A STUDY ON THE SIDE EFFECTS OF COVID-19 VACCINES IN BANGLADESH

By

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A thesis submitted to the Department of Pharmacy in partial fulfillment of the requirements for the degree of
Bachelor of Pharmacy

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Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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Approval

The thesis titled "A study on the side effects of Covid-19 vaccines in Bangladesh" submitted by Samiha Zaha Afrida (18146071) of Spring 2022 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy.

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Ethics Statement

This study does not involve human or animal trials.

Abstract

Pfizer-BioNTech, Oxford-AstraZeneca, Sinopharm, and Moderna have all recently introduced vaccines to combat the COVID-19 pandemic in Bangladesh. These vaccines have been associated with mild-to-moderate adverse events during clinical trials. Thus, we sought to assess the short-term adverse effects of vaccination. An internet-based survey of 210 Bangladeshi citizens was conducted from January 20 to February 10, 2022. In our survey, we discovered that respondents who received the Moderna vaccine experienced a greater number of adverse events. And the most frequently reported adverse reactions to all vaccines were fever, muscle aches, headache aches, and fatigue. Additionally, we used a chi-square test to determine the relationship between vaccine type and side effects. The survey found that the type of vaccine used is associated with post-vaccination side effects.

Keywords: SARS Cov-2; COVID-19; vaccine; side effects

Dedication

Dedicated to my Parents

Acknowledgement

I would like to begin by thanking the most gracious and merciful God for the strength and knowledge that enabled me to accomplish my job with diligence and perseverance.

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List of Acronyms

SARS	Severe Acute Respiratory Syndrome
COVID-19	Corona Virus Disease 2019
WHO	World Health Organization
BBIBP	Beijing Bio-Institute of Biological Products

Chapter 1

Introduction

1.1 Covid-19 Background

In December 2019, a number of people in Wuhan, China, started having short-term respiratory problems. This quickly spread from Wuhan to other places. Almost immediately, it was found that a new coronavirus was to blame. The new coronavirus was called the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2, 2019-nCoV) because it shares about 80% of its DNA with SARS-CoV, which caused acute respiratory distress syndrome (ARDS) and killed a lot of people in 2002 to 2003. Initially, the spread of SARS-CoV-2 was thought to have come from a zoonotic transmission at a seafood market in Wuhan, China. After the next outbreak, it was found that humans to humans spread the disease. The disease caused by this virus was called Coronavirus disease 19 (COVID-19), and the World Health Organization called it a pandemic. COVID-19 has had a significant impact on a large number of people globally. (Yuki et al., 2020)

SARS-CoV-2 is a member of the family Coronaviridae, the genus Betacoronavirus, and the subgenus Sarbecovirus. It is one of seven coronaviruses responsible for human disease: NL63, 229E, OC43, HKU1, SARS-CoV, and Middle East Respiratory Syndrome CoV (MERS-CoV) [3]. The SARS-CoV-2 genome has a nucleotide sequence similarity of approximately 89 percent to that of SARS-like CoVs (bat SL-CoVZC45, SARS-CoV Tor2) and is divided into two untranslated terminal regions (UTR) and 14 open reading frames (ORFs). The structural ORFs encode proteins such as Spike (S), Envelope (E), Membrane (M), and Nucleocapsid (N), while the remaining regions encode non-structural or accessory proteins. (Nguyen et al., 2020)

COVID-19 is a messenger RNA virus closely related to the common cold virus. The COVID-19 virus enters lung type II alveolar cells, small intestinal enterocytes, arterial and venous endothelial cells, and vasculature smooth muscle cells via its S spike protein binding to the target cells' ACE2 receptor. Variations in the expression of the ACE2 receptor may contribute to differences in infection susceptibility between sexes and ethnic groups. S-Spike protein mutations have been linked to differences in the virulence of COVID-19 subtypes. Current vaccines are directed against this S protein. (De Soto, 2021)

Human coronaviruses can cause mild disease (OC43, HKU1, 229E, and NL63) as well as severe disease (SARS-CoV-1, SARS-CoV-2, and MERS). SARS-CoV-2 infection causes asymptomatic infection or mild symptoms in the majority of patients (approximately 80%). A virus positive polymerase chain reaction (PCR) test is associated with the following symptoms: fatigue, fever, chills, loss of appetite, and persistent cough. Anosmia, or a loss of smell and taste, is a striking feature of SARS-CoV-2 infection, occurring in approximately 64% of cases in one study. It is unknown whether viral spread to the lower respiratory tract is a precursor to severe disease; pneumonia with characteristic changes in the pulmonary ground glass opacity on chest CT scans is common, even in asymptomatic individuals. Severe disease is characterized by blood clotting, respiratory compromise, renal damage, and cardiovascular collapse. Age is the greatest risk factor for severe COVID-19 disease: despite geographic variability in reported case fatality rates, the remarkable relationship with age is consistently observed. (Tregoning et al., 2020) Although numerous therapeutic drugs have been proposed to fight COVID-19, their efficacy and potency remain unknown due to the lack of randomized control studies. (Saeed et al., 2021)

1.2 What is a vaccine?

Vaccines are biological agents that confer active adaptive immunity against particular diseases. Vaccine creation involves the use of the microbes responsible for the disease, either in a killed or attenuated form, or the utilization of the bacteria' toxins or surface proteins. Vaccines are administered orally, intravenously, or nasally to boost the immune system against foreign invaders. When developing immunity, the body produces antibodies against certain microorganisms that create the defense mechanism. If a person later encounters the same bacteria, the antibodies created by the body in response to the microorganisms' antigens either prevent the individual from contracting the disease caused by the pathogen or lower the severity of the sickness. Vaccines are commonly regarded as the most cost-effective public health measures.(Kashte et al., 2021)

1.3 Why vaccines become important

The vaccine is critical to eradicating the COIVD-19 pandemic. To develop substantial herd immunity against SARS-CoV-2 infection and ultimately control the COVID-19 pandemic, a protective vaccination is required.(Medeiros et al., 2022) When a person contracts a virus-borne disease and recovers, they become immune to it. For instance, smallpox, measles, and chickenpox are all diseases to which a person can become permanently immune and never re-infected. However, some diseases, such as the flu, can strike multiple times. As a result, it is necessary to induce artificial immunity in the human body, a process known as active immunization, in order to eradicate them. It causes a mild form of the disease by injecting the weakened virus into the body. Active immunization, or vaccination, is a critical and cost-effective measure for preventing infectious diseases. With the global implementation of a universal vaccination program, the prevalence of numerous dangerous diseases in infants,

children, and adults has decreased significantly, to the point where serious diseases such as diphtheria, tetanus, whooping cough, measles, and polio are now eradicated through successful vaccination in children.(Ghiasi et al., 2021) So, Globally, mass vaccination against Coronavirus disease (COVID-19) has been a top priority for health systems. (Riad et al., 2021)

1.4 Side Effects of a Vaccine

Natural side effects of foreign medication injection include symptoms such as fever, muscle soreness, and inflammation at the injection site. The innate immune system is responsible for mediating them. When neutrophils or macrophages in the body identify vaccine components, they release cytokines, which are chemical messengers that initiate immunological reactions seen as fever, chills, nausea, and muscle pain. This cytokine response is expected to occur following the introduction of a foreign substance into the bloodstream. According to scientists, no link exists between the initial inflammatory response and the subsequent protective response. There is no scientific evidence that persons who experience more severe vaccine side effects are more protected against COVID-19. There is no reason to believe that an amplification of the innate response will aid the adaptive response.(Al Khames Aga et al., 2021)

1.5 Covid-19 Vaccines and their side effects

Bangladesh is likewise progressing with its vaccine and immunization strategies. A mandatory app-based registration mechanism is being created to enable willing individuals in priority list categories to indicate their interest in receiving COVID-19 vaccination. (Id et al., 2021) Vaccines have been provided in billions of doses worldwide. However, some recipients have

concerns about the safety and unwanted effects of the COVID-19 vaccine. (Beatty et al., 2021) Fever, lethargy, headaches, body pains, chills, and nausea are all common side effects of the COVID-19 vaccine. Additionally, an individual may experience negative effects near the injection site, which is typically the upper arm. Swelling, discomfort, redness, an itchy rash, and other mild kinds of irritation may occur.

The post vaccination side effects are highly variable depending on the recipient's age and gender.(Iguacel et al., 2021)

1.5.1 AstraZeneca Vaccine

The University of Oxford and AstraZeneca, a British-Swedish pharmaceutical company, collaborated to develop a non-replicating chimp viral vector vaccine formerly known as ChAdOx1nCoV-19 and renamed AZD1222.14. If manufactured by the Serum Institute of India, and commonly referred to as the 'AstraZeneca Vaccine' or the 'Covishield Vaccine'. (Francis et al., 2021) The WHO has granted EUL to AstraZeneca's COVID-19 vaccine for the prevention of COVID-19 in people aged 18 years and older, including those over the age of 65. WHO has licensed AstraZeneca's COVID-19 vaccine and the Indian Serum Institute's COVISHIELD vaccine for universal access during the COVID-19 epidemic. The EUL permits the administration of two doses of the vaccine at intervals of four to twelve weeks. Tenderness, pain, warmth, redness, itching, inflammation, and blisters at the injection site are all common side effects of Indian AstraZeneca, according to the Drugs Controller General of India (DCGI). Additionally, it causes generalized discomfort, lethargy, fatigue, chills and fever, headache, nausea, arm pain, joint and muscle pain, and nausea, all of which subside within a few days to a week following vaccination. According to the secretary of India's Ministry of Health, common side effects associated with the AstraZeneca vaccine will be eliminated within 24

hours. In Europe, the most common complication was fever, followed by headache, which is expected given the immune system's activation following vaccination. There have been no serious adverse events associated with the AstraZeneca vaccine. Along with the more common complications, uncommon symptoms may include excessive sweating, enlarged lymph nodes, pain, nausea, and confusion. According to AstraZeneca, prophylactic Acetaminophen use can help alleviate some symptoms. According to the European Medicines Agency (EMA), the vaccine's mild to moderate side effects include pain and stiffness at the injection site, fatigue, muscle aches, lethargy, chills, fever, joint pain, and nausea. (Ghiasi et al., 2021)

1.5.2 Pfizer Vaccine

The Pfizer-BioNTech vaccine (BNT162b2) is widely considered to be the first mRNA-based vaccine for infectious diseases that has been approved for human use. (Dighriri et al., 2022) The US Food and Drug Administration recently granted emergency approval to the Pfizer-BioNTech COVID-19 vaccine. (El-Shitany et al., 2021) This is a lipid nanoparticle-based, nucleoside-modified RNA vaccine that is effective against the S protein of the SARS-CoV-2 virus. This vaccine enables the body to generate an anti-bodies response that will neutralize the virus, which is dependent on the S protein to enter type 2 alveolar cells via the ACE2 receptor. (Francis et al., 2021) The most frequently reported adverse events associated with this vaccine were injection site pain, headaches, flu-like symptoms, fever, and fatigue. Fast heartbeat, generalized aches, difficulty breathing, joint pain, chills, and drowsiness were less common side effects. Bell's palsy and swelling and tenderness of the lymph nodes are uncommon side effects. Flu-like symptoms were more prevalent in those under the age of 60, whereas injection site pain was more prevalent in those 60 years and older. (El-Shitany et al., 2021)

1.5.3 Moderna Vaccine

This is a vaccine composed of nucleoside-modified messenger RNA (mRNA) encapsulated in lipid nanoparticles. It encodes the SARS-CoV-2 full-length, prefusion-stabilized spike protein. This spike glycoprotein regulates host cell attachment. As such, it is critical for virus entry and thus the primary target of the vaccine. The vaccine causes a strong antibody response that binds and neutralizes. This also includes the CD4+ T cell and CD8+ cytotoxic T cell responses that are necessary for virus elimination. After the first and second doses, adverse events occurred more frequently in the Moderna group. Mild pain was common at the injection site and lasted approximately 3 days. However, delayed injection site reactions such as erythema, tenderness, and induration were rare and typically resolved within 4 to 5 days. After the second dose of Moderna vaccine, fatigue, myalgia, arthralgia, and headache increased and lasted approximately 3 days. The incidence of adverse events was age-independent and had no sequelae in the Moderna group. Another study defined adverse events as localized axillary swelling or tenderness ipsilateral to the injection site, as well as systemic rash. (Francis et al., 2021) Additionally, dermatological adverse events (AEs) such as hypersensitivity reactions to certain vaccine components have been recorded. (Kong et al., 2021)

1.5.4 Sinopharm Vaccine

Sinopharm-COVID-19 vaccine, also known as BBIBP-CorV, is the first Chinese COVID-19 vaccine approved by the World Health Organization for use in an emergency. It was made by the Beijing Bio-Institute of Biological Products (BBIBP). In the studies, Sinopharm was so safe and well-tolerated that 100% of people who were vaccinated had a strong humoral immune response. In addition, animal studies on Sinopharm that were done on rats, mice, rabbits, and guinea pigs showed that it was able to protect them from SARS-CoV-2. Sinopharm's COVID-

19 vaccine report says that the most common side effects were dizziness, fatigue, headache, nausea, vomiting, fever, and allergic dermatitis. The vaccine had a 79 percent effectiveness rate against COVID-19 symptoms and a 79 percent effectiveness rate against hospitalization. This report was made by WHO. One of the good things about this vaccine is that it can be stored at normal refrigeration temperatures. Results from Phases I and II were shown by Xia et al. The most common side effects were pain at the injection site and fever, which were mild and self-limiting. There were no serious side effects, and the pain and fever were self-limiting. Overall, the number of people who had side effects was very low. Fever is the most common side effect of the BBIBP-CorV vaccine that Xia and her team found in another study (18-59 years, 4 percent in the 2 and 4 g groups and 8 percent in the 8 g group). Everyone who had the vaccine had mild or moderate side effects within 28 days. There were no major side effects in this time frame for anyone. There are more neutralizing antibodies in people who get two doses of the vaccine three or four weeks apart than there are in people who get a single dose or two doses on the same day. This shows that there must be enough time for enough neutralizing antibody titers to build up. (Ghiasi et al., 2021)

The pandemic of COVID-19 has devolved into a competition between effective immunization and new variations. Numerous important changes in the spike protein of newly discovered variations may increase their transmissibility, infectiousness, and lethality. There is a chance that more severe variations will emerge in the near future. (Bsoul & Loomer, 2022)

Chapter 2

Aims and Objectives

- Aim of the study

Since Coronavirus Disease 2019 (COVID-19) was made a pandemic, there has been no doubt that vaccination is the best way to fight it. Within a year, a lot of vaccines for COVID-19 were made and approved. This unprecedented vaccine development project raised a lot of questions about the vaccines' effectiveness and safety. The purpose of this study was to determine the post vaccination side effects of COVID-19 vaccination in Bangladesh.

- Objective of the study

The study's objective was to increase public awareness of the side effects in order to facilitate the implementation of preventative measures.

Chapter 3

Methodology

Research Design

The study's objective is to gain knowledge regarding the side effects of Covid-19 vaccines. The sample size for this study is 210 individuals.

Data Collection

Using Google Forms, a structured and well-vetted questionnaire was created, and the link was distributed to the appropriate students via various online social media platforms such as Messenger, Facebook, WhatsApp, and emails. Prior to responding, participants provided their full consent to the survey. No one was compelled to participate in the survey. A total of 213 students responded, with some responses being excluded due to derogatory data. In the end, 210 responses were used in the analysis. The survey was carried out between January 20 and February 10, 2022.

Data Analysis

A descriptive analysis was done to learn more about the demographics of the individuals who took part in the study. The chi-square test was used to determine the significant relationships between various variables and factors. All analyses were carried out using IBM SPSS 27.

Chapter 4

Result and Analysis

We will discuss the results of our survey questionnaire, as well as the analysis of our findings in relation to our research topic, in this chapter. We excluded 15 questions from 210 respondents. The results of our questionnaire are detailed below.

4.1 Demographic Data

- Gender

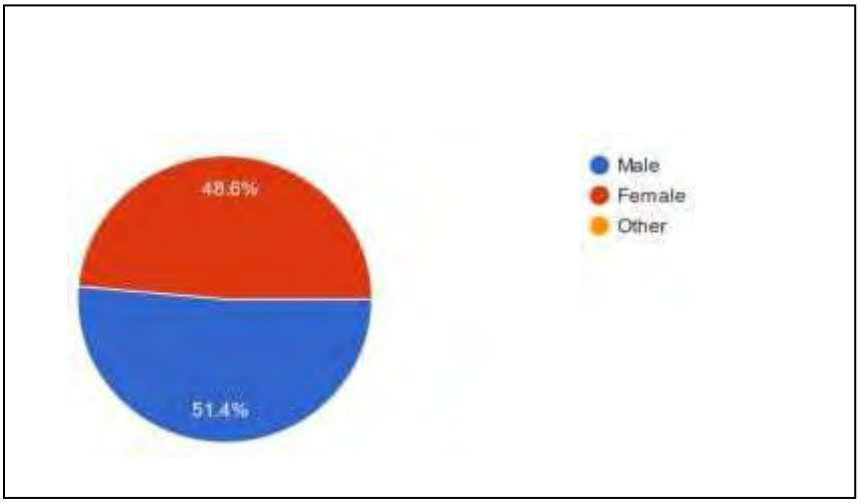

Figure 1: Gender

Figure 1 is about gender of this research has participated in a total of 210 students. Among 210 participants, 48.6% are male and 51.4% are female.

- Age Group

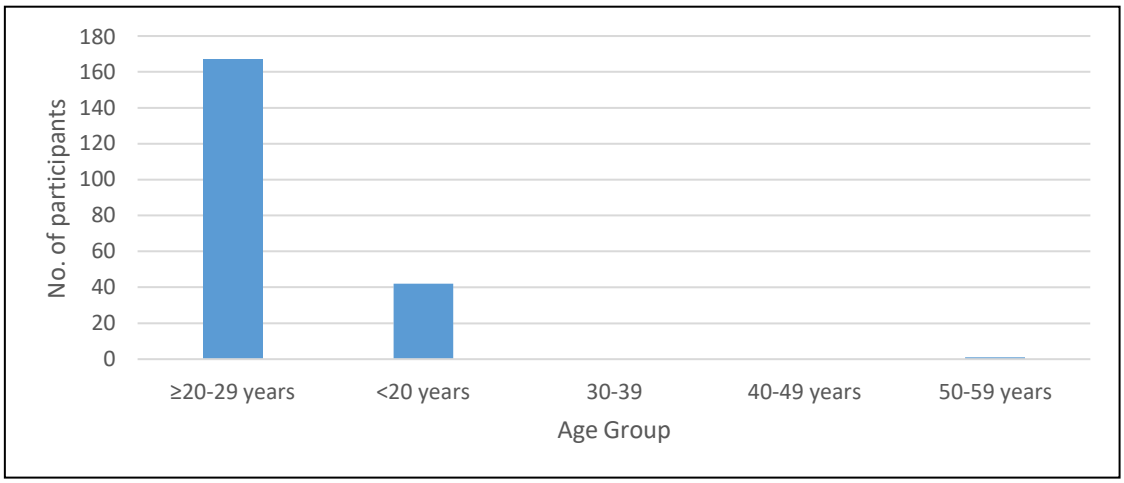

Figure 2: Age group of the participants

Figure 2 shows, among the participants, 167 of them fall in the age group ≥20-29 years, 42 of them falls in the age group <20 years and 1 of them falls in the age group 50-59 years.

- Employment status

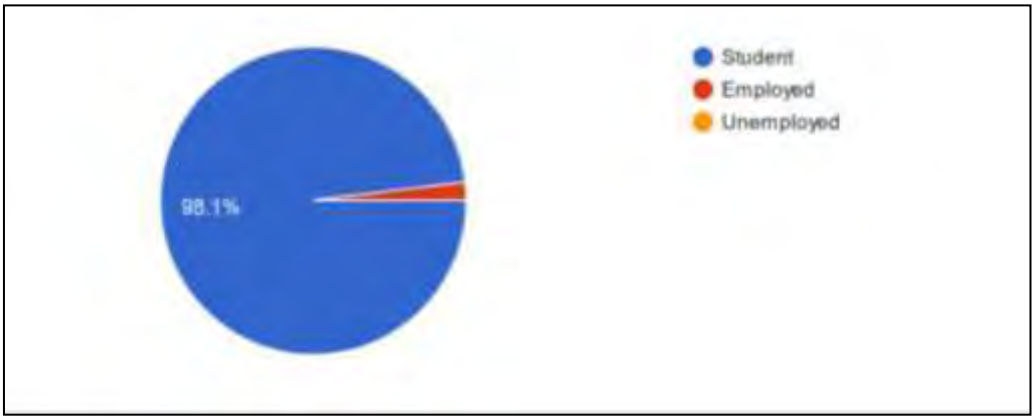

Figure 3: Employment status of the participants

Figure 3 shows, out of 210 partipants, 98.1% (206) of them are students and 1.9% (4) of them are employed.

4.2 General perception and data

- Participants infected with Covid-19

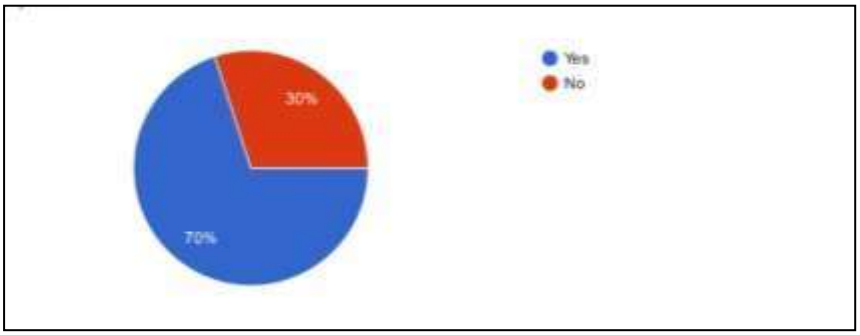

Figure 4: No. of participants infected with Covid-19

Figure 3 shows that 70% respondents have been infected with Covid-19.

- Type of vaccines

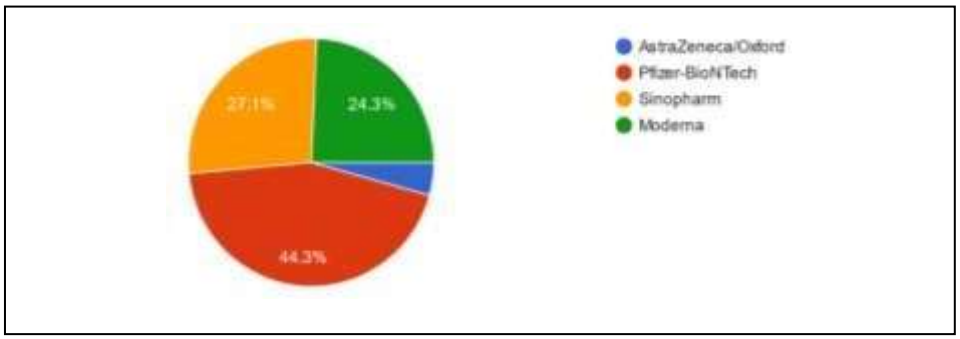

Figure 5: Participants received which type of vaccine

Figure 4 shows, among 210 participants, 93 (44.3%) of them received Pfizer-BioN Tech, 57 (27.1%) of them received Sinopharm, 51 (24.3%) of them received Moderna and 9 (4.3%) of them received AstraZeneca vaccine.

4.3 Post Vaccination Data

4.3.1 Post vaccination side Effects of Covid-19 vaccine after the first dose.

Table 1: Vaccine* Swelling Cross tabulation

			Swelling				P value	Inference
			No	Mild	Medium	Total		
Vaccine	AstraZeneca	Count	7	1	1	9	0.000	Significant
		% within Vaccine	77.8%	11.1%	11.1%	100.0%		
	Pfizer-BioNTech	Count	47	43	2	92		
		% within Vaccine	51.1%	46.7%	2.2%	100.0%		
	Sinopharm	Count	23	30	4	57		
		% within Vaccine	40.4%	52.6%	7.0%	100.0%		
	Moderna	Count	14	24	14	52		
		% within Vaccine	26.9%	46.2%	26.9%	100.0%		
Total		Count	91	98	21	210		
		% within Vaccine	43.3%	46.7%	10.0%	100.0%		

In table 1, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had medium swelling, 11.1% had mild swelling, and 77.8% had no swelling after getting the dose; 92 of them got Pfizer -BioNTech and 2.2% had medium swelling, 46.7% had mild swelling, and 51.1% had no swelling; 57 of them got Sinopharm and 7% had medium swelling, 52.6% had mild swelling, and 40.4% had no swelling ; again, 52 of them got Moderna and 26.9% had medium swelling, 46.2% had mild swelling, and 26.9% had no swelling. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 2: Vaccine* Redness Cross tabulation

			Redness				P value	Inference
			No	Mild	Medium	Total		
Vaccine	AstraZeneca	Count	7	1	1	9	0.042	Significant
		% within Vaccine	77.8%	11.1%	11.1%	100.0%		
	Pfizer-BioNTech	Count	87	3	2	92		
		% within Vaccine	94.6%	3.3%	2.2%	100.0%		
	Sinopharm	Count	49	7	1	57		
		% within Vaccine	86.0%	12.3%	1.8%	100.0%		
	Moderna	Count	41	10	1	52		
		% within Vaccine	78.8%	19.2%	1.9%	100.0%		
Total		Count	184	21	5	210		
		% within Vaccine	87.6%	10.0%	2.4%	100.0%		

In table 2, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had medium redness, 11.1% had mild redness, and 77.8% had no redness after getting the dose; 92 of them got Pfizer -BioNTech and 2.2% had medium redness, 3.3% had mild redness, and 94.6% had no redness; 57 of them got Sinopharm and 1.8% had medium redness, 12.3% had mild redness, and 86.0% had no redness; again, 52 of them got Moderna and 1.9% had medium redness, 19.2% had mild redness, and 78.8% had no redness. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 3: Vaccine*Itching Cross tabulation

			Itching					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	8	1	0	0	9	0.008	Significant
		% within Vaccine	88.9%	11.1%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	84	4	3	1	92		
		% within Vaccine	91.3%	4.3%	3.3%	1.1%	100.0%		
	Sinopharm	Count	48	9	0	0	57		
		% within Vaccine	84.2%	15.8%	0.0%	0.0%	100.0%		
	Moderna	Count	34	14	4	0	52		
		% within Vaccine	65.4%	26.9%	7.7%	0.0%	100.0%		
Total		Count	174	28	7	1	210		
		% within Vaccine	82.9%	13.3%	3.3%	0.5%	100.0%		

In table 3, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had mild itching, and 88.9% had no itching after getting the dose; 92 of them got Pfizer -BioNTech and 1.1% had heavy itching, 3.3% had medium itching, 4.3% had mild redness, and 88.9% had no redness; 57 of them got Sinopharm and 15.8% had mild itching, and 84.2% had no itching; again, 52 of them got Moderna and 7.7% had medium itching, 26.9% had mild itching, and 65.4% had no itching. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 4: Vaccine*Fever Cross tabulation

			Fever					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	6	2	0	1	9	0.000	Significant
		% within Vaccine	66.7%	22.2%	0.0%	11.1%	100.0%		
	Pfizer-BioNTech	Count	30	13	37	12	92		
		% within Vaccine	32.6%	14.1%	40.2%	13.0%	100.0%		
	Sinopharm	Count	14	3	27	13	57		
		% within Vaccine	24.6%	5.3%	47.4%	22.8%	100.0%		
	Moderna	Count	0	4	31	17	52		
		% within Vaccine	0.0%	7.7%	59.6%	32.7%	100.0%		
Total		Count	50	22	95	43	210		
		% within Vaccine	23.8%	10.5%	45.2%	20.5%	100.0%		

In table 4, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had heavy fever, 22.2% had mild fever, and 66.7% had no fever after getting the dose; 92 of them got Pfizer -BioNTech and 13% had heavy fever, 40.2% had medium fever, 14.1% had mild fever, and 32.6% had no fever; 57 of them got Sinopharm and 22.8% had heavy fever; 47.4% had medium fever, 5.3% had mild fever, and 24.6% had no fever; again, 52 of them got Moderna and 32.7% had heavy fever, 59.6% had medium fever and 7.7% had mild fever. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 5: Vaccine*Headache Cross tabulation

			Headache					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	4	3	2	0	9	0.000	Significant
		% within Vaccine	44.4%	33.3%	22.2%	0.0%	100.0%		
	Pfizer-BioNTech	Count	30	13	32	17	92		
		% within Vaccine	32.6%	14.1%	34.8%	18.5%	100.0%		
	Sinopharm	Count	12	4	31	10	57		
		% within Vaccine	21.1%	7.0%	54.4%	17.5%	100.0%		
	Moderna	Count	4	3	18	27	52		
		% within Vaccine	7.7%	5.8%	34.6%	51.9%	100.0%		
Total		Count	50	23	83	54	210		
		% within Vaccine	23.8%	11.0%	39.5%	25.7%	100.0%		

In table 5, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 22.2% had medium headache, 33.3% had mild headache, and 44.4% had no headache after getting the dose; 92 of them got Pfizer -BioNTech and 2.2% had medium redness, 3.3% had mild redness, and 94.6% had no redness; 57 of them got Sinopharm and 1.8% had medium redness, 12.3% had mild redness, and 86.0% had no redness; again, 52 of them got Moderna and 1.9% had medium redness, 19.2% had mild redness, and 78.8% had no redness. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 6: Vaccine*Muscle ache Cross tabulation

			Muscle ache					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	3	5	0	1	9	0.000	Significant
		% within Vaccine	33.3%	55.6%	0.0%	11.1%	100.0%		
	Pfizer-BioNTech	Count	3	18	44	27	92		
		% within Vaccine	3.3%	19.6%	47.8%	29.3%	100.0%		
	Sinopharm	Count	9	4	26	18	57		
		% within Vaccine	15.8%	7.0%	45.6%	31.6%	100.0%		
	Moderna	Count	0	2	16	34	52		
		% within Vaccine	0.0%	3.8%	30.8%	65.4%	100.0%		
Total		Count	15	29	86	80	210		
		% within Vaccine	7.1%	13.8%	41.0%	38.1%	100.0%		

In table 6, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had heavy muscle ache, 55.6% had mild muscle ache, and 33.3% had no muscle ache after getting the dose; 92 of them got Pfizer -BioNTech and 29.3% had heavy muscle ache, 47.8% had medium redness, 19.6% had mild muscle ache, and 3.3% had no muscle ache; 57 of them got Sinopharm and 31.6%had heavy muscle ache, 45.6% had medium muscle ache, 7% had mild muscle ache, and 15.8% had no muscle ache; again, 52 of them got Moderna and 65.4% had heavy muscle ache, 30.8% had medium muscle ache and 3.8% had mild muscle ache. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 7: Vaccine*Tiredness Cross tabulation

			Tiredness					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	5	3	1	0	9	0.000	Significant
		% within Vaccine	55.6%	33.3%	11.1%	0.0%	100.0%		
	Pfizer-BioNTech	Count	29	15	27	21	92		
		% within Vaccine	31.5%	16.3%	29.3%	22.8%	100.0%		
	Sinopharm	Count	10	8	22	17	57		
		% within Vaccine	17.5%	14.0%	38.6%	29.8%	100.0%		
	Moderna	Count	3	7	13	29	52		
		% within Vaccine	5.8%	13.5%	25.0%	55.8%	100.0%		
Total		Count	47	33	63	67	210		
		% within Vaccine	22.4%	15.7%	30.0%	31.9%	100.0%		

In table 7, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had medium tiredness, 33.3% had mild tiredness, and 55.6% had no tiredness after getting the dose; 92 of them got Pfizer -BioNTech and 22.8% had heavy tiredness, 29.3% had medium tiredness, 16.3% had mild tiredness and 31.5% had no tiredness; 57 of them got Sinopharm and 29.8% had heavy tiredness, 38.6% had medium tiredness, 14% had mild tiredness and 17.5% had no tiredness; again, 52 of them got Moderna and 55.8% had heavy tiredness, 25% had medium tiredness, 13.5% had mild tiredness and 5.8% had no tiredness. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 8: Vaccine*Tingling Cross tabulation

			Tingling					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	7	1	1	0	9	0.000	Significant
		% within Vaccine	77.8%	11.1%	11.1%	0.0%	100.0%		
	Pfizer-BioNTech	Count	68	16	7	1	92		
		% within Vaccine	73.9%	17.4%	7.6%	1.1%	100.0%		
	Sinopharm	Count	37	19	1	0	57		
		% within Vaccine	64.9%	33.3%	1.8%	0.0%	100.0%		
	Moderna	Count	11	29	10	2	52		
		% within Vaccine	21.2%	55.8%	19.2%	3.8%	100.0%		
Total		Count	123	65	19	3	210		
		% within Vaccine	58.6%	31.0%	9.0%	1.4%	100.0%		

In table 8, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had medium tingling, 11.1% had mild tingling and 77.8% had no tingling after getting the dose; 92 of them got Pfizer -BioNTech and 1.1% had heavy tingling, 7.6% had medium tingling, 17.4% had mild tingling; 57 of them got Sinopharm and 1.8% had medium tingling, 33.3% had mild tingling and 64.8% had no tingling; again, 52 of them got Moderna and 3.8% had heavy tingling, 19.2% had medium tingling, 55.8% had mild tingling and 21.2% had no tingling. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 9: Vaccine*Swollen lymph Crosstabulation

			Swollen Lymph Nodes					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	8	1	0	0	9	0.010	Significant
		% within Vaccine	88.9%	11.1%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	73	17	2	0	92		
		% within Vaccine	79.3%	18.5%	2.2%	0.0%	100.0%		
	Sinopharm	Count	42	14	1	0	57		
		% within Vaccine	73.7%	24.6%	1.8%	0.0%	100.0%		
	Moderna	Count	24	25	2	1	52		
		% within Vaccine	46.2%	48.1%	3.8%	1.9%	100.0%		
Total		Count	147	57	5	1	210		
		% within Vaccine	70.0%	27.1%	2.4%	0.5%	100.0%		

In table 9, of the 210 respondents, 9 of them got the first dose of AstraZeneca and 11.1% had mild swollen lymph nodes and 88.9% had none after getting the dose; 92 of them got Pfizer - BioNTech and 2.2% had medium swollen lymph nodes, 18.5% had mild swollen lymph nodes and 79.3% had no swollen lymph nodes; 57 of them got Sinopharm and 1.8% had medium swollen lymph nodes, 24.6% had mild swollen lymph nodes and 73.7% no swollen lymph nodes; again, 52 of them got Moderna and 1.9% had heavy swollen lymph nodes, 3.8% had medium swollen lymph nodes, 48.1% had mild swollen lymph nodes and 46.2% had none. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

4.3.2 Post vaccination side effects of the Covid-19 Vaccine after the second dose

Table 10: Vaccine*Swelling Cross tabulation

			Swelling					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	8	1	0	0	9	0.000	Significant
		% within Vaccine	88.9%	11.1%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	61	31	0	0	92		
		% within Vaccine	66.3%	33.7%	0.0%	0.0%	100.0%		
	Sinopharm	Count	35	19	3	0	57		
		% within Vaccine	61.4%	33.3%	5.3%	0.0%	100.0%		
	Moderna	Count	22	19	10	1	52		
		% within Vaccine	42.3%	36.5%	19.2%	1.9%	100.0%		
Total		Count	126	70	13	1	210		
		% within Vaccine	60.0%	33.3%	6.2%	0.5%	100.0%		

In table 10, of the 210 respondents, 9 of them got the second dose of AstraZeneca and 11.1% had mild swelling and 88.9% had no swelling after getting the dose; 92 of them got Pfizer - BioNTech and 33.7% had mild swelling 66.3% had no swelling; 57 of them got Sinopharm and 5.3% had medium swelling, 33.3% had mild swelling and 61.4% had no swelling; again, 52 of them got Moderna and 1.9% had heavy swelling, 19.2% had medium swelling, 36.5% had mild swelling and 41.3% had no swelling . To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 11: Vaccine* Redness Cross tabulation

			Redness				P value	Inference
			No	Mild	Medium	Total		
Vaccine	AstraZeneca	Count	9	0	0	9	0.000	Significant
		% within Vaccine	100.0%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	88	4	0	92		
		% within Vaccine	95.7%	4.3%	0.0%	100.0%		
	Sinopharm	Count	50	7	0	57		
		% within Vaccine	87.7%	12.3%	0.0%	100.0%		
	Moderna	Count	35	16	1	52		
		% within Vaccine	67.3%	30.8%	1.9%	100.0%		
Total		Count	182	27	1	210		
		% within Vaccine	86.7%	12.9%	0.5%	100.0%		

In table 11, of the 210 respondents, 9 of them got the second dose of AstraZeneca and none of them had redness after getting the dose; 92 of them got Pfizer -BioNTech and 4.3% had mild redness and 95.7% had no redness after getting the dose; 57 of them got Sinopharm and 12.3% had redness and 87.7% had no redness after getting the second dose of Sinopharm vaccine, 52 of them got Moderna and 1.9% had medium redness, 30.8% had mild redness and 67.3% had no redness after getting the dose. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 12: Vaccine*Itching Cross tabulation

			Itching					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	9	0	0	0	9	0.555	Insignificant
		% within Vaccine	100.0%	0.0%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	80	10	1	1	92		
		% within Vaccine	87.0%	10.9%	1.1%	1.1%	100.0%		
	Sinopharm	Count	48	8	1	0	57		
		% within Vaccine	84.2%	14.0%	1.8%	0.0%	100.0%		
	Moderna	Count	40	12	0	0	52		
		% within Vaccine	76.9%	23.1%	0.0%	0.0%	100.0%		
Total		Count	177	30	2	1	210		
		% within Vaccine	84.3%	14.3%	1.0%	0.5%	100.0%		

In table 12, of the 210 respondents, 9 of them got the second dose of AstraZeneca and none of them had itching after getting the dose; 92 of them got Pfizer -BioNTech and 1.1% had heavy itching, 1.1% had medium itching, 10.9 % had mild itching and 87% had no itching after getting the dose; 57 of them got Sinopharm and 1.8% had medium itching, 14% had mild itching and 84.2% had no itching after getting the dose; again, 52 of them got Moderna and 23.1% had mild itching and 76.9% had no itching after getting the dose. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 13: Vaccine*Fever Cross tabulation

			Fever					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	8	1	0	0	9	0.000	Significant
		% within Vaccine	88.9%	11.1%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	43	4	29	16	92		
		% within Vaccine	46.7%	4.3%	31.5%	17.4%	100.0%		
	Sinopharm	Count	21	0	27	9	57		
		% within Vaccine	36.8%	0.0%	47.4%	15.8%	100.0%		
	Moderna	Count	9	4	13	26	52		
		% within Vaccine	17.3%	7.7%	25.0%	50.0%	100.0%		
Total		Count	81	9	69	51	210		
		% within Vaccine	38.6%	4.3%	32.9%	24.3%	100.0%		

In table 13, of the 210 respondents, 9 of them got the second dose of AstraZeneca and 11.1% had mild fever and 88.9% had no fever after getting the dose; 92 of them got Pfizer -BioNTech and 17.4% had heavy fever, 31.5% had medium fever, 4.3% had mild fever and 46.7% had no fever after getting the dose; 57 of them got Sinopharm and 15.8% had heavy fever, 47.4% had medium fever and 36.8% had no fever after getting the dose; again, 52 of them got Moderna and 50% had heavy fever, 25% had medium fever, 7.7% had mild fever and 17.3% had no fever after getting the dose. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 14: Vaccine*Headache Cross tabulation

			Headache					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	8	1	0	0	9	0.016	Significant
		% within Vaccine	88.9%	11.1%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	41	4	30	17	92		
		% within Vaccine	44.6%	4.3%	32.6%	18.5%	100.0%		
	Sinopharm	Count	20	1	20	16	57		
		% within Vaccine	35.1%	1.8%	35.1%	28.1%	100.0%		
	Moderna	Count	14	2	17	19	52		
		% within Vaccine	26.9%	3.8%	32.7%	36.5%	100.0%		
Total		Count	83	8	67	52	210		
		% within Vaccine	39.5%	3.8%	31.9%	24.8%	100.0%		

In table 14, of the 210 respondents, 9 of them got the second dose of AstraZeneca and 11.1% had mild headache and 88.9% had no headache after getting the dose; 92 of them got Pfizer - BioNTech and 18.5% had heavy headache, 32.6% had medium headache, 4.3% had mild headache and 44.6% had no headache after getting the dose; 57 of them got Sinopharm and 28.1% had heavy headache, 35.1% had medium headache, 1.8% had mild headache and 35.1% had no headache after getting the dose; again, 52 of them got Moderna and 36.5% had heavy headache, 32.7% had medium headache, 3.8% had mild headache and 26.9% had no headache after getting the dose. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 15: Vaccine*Muscle ache Cross tabulation

			Muscle ache					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	6	3	0	0	9	0.000	Significant
		% within Vaccine	66.7%	33.3%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	35	4	32	21	92		
		% within Vaccine	38.0%	4.3%	34.8%	22.8%	100.0%		
	Sinopharm	Count	16	2	28	11	57		
		% within Vaccine	28.1%	3.5%	49.1%	19.3%	100.0%		
	Moderna	Count	11	3	13	25	52		
		% within Vaccine	21.2%	5.8%	25.0%	48.1%	100.0%		
Total		Count	68	12	73	57	210		
		% within Vaccine	32.4%	5.7%	34.8%	27.1%	100.0%		

In table 15, of the 210 respondents, 9 of them got the second dose of AstraZeneca and 33.3% had mild muscle ache and 66.7% had no muscle ache after getting the dose; 92 of them got Pfizer -BioNTech and 22.8% had heavy muscle ache, 34.8% medium muscle ache, 4.3% had mild muscle ache and 38% no muscle ache after getting the dose; 57 of them got Sinopharm and 19.3% had heavy muscle ache, 49.1% had medium muscle ache, 3.5% had mild muscle ache and 28.1% had no muscle ache after getting the dose; again, 52 of them got Moderna and 48.1% had heavy muscle ache, 25% had medium muscle ache, 5.8% had mild muscle ache and 21.2% had no muscle ache after getting the second dose of Moderna vaccine. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 16: Vaccine*Tiredness Cross tabulation

			Tiredness					p value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	8	1	0	0	9	0.000	Significant
		% within Vaccine	88.9%	11.1%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	43	4	34	11	92		
		% within Vaccine	46.7%	4.3%	37.0%	12.0%	100.0%		
	Sinopharm	Count	20	8	23	6	57		
		% within Vaccine	35.1%	14.0%	40.4%	10.5%	100.0%		
	Moderna	Count	13	3	12	24	52		
		% within Vaccine	25.0%	5.8%	23.1%	46.2%	100.0%		
Total		Count	84	16	69	41	210		
		% within Vaccine	40.0%	7.6%	32.9%	19.5%	100.0%		

In table 16, of the 210 respondents, 9 of them got the second dose of AstraZeneca and 11.1% had mild tiredness and 88.9% had no tiredness after getting the dose; 92 of them got Pfizer - BioNTech and 12% had heavy tiredness, 37% had medium tiredness, 4.3% had mild tiredness and 46.7% had no tiredness after getting the dose; 57 of them got Sinopharm and 19.3% had heavy muscle ache, 10.5% had heavy, 40.4% had medium, 14% had mild and 35.1% had no tiredness after getting the dose; again, 52 of them got Moderna and 46.2% had heavy, 23.1% had medium, 5.8% had mild and 25% had no tiredness after getting the dose. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 17: Vaccine*Tingling Cross tabulation

			Tingling					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	9	0	0	0	9	0.014	Significant
		% within Vaccine	100.0%	0.0%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	63	21	8	0	92		
		% within Vaccine	68.5%	22.8%	8.7%	0.0%	100.0%		
	Sinopharm	Count	39	14	3	1	57		
		% within Vaccine	68.4%	24.6%	5.3%	1.8%	100.0%		
	Moderna	Count	22	24	6	0	52		
		% within Vaccine	42.3%	46.2%	11.5%	0.0%	100.0%		
Total		Count	133	59	17	1	210		
		% within Vaccine	63.3%	28.1%	8.1%	0.5%	100.0%		

In table 17, of the 210 respondents, 9 of them got the second dose of AstraZeneca and none of them had tingling after getting the dose; 92 of them got Pfizer -BioNTech and 8.7% had medium tingling, 22.8% had mild tingling and 68.5% had no tingling after getting the dose; 57 of them got Sinopharm and 1.8% had heavy, 5.3% had medium, 24.6% mild and 68.4% had no tingling after getting the dose; again, 52 of them got Moderna and 11.5% had medium, 46.2% had mild and 42.3% had no tingling after getting the dose. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

Table 18: Vaccine*Swollen Lymph Nodes Cross tabulation

			Swollen Lymph Nodes					P value	Inference
			No	Mild	Medium	Heavy	Total		
Vaccine	AstraZeneca	Count	9	0	0	0	9	0.000	Significant
		% within Vaccine	100.0%	0.0%	0.0%	0.0%	100.0%		
	Pfizer-BioNTech	Count	73	18	1	0	92		
		% within Vaccine	79.3%	19.6%	1.1%	0.0%	100.0%		
	Sinopharm	Count	48	8	1	0	57		
		% within Vaccine	84.2%	14.0%	1.8%	0.0%	100.0%		
	Moderna	Count	28	14	1	9	52		
		% within Vaccine	53.8%	26.9%	1.9%	17.3%	100.0%		
Total		Count	158	40	3	9	210		
		% within Vaccine	75.2%	19.0%	1.4%	4.3%	100.0%		

In table18, of the 210 respondents, 9 of them got the second dose of AstraZeneca and none of them had swollen lymph nodes; 92 of them got Pfizer -BioNTech and 1.1% had medium, 19.6% had mild swollen lymph nodes and 79.3% had no swollen lymph nodes after getting the vaccine; 57 of them got Sinopharm and 1.8% had medium, 14% had mild swollen lymph nodes and 84.2% had no swollen lymph nodes after getting the vaccine; again, 52 of them got Moderna and 9% had heavy, 1.9% had medium, 26.9% had mild swollen lymph nodes and 53.8% had no swollen lymph nodes after getting the vaccine. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

4.3.3 Symptom Time of Covid-19 side effects

Table 19: Vaccine * Symptom time Crosstabulation

			Symptom time				Total	P value	Inference
			None	<24 hours	24-72 hours	>72 hours			
Vaccine	AstraZeneca	Count	3	2	4	0	9	0.820	Insignificant
		% within Vaccine	33.3%	22.2%	44.4%	0.0%	100.0%		
	Pfizer-BioNTech	Count	11	12	67	2	92		
		% within Vaccine	12.0%	13.0%	72.8%	2.2%	100.0%		
	Sinopharm	Count	8	7	41	1	57		
		% within Vaccine	14.0%	12.3%	71.9%	1.8%	100.0%		
	Moderna	Count	7	6	37	2	52		
		% within Vaccine	13.5%	11.5%	71.2%	3.8%	100.0%		
Total		Count	29	27	149	5	210		
		% within Vaccine	13.8%	12.9%	71.0%	2.4%	100.0%		

In our study, of the 210 respondents, 9 of them got the AstraZeneca vaccine, and 44.4% of their symptom time lasted for more than 24 to 72 hours, 22.2% of their symptom time lasted for less than 24 hours, and 33.3% of them had no side effects; 92 of them got the Pfizer-BioNTech vaccine, and 2.2% of their symptom time lasted for more than 72 hours, 71.9% for 24-72 hours, 12.3% for less than 24 hours, and 13.5% had no side effects; 57 of them got the Sinopharm vaccine, and 1% of their symptom time lasted for more than 72 hours, 71.9% of their symptom time lasted for 24 to 72 hours and 12.3% for less than 24 hours; 52 of them got the Moderna vaccine and 3.8% of their symptom time lasted for more than 72 hours, 71.2% for 24-72 hours,

11.5% for less than 24 hours, and 13.5% had no side effects; and 13.5% had no side effects. To determine whether there was a correlation between the types of vaccines and the side effects, a chi-square test of independence was used. The null hypothesis for a p-value greater than 0.05 was true.

4.3.4 Percentage data of side effects

Table 20: Respondents data of having side effects after receiving the first dose

	Swelling	Redness	Itching	Fever	Headache	Muscle ache	Tiredness	Tingling	Swollen Lymph Nodes
AstraZeneca	22.20%	22.20%	11.10%	33.30%	55.50%	66.70%	44.40%	22.20%	11.10%
Pfizer-BioNTech	48.90%	5.50%	8.70%	67.30%	67.40%	70.70%	68.50%	26.10%	20.70%
Sinopharm	59.60%	14.10%	15.80%	75.50%	78.90%	68.40%	82.50%	35.10%	26.30%
Moderna	73.10%	21.10%	34.60%	100%	92.30%	100.00%	94.20%	77.80%	94.20%

In the study, of the 210 respondents, 9 of them got the AstraZeneca Vaccine. Of them 22.20% had swelling, 22.20% had redness, 11.10% had itching, 33.30% had fever, 55.50% had headache, 66.70% had muscle ache, 44.40% had tiredness, 22.20% had tingling and 11.10% had swollen lymph nodes after getting the first dose. Again, 92 of them got the Pfizer-BioNTech vaccine and of them 48.90% had swelling, 5.50% had redness, 8.7% had itching, 67.30% had fever, 67.40% had headache, 70.70% had muscle ache, 68.50% had tiredness, 26.10% had tingling and 27.70% had swollen lymph nodes. Furthermore, 52 of them got the Moderna vaccine and of them 59.60% had swelling, 14.10% had redness, 15.80% had itching, 75.50% had fever, 78.90% had headache, 68.40% had muscle ache, 82.50% had tiredness,

35.10% had tingling and 26.30% had swollen lymph nodes. Moreover, 57 of them got the Sinopharm vaccine and of them 73.10% had swelling, 21.10% had redness, 34.60% had itching, 100% had fever, 92.30% had headache, 100% had muscle ache, 94.20% had tiredness, 77.80% had tingling and 94.20% had swollen lymph nodes.

- **Bar Diagram showing the of side effects of different vaccines after the first dose**

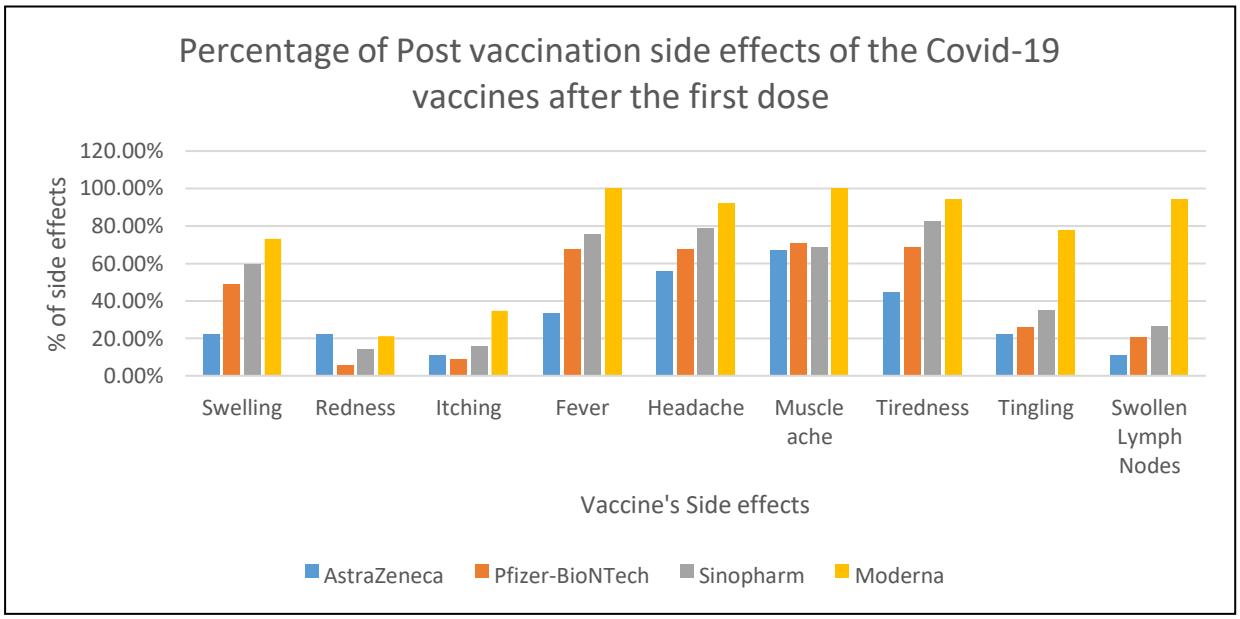

Figure 6: Graph bar showing the of side effects of different vaccines after the first dose

The graph bar diagram shows that the respondents faced more side effects after getting the first dose moderna vaccine. The most common side effects of the four vaccines are fever, headache, muscleache and tiredness.

Table 21: Respondents data of having side effects after receiving the second dose

	Swelling	Redness	Itching	Fever	Headache	Muscle ache	Tiredness	Tingling	Swollen Lymph Nodes
AstraZeneca	11.10%	0.00%	0.00%	11.10%	11.10%	33.30%	11.10%	0.00%	0.00%
Pfizer-BioNTech	33.70%	4.30%	13%	53.30%	55.40%	62.00%	53.30%	31.50%	20.70%
Sinopharm	38.60%	12.30%	15.80%	63.20%	64.90%	71.90%	64.90%	31.60%	15.80%
Moderna	57.70%	32.70%	23.10%	82.70%	73.10%	78.80%	75.00%	57.70%	46.20%

In the study, of the 210 respondents, 9 of them got the AstraZeneca Vaccine. Of them 11.10% had swelling, 11.10% had fever, 11.10% had headache, 33.30% had muscle ache and 11.10% had tiredness after getting the second dose. Again, 92 of them got the Pfizer-BioNTech vaccine and of them 33.70% had swelling, 4.30% had redness, 13% had itching, 53.30% had fever, 55.40% had headache, 62% had muscle ache, 53.30% had tiredness, 31.50% had tingling and 20.70% had swollen lymph nodes. Furthermore, 52 of them got the Moderna vaccine and of them 38.60% had swelling, 12.30% had redness, 15.80% had itching, 63.20% had fever, 64.90% had headache, 71.90% had muscle ache, 64.90% had tiredness, 31.60% had tingling and 15.80% had swollen lymph nodes. Moreover, 57 of them got the Sinopharm vaccine and of them 57.70% had swelling, 32.70% had redness, 23.10% had itching, 82.70% had fever, 73.10% had headache, 78.80% had muscle ache, 75% had tiredness, 57.70% had tingling and 46.20% had swollen lymph nodes.

- **Bar Diagram showing the of side effects of different vaccines after the second dose**

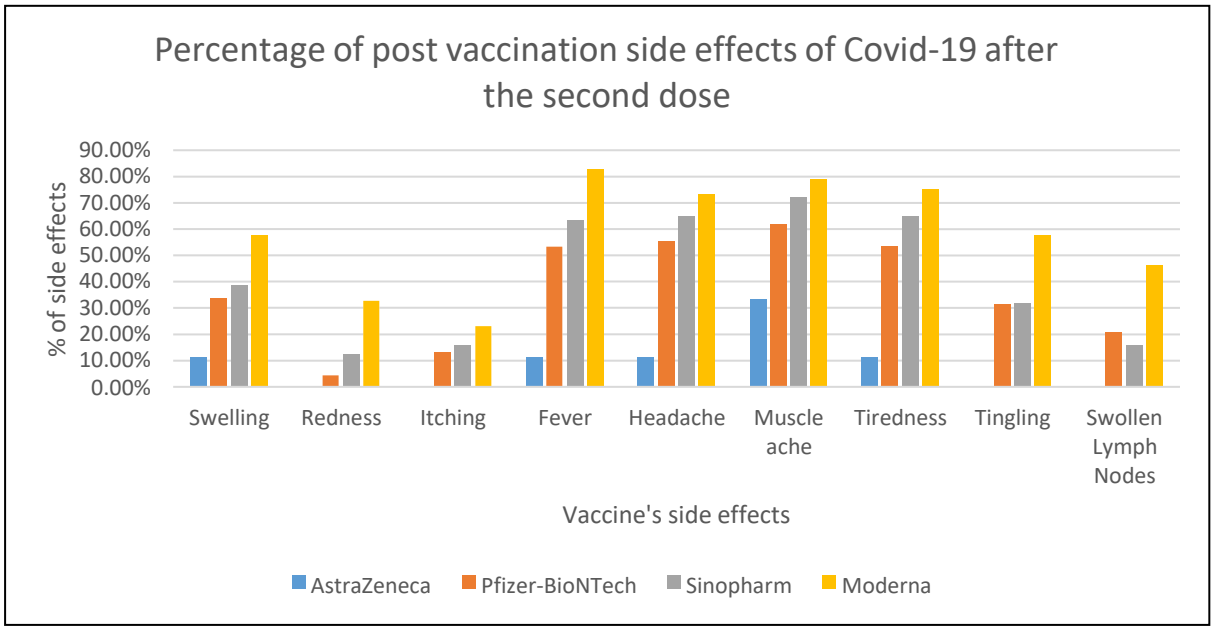

Figure 7: Graph bar showing the of side effects of different vaccines after the second dose

The graph bar diagram shows that the respondents faced more side effects after getting the second dose moderna vaccine. The most common side effects of the four vaccines are fever, headache, muscleache and tiredness.

Chapter 5

Discussion

Since the outbreak of COVID-19 in January 2020, the majority of countries have taken precautionary measures to halt SARS-CoV-2 transmission in the expectation of rapidly developing safe and effective vaccines. Numerous vaccine candidates were developed concurrently in response, but only a few were authorized for EUA. Bangladesh is one of the countries that initiated an early vaccination campaign as part of their pioneering efforts and activities to stop the spread of SARS-CoV-2. Despite the vaccine's availability to the Bangladeshi population, there are variances in people's willingness to take it, which is likely owing to the fact that these vaccinations were produced quickly in comparison to previously licensed vaccines, which often took years to develop. These major variables may cause some persons to express concern about the possibility of substantial side effects following vaccination, despite the recent publication of multiple publications explaining the expected side effects. As such, we sought to evaluate the short-term post vaccination side effects of the COVID-19 vaccinations being used in Bangladesh in this study. Individuals who got COVID-19 vaccinations from Oxford-AstraZeneca, Pfizer-BioNTech Vaccines Moderna, or Sinopharm in Bangladesh were enrolled in the study. Vaccines have been associated with a variety of side effects, which vary according to the individual's age, type, and dose.

A chi-square test of independence was used to see whether there is a correlation between the type of vaccine and the post-vaccination side effects. The first dosage of the four vaccinations AstraZeneca, Pfizer-BioNTech, Sinopharm, and Moderna has a chi square p value of 0.000, 0.042, 0.008, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, The second dose of the four

vaccines AstraZeneca, Pfizer-BioNTech, Sinopharm, and Moderna has a chi square p value of 0.000, 0.000, 0.555, 0.000, 0.016, 0.000, 0.000, 0.014, and 0.010, respectively, with post-vaccination swelling, redness, itching, fever, headache, muscle ache, tiredness, tingling, and swollen lymph nodes. Most of the result shows significant value. Thus, it demonstrates that there's a difference between different type of vaccine's post-vaccination adverse effects.

Despite the fact that our study is one of the few in Bangladesh to explore the post vaccination side effects of COVID-19 vaccinations, it has a number of limitations. Data was gathered using an online questionnaire that was self-administered, which could lead to reporting bias. We chose to conduct this study as a web-based study to safeguard the safety of all study participants due to the COVID-19 pandemic and the recommendation to continue social distance and prevention measures in Bangladesh. Furthermore, conducting community-based surveys would be challenging during this pandemic. As a result, the information was gathered through self-disclosure on the internet. We thought it would be instructive to include more people because the majority of the participants were young. Furthermore, because to a shortage of time, it was not able to evaluate the COVID-19 vaccine's long-term negative effects. However, in order to analyze the link between current vaccines and thromboembolic profiles and symptoms, it would be beneficial to assess the participants' thromboembolic profiles and symptoms.

Chapter 6

Future prospects

The study employs a limited sample size. A bigger population-based follow-up study is necessary to determine the vaccines' efficacy in controlling and preventing SARS-CoV-2 infection, as well as their long-term post vaccination side effects. Additionally, the results of these research can assist public health authorities in determining the safety of COVID-19 vaccines and the efficacy of mass immunizations, as well as in improving future vaccine education and use.

Chapter 7

Conclusion

COVID-19 has impacted millions of people and put enormous strain on global healthcare systems and economy. At the moment, there is no specific treatment for COVID-19 or its associated comorbidities. We believe that immunization is merely one strategy for eradicating or significantly reducing COVID-19. There are various vaccines available in this regard, each with a unique combination of efficacy and negative effects. Due to the exceptional rate at which COVID-19 vaccines are being made, this unprecedented undertaking is vulnerable to post-market surveillance and vaccine safety concerns. While the prophylactic efficacy of COVID-19 vaccinations is being contested in clinical studies, knowledge of what happens in the realworld following vaccination remains limited, particularly among the general population. As a result, understanding what to expect following immunization can assist in educating the public, dispelling myths, and alleviating concerns regarding COVID-19 vaccinations. The findings from these types of studies may serve as a critical foundation for increasing public knowledge about COVID-19 vaccinations. These findings may help increase public confidence in the safety of COVID-19 vaccines, hence expediting the vaccination process in Bangladesh by dispelling myths and conspiracy theories about COVID-19 vaccine post-vaccination side effects.

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