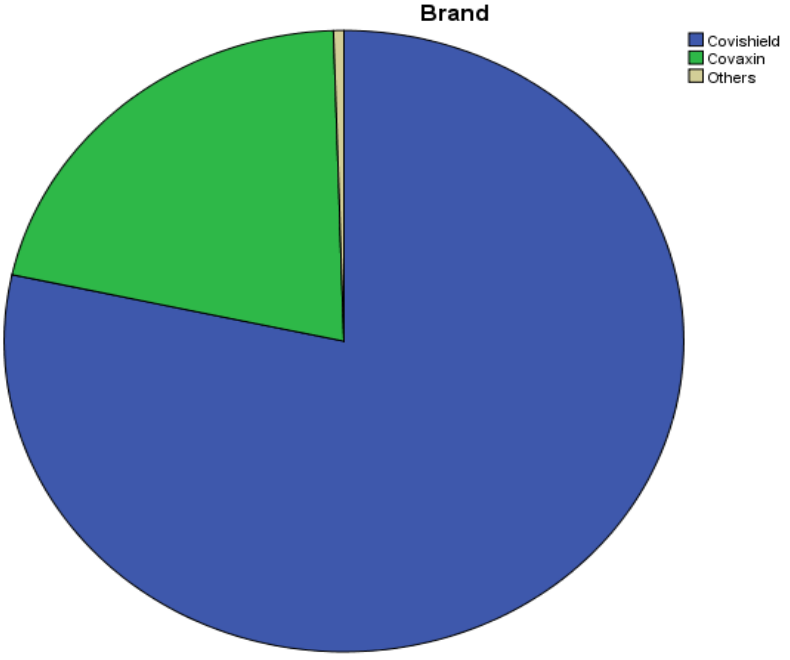

Fig. 4: A Pie chart depleting the distribution of the participants among the COVID-19 vaccine brands.

Many people reported experiencing more or severe vaccine adverse effects after the first dose hence 64 (92.8%) among those affected, and 5 (7.2%) had suffered the most after the second jab. Furthermore, among those affected, 61 (88.4%) had taken Covishield COVID-19 vaccine, 7 (10.1%) had administered Covaxin COVID-19 vaccine and 1 (1.4%) took others (Sputnik V COVID-19 vaccine).

Table 6: Showing distribution of the participants among the different vaccine Brands, which Dose with severe or more adverse effects.

Dose# * Brand Crosstabulation						
			Brand			Total
			Covishield	Covaxin	Others	
Dose with severe adverse effects	First dose	Count	56	7	1	64
		% within Dose#	87.5%	10.9%	1.6%	100.0%
		% within Brand	91.8%	100.0%	100.0%	92.8%
	Second dose	Count	5	0	0	5
		% within Dose#	100.0%	0.0%	0.0%	100.0%
		% within Brand	8.2%	0.0%	0.0%	7.2%
Total		Count	61	7	1	69
		% within Dose#	88.4%	10.1%	1.4%	100.0%
		% within Brand	100.0%	100.0%	100.0%	100.0%

Table 7: Chi-Square Tests among the different doses

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.707[a]	2	.702
Likelihood Ratio	1.282	2	.527
Linear-by-Linear Association	.635	1	.426
N of Valid Cases	69		
a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is .07.			

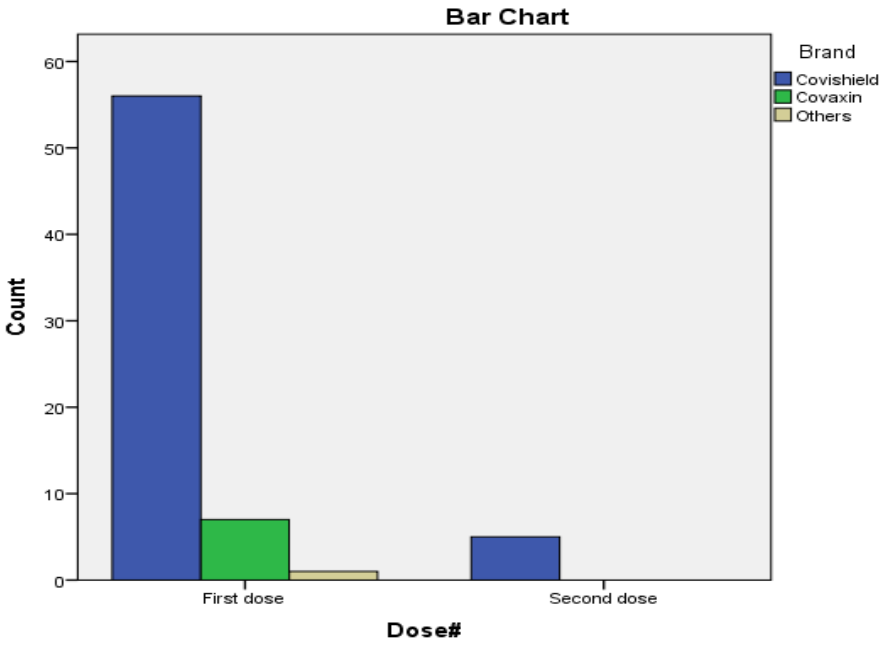

Fig. 5: A Graph showing distribution of the participants, according to the different COVID-19 vaccine Brands, which Dose the participants suffered severe or more vaccine adverse effects.

When asked about duration of the vaccine side effects to alleviate, among those who had taken Covishield COVID-19 vaccine (62): 14.4% (9) reported that the side effects lasted only for about an hour(s); 35.5% (22) reported to had suffered for about a day(s); then 40.3% (25) reported that the side effects disappeared after a week(s); and about 9.7% (6) said they lasted for only a month(s). On the other hand, among those who had administered Covaxin COVID-19 vaccine (10): only about 60% (6) reported that the adverse effects disappeared after a week(s), while 40% (4) reported to had suffered the side effects for a period of about a month(s). Worth-noting that within those who administered Covaxin COVID-19 vaccine none reported about hour(s) nor day(s).

Table 8: Showing Duration of adverse effects to disappear according to the different vaccine Brands.

Disappearance * Brand Crosstabulation					
			Brand		Total
			Covishield	Covaxin	
Disappearance	After hour(s)	Count	9	0	9
		% within Disappearance	100.0%	0.0%	100.0%
		% within Brand	14.5%	0.0%	12.5%
	After day(s)	Count	22	0	22
		% within Disappearance	100.0%	0.0%	100.0%

		% within Brand	35.5%	0.0%	30.6 %
	After week(s)	Count	25	6	31
		% within Disappearance	80.6%	19.4%	100. 0%
		% within Brand	40.3%	60.0%	43.1 %
	After month(s)	Count	6	4	10
		% within Disappearance	60.0%	40.0%	100. 0%
		% within Brand	9.7%	40.0%	13.9 %
Total		Count	62	10	72
		% within Disappearance	86.1%	13.9%	100. 0%
		% within Brand	100.0%	100.0%	100. 0%

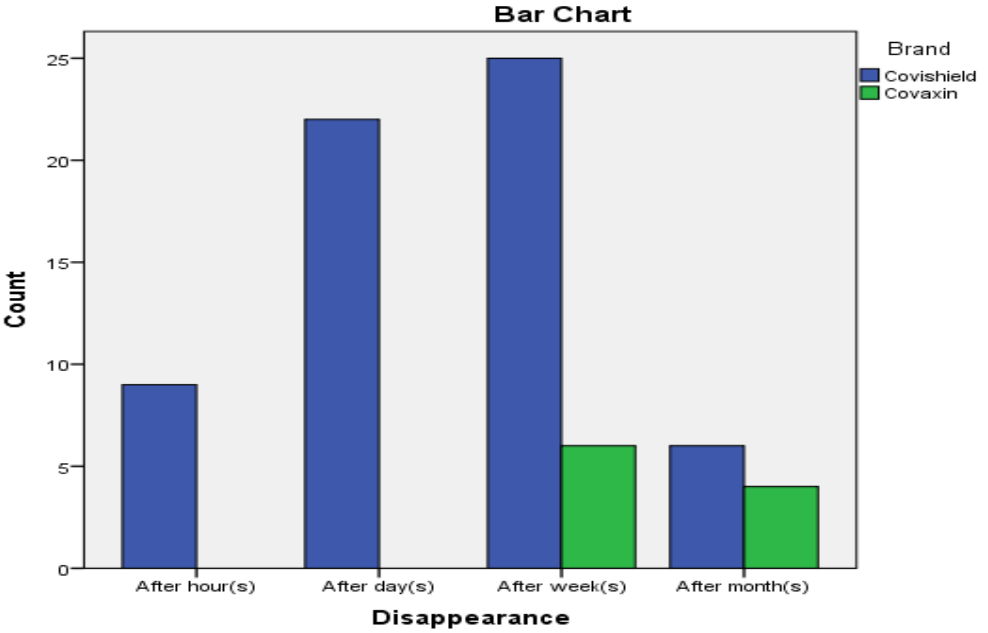

Fig. 6: A Graph presenting the Duration of vaccine adverse effects to disappear according to the different vaccine Brands.

This study also touched on how the people perceive the COVID-19 vaccines. A number of statements about the COVID-19 vaccines perceptions were well-structured. The participants were asked to sate how strongly AGREE or DISAGREE with the statements as far as their beliefs were concerned towards the COVID-19 vaccines. From the set of statements, the participants responded as follow (Table 9):

Table 9: Showing how the participants responded to different statements about their perceptions towards the COVID-19 vaccines.

Statements		Count
COVID-19 vaccine may lead to long-term health problems.	Strongly Disagree	51
	Disagree	90
	Neutral	44
	Agree	16
	Strongly Agree	3
COVID-19 vaccine can protect you against coronavirus	Strongly Disagree	12
	Disagree	9
	Neutral	31
	Agree	109
	Strongly Agree	43
COVID-19 vaccine can reduce your risk of contracting coronavirus	Strongly Disagree	12
	Disagree	12
	Neutral	45
	Agree	101
	Strongly Agree	34
COVID-19 vaccine may cause more harm than COVID-19 itself	Strongly Disagree	61
	Disagree	92
	Neutral	34
	Agree	13
	Strongly Agree	4
COVID-19 vaccines are safe	Strongly Disagree	4
	Disagree	1
	Neutral	43
	Agree	122
	Strongly Agree	34
COVID-19 vaccines are effective	Strongly Disagree	1
	Disagree	3
	Neutral	29
	Agree	116
	Strongly Agree	55
COVID-19 vaccine can decrease the severity and the chances of having complications if you are infected	Strongly Disagree	5
	Disagree	3
	Neutral	30
	Agree	98
	Strongly Agree	68
Having COVID-19 vaccinated is important for health of others in your area	Strongly Disagree	1
	Disagree	1
	Neutral	26
	Agree	109
	Strongly Agree	67
Getting vaccinated was a good way to protect yourself against	Strongly Disagree	3
	Disagree	14
	Neutral	39

diseases	Agree	100
	Strongly Agree	48
COVID-19 vaccines can prevent people from spreading coronavirus to others	Strongly Disagree	7
	Disagree	24
	Neutral	46
	Agree	95
	Strongly Agree	32
Your confidence in COVID-19 vaccine is dependent on the type/brand of the vaccines	Strongly Disagree	6
	Disagree	38
	Neutral	70
	Agree	72
	Strongly Agree	18
COVID-19 vaccines information from the vaccine programs is reliable & trustworthy	Strongly Disagree	4
	Disagree	8
	Neutral	39
	Agree	111
	Strongly Agree	42

When self-rating their health status since the participants had taken the vaccine doses compared before taking them, Table 10 and Fig. 7 below show how they rated themselves:

Table 10: Showing statistics on the Health Status of the participants after taking COVID-19 vaccines, according to the different vaccine Brands.

Your health * Brand Crosstabulation						
			Brand			Total
			Covishield	Covaxin	Others	
Your health	Not Good Health	Count	1	0	0	1
		% within Brand	0.7%	0.0%	0.0%	0.5%
	Moderate Health	Count	24	10	0	34
		% within Brand	16.1%	24.4%	0.0%	17.8%
	Good Health	Count	124	31	1	156
		% within Brand	83.2%	75.6%	100.0%	81.7%
Total		Count	149	41	1	191
		% within Brand	100.0%	100.0%	100.0%	100.0%

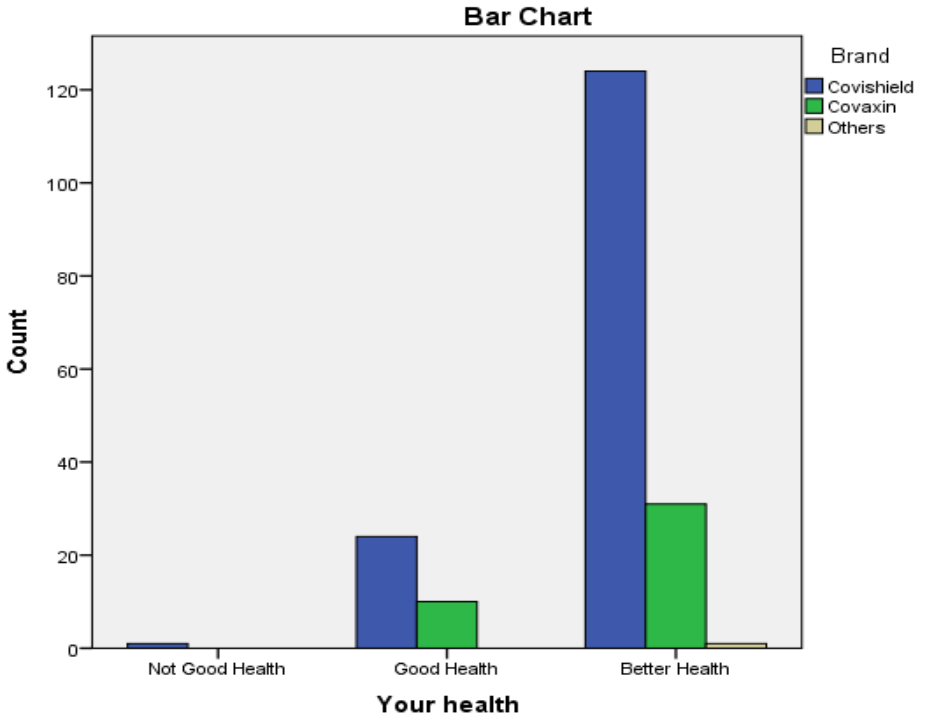

Fig. 7: A Graph illustrating Health Status of the participants after taking COVID-19 vaccines, according to the different vaccine Brands.

Since our study was dealing with healthcare providers (as participants) from different sectors, among them there were prescribers (i.e., physicians/doctors, some nurses). These prescribers are the first-hand health practitioners in treating the public. The investigator, through the prescribers, searched on what the public experiencing after taking the COVID-19 vaccines, too. In the group of the prescribers (108), 94 of them reported that had seen patients presenting adverse effects after taking COVID-19 vaccines, though the side effects were mild to moderate. Then about 14 of the prescribers had not seen any patients with side effects.

Table 11: Showing distribution of the Prescribers have or have not seen patients with adverse effects after taking COVID-19 vaccines.

Prescribers * Patients with side effects Crosstabulation					
			Patients with side effects		Total
			No	Yes	
Prescribers	Yes	Count	14	94	108
		% within Patients with side effects	100.0%	100.0%	100.0%
Total		Count	14	94	108
		% within Patients with side effects	100.0%	100.0%	100.0%

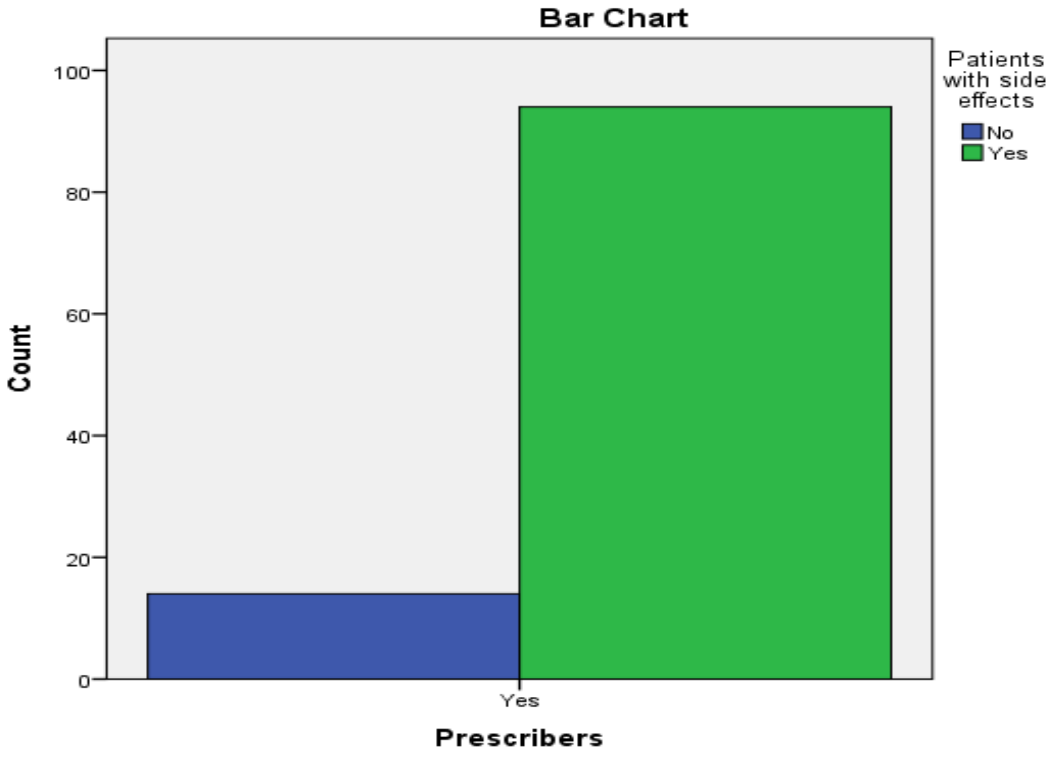

Fig. 8: Showing distribution among prescribers have seen and have not seen patients with vaccine side effects.

It has been observed that not everyone had taken COVID-19 vaccine developed adverse effects. The prescribers were asked to rate themselves on how often do they see patients presenting vaccine adverse effects after taking COVID-19 vaccines. Most of the prescribers (30) rarely see patients with vaccine adverse effects, yet a least number of about 12 prescribers see patients with side effects very often. The diagrams below show the distribution of the prescribers on how often they see the patients presenting vaccine adverse effects (Table 12 & Fig. 9):

Table 12: Showing distribution of the Prescribers on how often see patients with COVID-19 vaccine adverse effects.

Prescribers * Rate Crosstabulation						
			Rate			Total
			Very often	Often	Rarely	
Prescribers	Yes	Count	12	15	30	57
		% within Rate	100.0%	100.0 %	100.0 %	100.0 %
Total		Count	12	15	30	57

	% within Rate	100.0%	100.0 %	100.0 %	100.0 %

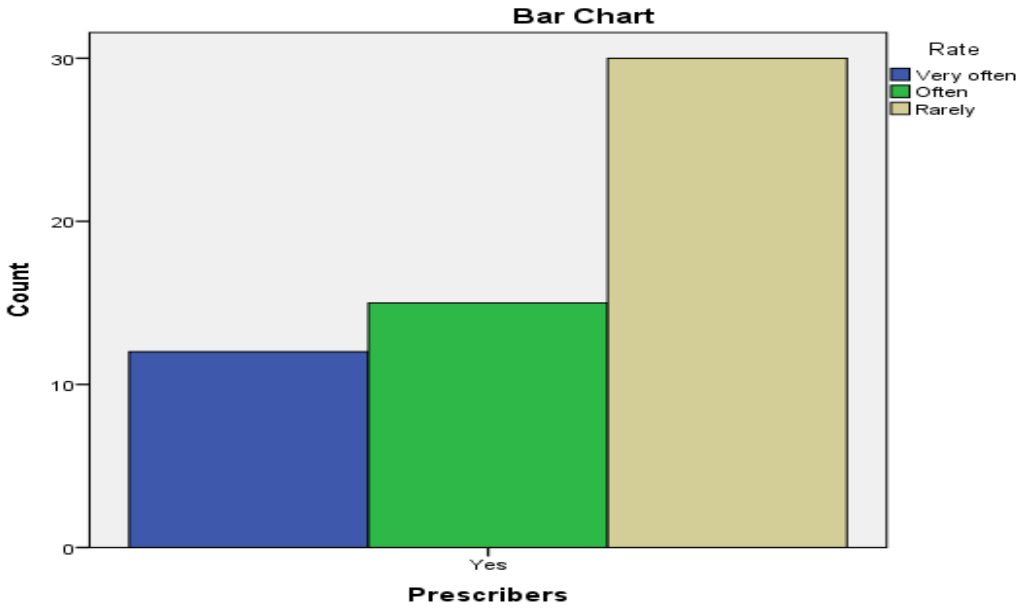

Fig. 9: A Graph illustrating distribution of the Prescribers on how often see patients with COVID-19 vaccine adverse effects.

Discussion

In this study 204 participants, healthcare practitioners, reported had received at least the first dose of COVID-19 vaccination. It has been revealed that the COVID-19 vaccines have potential of causing adverse effect reactions, regardless of the brands. WHO, on its Data-base about vaccine-related side effects has made it clear that just like other vaccines, the COVID-19 vaccines have potential of causing adverse effects to patients [www.who.int/docs/default-source/coronavirus/risk-comms-upadates/update52_vaccines.pdf?sfvrsn=b11be994 4]. In our study, vaccine adverse effects were reported more commonly after the first dose of vaccination, especially with Covishield COVID-19 vaccine, particularly, with younger ages and female sex.

Abanoub R *et al.* in their study found that the COVID-19 vaccines had ability to cause adverse effect reactions as it was revealed that, in relation to the vaccinated population in Czech Republic, adverse effects were more prevalent as compared to the vaccinated population in the U.S and Turkey [Riad *at el.*, 2021]. Most of the adverse effects reported were mild while rarely reported were the serious ones, such as anaphylaxis or allergy. Alexis L *et al.* they found that serious adverse effects were of low rate and constant with data that had been collected from randomized clinical trial.[28] As much as the vaccines had an ability of triggering

immune response against COVID-19 but adverse effects were spotted, however, the rate was very low [Saeed *et al.*, 2021].

In our study, among the participants, only 78.4% (160) had taken Covishield COVID-19 vaccine. Out of those took Covishield vaccine, only 44.3% (71) had experienced adverse effects. On the other hand, 21.1% (43) of the total participants had administered Covaxin COVID-19 vaccine and only about 23.3% (10) had suffered vaccine adverse effects. Our study also found that the first dose of vaccination was reported to have more side effects than the second dose (Table 4).

More people reported to be victims of the Covid-19 vaccine side effects are between age 21 to 30 years (32), of which 23 are females while 9 are males. On the other hand, Age group with least number of affected people is 60 years and above, with only one victim. In general, among the affected participants, males are more affected than females, according to our study findings.

Table 13: Showing distribution of participants affected and not affected by vaccine adverse effects, according to Gender among the Age groups.

Affected * Age * Gender Crosstabulation									
Gender				Age					Total
				Less than 20 Years	21 to 30 Years	31 to 40 Years	41 to 50 Years	51 to 60 Year	Above 60 Years	
Male	Affected	No	Count		22	18	13	16	4	73
			% within Affected		30.1%	24.7%	17.8%	21.9%	5.5%	100.0%
			% within Age		71.0%	64.3%	52.0%	88.9%	100.0%	68.9%
		Yes	Count		9	10	12	2	0	33
			% within Affected		27.3%	30.3%	36.4%	6.1%	0.0%	100.0%
			% within Age		29.0%	35.7%	48.0%	11.1%	0.0%	31.1%
	Total		Count		31	28	25	18	4	106
			% within Affected		29.2%	26.4%	23.6%	17.0%	3.8%	100.0%
			% within Age		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Female	Affected	No	Count	1	22	11	7	8	1	50
			% within Affected	2.0%	44.0%	22.0%	14.0%	16.0%	2.0%	100.0%

			% within Age	100.0 %	48.9%	44.0%	46.7%	80.0%	50.0%	51. 0%
		Yes	Count	0	23	14	8	2	1	48
			% within Affected	0.0%	47.9%	29.2%	16.7%	4.2%	2.1%	100 .0%
			% within Age	0.0%	51.1%	56.0%	53.3%	20.0%	50.0%	49. 0%
	Total		Count	1	45	25	15	10	2	98
			% within Affected	1.0%	45.9%	25.5%	15.3%	10.2%	2.0%	100 .0%
			% within Age	100.0 %	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100 .0%
Total	Affect ed	No	Count	1	44	29	20	24	5	123
			% within Affected	0.8%	35.8%	23.6%	16.3%	19.5%	4.1%	100 .0%
			% within Age	100.0 %	57.9%	54.7%	50.0%	85.7%	83.3%	60. 3%
		Yes	Count	0	32	24	20	4	1	81
			% within Affected	0.0%	39.5%	29.6%	24.7%	4.9%	1.2%	100 .0%
			% within Age	0.0%	42.1%	45.3%	50.0%	14.3%	16.7%	39. 7%
	Total		Count	1	76	53	40	28	6	204
			% within Affected	0.5%	37.3%	26.0%	19.6%	13.7%	2.9%	100 .0%
			% within Age	100.0 %	100.0 %	100.0%	100.0 %	100.0 %	100.0 %	100 .0%

Table 14: Chi-Square Tests among Gender

Chi-Square Tests				
Gender		Value	df	Asymp. Sig. (2-sided)
Male	Pearson Chi-Square	8.829[b]	4	.066
	Likelihood Ratio	10.448	4	.034
	Linear-by-Linear Association	1.157	1	.282
	N of Valid Cases	106		
Female	Pearson Chi-Square	5.010[c]	5	.415
	Likelihood Ratio	5.650	5	.342
	Linear-by-Linear	.834	1	.361

	Association			
	N of Valid Cases	98		
Total	Pearson Chi-Square	12.188[a]	5	.032
	Likelihood Ratio	13.813	5	.017
	Linear-by-Linear Association	3.477	1	.062
	N of Valid Cases	204		
a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .40.				
b. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.25.				
c. 5 cells (41.7%) have expected count less than 5. The minimum expected count is .49.				

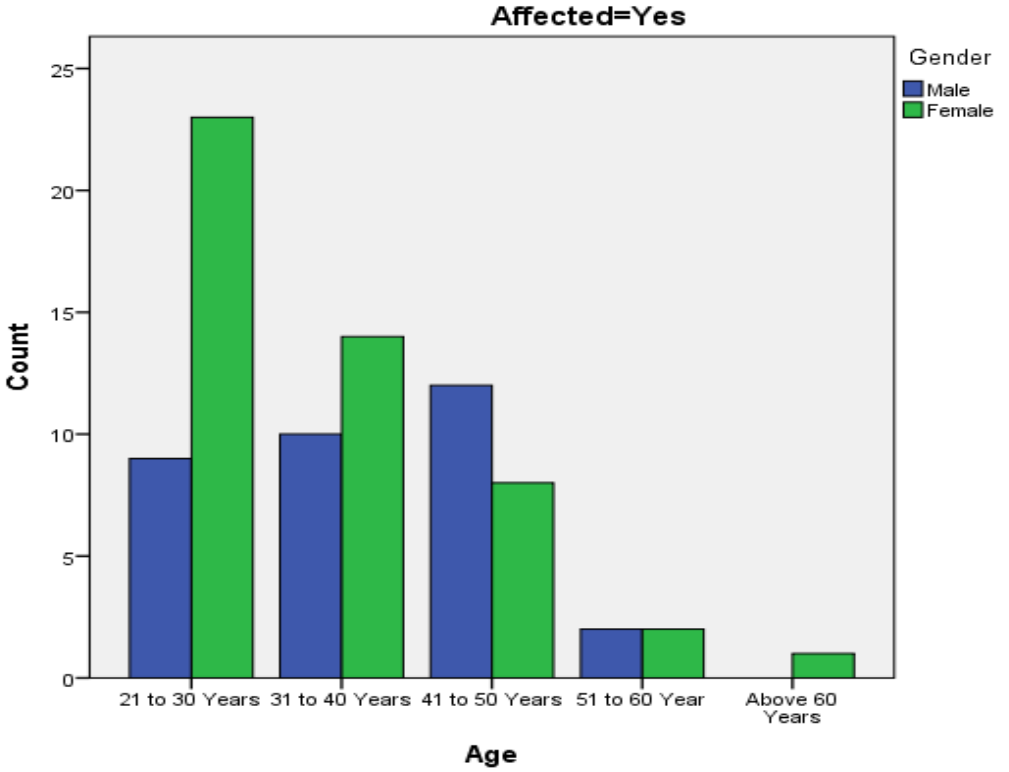

Fig. 10: A Bar Chart showing distribution of the participants affected by vaccine side effects, according to Gender among the Age groups.

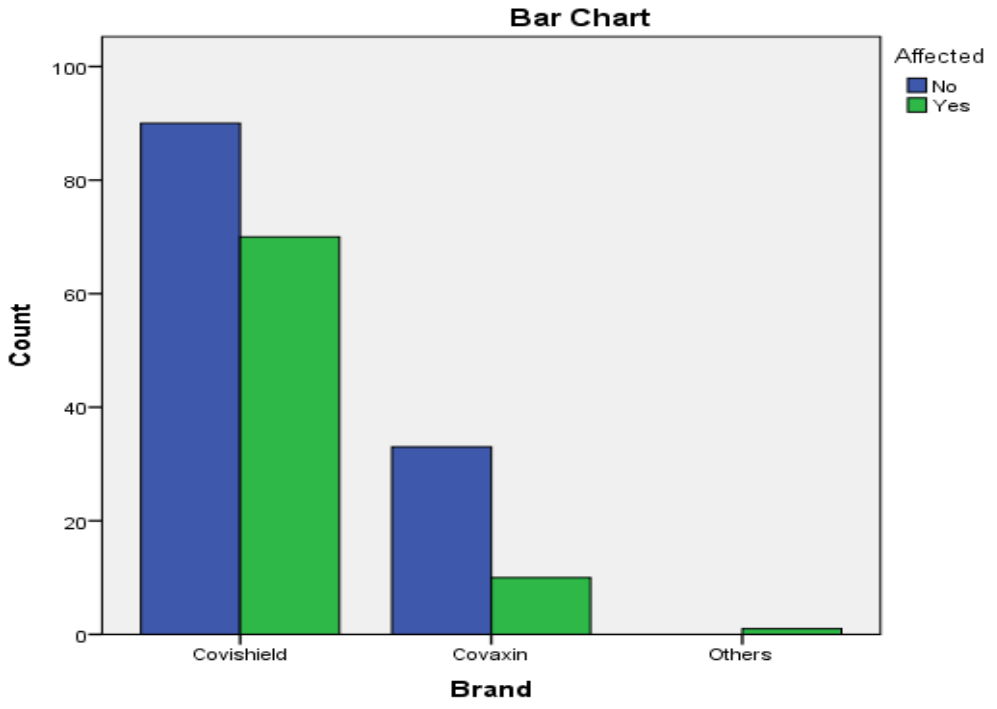

Fig. 11: A Graph illustrating the distribution participants affected and not affected by vaccine adverse effects, according to the different COVID-19 vaccine Brands.

A number of adverse effect reactions were reported, both local and systemic, in this study. [Wu *et al.*, 2021] found that most common local adverse effect reactions reported were pain on injection site and tenderness, while headache and fatigue were the commonest systemic reactions. According to our study, the most common reported vaccine adverse effects were ranging from headache, fever, pain and swelling at injection site, pain on joints, dizziness and weakness.

Conclusion

This study showed that post-vaccination, of both first and second dose, adverse effects that were mild to moderate, non-serious and non-life threatening. Noted was that adverse effects were more common with Covishield COVID-19 vaccine. As COVID-19 is new in humans' lives, more new things, can it be either of short or long-term effect are still going to creep out hence close monitoring, especially of the vaccines, is of very importance at this particular juncture.

Human rights and ethical considerations

While during the study, human rights and ethical considerations were greatly observed. No one was compelled to participate in this study. Participation was strictly voluntary. Participants were free to withdraw from the study at any time and that was not disadvantaging anyone in anyway. To make sure the human rights were fully respected, an inform consent was given before participating in

this study. To add on that, there was no question that was asked requiring so personal information that may disclose anyone's personality.

Limitations

This study, just like many studies if not all, has limitations. Having limited financial resources was one of the most prevailed limitations. It was frustrating to see people declining to participate in the study for different personal reasons. Other participants were skipping other questions leaving them unanswered and gave the researcher hard time when analyzing the data.

References

V'kovski, P., Kratzel, A., Steiner, S., *Stalder, H., & Thiel, V. (2021).* Coronavirus biology and replication: implications for SARS-CoV-2. *Nat Rev Microbiol* 19**,** 155–170. DOI: 10.1038/s41579-020-00468-6

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., Ren, R., Leung, K. S. M., Lau, E. H. Y., Wong, J. Y., Xing, X., Xiang, N., et al. (2020). Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus- Infected Pneuminia. New Englind Journal of Medicine, 382: 1199-1207. DOI: 10.1056/NEjMoa2001316.

He, F., Deng, Y., Li, W., (2020). Coronavirus disease 2019: What we know? Journal of Medicical Virology, 92(7): 719-725. DOI: 10.1002/jmv.25766.

Zhou, D., Zhang, P., Bao, C., Zhang, Y., Zhu, N. (2020) Emerging Understanding of Etiology and Epidemiology of the Novel Coronavirus (COVID-19) infection in Wuhan, China. *Preprints*, 2020020283. DOI: 10.20944/preprints202002.0283.v1).

Lone, S. A., Ahmad, A., (2020). COVID-19 pandemic- an African perspective, Emerging Microbes & Infections,9(1), 1300-1308, DOI: 10.1080/22221751.2020.1775132. http//doi.org/10.1080/22221751.2020.1775132

Rauf A., Abu-Izneid T., Olatunde A., Khalil A. A., Alhumaydhi F. A., Tufail T., Shariati M. A., Rebezow M., Almarhoon Z. M., Mabkhot Y. N.,Alsayari A., Rengasamy K. R.R.*et al.* 2020. COVID-19 Pandemic: Epidemiology, Etiology, Conventional and Non-Conventional Therapies. *Int. J. Environ.Res. Public Health.*17,8155; doi:103390/ijerph17218155. www.mdpi.com/journal/ijerph

Huang, C., Wang,Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Cao, B., *et al.* (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 395(10223), 497-506. DOI: 10.1016/S0140-673(20) 30183-5.

Rothan H. A., Byrareddy S. N. 2020. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun* 109, 102433.

Yamamoto, V., Bolanos, J. F., Fiallos, J., Strand, S. E., Morris, K., Shahrokhinia, S., Cushing, T. R., Hopp, L., Tiwari, A., Hariri, R., Sokolov, R., Wheeler, C., Kaushik, A., Elsayegh, A., Eliashiv, D., Hedrick, R., Jafari, B., Johnson, J. P., Khorsandi, M., Gonzalez, N., Balakhani, G., Lahiri, S., Ghavidel, K., Amaya, M., Kloor, H., Hussain, N., Huang, E., Cormier, J., Wesson Ashford J., Wang, J. C, Yaghobian, S., Khorrami, P., Shamloo, B., Moon, C., Shadi, P., Kateb, B. COVID-19: Review of a 21st Century Pandemic from Etiology to Neuro-

psychiatric Implications. (2020). J Alzheimers Dis. 77(2),459-504. DOI:10.3233/JAD-200831.

Schoeman, D., Fielding, B.C. (2019) Coronavirus envelope protein: current knowledge *Virol J* 16, 69 (2019). DOI:10.1186/s12985-019-1182-0

Hoffmann, M., Kleine-Weber, H., Schroeder, S., Krüger, N., Herrler, T., Erichsen, S., Schiergens, T. S., Herrler, G., Wu N. H., Nitsche, A., Müller, M. A., Drosten, C., Pöhlmann, S. (2020). SARS-CoV-2 Cell Entry Depends on ACE2 and TMPRSS2 and Is Blocked by a Clinically Proven Protease Inhibitor. Cell. 2020 Apr 16;181(2):271-280.e8. DOI: 10.1016/j.cell.2020.02.052.

Lu, R., Zhao, X., Li, J., Niu, P., Yang, B., Wu, H., Wang, W., Song, H., Huang, B., Zhu, N., Bi, Y., Ma, X., Zhan, F., Wang, L., Hu, T., Zhou, H., Hu, Z., Zhou, W., Zhao, L., Chen, J., Meng, Y., Wang, J., Lin, Y., Yuan, J., Xie, Z., Ma, J., Liu, W. J., Wang, D., Xu, W., Holmes, E. C., Gao, G. F., Wu, G., Chen, W., Shi, W., Tan, W. (2020). Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet, 22;395(10224):565-574. DOI:10.1016/S0140-6736(20)30251-8.

Jiang, M. D., Zu, Z. Y., Schoepf, U. J., Savage, R. H., Zhang, X. L., Lu, G. M., & Zhang, L. J. (2020). Current Status of Etiology, Epidemiology, Clinical Manifestations and Imagings for COVID-19. *Korean journal of radiology*, *21*(10), 1138–1149. DOI: 10.3348/kjr.2020.0526

Hadj Hassine, I. Covid-19 vaccines and variants of concern: A review. (2021). Rev Med Virol, 9;e2313. DOI: 10.1002/rmv.2313.

Milligan, I. D., Gibani, M. M., Sewell, R., *et al.* (2016) Safety and Immunogenicity of Novel Adenovirus Type 26– and Modified Vaccinia Ankara–Vectored Ebola Vaccines: A Randomized Clinical Trial. *JAMA.* 2016;315(15):1610–1623. DOI:10.1001/jama.2016.4218

Matz, K. M., Marzi, A., Feldmann, H. (2019) Ebola vaccine trials: progress in vaccine safety and immunogenicity. Expert Rev Vaccines, 18(12):1229-1242. DOI: 10.1080/14760584.2019.1698952.

Bandyopadhyay, A. S., Garon, J., Seib, K., & Orenstein, W. A. (2015). Polio Vaccination: Past, present and future. Future Microbiology, 10(5). DOI: 10.2217/FMB.15.19.

Keshavarz, M., Mirzaei, H., Salemi, M., Momeni, F., Mousavi, M. J., Sadeghalvad, M., Arjeini, Y., Solaymani-Mohammadi, F., Sadri Nahand, J., Namdari, H., Mokhtari-Azad, T., Rezaei, F. (2019). Influenza vaccine: Where are we and where do we go? Rev Med Virol, 29(1):e2014. DOI: 10.1002/rmv.2014.

www. Mohfw.gov.n/www.cowin.gov.in

https://www.schengenvisainfo.com/news/another-eu-country-accepts-covishield-vaccine-as-valid-proof-of-immunity-for-travel-bringing-the-number-to-18/#:~:text=The%20number%20of%20European%20Union,country%20–%20also%20recognises%20the%20vaccine.

https://www.medicalnewstoday.com/articles/oxford-astrazeneca-vaccine-what-to-know-about-side-effects

https://www.mpnrc.org/covaxin-vs-covishield/

https://www.bharatbiotech.com/covaxin.html

Barat Biotech International Limited. (2021). Restricted Use of COVAXIN™ Under Clinical Trail Mode: Implementation Plan No: BBIL/COVAXIN™/2021. *ICMR Journal*, 4

https://www.who.int/docs/default-source/coronaviruse/risk-comms-updates/update52_vaccines.pdf?sfvrsn=b11be994_4

Riad, A., Schünemann, H., Attia, S., Peričić, T. P., Žuljević, M. F., Jürisson, M., Kalda, R., Lang, K., Morankar, S., Yesuf, E. A., Mekhemar, M., Danso-Appiah, A., Sofi-Mahmudi, A., Pérez-Gaxiola, G., Dziedzic, A., Apóstolo, J., Cardoso, D., Marc, J., Moreno-Casbas, M., Wiysonge, C. S., Qaseem, A., Gryschek, A., Tadić, I., Hussain, S., Khan, M. A., Klugarova, J., Pokorna, A., Koščík, M., Klugar, M. (2021). COVID-19 Vaccines Safety Tracking (CoVaST): Protocol of a Multi-Center Prospective Cohort Study for Active Surveillance of COVID-19 Vaccines' Side Effects. Int J Environ Res Public Health, 18(15):7859. DOI:10.3390/ijerph18157859.

Beatty, A. L., Peyser, N. D., Butcher, X. E., *et al.* (2021) Analysis of COVID-19 Vaccine Type and Adverse Effects Following Vaccination. *JAMA Netw Open,* 4(12):e2140364. DOI:10.1001/jamanetworkopen.2021.40364.

Saeed, B. Q., Al-Shahrabi, R., Alhaj, S. S., Alkokhardi, Z. M., Adrees, A. O. (2021). Side effects and perceptions following Sinopharm COVID-19 vaccination. Int J Infect Dis, 111:219-226. DOI: 10.1016/j.ijid.2021.08.013.

Wu, Q., Dudley, M. Z., Chen, X., Bai, X., Dong, K., Zhuang, T., Salmon, D., Yu, H. (2021). Evaluation of the safety profile of COVID-19 vaccines: a rapid review. BMC Med, 19(1):173. DOI: 10.1186/s12916-021-02059-5.