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Local and Systemic side effects of COVID-19 Vaccines

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Abstract

Background:
To increase the public's acceptance of the vaccine, knowledge of its side effects is crucial. Thus, the purpose of this study was to identify side effects in the Saudi population following vaccinations with Pfizer BioNTech and AstraZeneca.

Method:
In Saudi Arabia, an online survey was conducted between March and October of 2021. Participants from Saudi Arabia who received two doses of the Pfizer BioNTech or AstraZeneca vaccine took part. The survey identified side effects following vaccinations.

Results:
AstraZeneca and Pfizer BioNTech administered vaccines to 174 and 224 of the 398 subjects, respectively. Fatigue (83.9%), local pain (78.2%), bone or joint pain (74.1%), fever (67.8%), vomiting or loss of appetite (24.1%), swelling (24.1%), and redness (21.8%) were the most commonly reported side effects for participants who took AstraZeneca.
For the participants who received Pfizer BioNTech, the most common adverse effects that were reported were fatigue (43.8%), bone or joint pain (38.4%), swelling (28.6%), fever (22.8%), redness (15.1%), and nausea or vomiting (11.2%). Local pain accounted for 90.6% of the adverse effects that participants reported.

Conclusions:
After receiving the COVID-19 vaccine, the majority of participants reported experiencing at least one side effect. Whereas the AstraZeneca vaccination was linked to a higher prevalence of systemic side effects, the Pfizer BioNTech vaccination was linked to a higher prevalence of local adverse effects. Most adverse events following vaccination are not fatal. After receiving an AstraZeneca or Pfizer BioNTech vaccination, side effects were more common in women and younger age groups. Vaccinations against coronavirus have a good safety record.

Keywords: Pfizer BioNTech; AstraZeneca; COVID-19 vaccine; vaccine side effects

Introduction

The most fascinating topic in the world this past year has been COVID-19 vaccinations. [1-3] A lot of businesses made quick work of creating vaccines that are both safe and effective. By promoting the production of antibodies by the immune system, coronavirus vaccinations may shield people against infection or severe symptoms of the virus. [4-6] After immunization, the invader spike protein binds to the generated antibodies, blocking the virus's ability to enter the cells. [7, 8] Many vaccines are currently authorized for use worldwide. Certain vaccines, like Moderna (mRNA1273) and Pfizer (BNT162), are based on mRNA technology. Vector-borne vaccines include Sputnik-V and AstraZeneca's ChAdOx1. [9, 10] In certain nations, additional vaccines like Sinopharm and Sinovac (BBIBP-CorV) are also utilized. [5, 11]
After vaccination, side effects are occasionally possible to develop immunity to. Most people agree that the main cause of vaccine reluctance in the general public is these possible side effects. [12, 13] It is essential to inform the public about the vaccine's side effects and boost public awareness of its effectiveness in order to boost vaccination acceptance. [12] The side effects of a vaccine differ depending on its kind. Compared to other vaccinations, post-vaccination complications are more common after RNA

(mRNA) vaccination. [14] Most people who receive a vaccination develop immunity against the coronavirus, whether or not side effects occur. A prior study found that mild and temporary side effects were experienced by only 1 in 4 people after receiving a coronavirus vaccination. [15] According to the World Health Organization, fever, exhaustion, headaches, nausea, diarrhea, and injection site pain are the most commonly reported adverse reactions to coronavirus vaccinations. [4] The purpose of this study was to ascertain the side effects of the AstraZeneca and Pfizer BioNTech vaccinations on the Saudi population.

Methods

The study design:

All of the experiments described here were conducted with permission from the Institutional Ethics Committee at Jouf University. An online survey was used to conduct the study in Saudi Arabia from March to October of 2021.

Sampling technique:

To evaluate adverse events following vaccination, an online survey was developed. Subjects who received two doses of the Pfizer BioNTech (BNT162) or AstraZeneca (ChAdOx1) vaccines were recruited for the study. The two doses were given to the subjects who received Pfizer BioNTech 21 days apart. One month separated the two dosages for the AstraZeneca-treated subjects.

Data collection:

Data from the participants was gathered online using a survey. It took five minutes to complete the questionnaire. The FDA and WHO data that were published were used to create the questionnaire items.[16]

There were two sections to the questionnaire:

1. Participant demographics: age, gender, marital status, occupation, average monthly income, nationality, and highest certificate attained
2. Local and systemic side effects following vaccination.

Results

Demographic information of participants

In all, 398 participants—163 of whom were female—were enrolled in this study. Of them, 224 participants received the Pfizer BioNTech vaccine and 174 received the AstraZeneca vaccine. Most of the participants were Saudi nationals working for the government, single, and between the ages of 18 and 35. Their average monthly income was less than $5,000 SAR.

Table 1 shows the demographic information of participants.

Post-vaccine local and systemic side effects:

Local side effects

Compared to the AstraZeneca vaccine group, the Pfizer BioNTech vaccine group had more local side effects. Among the participants who received Pfizer BioNTech, the most commonly reported local side effects were redness (15.1%), swelling (28.6%), and pain (90.6%). According to AstraZeneca, the most common local side effects were redness (21.8%), swelling (24.1%), and pain (78.2%).

Systemic side effects

Systemic side effects were more common in the AstraZeneca vaccine group compared to the Pfizer BioNTech vaccine group. For the participants who took AstraZeneca, fatigue (83.9%), bone or joint pain (74.1%), fever (67.8%), and vomiting or loss of appetite (24.1%) were the most commonly reported systemic side effects. Systemic side effects for Pfizer BioNTech included fatigue (43.8%), joint or bone pain (38.4%), fever (22.8%), and nausea or vomiting (11.2%).

Table 2 shows post-vaccine local and systemic side effects. Table 3 shows the association between type of vaccine and the side effects (Chi2 frequencies)

Discussion

Many vaccines have been developed in the past year. In order to stop the virus from spreading, vaccinations need to be both secure and efficient. [17]

It is imperative that the general public be informed about what happens after vaccination. This could help spread the word about coronavirus vaccinations to a wider audience. [18, 19] Hesitancy to receive the coronavirus vaccine is thought to be caused by a number of factors, including fear and rumors, as well as a lack of knowledge about clinical trials. [19] The information on the WHO and FDA websites was taken into consideration when designing the study questionnaire. [16].

The majority of participants had side effects following vaccination, which suggests that their immune systems were operating normally.[20] In this study, local pain, fever, redness, swelling, fatigue, bone or joint pain, vomiting, and appetite loss were the most frequently reported post-vaccine side effects. A study that was just published supported these conclusions. [5, 18, 21] After vaccination, allergies may develop. Therefore, it is advised that the person not get vaccinated if they experience a severe allergic reaction (anaphylaxis) or an allergy to any of the vaccine's ingredients.[22] The study's reported side effects were not considered fatal. These results were supported by other researches. [17, 21]. Post-vaccination adverse events are similar for all coronavirus vaccines, and each vaccine's type and mode of action has been linked to the quantity and intensity of adverse events. Compared to Pfizer BioNTech, AstraZeneca had more side effects. This was demonstrated by Ma'mon et al. in a previous study. [5] This may be associated with the reaction of the immune system. [21].

Table 1. Demographic data of the subjects

Characteristic	N (%)
Gender	
male	235(59.05%)
female	163(40.95%)
Age (years)	
18-35	155(38.94%)
36-50	22(5.53%)
51-65	115(28.89%)
> 65	106(26.63%)
Occupation	
Other	
Student	
free business	
government employee	
private sector employee	
Retired	
Average monthly income	
No comment	17.84%)
< 5 thousand SAR	(35.43%)
5 - 15 thousand SAR	11.81%)
15 - 20 thousand SAR	19.6%)
> 20 thousand SAR	15.33%)
Marital Status	
widower	.27%)
single	69.35%)
Married	5%)
divorced	26.88%)
Nationality	
Non-Saudi	16(4.02%)
Saudi	382(95.98%)
Highest Certificate Obtained	
Other	.27%)
high school	)6%)
Post-secondary diploma	5%)
Bachelor	%)
Masters	)8%)
PhD	1%)

The Pfizer BioNTech vaccination group experienced more local side effects than the AstraZeneca vaccine group, including redness and pain. Conversely, the Pfizer BioNTech vaccine group was less likely than the AstraZeneca vaccine group to experience systemic side effects, such as fever, fatigue, joint or bone pain, nausea, or loss of appetite. These results are comparable to Miloslav Klugar et al.'s study. [15] Our results are in line with a UK study that found that among British people, the Pfizer BioNTech vaccine was linked to a higher prevalence of local side effects (71.7 % vs. 58.7%), while the AstraZeneca vaccine was linked to a higher prevalence of systemic side effects (33.7 % vs. 20%). [23] Conversely, Alhazmi et al., 2021 found that there was no discernible variation in the local side effects experienced by Saudi Arabian immunization recipients; nonetheless, the AstraZeneca vaccination

remained substantially associated with a heightened risk of systemic side effects. [12, 24]

Table 2. Post-vaccine local and systemic side effects

Item	AstraZeneca (%)	Pfizer BioNTech (%)
Local side effects		
• Local pain	78.2%	90.6%
• Redness	21.8%	15.1%
• Swelling	24.1%	28.6%
Systemic side effects		
• Fatigue	83.9%	43.8%
• Vomiting or loss of appetite	24.1%	11.2%
• Fever	67.8%	22.8%
• Bone or joint pain	74.1%	38.4%

In a recently published study, it was found that many more people experienced side effects after the second dose of the Pfizer vaccination than after the first, with the AstraZeneca vaccine causing more side effects than either dose. [4, 25]

Inflammatory mediators, such as cytokines, are produced by the immune system after vaccination and lead to inflammation in the body's organs. The coronavirus vaccine consequently causes side effects that persist for a few days after vaccination. [25, 26] Most post-vaccination adverse effects start within the first 24 hours and last for one to two days.[23, 27]

90% of those vaccinated developed immunity to the virus, but 50% of those vaccinated did not experience any side effects, according to Pfizer BioNTech clinical trials. [12, 28] These side effects might indicate that the body is building the defenses required for immunity. [29, 30]

According to past studies [17, 21], the immune system develops enough antibodies after immunization to shield the body from coronavirus infection. Many people take nonsteroidal anti-inflammatory drugs (NSAIDs) to treat side effects following a coronavirus vaccination. Fears have been linked to the use of NSAIDs to treat side effects following vaccinations; however, NSAIDs inhibit pro-inflammatory mediators called cytokines as well as the enzymes cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2). After vaccination, sufficient antibody production depends on the Cox enzymes. Afterwards, it is advised against using NSAIDs following a coronavirus vaccination or infection because they reduce the production of antibodies. [17, 31]

An earlier study found that after receiving an AstraZeneca first dose vaccination for 12–21 days, infection rates decreased by 39%. [29, 32]

More immunity was developed in participants with prior coronavirus infections than in those without any prior infections. Compared to those who have never been infected or vaccinated, vaccinated individuals who have previously been infected typically have higher antibody concentrations. The reason for this could be that individuals who received the vaccination after an infection experienced heightened immune responses to the vaccine because the body views the vaccine as a potential second infection. [33] According to a previous study, people who have previously been exposed to the coronavirus only need to receive one dose of the vaccine in order to produce a sufficient amount of antibodies. [33, 34] They brought up this issue in an effort to help address the present crisis of vaccine shortage. In contrast, a major problem is the worldwide lack of coronavirus vaccines. [33, 35]

A recent study discovered that younger people experience post-vaccine side effects more frequently, and that these side effects are linked to the process of developing immunity through the generation of post-vaccine antibodies. [18].

According to a previous study, men may have fewer side effects than women because of their higher testosterone levels, which may also be the reason why women experience more side effects than men. [29] According to Alghamdi et al. (2021), among AstraZeneca vaccine participants, the incidence of post-vaccination side effects was significantly higher in females than in males. [36] Additionally, they noted that women experience side effects more frequently, at a higher intensity, and with a quicker onset than men. [36] Additionally, Pfizer BioNTech's mRNA-based and inactivated viral vaccinations have demonstrated a preponderance of female recipients. [10, 20, 29]

Females' stronger immunological responses and lower pain thresholds are proposed reasons to explain gender differences in self-reported health. Side effects of COVID-19 vaccinations. [22] The most frequent local side effect in our sample was pain, which was followed by injection swelling and redness. For both vaccines, the Czech Republic, Saudi Arabia, Jordan, the United Kingdom, and Saudi Arabia all reported the same order. [23, 29, 37] In general, all systemic side effects were much more common in users of AstraZeneca vaccines than in recipients of Pfizer BioNTech vaccines.

The most common systemic side effect among our Pfizer BioNTech vaccine recipients was fatigue, followed by bone or joint pain, fever and vomiting or loss of appetite. The most common systemic side effect reported by phase III volunteers in the Centers for Disease Control and Prevention (CDC) safety report for BNT162b2 (Pfizer BioNTech) vaccine was headache/fatigue, followed by muscle pain, chills, joint pain, and fever. [15] According to the

CDC assessment on the mRNA-1273 vaccine (Pfizer BioNTech), the most common systemic side effect was headache/fatigue, followed by muscle discomfort, and joint pain.[15]

Table 3. Association between type of vaccine and the side effects (Chi2 frequencies)

		No	Yes	Pearson chi2(1)	likelihood-ratio chi2(1)	Cramér's V
Local pain	**AstraZeneca**	38	136	12.0489 Pr = 0.001	11.9999 Pr = 0.001	0.174
	expected frequency	25.8	148.2			
	chi2 contribution	5.8	1			
	row percentage	21.84	78.16			
	column percentage	64.41	40.12			
	cell percentage	9.55	34.17			
	Pfizer	21	203			
	expected frequency	33.2	190.8			
	chi2 contribution	4.5	0.8			
	row percentage	9.38	90.62			
	column percentage	35.59	59.88			
	cell percentage	5.28	51.01			
Fever	**AstraZeneca**	56	118	81.3418 Pr = 0.000	83.7027 Pr = 0.000	-0.4521
	expected frequency	100.1	73.9			
	chi2 contribution	19.4	26.3			
	row percentage	32.18	67.82			
	column percentage	24.45	69.82			
	cell percentage	14.07	29.65			
	Pfizer	173	51			
	expected frequency	128.9	95.1			
	chi2 contribution	15.1	20.5			
	row percentage	77.23	22.77			
	column percentage	75.55	30.18			
	cell percentage	43.47	12.81			
Bone or joint pain	**AstraZeneca**	45	129	50.3759 Pr = 0.000	51.9018 Pr = 0.000	-0.3558
	expected frequency	80	94			
	chi2 contribution	15.3	13			
	row percentage	25.86	74.14			
	column percentage	24.59	60			
	cell percentage	11.31	32.41			
	Pfizer	138	86			
	expected frequency	103	121			
	chi2 contribution	11.9	10.1			
	row percentage	61.61	38.39			
	column percentage	75.41	40			
	cell percentage	34.67	21.61			
Fatigue	**AstraZeneca**	28	146	66.5756 Pr = 0.000	70.6609 Pr = 0.000	-0.409
	expected frequency	67.3	106.7			
	chi2 contribution	23	14.5			
	row percentage	16.09	83.91			
	column percentage	18.18	59.84			
	cell percentage	7.04	36.68			
	Pfizer	126	98			
	expected frequency	86.7	137.3			
	chi2 contribution	17.8	11.3			
	row percentage	56.25	43.75			

	column percentage	81.82	40.16			
	cell percentage	31.66	24.62			
Vomiting or loss of appetite	**AstraZeneca**	132	42	11.7799 Pr = 0.001	11.7190 Pr = 0.001	-0.172
	expected frequency	144.7	29.3			
	chi2 contribution	1.1	5.5			
	row percentage	75.86	24.14			
	column percentage	39.88	62.69			
	cell percentage	33.17	10.55			
	Pfizer	199	25			
	expected frequency	186.3	37.7			
	chi2 contribution	0.9	4.3			
	row percentage	88.84	11.16			
	column percentage	60.12	37.31			
	cell percentage	50	6.28			
Redness	**AstraZeneca**	136	38	2.9319 Pr = 0.087	2.9104 Pr = 0.088	-0.0858
	expected frequency	142.5	31.5			
	chi2 contribution	0.3	1.4			
	row percentage	78.16	21.84			
	column percentage	41.72	52.78			
	cell percentage	34.17	9.55			
	Pfizer	190	34			
	expected frequency	183.5	40.5			
	chi2 contribution	0.2	1			
	row percentage	84.82	15.18			
	column percentage	58.28	47.22			
	cell percentage	47.74	8.54			
Swelling	**AstraZeneca**	132	42	0.9851 Pr = 0.321	0.9904 Pr = 0.320	0.0498
	expected frequency	127.7	46.3			
	chi2 contribution	0.1	0.4			
	row percentage	75.86	24.14			
	column percentage	45.21	39.62			
	cell percentage	33.17	10.55			
	Pfizer	160	64			
	expected frequency	164.3	59.7			
	chi2 contribution	0.1	0.3			
	row percentage	71.43	28.57			
	column percentage	54.79	60.38			
	cell percentage	40.2	16.08			

Conclusions

After receiving the COVID-19 vaccine, the majority of participants reported experiencing at least one side effect. Whereas the AstraZeneca vaccination was linked to a higher prevalence of systemic side effects, the Pfizer BioNTech vaccination was linked to a higher prevalence of local adverse effects. Most adverse events following vaccination are not fatal. The most common systemic adverse event reported by participants receiving AstraZeneca was fatigue. The most common local adverse event reported by participants receiving Pfizer BioNTech was pain. After receiving an AstraZeneca or Pfizer BioNTech vaccination, side effects were more common in women and younger age groups. Vaccinations against coronavirus have a good safety record.

Author contributions

Concept, Experiment, data entry, writing, data analysis and interpretation: Marwa O. Elgendy, Ahmed M. Sayed.
Concept, planning of study design, and reviewing the manuscript:

Conflict of interest

Nothing to declare

Data availability statement

The *datasets* analyzed during the current study are available from the corresponding author on reasonable request.

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