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Adverse health events experienced by the recipients of COVID-19 vaccines and the associated factors in southwestern Saudi Arabia

Ashraf Ewis[1,2*], Omer Abdelbagi[3], Marwa Abdelrahim[2], Eman Ghazawy[2], Shaza Fadel[2], Doaa Mahmoud Khalil[4], Omar AlHazazi[5], Mosad Odah[6] and Mohamed Elhefny[7,8*]

[1]Department of Public Health, Faculty of Health Sciences-AlQunfudah, Umm Al-Qura University, Makkah, Saudi Arabia.
[2]Department of Public Health and Occupational Medicine, Faculty of Medicine, Minia University, El-Minia, Egypt.
[3]Department of Pathology, Faculty of Medicine-AlQunfudah, Umm Al-Qura University, Makkah, Saudi Arabia.
[4]Department of Public Health and Community Medicine, Faculty of Medicine, Beni Suef University, Beni Suef, Egypt.
[5]Department of Chemistry, Faculty of Applied Medical Sciences, Umm Al-Qura University, Makkah, Saudi Arabia.
[6]Department of Biochemistry, Faculty of Medicine-AlQunfudah, Umm Al-Qura University, Makkah, Saudi Arabia.
[7]Department of Genetics, Faculty of Medicine-AlQunfudah, Umm Al-Qura University, Makkah, Saudi Arabia.
[8]Department of Cancer and Molecular Biology, NCI Cairo University, Cairo, Egypt.
Email: aaewis@uqu.edu.sa; maabdelrahman@uqu.edu.sa

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ABSTRACT

Aims: Studying the post-vaccination adverse health events is crucial to determine the confidence and acceptance of the public to the newly-developed COVID-19 vaccines. The present study aimed to investigate the prevalence rates of the adverse health events experienced by the recipients of COVID-19 vaccines in Saudi Arabia.
Methodology and results: A cross-sectional study was conducted in October 2021 using a google form of an online self-administered questionnaire sent via different social media platforms for recruiting participants from southwestern Saudi Arabia. The questionnaire was prepared by medical and public health professionals and then translated into Arabic, pilot-studied and validated. Among the 453 Saudi adults who participated in the study with at least one dose of the COVID-19 vaccine, about (77.9%) were males aged 25.5 ± 10.6 years. Most of the participants were college students living in the Makkah region. Nearly 68.3% reported post-vaccination adverse events, such as injection site pain/swelling (91.9%), fatigue (67.9%), bone and muscle pain (65.2%) and flu-like symptoms (58%). The type of vaccine was significantly associated with the development of adverse events p=0.002 (OR of Pfizer-BioNTech versus AstraZeneca: 0.33, 95% CI: 0.18-0.61). Additionally, ageing of more than the 3rd decade, male gender and being married were significantly associated with lower rates of reporting post-vaccination adverse events.
Conclusion, significance and impact of study: The development of COVID-19 vaccine-related adverse health events had no significant associations with residence, education, occupation, BMI, chronic diseases or smoking. However, age, gender, marital state and vaccine type may be considered significant predictors for developing post-vaccination adverse reactions.

Keywords: AstraZeneca, Pfizer BioNTech, COVID-19 pandemic, vaccine adverse events, Saudi Arabia

INTRODUCTION

Globally, severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) has been associated with higher rates of morbidity and mortality in the general population (Zhang *et al.*, 2022). In Saudi Arabia, up to January 19th, 2023, there were 827,488 confirmed cases of COVID-19, with about 9,549 deaths (Worldometer, 2023). All countries tried their best to reach 100% vaccination coverage of high-risk groups, including healthcare workers and about 70% vaccination of the general population (Aschwanden, 2021). The novel COVID-19 vaccination relies on two platforms, the well-known adenovirus and the newly emerging messenger RNA, which started in the early 1990s by the French and was later confirmed by American and German scientists and companies (Conry *et al.*, 1995; Hoerr *et al.*, 2000). The vaccine model that depends on *in vitro* synthesis of mRNA was earlier neglected because of common beliefs that made many scientists think that mRNA is fragile (Schlake *et al.*, 2012; Pardi *et al.*, 2018). Scientifically and practically, such beliefs are proven not true specially, when the mRNA is dealt with in RNase-free and neutral media (Pascolo, 2015). In the absence of the RNase

***Corresponding author**

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enzyme, the mRNA is very robust and can withstand up to 95 °C. It can also be frozen, thawed, lyophilised and reconstituted without losing its physiochemical properties (Pascolo, 2021). It has been proven that COVID-19 vaccines could considerably reduce disease severity in all vulnerable groups. Additionally, most vaccinated persons who contracted post-vaccination infection were less infectious to other people. If they become infectious, it will be shorter compared to unvaccinated patients (Antonelli *et al.*, 2022). In the United States of America, many studies showed a considerable decrease in the magnitude of disease by halting serious illness in fully vaccinated people and arresting the chain of transmission (Moghadas *et al.*, 2020). Some data showed less severe disease in women and younger patients than in older patients (Chen *et al.*, 2020). It is fundamental to find a precise and efficient announcing system of vaccination assurance, and these need to work closely between policymakers' health providers, the industry and the public (Lu *et al.*, 2021). AstraZeneca (AZ) and Pfizer-BioNTech vaccines showed side effect rates that ranged from 60-80% depending on the type of vaccine, the age of the recipient and the dose (Polack *et al.*, 2020; Voysey *et al.*, 2021). The adverse reaction to vaccination can be seen in all types of vaccines and in some cases, it needs prompt management (Battaglini *et al.*, 2022). Vaccination side effects are common and reflect the immune response. Still, the downside of vaccines can be serious and arouse panic, which can dim the benefits of vaccines. The side effect of AZ's first dose is commoner than the first and second doses of the Pfizer vaccine (Andrzejczak-Grządko *et al.*, 2021). However, AZ vaccine-related side effects started during the first day and subsided after 2-3 days, with infrequent serious symptoms; still, those adverse events were the main cause of not recommending the COVID-19 vaccine to other people and the main cause of hesitancy of the people regarding receiving the second dose (Solomon *et al.*, 2021). Almost 90% of AZ vaccine recipients experienced side effects such as chills, headache, nausea, malaise, muscle ache and pain at the site of injection, which lasted for more than seven days (Ashraf *et al.*, 2021). The major concern about the AZ vaccine is venous thrombosis, especially in the cerebral sinus. By the end of March 2021, more than sixty cases of cerebral thrombosis were reported by the European drug safety database, which is slightly more than the incidence in the general population (Bikdeli *et al.*, 2021). The thrombosis side effect was common with vaccines that use virus vectors, such as the AZ vaccine and Johnson and Johnson vaccine (Wise, 2021; Battaglini *et al.*, 2022). Regarding the Pfizer-BioNTech vaccine, a study from the Singapore literary hospital revealed that side effects after the first and second doses of the Pfizer-BioNTech coronavirus vaccine were very minimal and self-limited with no anaphylactic reaction noted (Lim *et al.*, 2021). Besides the disparate adverse reactions such as fatigue and headache, the Pfizer vaccine showed differing severity of skin involvement weeks after vaccination (Alamri *et al.*, 2022). A study performed in Qatar by Abdulgayoom *et al.* (2021) reported signs and symptoms of the nephrotic syndrome among COVID-19 vaccine recipients a few days following the first dose of vaccination with Pfizer vaccine (Abdulgayoom *et al.*, 2021). To address this issue of the experienced adverse health events following COVID-19 vaccination among Saudi adults, we designed this cross-sectional study. The aim of this study was to investigate the prevalence of the common adverse health events that were experienced by the recipients of the different COVID-19 vaccines and the associated predictors in southwestern Saudi Arabia.

MATERIALS AND METHODS

Study design and target population

This cross-sectional study was conducted during the period from October 15th to 31st, 2021, to investigate the adverse events experienced by the recipients of COVID-19 vaccines in Saudi Arabia.

The sample size was calculated using Epi Info version 6 statistical software under the assumption that 50% of the vaccine recipients will experience adverse health events following COVID-19 vaccine immunization. The predicted sample size was 385 and nearly 20% of the calculated required samples were added in order to guard against the non-response based on a 95% confidence range and an 80% degree of precision. Therefore, our final study sample size was 453 COVID-19 vaccine recipients.

The main study tool was a questionnaire that was well-prepared by the authors based on the literature review and it was evaluated by three experts in the relevant fields of Medicine and Public Health. Then native Arabic speakers in the medical fields translated it into the Arabic language. The questionnaire was tested in a pilot study on 20 participants to check the questions' clarity, understandability, internal consistency, and validation. An online google form version of the Arabic questionnaire was prepared and distributed on the available different social media platforms (WhatsApp, Twitter, Facebook, Instagram, etc.). The same questionnaire was used in our parallel study that was recently, published on the post-COVID-19-vaccination adverse health effects on the Egyptian adult population (an Arab country in the Middle East region) (Hatmal *et al.*, 2022).

Before implementing the main study, a pilot study was conducted on 20 participants to determine the clarity and simplicity of the questions, language comprehensibility and the average completion time for the questionnaire. All the questions were internally consistent and reliable according to the reliability test (Cronbach's alpha was 0.82). The questionnaire was re-evaluated based on the findings, and however, only minor changes were made to the study tool. The responses of the pilot study were excluded from the main study.

Data collection

An Arabic Google form online self-administered

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questionnaire was used for collecting data for this study. The questionnaire started with demonstrating the purposes of the survey and eligibility criteria for participating in the study while confirming that sharing in the survey is full voluntary and every participant has full right to decline the survey or withdraw from the study at any point of time without any penalties. The subsequent sections of the questionnaire included inquiries regarding the socio-demographic characteristics of the participants, the type of administered COVID-19 vaccine(s), opinions regarding the vaccines and the incidence of any adverse health events experienced after receiving COVID-19 vaccines. Additional questions inquired about the adverse events' onset, duration, and relation to the first, second or third dose if any.

A total of 453 Saudi Arabia adults aged 18 years and above who received at least one dose of the COVID-19 vaccine participated in the study through the snowball sampling technique used for recruiting participants from different regions in southwestern Saudi Arabia.

Statistical analysis

The collected data were analyzed using the Statistical Package for Social Science (SPSS), (IBM SPSS Statistics for Windows, Version 25.0, IBM Corporation, Armonk, New York).

Quantitative data were analyzed and presented as descriptive statistics (mean ± SD), while numbers and percentages were used for qualitative data. Chi-squared tests and binary logistic regression were used to determine the factors that were significantly associated with adverse events following COVID-19 vaccination. Multivariate logistic regression was used to predict the risk factors that may likely lead to the development of COVID-19 post-vaccination adverse health events. P-values of less than 0.05 were considered significant.

Ethical considerations

The Biomedical Research Ethics Committee of Umm Al-Qura University approved this study. Approval number (HAPO-02-K-012-2021-03-624). The purpose, conditions and eligibility criteria of the study and the right to continue, decline or withdraw from the study were described in the first section of the online google form-based questionnaire. Every participant had to accept/decline the conditions of sharing in the study and choose to accept if he/she agreed to proceed in filling out and submitting the rest of the questionnaire. Acceptance to proceed with the questionnaire was considered as approval and informed consent for participation in the study.

RESULTS

This study included 453 Saudi adults who reported receiving at least one dose of a COVID-19 vaccine, with a mean (SD) age of 25.5 ± 10.6 years and 353 (77.9%) were males. Most of the participants were college students (79.7%) who live in the Makkah region (83.9%) with no history of chronic diseases (77%), as shown in Table 1. The development of post-vaccination adverse events was significantly associated with age, sex, marital status and type of vaccine. Regarding the COVID-19 vaccine, the most utilized type was Pfizer-BioNTech (69.5%), followed by AstraZeneca (28.7%). Most participants (96%) received two doses and about 60% felt protected after the second dose. Moreover, 9.7% of the participants reported acquiring COVID-19 infection after being vaccinated and 8.6% suffered the same or less severe infection. It was found that 40.6% of the participants had already received or were willing to take the third dose and 75.1% advised others about the vaccination, as shown in Table 2.

Nearly 68.3% of the participants reported adverse events after receiving COVID-19 vaccination.

Table 3 shows a comparison between the two main vaccines utilized by the study participants (Pfizer-BioNTech and AstraZeneca) regarding the vaccine-related adverse effects reported by the study participants. It was found that AstraZeneca recipients were more likely to report side effects and more likely to suffer after the 1st dose (76.9% and 49.2%, respectively) compared to Pfizer-BioNTech consumed persons (61.3% and 10.8%, respectively). The most common vaccine adverse effects, regardless of the type of vaccine, were injection site pain/swelling (91.9%), fatigue (67.9%), bone and muscle pain (65.2%) and flu-like symptoms (58%), as shown in Table 3. Table 4 presents the possible predictors of vaccine-related side effects. In the multivariable logistic regression analysis, there were no significant associations of residence, education, occupation, BMI, chronic diseases or smoking with the development of vaccine-related side effects. However, gender, marital state and type of vaccine were significant predictors for post-vaccination reactions. Being at the age of 21-30 years was associated with almost double risk for developing side effects following COVID-19 vaccination (OR: 2.22, 95% CI: 1.21-4.04, p=0.03). Additionally, the male gender had significantly fewer correlations with vaccine-related adverse effects than females (OR: 0.19, 95% CI: 0.08-0.44, p-value: <0.0001). Being married was also significantly associated with lower rates of reporting post-vaccination side effects (OR: 0.45, 95% CI: 0.26-0.78). Moreover, the type of vaccine was significantly associated with the development of adverse effects p=0.002 (OR of Pfizer-BioNTech versus AstraZeneca: 0.33, 95% CI: 0.18-0.61).

DISCUSSION

The most striking finding of this study was the COVID-19 vaccination coverage (96%) of participants who received two doses, representing one of the highest vaccination rates worldwide. This high rate of COVID-19 vaccination coverage can be attributed to the free access to vaccines for all citizens and residents in Saudi Arabia and the strict rules deployed by the Saudi authorities. For instance, the unvaccinated subjects were not allowed to enter

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Table 1: Sociodemographic characteristics of the study participants and relationship with experiencing post-COVID-19 vaccination adverse health events.

	Total number (%) (n=453)	Side effects (n=355) N (%)	No side effects (n=98) N (%)	p-value
Age, (Mean ± SD)	25.55 ± 10.62	25 ± 9.70	27.5 ± 12.8	
18-20 years	173 (38.1)	134 (37.7)	39 (39.8)	
21-30 years	200 (44.2)	166 (46.8)	34 (34.7)	0.030
>30 years	80 (17.7)	55 (15.5)	25 (25.5)	
Sex				
Female	100 (22.1)	93 (26.2)	7 (7.1)	
Male	353 (77.9)	262 (73.8)	91 (92.9)	0.0001
Marital status				
Unmarried	361 (79.7)	290 (81.7)	71 (72.4)	
Married	92 (20.3)	65 (18.3)	27 (27.6)	0.044
Residence				
Makkah	380 (83.9)	301 (84.8)	79 (80.6)	
Others	73 (16.1)	54 (15.2)	19 (19.4)	0.352
Education				
Secondary or less	57 (12.6)	45 (12.7)	12 (12.2)	
University	361 (79.7)	282 (79.4)	79 (80.6)	0.961
Postgraduate	35 (7.7)	28 (7.9)	7 (7.2)	
Occupation				
Medical field	39 (8.6)	35 (9.9)	4 (4.1)	
Medical student	264 (58.3)	207 (58.3)	57 (58.1)	
Non-medical student	49 (10.8)	40 (11.2)	9 (9.2)	0.139
Other	101 (22.3)	73 (20.6)	28 (28.6)	
History of chronic disease				
No	349 (77)	277 (78)	72 (73.5)	
Yes	104 (23)	78 (22)	26 (26.5)	0.345
BMI				
Normal	264 (58.3)	211 (59.4)	53 (54.1)	
Overweight	109 (24)	88 (24.8)	21 (21.4)	0.133
Obese	80 (17.7)	56 (15.8)	24 (24.5)	
Smoking				
Non-smoker	375 (82.8)	297 (83.7)	78 (79.6)	
Smoker	78 (17.2)	58 (16.3)	20 (20.4)	0.365
Types of vaccine				
AstraZeneca	130 (28.7)	115 (32.4)	15 (15.3)	
Pfizer-BioNTech	315 (69.5)	233 (65.6)	82 (83.7)	0.003
Other/don't remember	8 (1.8)	7 (2)	1 (1)	
Number of doses				
One	8 (1.8)	6 (1.7)	2 (2)	
Two	435 (96)	344 (96.9)	91 (92.6)	0.085
Three	10 (2.2)	5 (1.4)	5 (5.1)	

universities, schools, theatres, cinemas, soccer playgrounds, public services, markets, airports and worship places. Two independent mathematical modelling simulation studies from Japan and France concluded that when vaccination coverage is high, it is possible to lift all non-pharmaceutical intervention restrictions regarding the COVID-19 pandemic, which can be applied to other countries (Furuse, 2021; Kiem *et al.*, 2021). The COVID-19 pandemic has affected Saudi Arabia more than other countries because of heavy travelling in and out from all over the world (Algaissi *et al.*, 2020), since Saudi Arabia had the two Islamic Holy cities of Makkah and Al-Madinah Al-Monawarah, where millions of Muslim pilgrims visit annually. Saudi Arabia was one of the earliest countries to start vaccinating the high-risk groups of its population in December 2020. The national health authorities in Saudi Arabia approved two vaccines in the first round, Pfizer-BioNTech vaccine followed by the AstraZeneca vaccine (WHO, 2022). This study found that the development of post-COVID-19 vaccination adverse events was significantly associated with age, sex, marital status, and type of vaccine (Table 1). This agrees with the results of two other studies from the United Kingdom (Antonelli *et al.*, 2022) and Ethiopia (Abebe *et al.*, 2022). Our study showed that a minority of the studied population contracted COVID-19 infection

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Table 2: Utilization and perception of COVID-19 vaccines among the study participants.

	Total number (%) (n=453)
COVID-19 vaccine	
AstraZeneca, one dose	1 (0.2)
AstraZeneca, two doses	129 (28.5)
Pfizer-BioNTech, one dose	6 (1.3)
Pfizer-BioNTech, two doses	299 (66)
Pfizer-BioNTech, three doses	10 (2.2)
Don't remember	8 (1.8)
COVID-19 infection	
No/Not sure	328 (72.4)
Yes, before vaccination	81 (17.9)
Yes, after vaccination	44 (9.7)
Method of diagnosis	
Not infected	328 (72.4)
Clinical only	28 (6.2)
PCR	93 (20.5)
Radiological ± blood tests	4 (0.9)
The severity of infection after vaccination	
Not infected	409 (90.3)
Less severe	31 (6.8)
Same severity	8 (1.8)
More severe	5 (1.1)
Willing to take a third dose	
No	94 (20.8)
Yes/already had a 3rd dose	184 (40.6)
May be	175 (38.6)
Decision of vaccination	
Personal/family	156 (34.4)
Forcing employer/university	56 (12.4)
Governmental requirement	44 (9.7)
Community protection	68 (15)
Most of causes	129 (28.5)
Opinion about vaccine safety	
No	31 (6.8)
Yes	116 (25.7)
Neutral	306 (67.5)
Advice others with vaccination	
No	19 (4.1)
Yes	340 (75.1)
Neutral	94 (20.8)
Feel protected after vaccination	
No/maybe	124 (27.4)
Yes, after 1st dose	58 (12.8)
Yes, after 2nd dose	271 (59.8)
Need protective measures after vaccination	
No	69 (15.2)
Yes	303 (66.9)
I don't know	81 (17.9)

after being vaccinated (9.7%). Similar findings were reported in studies from the USA (Juthani *et al.*, 2021) and India (Jain *et al.*, 2021). This study revealed that nearly half of the participants had already taken or were willing to take the third dose of COVID-19 vaccination and three-quarters of them offered advice to others to get it. Such results were consistent with that of a study from China, which found that Chinese people showed high enthusiasm to have the third dose of the COVID-19 vaccine (Qin *et al.*, 2022). Our current study showed that recipients of AstraZeneca were more prone to record adverse effects and more likely to suffer after the 1st dose (76.9% and 49.2%, respectively), while those who received the Pfizer-BioNTech vaccine reported adverse effects generally and after the first dose in low frequency (61.3% and 10.8%, respectively). Studies from Poland and Germany showed similar results, where the adverse effects reported generally and after receiving the first dose of COVID-19 vaccines were (84.2%) and (78.3%) after AstraZeneca vaccination, respectively, while it was (64%) and (70.4%) after Pfizer-BioNTech vaccination, respectively (Andrzejczak-Grządko *et al.*, 2021; Klugar *et al.*, 2021).

These findings can be explained by the fact that the AZ vaccine platform is an adenovirus-based platform that, when administered, can cause flu-like symptoms. However, the mRNA vaccine of Pfizer-BioNTech vaccination causes pain at the site of injection.

In this study, the most common adverse effects were injection site pain/swelling (91.9%), fatigue (67.9%), bone and muscle pain (65.2%) and flu-like symptoms (58%), (Table 3). Similar findings were reported in a study from the Czech Republic that investigated the adverse health effects of COVID-19 vaccines among healthcare workers and listed these events such as injection site pain, fatigue, headache, muscle pain and chills with a prevalence of (89.8%, 62.2%, 45.6%, 37.1% and 33.9%, respectively) (Riad *et al.*, 2021a). Additionally, a recent meta-analysis study screened more than 30,000 publications and concluded that the most common adverse events of AstraZeneca and Pfizer-BioNTech vaccines were site pain/swelling, followed by fatigue, bone and muscle pain and flu-like symptoms (Pormohammad *et al.*, 2021).

Our current study found no significant associations between residence, education, occupation, BMI, chronic diseases, or smoking and the development of vaccine-related adverse effects. These results were in agreement with those of a large observational study done in the United Kingdom, which showed no association between BMI or chronic disease and severity of adverse effects of both AstraZeneca and Pfizer-BioNTech vaccines (Menni *et al.*, 2021).

In the current study, being above 30 years old, male gender as well as married had significantly lower reporting rates of COVID-19 vaccine-related adverse health events (Table 4). Similarly, in their real-world cohort study, Beatty *et al*. (2021) found that older age and male gender were associated with lower rates of adverse events (Beatty *et al.*, 2021). Additional two other studies that were performed in Malaysia, by Elnaem *et al.* (2021) and in Turkey, by Riad *et al.* (2021a), reported similar results regarding male gender and older age (Elnaem *et al.*, 2021; Riad *et al.*, 2021b).

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Table 3: Post-COVID-19 vaccine-related adverse health events and its relationship with the type of vaccine as reported by the Saudi participants.

Post-COVID-19 vaccine adverse health events	Total numbers (%) (n=445)	COVID-19 vaccine N (%)		P-value
		AstraZeneca (n=130)	Pfizer-BioNTech (n= 315)	
Adverse health events				
No	97 (21.8)	15 (10.0)	82 (26.7)	
Yes	348 (78.2)	115 (76.9)	233 (61.3)	0.001
Timing				
No symptoms/mild local	133 (29.9)	22 (16.9)	111 (35.2)	
After 1st dose	98 (22.0)	64 (49.2)	34 (10.8)	<0.0001
After 2nd dose	89 (20.0)	8 (6.2)	81 (25.7)	
After 1st and after 2nd dose	125 (28.1)	36 (27.7)	89 (28.3)	
Onset				
No symptoms	97 (21.8)	13 (10.0)	84 (26.7)	
<1 day	287 (64.5)	100 (76.9)	187 (59.4)	
1-2 days	43 (9.7)	12 (9.3)	31 (9.8)	0.001
≥3 days	18 (4.0)	5 (3.8)	13 (4.1)	
Duration				
No symptoms	97 (21.8)	15 (11.5)	82 (26.0)	
<1 day	83 (18.7)	41 (31.5)	42 (13.3)	
1-3 days	224 (50.3)	66 (50.8)	158 (50.2)	<0.0001
4-7 days	31 (7.0)	5 (3.8)	26 (8.3)	
>1 weeks	10 (2.2)	3 (2.3)	7 (2.2)	
Types *				
Injection site pain/swelling	409 (91.9)	123 (94.6)	286 (90.8)	0.251
Hypersensitivity	57 (12.8)	18 (13.8)	39 (12.4)	0.755
Bone and muscle	290 (65.2)	104 (80.0)	186 (59.0)	<0.0001
Flu-like symptoms	258 (58.0)	94 (72.3)	164 (52.1)	<0.0001
Fatigue	302 (67.9)	103 (79.2)	199 (63.2)	0.001
Gastrointestinal	97 (21.8)	35 (29.9)	62 (19.7)	0.101
Menstrual changes**	25 (26.0)	7 (25.0)	18 (26.5)	0.881
Miscellaneous	55 (12.4)	19 (14.6)	36 (11.4)	0.347
Serious	6 (1.3)	2 (1.5)	4 (1.3)	0.823
Management				
No symptoms	97 (21.8)	14 (10.8)	83 (26.3)	
Rest at home/painkillers	339 (76.2)	113 (86.9)	226 (71.7)	
Doctor visit	5 (1.1)	2 (1.5)	3 (1.0)	0.004
Admission to hospital	4 (0.9)	1 (0.8)	3 (1.0)	

*The sum may not add up to 100% because the symptoms are not mutually exclusive as the questionnaire items allow multiple choices;
**Total=96 females who experienced at least one menstrual period after being vaccinated.

In the current study, there were significant associations between the development of adverse effects and the type of vaccine, where recipients of the AZ vaccine reported higher rates of adverse events than Pfizer-BioNTech recipients (Table 4). Similar findings were reported regarding the safety and efficacy of COVID-19 vaccines in an interim analysis of four randomized controlled trials in Brazil, South Africa and the UK (Voysey *et al.*, 2021).

Among the 453 Saudi adults who participated in our study and received at least one dose of a COVID-19 vaccine, nearly 68.3% reported post-vaccination adverse health events. The most common vaccine adverse effects, regardless of the type of vaccine, were injection site pain/swelling (91.9%), fatigue (67.9%), bone and muscle pain (65.2%) and flu-like symptoms (58%), (Table 3). The type of vaccine was significantly associated with the development of adverse effects p=0.002 (OR of Pfizer-BioNTech versus AstraZeneca: 0.33, 95% CI: 0.18-0.61) (Table 4). Being older than 30 years, female gender and being unmarried were significantly associated with higher rates of reporting post-COVID-19-vaccination adverse events (Table 4).

Limitations of the study

One of the significant limitations of our study is the cross-sectional design that may have affected the detection of severe, uncommon, or rare post-COVID-19 vaccination adverse events and establishing inferences or causality relationships, which may require other longitudinal studies with a large number of participants. This cross-sectional

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Table 4: Predictors for the development of post-COVID-19 vaccination adverse health events.

		Crude OR (95% CI) p-value	Adjusted OR (95% CI) p-value
Age	>30 years	1	
	18-20 years	1.56 (0.86-2.82)	
	21-30 years	2.22 (1.21-4.04)	
		0.033	
Sex	Female	1	1
	Male	0.22 (0.10-0.48)	0.19 (0.08-0.44)
		<0.0001	<0.0001
Marital status	Unmarried	1	1
	Married	0.59 (0.35-0.98)	0.45 (0.26-0.78)
		0.046	0.005
Residence	Makkah	1	
	Others	0.75 (0.42-1.33)	
		0.321	
Education	University or less	1	
	Postgraduate	1.11 (0.47-2.63)	
		0.807	
Occupation	Medical field	1	
	Medical student	0.41 (0.14-1.22)	
	Non-medical student/other	0.35 (0.12-1.05)	
		0.167	
Chronic disease	No	1	
	Yes	1.28 (0.77-2.14)	
		0.343	
BMI	Normal	1	
	Overweight/Obese	0.80 (0.51-1.26)	
		0.342	
Smoking	Non-smoker	1	
	Smoker	0.76 (0.43-1.34)	
		0.346	
Types of vaccine	AstraZeneca	1	1
	Pfizer-BioNTech	0.37 (0.21-0.67)	0.33 (0.18-0.61)
	Others	0.91 (0.11-7.94)	0.70 (0.08-6.50)
		0.004	0.002
Number of doses	One	1	
	Two	1.26 (0.25-6.35)	
	Three	0.33 (0.04-2.52)	
		0.115	

study evaluated only immediate and short-term adverse events, not long-term or late ones. A second limitation is the utilization of the google form online self-administered questionnaire, which could result in selection bias, recall bias and non-response bias. However, the online surveys were cost-effective and fast approaching large numbers of respondents. In order to overcome this limitation, we distributed the survey on different online social media platforms to improve its visibility and accessibility among the target population who were difficult to reach by traditional methods. One of the major limitations of this study was the snowball sampling technique that resulted from using the internet-based google form online self-administered questionnaire for data collection. However, this technique is cost-effective and was convenient during the COVID-19 pandemic because of minimizing direct contact during interviews and handling of the paper questionnaires etc. But sampling and selection bias was considerable limitations of such techniques. The majority of the respondents to this study belonged to one region and its surroundings. Therefore, we proposed adding the word "southwestern" to the title to best fit with the participating sample of Southwestern Saudi Arabia provinces.

Lastly, our study participants were mostly young and a large percentage of them were university students. This was also one of the limitations because of the snowball sampling technique and the use of the online self-administered data collection tool. This limitation will undoubtedly affect the generalizability of the results, which may have failed to present real associations between other age groups and the occurrence of adverse events after COVID-19 vaccination.

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CONCLUSION

The most commonly reported post-COVID-19 vaccination adverse events were injection site pain/swelling, fatigue, bone and muscle pain, and flu-like symptoms. These adverse events were significantly associated with AstraZeneca than the Pfizer-BioNTech vaccine. There were no significant associations of residence, education, occupation, BMI, chronic diseases or smoking with the development of vaccine-related adverse events. However, older age, female gender, being unmarried and type of vaccine were significant predictors for developing post-vaccination adverse health events. Most post-COVID-19 vaccination adverse health events were mild to moderate in severity, did not require hospitalization and usually resolved within a few days after vaccination. However, longitudinal surveillance studies are needed to investigate the possible COVID-19 vaccine-related late or long-term adverse events.

Comprehending the variety of symptoms that COVID-19 vaccination might cause is crucial to fight the rumors, minimizing hesitation, increasing public confidence in vaccine safety and hastening the vaccination.

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