

Original Research Article

Assessing COVID-19 vaccine side effects among the general population in Jordan: A nationwide perspective

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Abstract

Purpose: To assess the nature of COVID-19 vaccine side effects in Jordan, addressing public concerns and vaccine hesitancy.

Methods: A total of 405 participants were surveyed, having received one to four doses of the COVID-19 vaccines approved in Jordan. Data were collected via a self-administered online survey created with Google Forms and shared through social media platforms.

Results: Of these, 355 participants met the inclusion criteria - primarily female (57.7 %) and educated to a bachelor's level (53.5 %). Most had no serious medical conditions (75.5 %) and had received two doses (71.3 %), with Pfizer-BioNTech being the most common (56.9 %). Side effects were reported by 68.1 %, mostly minor, such as injection site pain (45.8 %) and fatigue (42.7 %). Severe effects (10.7 %), including anaphylaxis and dyspnea, were infrequent and non-hospitalized.

Conclusion: This study affirms the high safety profile of COVID-19 vaccines, with most side effects being mild and short-lived. The rarity of severe adverse events underscores the vaccines' overall benefits, supporting their continued use in public health efforts. Transparent communication and ongoing safety monitoring remain essential to enhance public confidence and combat vaccine hesitancy.

Keywords: COVID-19, Vaccine side effects, Jordan population, Vaccine hesitancy, Public health strategies

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INTRODUCTION

The COVID-19 pandemic has been one of the most significant public health crises in modern history, leading to the rapid development of vaccines to mitigate the spread of the virus and reduce morbidity and mortality [1]. Vaccines are widely regarded as a critical tool in controlling the pandemic, with various types such as mRNA vaccines (Pfizer-BioNTech, Moderna), viral

vector vaccines (AstraZeneca, Sputnik V), and inactivated vaccines (Sinovac, Sinopharm) being administered across the globe [2]. However, like all pharmaceutical interventions, vaccines can elicit adverse reactions, ranging from mild and self-limiting symptoms to severe, although rare side effects. Understanding the side effects associated with COVID-19 vaccines is crucial to ensuring public confidence, guiding healthcare professionals, and improving vaccine

formulations and policies [1,2]. COVID-19 vaccines have been developed using various platforms, each with its own safety and efficacy profiles. mRNA vaccines like Pfizer-BioNTech (Comirnaty) and Moderna have demonstrated high efficacy in preventing COVID-19 infection, especially severe disease outcomes. These vaccines function by delivering a small fragment of the virus's spike protein mRNA, which induces an immune response without causing disease. The viral vector vaccines, such as AstraZeneca and Sputnik V, use a modified adenovirus to carry genetic material from the SARS-CoV-2 virus into cells to stimulate an immune response [3]. Inactivated vaccines like Sinopharm and Sinovac contain a virus that has been killed or inactivated, thus incapable of causing infection, while still stimulating immunity [4]. By August 19, 2022, Jordan, with a population of approximately 11 million, reported 1,731,549 COVID-19 cases and 14,105 deaths.

The pandemic in Jordan progressed through various stages, starting on March 2, 2020, with its first recorded case from Italy. Initially, the spread was moderate, with fewer than 2,000 cases and 25 fatalities by August 2020. However, cases surged significantly thereafter. The Jordanian government implemented stringent preventive measures to control the outbreak, including movement restrictions, strict curfews, shorter work hours, remote work, distance learning, banning large gatherings, suspending international flights, and a nationwide lockdown starting March 14, 2020, lasting several weeks. These efforts aimed to curb the virus's spread and protect public health [5]. The emergency use authorization (EUA) of these vaccines has led to mass vaccination campaigns globally. In Jordan, the government rolled out its vaccination program in early 2021, administering various vaccines based on availability. The vaccination efforts aimed to protect the population, especially vulnerable groups, and reduce the burden on the healthcare system.

Vaccination campaigns have been accompanied by ongoing monitoring of vaccine safety through pharmacovigilance systems to identify and manage adverse drug reactions (ADRs). According to global and regional studies, the most common side effects reported for the COVID-19 vaccines include mild to moderate symptoms such as injection site pain, fatigue, headache, muscle aches, and fever, which typically resolve within a few days. These effects are consistent across different vaccine types, though their frequency and intensity may vary [2]. More severe side effects, while rare, have also been documented. These include allergic

reactions, anaphylaxis, myocarditis, thrombosis with thrombocytopenia syndrome (TTS), and Guillain-Barré syndrome (GBS), particularly following mRNA and viral vector vaccines. For instance, the AstraZeneca vaccine has been associated with a small but significant risk of blood clot formation, leading to hesitancy in certain populations. Despite these risks, regulatory bodies such as the European Medicines Agency (EMA) and the World Health Organization (WHO) continue to affirm that the benefits of COVID-19 vaccines far outweigh the potential risks [4]. In Jordan, COVID-19 vaccine acceptance and hesitancy have been influenced by various factors, including concerns over vaccine safety, religious beliefs, misinformation, and general mistrust of the healthcare system. Studies conducted in the region highlight the need for more robust public health campaigns to address these issues. A survey conducted by Jordan's Ministry of Health revealed that a significant portion of the population expressed concerns about vaccine side effects, particularly with newer platforms like mRNA vaccines [5].

Pharmacovigilance efforts in Jordan have been crucial in documenting vaccine-related ADRs. Reporting systems allow healthcare providers and the general population to report suspected adverse events post-vaccination. These systems help to build a comprehensive safety profile for the vaccines being used in the country, providing essential data for both local and global health authorities [6]. Globally, data from countries with large vaccination programs indicate a similar pattern of side effects. For example, studies from the United States and Europe report that the side effects of the Pfizer-BioNTech and Moderna vaccines are generally mild and transient [2]. Saudi Arabia has also extensively monitored the AstraZeneca vaccine's side effect profile, particularly in younger populations, where the risk of rare blood clots has been noted. Comparatively, inactivated vaccines like Sinopharm, which were heavily administered in Jordan and other Middle Eastern countries, have shown fewer systemic reactions, although efficacy data suggests they may have lower protection compared to mRNA vaccines [7]. Therefore, this study aimed to comprehensively evaluate the side effects of different COVID-19 vaccines among the general population in Jordan.

METHODS

Study design and participants

This cross-sectional study was conducted over six months, from October 2022 to March 2023,

involving 405 participants from various districts of Jordan. Participants included individuals who had received one, two, three, or four doses of COVID-19 vaccines approved and administered in Jordan. Data were collected using a self-administered online survey created with Google Forms and distributed through social media platforms.

To ensure participant confidentiality, all personal identifiers such as names, addresses, and marital status were removed. Before proceeding to the survey, participants were directed to an introductory page detailing the study's purpose. Informed consent was obtained electronically, with participants explicitly agreeing to participate. Statements about the voluntary and anonymous nature of the study were included to ensure ethical compliance.

Online survey tool

The survey was initially developed in English and subsequently translated into Arabic, the official language of Jordan, to ensure comprehensibility and accessibility for participants. A pilot test was conducted with a group of 10 individuals to evaluate the clarity, relevance, and user-friendliness of the survey tool. Feedback from the pilot study was used to make necessary adjustments, ensuring the survey's reliability and validity. Additionally, the survey incorporated previously validated questionnaires to enhance the quality and standardization of the data collection process.

Sample size

The sample size was calculated using the online Raosoft sample size calculator (Raosoft Inc., Seattle, WA, USA) based on the following parameters: a 50 % anticipated response rate, a 90 % confidence interval, and a 5 % margin of error. With 4,817,036 individuals vaccinated in Jordan as of August 19, 2022, according to the Jordanian Ministry of Health, the required sample size was determined to be 271.

In this study, 405 participants completed the survey, exceeding the minimum sample size requirement. This suggests the use of a convenience sampling technique, which allowed for a larger representation of the target population within the specified timeframe. The higher response rate enhances the reliability and generalizability of the study findings.

RESULTS

Demographics and general characteristics of participants

This cross-sectional study included responses from 405 participants across different districts in Jordan for over six months. However, 50 responses were excluded due to inconsistencies or incomplete data (e.g., informed consent, age, vaccine type, and number of doses). The final analysis was conducted on 355 participants whose demographic and general characteristics are presented in Table 1.

The majority of participants were female (57.7 %), and most held a bachelor's degree (60.5 %). Regarding health conditions, 75.5 % reported no serious medical issues, and 71.6 % had a prior SARS-CoV-2 infection. Participants' ages were categorized as ≤ 25 years (44.5 %), 26–30 years (14.4 %), and ≥ 31 years (41.1 %). In terms of vaccine doses, 71.3 % received two doses, 15.5 % received three doses, and a smaller proportion received one dose (10.7 %) or four or more doses (2.5 %).

Regarding the type of vaccine administered, Pfizer-BioNTech was the most frequently received vaccine (56.9 %), followed by AstraZeneca (19.5 %) and Sinopharm (14.6 %). A smaller percentage (9 %) received other vaccines, including Sanofi & Glaxo, Moderna, Janssen, CureVac, Turkovac, and Sputnik V.

Side effects following COVID-19 vaccination

Out of the 355 participants, 242 (68.1 %) reported experiencing side effects after vaccination, as shown in Figure 1. Among these, 79.8 % experienced minor side effects, 12 % reported major side effects, and 8.2 % experienced both minor and major side effects. Side effects were most frequently reported after the first dose (31.8 %), followed by the second dose (15.8 %). About 16 % of participants experienced side effects after both the first and second doses, with fewer reports after subsequent doses (Table 2). The most commonly reported minor side effects were injection site pain (45.8 %), tiredness and fatigue (42.7 %), joint pain (40.1 %), low-grade fever ($< 39^{\circ}\text{C}$) (36.7 %), myalgia (23.7 %), and inflammation at the injection site (6.8 %). Nausea and vomiting were reported by 4.8 % of participants as shown in Figure 1.

Among major side effects, anaphylaxis and dyspnea (10.7 % each) were the most frequently reported, followed by anxiety (9.3 %) and high-

grade fever ($> 39^{\circ}\text{C}$) (8.5 %). Other major side effects were reported less commonly, as shown in Figure 2. The timing of side effects varied, with the majority occurring within 12 h post-vaccination (46 %), followed by 12 – 24 h (40.6

Table 1: Characteristics of the study population (n = 355)

Variable	Sub-variable	Female (N=205; 57.7%)		Male (N=150; 42.3%)		Total	
		n	%	n	%	n	%
Age	≤ 25 years	90	43.9	68	45.3	158	44.5
	26–30 years	28	13.6	23	15.3	51	14.4
	≥ 31 years	87	42.5	59	39.4	146	41.1
Education level	School Graduate	45	22	34	22.6	79	22.2
	Diploma	21	10.2	30	20	51	14.4
	Bachelor's degree	124	60.5	66	44	190	53.5
	Master's degree	13	6.3	15	10	28	7.9
	PhD	2	1	5	3.4	7	2
Allergies	No allergy	179	87.3	134	89.4	313	88.1
	Seasonal allergy	8	3.9	2	1.4	10	2.8
	Food allergy	7	3.4	1	0.6	8	2.3
	Penicillin allergy	11	5.4	13	8.6	24	6.8
Presence of a medical condition	No serious medical condition	162	79	106	70.7	268	75.5
	Hypertension	14+(8)	6.8+(3.9)	8+(16)	5.3+(10.7)	22+(24)	6.2+(6.7)
	Diabetes mellitus	5+(8)	2.4+(3.9)	6+(16)	4+(10.7)	11+(24)	3.1+(6.7)
	Cardiac disorders	3	1.6	1	0.6	4	1.1
	Respiratory disorders	6	2.9	10	6.7	16	4.6
	Renal disorders	-	-	-	-	-	-
	Liver disorders	1	0.5	3	2	4	1.1
	Hypothyroidism	4	1.9	-	-	4	1.1
	Glaucoma	1	0.5	-	-	1	0.3
	Cancer	1	0.5	-	-	1	0.3
COVID-19 Vaccine	One dose	22	10.7	16	10.6	38	10.7
	Two doses	158	77	95	63.4	253	71.3
	Three doses	22	10.7	33	22	55	15.5
	Four doses	3	1.6	2	1.4	5	1.4
	Five doses	-	-	4	2.6	4	1.1
History of COVID-19 Infection	Never	49	23.9	52	34.6	101	28.4
	Yes	156	76.1	98	65.3	254	71.6
Type of COVID-19 Vaccines	Pfizer-BioNTech Vaccine	119	58	83	55.4	202	56.9
	Oxford-AstraZeneca	36	17.6	33	22	69	19.5
	Sinovac–Coronovac	-	-	1	0.6	1	0.2
	Janssen	3	1.5	2	1.4	5	1.4
	Sanofi Glaxo	6	3	7	4.7	13	3.7
	Curevac	2	1	-	-	2	0.6
	Moderna	2	1	4	2.7	6	1.7
	Turkovac	2	1	1	0.6	3	0.8
	Sinopharm	34	16.5	18	12	52	14.6
	Others (SputnikV)	1	0.4	1	0.6	2	0.6

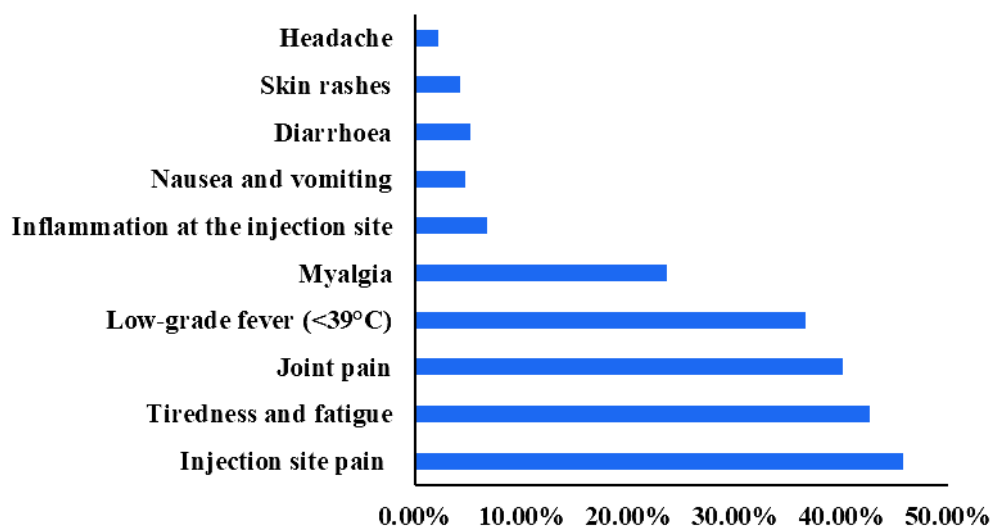


Figure 1: Minor side effects post COVID-19 vaccination

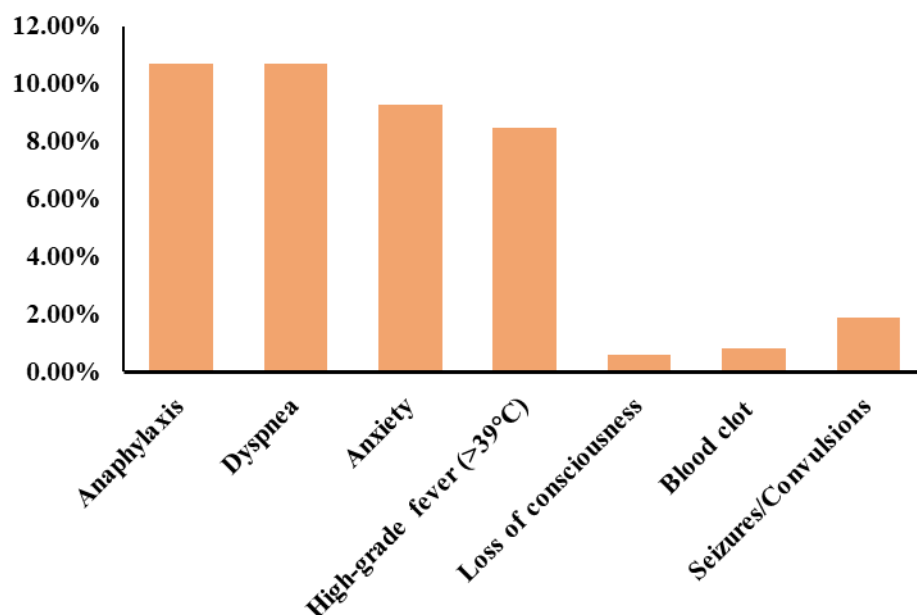


Figure 2: Major side effects post COVID-19 vaccination

The severity of side effects appeared to be influenced by the type of vaccine administered, with Pfizer-BioNTech associated with the highest frequency and severity, followed by AstraZeneca and Sinopharm, as shown in Figure 4.

Hospitalization due to vaccine side effects was reported by only 5% of participants. Paracetamol

(500 – 1000 mg) and azithromycin were the most common medications used to manage post-vaccination symptoms. These findings emphasize the variability in side effect profiles among COVID-19 vaccines and highlight the relatively mild and self-limiting nature of most reported side effects.

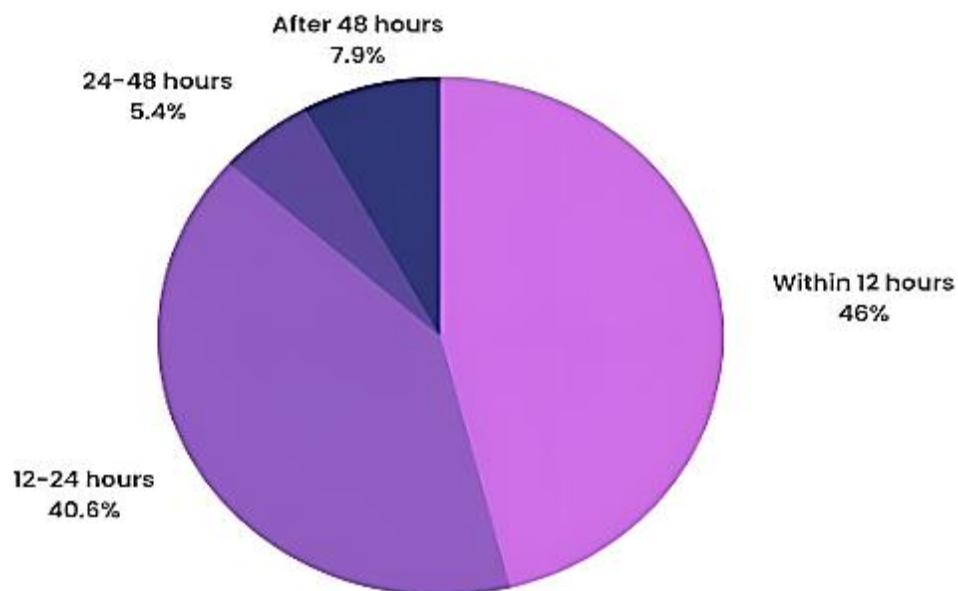


Figure 3: Onset timing of post-vaccination side effects following COVID-19 vaccination

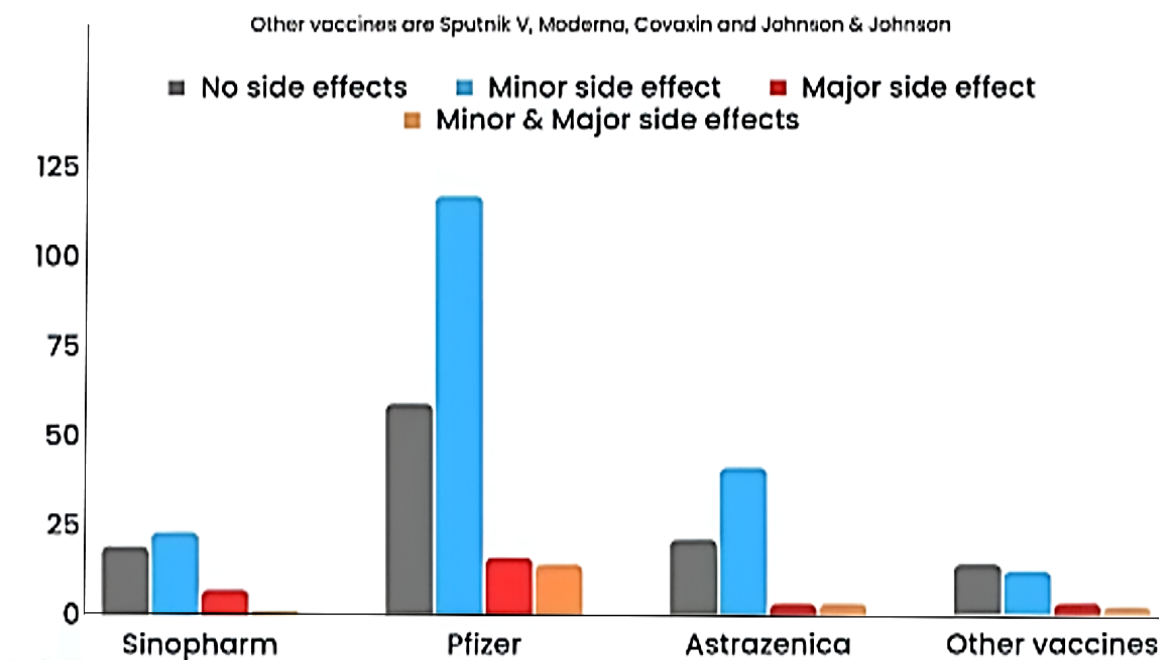


Figure 4: Severity of side effects across different types of COVID-19 vaccine

Table 2: Side effects after receiving different doses of vaccines (N = 355)

Variable	Population size & Percentage (%)					
Having any side effects	NEVER	After 1 st DOSE	2 nd DOSE	3 rd DOSE	4 th DOSE	5 th DOSE
	113 (31.8%)	113 (31.8%)	56 (15.8%)	6 (1.7%)	2 (0.6%)	1 (0.3%)
		After 1 st and 2 nd DOSE				
		57 (16%)				
		After 1 st , 2 nd and 3 rd DOSE				
		5 (1.4%)				
		After 1 st , 2 nd , 3 rd and 4 th DOSE				
		1 (0.3%)				
		After 1 st , 2 nd , 3 rd , 4 th and 5 th DOSE				
1 (0.3%)						
Time to experience side effects	Within 12 hours	12-24 hours	24-48 hours	After 48 hours	Did not experience	
	110 (31%)	97 (27.3%)	13 (3.7%)	19 (5.3%)	116 (32.7%)	
Severity of side effects	Major side effects reported		Minor side effects reported		No side effects reported	
	29 (8.1%)		194 (54.6%)		113 (31.8%)	
	Both Major and Minor side effects					
	19 (5.3%)					
Require medical assistance or Hospitalization for having Major side effects	Yes of (13.4%)			No of (13.4%) + of (100%)		
	18 (5%)			30(8.5%) +307 (86.5%)		
Recovered fully from major side effects	Yes of (13.4%)			No of (13.4%)		
	29 (8.1%)			19 (5.3%)		
How long did it take for a full recovery from major side effects	1-2 days		More than 2 days		Didn't recover yet	
	8		31		9	

DISCUSSION

The study provides valuable insights into the side effects experienced by individuals who received COVID-19 vaccines in Jordan. A significant proportion of participants (68.1 %) reported various side effects, predominantly mild to moderate in severity, such as injection site pain, headache, fatigue, joint pain, and low-grade fever. These findings align with numerous studies conducted globally, which consistently reported similar adverse effects across different populations [8]. For instance, a study conducted in the United States on the Pfizer-BioNTech and Moderna vaccines identified fatigue (63 %), headache (55 %), and injection site pain (71 %) as the most commonly reported side effects

following vaccination [9]. Similar to findings in this study, these symptoms were typically transient and resolved within a few days without the need for medical intervention. Additionally, this study corroborates reports indicating that side effects are more prevalent after the first dose and among females. A meta-analysis of global vaccine data found that women were more likely to experience side effects due to potential immunological and hormonal differences, which might explain the higher prevalence in the sample used in this study [10].

In the current study, severe symptoms, including high-grade fever, dyspnea, and anaphylaxis, were reported but accounted for a small proportion of cases (12 %). These findings are consistent with a global review of severe adverse effects associated with COVID-19 vaccines,

which concluded that such reactions are rare and typically non-life-threatening [11]. Specifically, the rate of anaphylaxis has been reported to be approximately 2 – 5 cases per million vaccine doses administered, similar to rates observed in other vaccines [12]. In this study, severe cases requiring hospitalization were minimal (5 %), and most participants recovered fully within a few days. The variation in reported side effects across vaccine types, as observed in this study, is a noteworthy finding. Participants receiving the Pfizer-BioNTech vaccine reported a higher frequency of side effects compared to those receiving Sinopharm or AstraZeneca. These results align with studies from Europe and the Middle East, which also found that mRNA-based vaccines (Pfizer and Moderna) were associated with a higher incidence of side effects than inactivated vaccines like Sinopharm [13]. For example, a UAE-based study comparing Pfizer-BioNTech and Sinopharm vaccines revealed that side effects such as fever, fatigue, and injection site pain were more commonly reported by Pfizer recipients [14]. This may be due to the difference in vaccine platforms, where mRNA vaccines elicit a stronger immune response, potentially leading to a higher likelihood of side effects [15].

A notable aspect of this study is the self-reported nature of data collection via an online survey. While this approach allowed for a broader reach across Jordan's districts, it may have introduced selection bias. Participants with internet access and an interest in COVID-19 vaccines may be overrepresented, limiting the generalizability of findings. Moreover, the reliance on self-reported data may lead to underreporting or overreporting of symptoms, as participants' perceptions can influence their responses [16]. When comparing these findings to those of other studies, the high acceptance rate of vaccines in Jordan despite the reported side effects is commendable. In many countries, vaccine hesitancy has been a significant barrier to achieving herd immunity [17]. A global survey on COVID-19 vaccine acceptance found that safety concerns were a major reason for vaccine hesitancy [18]. This study underscores the importance of transparent communication about potential side effects, which are mostly mild and self-limiting, to build public confidence in vaccination campaigns.

The study's limitations underscore important directions for future research. Uneven gender and regional representation, coupled with the absence of official demographic data on vaccinated individuals in Jordan, limits assessment of sample representativeness; therefore, large-scale, demographically diverse, and longitudinal studies are warranted to

elucidate long-term vaccination outcomes and differential effects across vaccine platforms.

Limitations of this study

The limitations of the current study highlight opportunities for future research. The sample was not evenly distributed by gender or region, and the lack of official data on the demographics of vaccinated individuals in Jordan makes it difficult to evaluate the representativeness of the sample used. Further studies with larger, more diverse samples and longitudinal designs could provide a deeper understanding of the long-term effects of vaccination and the impact of different vaccine types.

CONCLUSION

This study reinforces global evidence that COVID-19 vaccines are safe and well-tolerated, with most side effects being mild, temporary, and reflective of a robust immune response. Severe adverse reactions were found to be exceedingly rare, highlighting the vaccines' favorable risk-benefit profile. These findings are crucial in addressing vaccine hesitancy and building public trust by showing that common side effects are non-threatening. These findings also emphasize the importance of ongoing safety monitoring and transparent public education to address concerns about expected side effects. By fostering greater vaccine acceptance, these efforts can play a pivotal role in mitigating the impact of COVID-19, not only in Jordan but also on a global scale.

Recommendations

These findings are crucial for addressing vaccine hesitancy and ensuring broader vaccine uptake by dispelling fears of serious adverse events. Transparent communication of vaccine safety data, coupled with robust monitoring systems, can enhance public trust and reinforce the critical role of immunization in controlling the pandemic. Moving forward, continued surveillance of vaccine safety across diverse populations remains essential to detect and address rare adverse events. Furthermore, personalized public health campaigns and targeted interventions can help mitigate hesitancy and improve vaccination coverage. This study adds to the growing body of evidence supporting the safety and efficacy of COVID-19 vaccines, contributing to global efforts to curb the pandemic and protect public health.

DECLARATIONS

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Ethical approval

Ethical approval for this study was obtained from the European University of Lefke Ethics Committee.

Use of Artificial intelligence/Large language models

We also declare that we did not use Generative artificial intelligence (AI) and AI-assisted technologies in writing the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Contribution of authors

We declare that this work was done by the author(s) named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Essam Nairoukh: Data Collection, Writing – Initial Draft. Syed Sikandar Shah: Conceptualization, Validation, Analysis, Writing – Review & Editing. Aftab Alam: Writing – Review & Editing, Validation, Analysis, Data Curation. Jamil Ahmad: Writing – Review & Editing, Data Curation. Ashfaq Ahmad Shah Bukhari: Review and Editing.

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