Preventive Medicine Reports 37 (2024) 102558

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr

Assessing the prevalence and patterns of COVID-19 vaccine side effects among Syrian adults: A cross-sectional study

Mohamad Klib [a,*], Osama Alazki [b], Ayman Issa Nabhan [c], Aml M. Brakat [d], Bana Zuhair Alafandi [e], Fatima Abdulmoain Idres [f], Ruba Almenchaf [f], Farah Albakkar [e], Munir Ghandour [a], Jaafar Zahlout [b], Somayya Tabsho [e], Samar Mouazen [a], Data Collection Group [1]

[a] Faculty of Medicine, Damascus University, Damascus, Syria
[b] Faculty of Medicine, Tishreen University, Latakia, Syria
[c] Faculty of Medicine, Al Andalus University for Medical Sciences, Tartus, Syria
[d] Faculty of Medicine, Zagazig University, Ash Sharqia Governorate ,Egypt
[e] Faculty of Medicine, University of Aleppo, Aleppo, Syria
[f] Faculty of Medicine, AL-Baath University, Homs, Syria

ARTICLE INFO

Keywords:
COVID-19
Vaccine
Side effect
AstraZeneca
Sputnik Light
Sleepiness
Lethargy
Fever

ABSTRACT

Aim: This study aimed to assess the prevalence and patterns of COVID-19 vaccine side effects among Syrian adults, with a focus on the AstraZeneca and Sputnik Light vaccines, in light of the low vaccination rate in Syria (below 18%) attributed to fear of side effects.

Method: A cross-sectional study was conducted between January and May 2022, using probability-based and convenient sampling strategies. Data was collected through online, paper, and face-to-face questionnaires that included demographic and vaccine-related questions.

Result: Out of 3,766 participants, the majority were female (56.7 %) and aged 18–24 years (53.3 %). Most participants had a university-level qualification (71.2 %) and were related to the medical sector (53.2 %). A significant proportion (47.0 %) received AstraZeneca, Sputnik Light (22.1 %) and Sinopharm (14.7 %). Common side effects included sleepiness and lethargy (50.0 %), fever and chills (45.0 %), and pain/swelling at the injection site (35.9 %). Multivariate logistic regression analysis revealed that male (OR: 0.57, CI: 0.48–0.68) and participants aged 45–65 years (OR: 0.53, CI: 0.40–0.70) were less likely to experience side effects. Participants who believed COVID-19 posed a high threat to their personal life had higher odds of side effects (OR: 1.74, CI: 1.22–2.46). Vaccine type was also associated with side effects, with Sputnik Light (OR: 2.52, CI: 1.85–3.46) and AstraZeneca (OR: 1.61, CI: 1.26–2.05) having increased odds.

* Corresponding author.
E-mail address: mohamad7.klib@damascusuniversity.edu.sy (M. Klib).

[1] **List names of collaborators: Majd Souhel Khaddour** (Faculty of Medicine, Al Andalus University for Medical Sciences). **Hasan M. Masoum Hamoud** (Faculty of Dentistry, University of Kalamoon)**, Hassan Karahbatak, Heba Cheikh Othman, Mohamad Abdalrahman Alayoubi, Mohammad Ekbal Atik, Mohammad Ghieh, Mohammad Rabee. Mslmani, Zain Houssen Hasan, Zienab Klib** (Faculty of Medicine, Damascus University)**. Okbah Mohamad** (Plastic and reconstructive surgery, Damascus University)**. Batoul Mohammad** (Faculty of Pharmacy, Damascus University)**. Mhd Maher Marzouk, Mohamad Wassim Almasri, Nagham Zaino** (Faculty of Dentistry, Damascus University)**. Eman Awwad, Ghada Bawadekji, Maria Chakhide, Jude Sumakie, Mohamed Amin Akil, Nour Alsamou Alnajjar, Ola Ramadan, Qamar Alamki, Rahaf Maeri, Rama Zammar, Salma Mahmoud Omar, Sana Zammar, Souzan Abboud** (Faculty of Medicine, University of Aleppo)**. Alaa Khaddour, Hazar Husien, Iyad Ali, Maha Mansour, Rita Mohammad, Zeyazan Ebrahim** (Faculty of Medicine, Tishreen University)**. Ghina Ismail** (Department of Gastroenterology, Faculty of Medicine, Tishreen University)**. Mary Hassoun (Plastic and Reconstructive surgery, Tishreen University Hospital). Aghareed Sujaa, Ahmad Yasin Saleh, Elias Afesa** (Faculty of Medicine, Al-Andalus University for Medical Sciences). **Zeina Al-khatib** (Faculty of Pharmacy, Al-Andalus University for Medical Sciences)**. Aya Younes, Mohamad Mostafa, Mustafa Youssef** (Faculty of Medicine, Tartous University)**. Agead Sheikh Sobeh, Ahmad Yaman Baker, Ahmed Sabbagh, Alaa Koujah, Bahaa Almalohi, Hadi Alabdullah, Hasan Khaldoun Haydar, Kenana Tawashi, Mostafa Ghandour** (Faculty of Medicine, Hama University)**. Abdulrahman Khaldoun Haydar, Sumiah Ghandour** (Faculty of Dentistry, Arab private University for Science and Technology)**. Dana Alsibai, Nour Atmaz Alsibai** (Faculty of Medicine, Al- Baath University)**. Sumaya Alsabea** (Faculty of Pharmacy, Al- Wataniya Private University)**. Roaa Musa** (Al-Sham Private University)**, Lina Aljaber** (Faculty of Medicine, Al-Furat University)**.**

https://doi.org/10.1016/j.pmedr.2023.102558
Received 22 June 2023; Received in revised form 24 November 2023; Accepted 11 December 2023
Available online 13 December 2023

Conclusion: Our study found that COVID-19 vaccines are well tolerated among the Syrian population, with short-term side effects that typically resolve within three days. These findings are expected to bolster vaccination rates through enhanced public confidence and acceptance.

1. Introduction

Health systems worldwide were overwhelmed by the rising demand for health care for people with COVID-19 (COVID-19, 2020). Since World War II, vaccination has shown efficacy in human health, by reducing morbidity and mortality of many diseases such as smallpox and polio (Bloom et al., 2005). Since the pandemic started, the race to develop an effective vaccine had started along drug companies.

COVID-19 pandemic has had a significant impact on the healthcare system in Syria, which has been further complicated by ongoing conflict and limited access to vaccines. According to the World Health Organization (WHO), as of April 2023, there were over 57,423 confirmed cases of COVID-19 in Syria, with over 3,163 deaths reported. The low vaccination rates, where only around 18 % of the population had received at least one dose of a COVID-19 vaccine (Syrian Arab Republic, 2023), have contributed to the challenges faced by the healthcare system and the population.

A study involving 17,000 Syrian adults revealed that almost half of them (44.9 %) expressed trust in all types of vaccines, while a significant percentage (14.3 %) had no trust in vaccines whatsoever. The majority of participants in the study (45.5 %), who expressed a willingness to receive the vaccine, believed that there should be additional information regarding the potential side effects of vaccines in order to increase the vaccination rate (Nikoloski et al., 2023). Another study conducted on Syrian adults found that the primary reason for refusing vaccination was fear of side effects (n = 1615; 62.4 %) (Shibani et al., 2021). A study conducted in rural Bangladesh involving 655 participants revealed that 81 % believed the COVID-19 vaccine to be safe, while 68 % perceived it to have no serious side effects. However, an overwhelming 99.5 % expressed the need for further knowledge about the vaccine (Roy et al., 2022).

Considering the distinctive cultural, social, and economic factors that can impact vaccine acceptance and compliance in Syria, as well as the limited information available about vaccine side effects, it is crucial to comprehend the occurrence and characteristics of COVID-19 vaccine side effects within this population.

This study contributes to the existing body of knowledge by providing empirical data on the side effects of COVID-19 vaccines specifically among the Syrian population, addressing a significant gap in the literature and providing valuable insights into the prevalence, types, and patterns of side effects experienced in Syria. Additionally, the study offers a unique insights into the complex social factors that shape vaccine acceptance and uptake in similar contexts, which can inform public health policies and interventions aimed at increasing vaccine confidence in Syria and other similar settings. The objective of this study is to

1. evaluate the prevalence and patterns of COVID-19 vaccine side effects among Syrian adults, mainly the AstraZeneca and Sputnik vaccines.
2. Investigate whether there are any differences in the prevalence and patterns of COVID-19 vaccine side effects among Syrian adults based on demographic factors such as age and gender.
3. Provide insights into the safety and tolerability of the vaccines among the Syrian population.

2. Method

2.1. Sample size

We conducted a cross-sectional study using a combination of online and printed questionnaires and face-to-face interviews between January and May 2022. The target population was the adults from all major governorates in Syria. The minimum recommended sample size was 2400 with an expected acceptance prevalence of 50 %, a confidence level of 95 %, an acceptable margin of error of 2 %, and considering the number of Syrians who received at least one dose of the vaccine is 3,209,797 people (Syrian Arab Republic, 2023). The sample size was calculated with https://www.checkmarket.com/sample-size-calculator/. Participants were included if they were at least 18 years old, voluntarily agreed to participate in the study, lived in Syria, and had received at least one dose of any of the COVID-19 vaccines administered in the country. The distribution of participants and the number of individuals who declined to provide informed consent from online questionnaires (76 participants) is depicted in Fig. 1. The institutional review board of Aleppo University approved study protocol and the study performed as per Helsinki Declaration principles. In addition, signed informed consent was obtained from all participants for the use of their responses before answering the questionnaire.

2.2. Data collection

To collect the data, a set of questions were constructed after an extensive review of the literature. The questionnaire underwent pretesting, revision, and finalization based on a pilot sample (n = 30). The pilot responses were not included in the final analysis. All questions were written in Arabic, the native language of the Syria, and were designed to be simple and clear. Informed consent was obtained at the beginning of the questionnaire, using a "Yes or No" question, to ensure participant approval. The survey was voluntary, self reported, anonymous, and participants were encouraged to share it with their contacts. Personal identification was not obtained, and data confidentiality was maintained in accordance with Syrian culture and traditions.

We used the modified version of a validated questionnaire which was employed to assess the adverse side effects associated with COVID-19 vaccination in an Arab country (Hatmal et al., 2022). Adjustments were made to customize the survey tool according to the specific requirements and context of our country. We calculated Cronbach's alpha for internal consistency and found it at 0.76.

Data was collected in two approaches:

1) A paper questionnaire and a face-to-face interview were made to reduce the sampling error, increase the study power, and ensure that the questionnaire will reach all individuals such as old people, people without internet access or mobile phones. The paper questionnaire and the face-to-face interview were conducted in all suitable places (hospitals, private clinics, pharmacies, markets, and university housing). 2) An online questionnaire was created by the authors, designed via Google form, and disseminated electronic links through social media networks.

To minimize the impact of sampling bias and increase the representativeness of the sample, we use a combination of sampling strategies to reach a diverse range of participants. We use a probability-based sampling strategy to select participants from urban and rural areas across different governorates, and supplement this with a convenient sampling strategy to reach participants who may be difficult to access through traditional methods, such as elderly or disabled individuals. Additionally, the snowball sampling strategy was used to increase the sample size and diversity of the sample.

The data was collected by fifty-nine collaborators from different cities in Syria. To ensure the accuracy and validity of the data collection process, the first author trained them how to conduct the data collection process. The training involved educating on the study objectives and

procedures, reviewing the questionnaire and its variables, and providing guidance on how to approach potential participants. The collaborators also have received training on how to handle illiterate participants and avoid duplication of participants by asking them if they participated in the survey before.

2.3. Structure and content of the questionnaire

The questionnaire were categorized into 2 sections:

The first section focused on participants social demographic characteristics age, gender, place of residence (urban or rural), the governorate, education level, studying or working in healthcare sectors, having health insurance, the amount of risk that COVID-19 poses towards the community and the participant in person and if they had any history of COVID-19 infection or any family member had died from COVID-19.

2-The second section targeted self-reported side effects of COVID-19 vaccines.

Vaccine side effects: Participants were asked if they experienced any side effects after receiving the COVID-19 vaccine. If they answered yes, they were asked to indicate which side effects they experienced from a list of side effects that were commonly reported in previous studies.

2.4. Independent variable

We used the forward selection method in performing multivariate regression. Predictors are added one at a time beginning with the predictor with significant results in univariate analysis with the dependent variable.

2.5. Statistical analysis

Descriptive analysis was used to describe the study population, and the results were expressed in numbers and percentages. Univariate binary logistic regression models were performed to determine the association between the predictor (Is COVID-19 a threat to your personal life?) and dependent variables, followed by multiple logistic regression analysis, including all factors showing significance ($p < 0.05$). The Multivariate Binary Logistic Regression Analysis was used to determine what factors could explain people's symptoms and side effects after taking COVID-19 vaccination and the relationship between predictors and outcome-dependent variables was examined. Presented as a multivariate-adjusted Odds Ratio (OR) with 95 % confidence intervals. The P-value less than 0.05 was considered statistically significant. All statistical calculations were done using R language programming

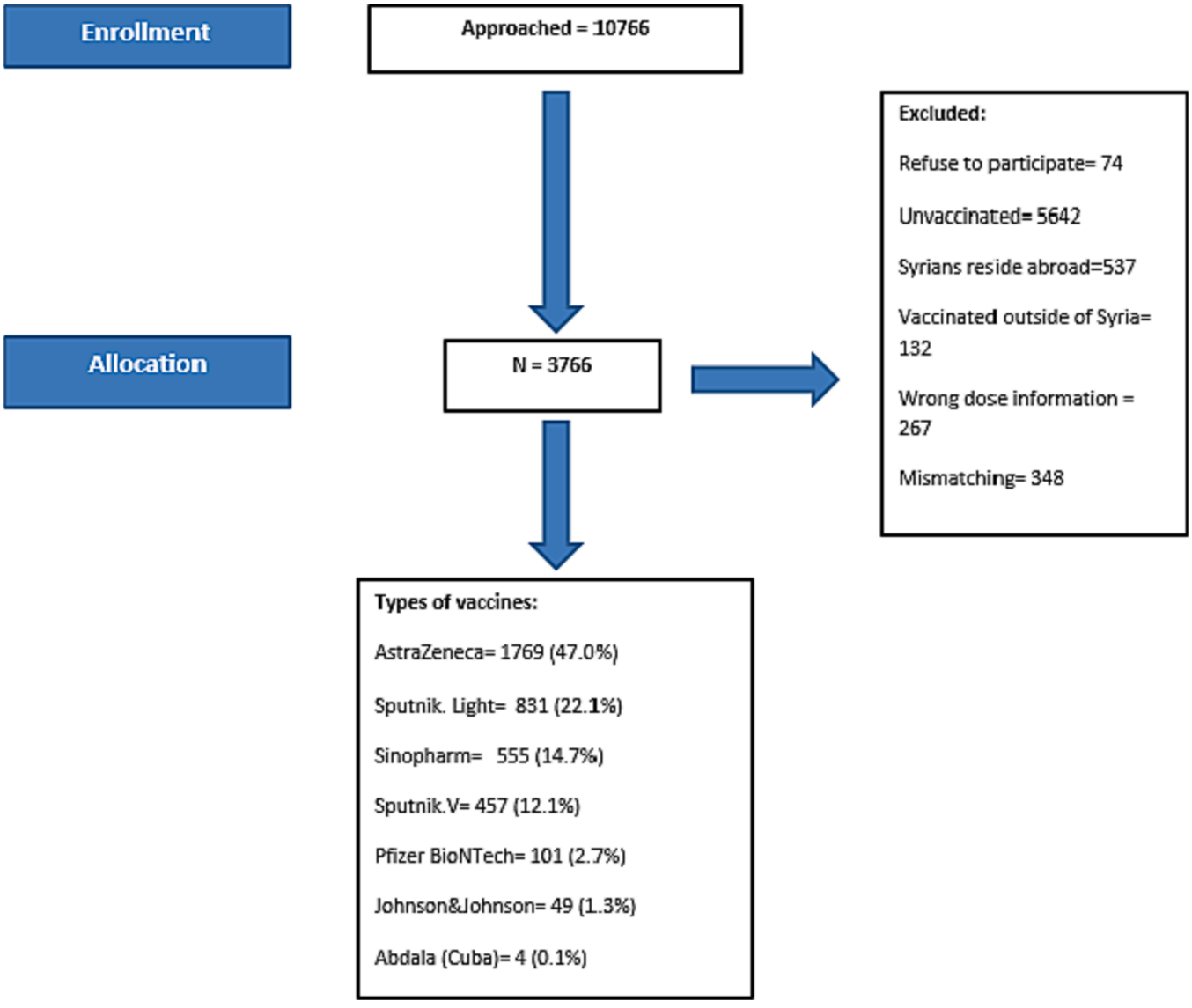

Fig. 1. The distribution of participants in the study.

software version 4.1.2 and Microsoft Excel 365.

Statement: The work has been reported in line with the STROBE guidelines (von Elm et al., 2007).

3. Results

3.1. Participants characteristics and vaccine prevalence

A total of 10,766 participants completed the questionnaire. However, 7000 were excluded due to not meeting the inclusion criteria. The final analysis was conducted on a sample of 3,766 participants. Of these, (56.7 %, n = 2,137) were female. The majority of participants were fell within the age range of 18–24 years old (53.3 %, n = 2,007). Most of the enrolled participants had a university-level qualification (71.2 %, n = 2,682), and (53.2 %, n = 2,003) were related to the medical sector. The majority of participants did not have health insurance (75.3 %, n = 2,837).

Regarding vaccination status, (47.0 %, n = 1,769) of the enrolled participants reported receiving the AstraZeneca vaccine, followed by Sputnik Light (22.1 %, n = 831) and Sinopharm (14.7 %, n = 555). Furthermore, 2,167 (57.5 %) of the participants had a history of COVID-19 virus infection, with 750 (19.9 %) confirmed by PCR, as reported in Table 1.

Table 1
Socio-demographic characteristics of the respondents.

		Total (n = 3766)	Sputnik.V (n = 457)	Sputnik. Light (n = 831)	Sinopharm (n = 555)	AstraZeneca (n = 1769)	Abdalla (Cuba) (n = 4)	The Pfizer (BioNTech) (n = 101)	Johnson&Johnson (n = 49)
Age (years) (%)	**18–24**	2007 (53.3)	191 (41.8)	527 (63.4)	261 (47.0)	955 (54.0)	3 (75.0)	52 (51.5)	18 (36.7)
	25–44	1209 (32.1)	208 (45.5)	229 (27.6)	180 (32.4)	540 (30.5)	1 (25.0)	28 (27.7)	23 (46.9)
	45–65	475 (12.6)	50 (10.9)	67 (8.1)	96 (17.3)	236 (13.3)	0 (0.0)	18 (17.8)	8 (16.3)
	65+	75 (2.0)	8 (1.8)	8 (1.0)	18 (3.2)	38 (2.1)	0 (0.0)	3 (3.0)	0 (0.0)
Gender (%)	**Female**	2137 (56.7)	233 (51.0)	503 (60.5)	322 (58.0)	1008 (57.0)	0 (0.0)	47 (46.5)	24 (49.0)
	Male	1629 (43.3)	224 (49.0)	328 (39.5)	233 (42.0)	761 (43.0)	4 (100.0)	54 (53.5)	25 (51.0)
Residency (%)	**City inside Syria**	3003 (79.7)	388 (84.9)	699 (84.1)	392 (70.6)	1402 (79.3)	2 (50.0)	83 (82.2)	37 (75.5)
	Countryside in Syria	763 (20.3)	69 (15.1)	132 (15.9)	163 (29.4)	367 (20.7)	2 (50.0)	18 (17.8)	12 (24.5)
City (%)	**Aleppo**	559 (14.8)	76 (16.6)	102 (12.3)	57 (10.3)	302 (17.1)	0 (0.0)	17 (16.8)	5 (10.2)
	Damascus	811 (21.5)	138 (30.2)	154 (18.5)	96 (17.3)	369 (20.9)	1 (25.0)	40 (39.6)	13 (26.5)
	Damascus Countryside	269 (7.1)	32 (7.0)	49 (5.9)	42 (7.6)	127 (7.2)	0 (0.0)	11 (10.9)	8 (16.3)
	Eastern Governorate (Deir ez-Zor, Raqqa, Alhasakah)	67 (1.8)	6 (1.3)	3 (0.4)	15 (2.7)	41 (2.3)	0 (0.0)	2 (2.0)	0 (0.0)
	Hama	729 (19.4)	62 (13.6)	167 (20.1)	71 (12.8)	416 (23.5)	2 (50.0)	9 (8.9)	2 (4.1)
	Homs	368 (9.8)	35 (7.7)	71 (8.5)	57 (10.3)	193 (10.9)	1 (25.0)	5 (5.0)	6 (12.2)
	Idleb	22 (0.6)	0 (0.0)	0 (0.0)	9 (1.6)	13 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)
	Lattakia	457 (12.1)	63 (13.8)	158 (19.0)	88 (15.9)	135 (7.6)	0 (0.0)	11 (10.9)	2 (4.1)
	Southern Governorate (Daraa, Al-Suwayda, Quneitra)	132 (3.5)	13 (2.8)	11 (1.3)	14 (2.5)	89 (5.0)	0 (0.0)	2 (2.0)	3 (6.1)
	Tartous	352 (9.3)	32 (7.0)	116 (14.0)	106 (19.1)	84 (4.7)	0 (0.0)	4 (4.0)	10 (20.4)
Educational Level (%)	**Did not go to school**	45 (1.2)	4 (0.9)	4 (0.5)	11 (2.0)	24 (1.4)	0 (0.0)	1 (1.0)	1 (2.0)
	High school	209 (5.5)	17 (3.7)	25 (3.0)	44 (7.9)	110 (6.2)	1 (25.0)	12 (11.9)	0 (0.0)
	Master \PhD	660 (17.5)	199 (43.5)	99 (11.9)	69 (12.4)	271 (15.3)	1 (25.0)	10 (9.9)	11 (22.4)
	Middle school	170 (4.5)	16 (3.5)	15 (1.8)	33 (5.9)	98 (5.5)	0 (0.0)	5 (5.0)	3 (6.1)
	University \Institute	2682 (71.2)	221 (48.4)	688 (82.8)	398 (71.7)	1266 (71.6)	2 (50.0)	73 (72.3)	34 (69.4)
Education Specialty (%)	**Did not go to university**	371 (9.9)	29 (6.3)	38 (4.6)	81 (14.6)	204 (11.5)	1 (25.0)	14 (13.9)	4 (8.2)
	Medical sector	2003 (53.2)	359 (78.6)	509 (61.3)	239 (43.1)	823 (46.5)	2 (50.0)	49 (48.5)	22 (44.9)
	Other	1392 (37.0)	69 (15.1)	284 (34.2)	235 (42.3)	742 (41.9)	1 (25.0)	38 (37.6)	23 (46.9)
Health insurance (%)	**No**	2837 (75.3)	322 (70.5)	650 (78.2)	400 (72.1)	1353 (76.5)	3 (75.0)	74 (73.3)	35 (71.4)
	Yes	929 (24.7)	135 (29.5)	181 (21.8)	155 (27.9)	416 (23.5)	1 (25.0)	27 (26.7)	14 (28.6)
History of COVID-19 infection (%)	**No**	532 (14.1)	59 (12.9)	87 (10.5)	84 (15.1)	274 (15.5)	2 (50.0)	19 (18.8)	7 (14.3)
	Not sure (suspected symptoms)	1067 (28.3)	120 (26.3)	243 (29.2)	173 (31.2)	494 (27.9)	1 (25.0)	25 (24.8)	11 (22.4)
	Yes	2167 (57.5)	278 (60.8)	501 (60.3)	298 (53.7)	1001 (56.6)	1 (25.0)	57 (56.4)	31 (63.3)
Was the COVID-19 laboratory confirmed using the PCR test? (%)	**No**	2826 (75.0)	358 (78.3)	640 (77.0)	405 (73.0)	1315 (74.3)	3 (75.0)	71 (70.3)	34 (69.4)
	Not sure	190 (5.0)	16 (3.5)	35 (4.2)	35 (6.3)	91 (5.1)	0 (0.0)	9 (8.9)	4 (8.2)
	Yes	750 (19.9)	83 (18.2)	156 (18.8)	115 (20.7)	363 (20.5)	1 (25.0)	21 (20.8)	11 (22.4)
Dose of the Vaccine (%)	**Booster Dose**	36 (1.0)	9 (2.0)	4 (0.5)	5 (0.9)	14 (0.8)	0 (0.0)	3 (3.0)	1 (2.0)
	Full Course (1 dose)	875 (23.2)	0 (0.0)	827 (99.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	48 (98.0)
	Full Course (2 doses)	2102 (55.8)	397 (86.9)	0 (0.0)	447 (80.5)	1177 (66.5)	2 (50.0)	79 (78.2)	0 (0.0)
	Only first Dose	753 (20.0)	51 (11.2)	0 (0.0)	103 (18.6)	578 (32.7)	2 (50.0)	19 (18.8)	0 (0.0)

3.2. Perception towards COVID-19 and vaccination and source of information

Table 2 presents the results of the survey responses related to the perceptions and experiences of the enrolled participants regarding COVID-19. Of the 3,766 participants, 2,247 (59.7 %) believed that COVID-19 posed a high threat to the world, and 1,114 (29.6 %) believed that COVID-19 posed a high risk to their personal life, while 1,842 (48.9 %) reported a small risk.

In terms of personal experience, 597 (15.9 %) of the participants reported experiencing the death of a family member due to COVID-19, while the majority (81.1 %, n = 3,055) did not. Regarding factors influencing vaccine confidence, 2,056 (54.6 %) of the participants believed that the country of manufacture of the vaccine affected their degree of confidence, and 2,608 (69.3 %) reported that WHO approval of a vaccine license influenced their decision to take the vaccine. Only 891 (23.7 %) of the participants reported taking the vaccination for travel policy.

The most common sources of information were social media (41.7 %, n = 1,571), followed by internet search engines (Google) (34.6 %, n = 1,303) and publications of refereed scientific journals and societies (30.7 %, n = 1,156).

3.3. Prevalence of COVID-19 vaccines' side effects and their severity

The study participants reported experiencing various side effects

Table 2
Presents the perceptions towards accepting different COVID- 19 vaccines and source of information.

		Total (n = 3766)	Sputnik.V (n = 457)	Sputnik. Light (n = 831)	Sinopharm (n = 555)	AstraZeneca (n = 1769)	Abdalla (Cuba) (n = 4)	The Pfizer (BioNTech) (n = 101)	Johnson&Johnson (n = 49)
IS COVID-19 a threat to the world? (%)	**I do not know**	345 (9.2)	26 (5.7)	55 (6.6)	57 (10.3)	184 (10.4)	1 (25.0)	19 (18.8)	3 (6.1)
	No Risk at all	133 (3.5)	20 (4.4)	15 (1.8)	33 (5.9)	63 (3.6)	0 (0.0)	0 (0.0)	2 (4.1)
	There is a high risk	2247 (59.7)	299 (65.4)	567 (68.2)	310 (55.9)	1004 (56.8)	2 (50.0)	46 (45.5)	19 (38.8)
	There is a small risk	1041 (27.6)	112 (24.5)	194 (23.3)	155 (27.9)	518 (29.3)	1 (25.0)	36 (35.6)	25 (51.0)
Is COVID-19 a threat to your personal life? (%)	**I do not know**	348 (9.2)	29 (6.3)	74 (8.9)	52 (9.4)	168 (9.5)	1 (25.0)	22 (21.8)	2 (4.1)
	No Risk at all	462 (12.3)	51 (11.2)	69 (8.3)	84 (15.1)	241 (13.6)	1 (25.0)	9 (8.9)	7 (14.3)
	There is a high risk	1114 (29.6)	144 (31.5)	269 (32.4)	157 (28.3)	506 (28.6)	1 (25.0)	27 (26.7)	10 (20.4)
	There is a small risk	1842 (48.9)	233 (51.0)	419 (50.4)	262 (47.2)	854 (48.3)	1 (25.0)	43 (42.6)	30 (61.2)
Has anyone in your family died of COVID-19? (%)	**No**	3055 (81.1)	376 (82.3)	680 (81.8)	454 (81.8)	1425 (80.6)	2 (50.0)	81 (80.2)	37 (75.5)
	Not sure	114 (3.0)	13 (2.8)	20 (2.4)	15 (2.7)	63 (3.6)	1 (25.0)	2 (2.0)	0 (0.0)
	Yes	597 (15.9)	68 (14.9)	131 (15.8)	86 (15.5)	281 (15.9)	1 (25.0)	18 (17.8)	12 (24.5)
Vaccine-related Information Sources	**Relatives and friends (%)**	736 (19.5)	63 (13.8)	138 (16.6)	119 (21.4)	380 (21.5)	1 (25.0)	19 (18.8)	16 (32.7)
	Social media (%)	1571 (41.7)	172 (37.6)	367 (44.2)	222 (40.0)	750 (42.4)	1 (25.0)	36 (35.6)	23 (46.9)
	TV and Radio (%)	499 (13.3)	53 (11.6)	108 (13.0)	91 (16.4)	229 (12.9)	1 (25.0)	11 (10.9)	6 (12.2)
	Internet search. engines (Google) (%)	1303 (34.6)	149 (32.6)	346 (41.6)	180 (32.4)	568 (32.1)	0 (0.0)	46 (45.5)	14 (28.6)
	My doctor (%)	645 (17.1)	80 (17.5)	179 (21.5)	98 (17.7)	268 (15.1)	1 (25.0)	11 (10.9)	8 (16.3)
	Publications of refereed scientific journals and societies (%)	1156 (30.7)	208 (45.5)	295 (35.5)	141 (25.4)	465 (26.3)	1 (25.0)	32 (31.7)	14 (28.6)
	Community and governmental education campaigns carried out by the Ministry of Health (%)	1087 (28.9)	143 (31.3)	264 (31.8)	154 (27.7)	485 (27.4)	2 (50.0)	31 (30.7)	8 (16.3)
	Do not search about COVID-19 vaccines (%)	436 (11.6)	46 (10.1)	84 (10.1)	71 (12.8)	217 (12.3)	0 (0.0)	12 (11.9)	6 (12.2)
Do you think that the country of manufacture of the vaccine affect the degree of confidence in the vaccine? (%)	**No**	1083 (28.8)	148 (32.4)	257 (30.9)	202 (36.4)	444 (25.1)	3 (75.0)	23 (22.8)	6 (12.2)
	Not sure	627 (16.6)	71 (15.5)	152 (18.3)	102 (18.4)	274 (15.5)	0 (0.0)	19 (18.8)	9 (18.4)
	Yes	2056 (54.6)	238 (52.1)	422 (50.8)	251 (45.2)	1051 (59.4)	1 (25.0)	59 (58.4)	34 (69.4)
Does WHO approval of a vaccine license influence your decision to take it? (%)	**I do not know WHO**	289 (7.7)	13 (2.8)	28 (3.4)	60 (10.8)	177 (10.0)	0 (0.0)	5 (5.0)	6 (12.2)
	No	511 (13.6)	80 (17.5)	110 (13.2)	83 (15.0)	214 (12.1)	1 (25.0)	14 (13.9)	9 (18.4)
	Not sure	358 (9.5)	41 (9.0)	80 (9.6)	49 (8.8)	178 (10.1)	0 (0.0)	5 (5.0)	5 (10.2)
	Yes	2608 (69.3)	323 (70.7)	613 (73.8)	363 (65.4)	1200 (67.8)	3 (75.0)	77 (76.2)	29 (59.2)
Taking vaccine for travel policiy (%)	**No**	2875 (76.3)	401 (87.7)	762 (91.7)	405 (73.0)	1206 (68.2)	3 (75.0)	80 (79.2)	18 (36.7)
	Yes	891 (23.7)	56 (12.3)	69 (8.3)	150 (27.0)	563 (31.8)	1 (25.0)	21 (20.8)	31 (63.3)

following COVID-19 vaccination. The most commonly reported side effect was sleepiness and lethargy, with 1,884 participants (50.0 %) reporting this symptom Fig. 2. Fever and chills were reported by 1,696 participants (45.0 %), while pain and swelling at the injection site were reported by 1,352 participants (35.9 %). Approximately 20.4 % (n = 768) of the participants reported having no symptoms. The prevalence of other reported side effects ranged from 0.4 % (n = 16) for blood clotting accidents to 9.4 % (n = 354) for nausea and vomiting Table 3.

Fig. 3 shows the distribution of symptoms across different COVID-19 vaccines.

However, the duration of symptoms was considerably longer for those who received the AstraZeneca vaccine (68 cases, 3.8 %) and Sinopharm vaccine (21 cases, 3.8 %), as shown in Table 3.

3.4. Factors associated with COVID-19 vaccine side effects

Multivariate logistic regression analysis was performed to identify influential factors for experiencing side effects from the COVID-19 vaccine. The analysis was based on factors that had a significant association with experiencing side effects at a 20 % level of significance, as presented in Table 4. The odds ratio (OR) was used to interpret the estimated parameters from the logistic regression analysis. The odds ratio is calculated by dividing the probability of experiencing the event by the probability of not experiencing it. At a 5 % level of significance, parameters were considered statistically significant.

In the multinomial logistic regression analysis presented in Table 5, a significant difference was found between male and female respondents in the proportion who experienced side effects after vaccination (OR: 0.57, CI: 0.48–0.68). Participants aged 25–44 years (OR: 1.30, CI: 1.11–1.52) and participants who thought COVID-19 posed a high threat to their personal life (OR: 1.74, CI: 1.22–2.46) were more likely to experience side effects after the COVID-19 vaccine than other age groups and those who thought there was no or small risk to their personal life.

No significant difference was found between residency, educational level, and health insurance specialty with side effects after vaccination. However, respondents who were vaccinated with Sputnik Light (OR: 2.52, CI: 1.85–3.46), Sinopharm (OR: 0.3, CI: 0.23–0.39), and AstraZeneca (OR: 1.61, CI: 1.26–2.05) were more likely to experience side effects.

Table 6 presents the gender and age-related differences in symptoms and doctor visits among AstraZeneca vaccine recipients. Females had higher odds of reporting sleepiness, lethargy (OR 0.77, 95 % CI 0.63–0.93), and pain/swelling (OR 0.65, 95 % CI 0.53–0.79) compared to males. Participants aged ≤ 44 years had higher odds of reporting sleepiness, lethargy (OR 1.52, 95 % CI 1.17–1.97), fever, and chills (OR 2.48, 95 % CI 1.89–3.25). Males had a higher likelihood of reporting no symptoms (OR 1.58, 95 % CI 1.22–2.04), while females and younger participants were more likely to require medical visits. In Table 7, among recipients of the Sputnik Light vaccine, males had higher odds of reporting no symptoms compared to females (OR 1.91, 95 % CI 1.19–3.04). Younger participants were more likely to report sleepiness/lethargy (OR 1.92, 95 % CI 1.19–3.11) and require doctor visits (OR 1.45, 95 % CI 0.29–26.31). These findings indicate significant gender and age differences in vaccine reactions and medical consultations.

4. Discussion

This cross-sectional study aimed to investigate the prevalence of side effects associated with different Covid-19 vaccines in the Syrian population. Given the significant impact of the Covid-19 pandemic in Syria and the efforts of official campaigns to raise awareness towards the vaccines and the disease itself, it is crucial to evaluate the safety and efficacy of Covid-19 vaccines.

A study included a comprehensive sample of participants covering 23 Arab countries, 36,220 individuals. Among the 29 identified barriers to COVID-19 vaccine acceptance, the most commonly reported concern was the fear of developing vaccine side effects. A significant majority of participants, 22,235 individuals (61.4 %) expressed this apprehension (Qunaibi et al., 2021). Another study focused on healthcare workers in the Arab countries, with a sample size of 5,708 participants. The study aimed to identify the most common barriers among healthcare workers towards COVID-19 vaccination. Notably, more than half of the participants, comprising 3,313 individuals (58.0 %), indicated their fear of experiencing vaccine side effects as the primary barrier (Qunaibi et al., 2021).

These findings highlight the prevalent concern among individuals from developing countries, particularly within the Arab region, regarding the potential side effects of COVID-19 vaccines. We provide valuable insights into the factors influencing vaccine acceptance and the importance of addressing concerns related to side effects to enhance vaccine uptake in these populations.

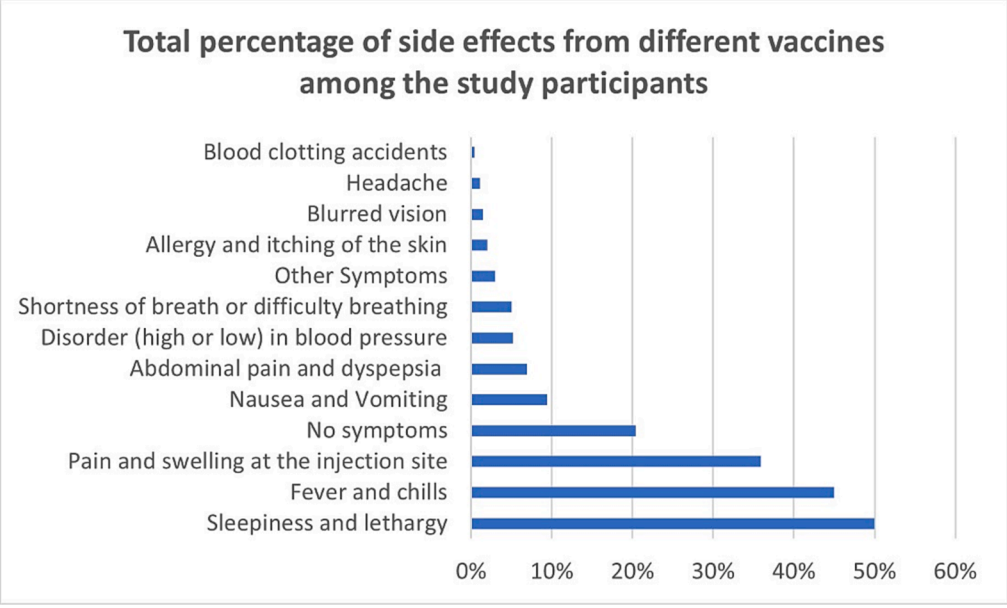

Fig. 2. Percentage distribution of side effects of different COVID-19 vaccines.

Table 3
Percentage distribution of side effects across different COVID-19 vaccines.

		Total (n = 3766)	Sputnik.V (n = 457)	Sputnik. Light (n = 831)	Sinopharm (n = 555)	AstraZeneca (n = 1769)	Abdalla (Cuba) (n = 4)	The Pfizer (BioNTech) (n = 101)	Johnson&Johnson (n = 49)
	No symptoms	768 (20.4)	101 (22.1)	78 (9.4)	276 (49.7)	278 (15.7)	2 (50.0)	24 (23.8)	9 (18.4)
	Yes	2998 (79.6	356 (77.9	753 (90.6	279 (50.3)	1491 (84.3	2 (50.0	77 (76.2)	40 (81.6)
Symptoms (%)	Sleepiness and lethargy	1884 (50.0)	238 (52.1)	466 (56.1)	151 (27.2)	950 (53.7)	2 (50.0)	56 (55.4)	21 (42.9)
	Pain and swelling at the injection site	1352 (35.9)	179 (39.2)	412 (49.6)	114 (20.5)	599 (33.9)	0 (0.0)	33 (32.7)	15 (30.6)
	Shortness of breath or difficulty breathing	190 (5.0)	13 (2.8)	34 (4.1)	19 (3.4)	113 (6.4)	0 (0.0)	4 (4.0)	7 (14.3)
	Disorder (high or low) in blood pressure	197 (5.2)	14 (3.1)	31 (3.7)	15 (2.7)	132 (7.5)	0 (0.0)	2 (2.0)	3 (6.1)
	Blurred vision	58 (1.5)	8 (1.8)	8 (1.0)	7 (1.3)	32 (1.8)	0 (0.0)	2 (2.0)	1 (2.0)
	Blood clotting accidents	16 (0.4)	1 (0.2)	3 (0.4)	2 (0.4)	9 (0.5)	0 (0.0)	1 (1.0)	0 (0.0)
	Allergy and itching of the skin	77 (2.0)	8 (1.8)	8 (1.0)	8 (1.4)	48 (2.7)	0 (0.0)	3 (3.0)	2 (4.1)
	Fever and chills	1696 (45.0)	197 (43.1)	432 (52.0)	92 (16.6)	923 (52.2)	0 (0.0)	27 (26.7)	25 (51.0)
	Headache	40 (1.1)	5 (1.1)	10 (1.2)	3 (0.5)	20 (1.1)	0 (0.0)	0 (0.0)	2 (4.1)
	Nausea and Vomiting	354 (9.4)	32 (7.0)	63 (7.6)	18 (3.2)	225 (12.7)	0 (0.0)	6 (5.9)	10 (20.4)
	Abdominal pain and dyspepsia	261 (6.9)	24 (5.3)	47 (5.7)	21 (3.8)	159 (9.0)	0 (0.0)	7 (6.9)	3 (6.1)
	Other Symptoms	112 (3.0)	13 (2.8)	21 (2.5)	16 (2.9)	57 (3.2)	0 (0.0)	2 (2.0)	3 (6.1)
Duration of the symptoms (%)	Less than three days	2551 (67.7)	317 (69.4)	666 (80.1)	220 (39.6)	1252 (70.8)	1 (25.0)	60 (59.4)	35 (71.4)
	No symptoms	768 (20.4)	101 (22.1)	78 (9.4)	276 (49.7)	278 (15.7)	2 (50.0)	24 (23.8)	9 (18.4)
	One week	333 (8.8)	32 (7.0)	72 (8.7)	38 (6.8)	171 (9.7)	1 (25.0)	15 (14.9)	4 (8.2)
	Over a week	114 (3.0)	7 (1.5)	15 (1.8)	21 (3.8)	68 (3.8)	0 (0.0)	2 (2.0)	1 (2.0)
	No symptoms	768 (20.4)	101 (22.1)	78 (9.4)	276 (49.7)	278 (15.7)	2 (50.0)	24 (23.8)	9 (18.4)
	No	2829 (75.1)	344 (75.3)	736 (88.6)	249 (44.9)	1391 (78.6)	1 (25.0)	70 (69.3)	38 (77.6)
	Yes	169 (4.5)	12 (2.6)	17 (2.0)	30 (5.4)	100 (5.7)	1 (25.0)	7 (6.9)	2 (4.1)

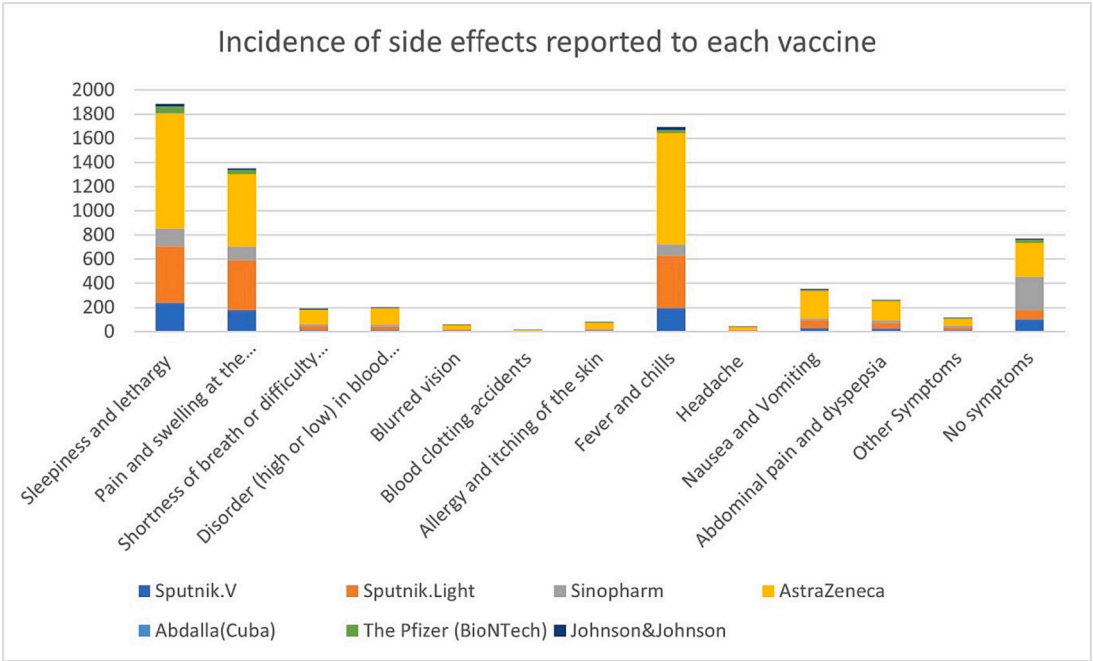

Fig. 3. Side effects to each vaccine.

Table 4
Association between potential factors and COVID-19 vaccine side effects.

		univariate analysis		
		OR	CI	P value
Age (years) (%)	18–24	Ref		
	25–44	0.82	0.68, 0.98	0.028
	45–65	0.46	0.37, 0.58	<0.001
	65+	0.45	0.28, 0.75	0.002
Gender (%)	Female	Ref		
	Male	0.63	0.54, 0.74	<0.001
Residency (%)	City inside Syria	Ref		
	Countryside in Syria	0.73	0.61, 0.89	0.001
Educational Level (%)	Did not go to school	Ref		
	High school	0.5	0.21, 1.08	0.094
	Master \PhD	0.73	0.31, 1.52	0.4
	Middle school	0.61	0.25, 1.35	0.2
	University\Institute	0.95	0.41, 1.96	>0.9
Education Specialty (%)	Did not go to university	Ref		
	Medical sector	1.81	1.40, 2.32	<0.001
	Other	1.32	1.01, 1.70	0.038
Health insurance (%)	No	Ref		
	Yes	0.82	0.68, 0.98	0.027
IS COVID-19 a threat to the world? (%)	I do not know	Ref		
	No Risk at all	0.49	0.32, 0.75	<0.001
	There is a high risk	1.38	1.04, 1.80	0.021
	There is a small risk	1.13	0.84, 1.50	0.4
Is COVID-19 a threat to your personal life?(%)	I do not know	Ref		
	No Risk at all	0.83	0.60, 1.13	0.2
	There is a high risk	1.64	1.23, 2.18	<0.001
	There is a small risk	1.37	1.04, 1.78	0.022
History of COVID-19 infection (%)	No	Ref		
	Not sure (suspected symptoms)	1.94	1.53, 2.45	<0.001
	Yes	2.11	1.71, 2.61	<0.001
Was the COVID-19 laboratory confirmed using the PCR test? (%)	No	Ref		
	Not sure	0.79	0.56, 1.13	0.2
	Yes	0.97	0.79, 1.18	0.7
Has anyone in your family died of COVID-19? (%)	No	Ref		
	Not sure	1.01	0.65, 1.65	>0.9
	Yes	0.99	0.80, 1.23	>0.9
Vaccine-related Information Sources	Relatives and friends (%)	1.06	0.87, 1.30	0.6
	Social media (%)	1.29	1.09, 1.51	0.003
	TV and Radio (%)	0.97	0.78, 1.24	0.8
	Internet search.engines (Google) (%)	1.34	1.13, 1.60	<0.001
	My doctor (%)	1.23	0.99, 1.53	0.066
	Publications of refereed scientific journals and societies (%)	1.52	1.27, 1.83	<0.001
	Community and governmental education campaigns carried out by the Ministry of Health (%)	1.08	0.90, 1.28	0.4
	Do not search about COVID-19 vaccines (%)	0.62	0.50, 0.78	<0.001
Do you think that the country of manufacture of the vaccine affect the degree of confidence in the vaccine? (%)	No	Ref		
	Not sure	1.09	0.86, 1.38	0.5
	Yes	1.33	1.11, 1.59	0.002
Does WHO approval of a vaccine license influence your decision to take it? (%)	I do not know WHO	Ref		
	No	0.96	0.68, 1.34	0.8
	Not sure	1.06	0.73, 1.53	0.8
	Yes	1.27	0.94, 1.68	0.11
Dose of the Vaccine (%)	Booster Dose	Ref		
	Full Course (1 dose)	3.34	1.50, 6.90	0.002
	Full Course (2 doses)	1.19	0.54, 2.38	0.6
	Only first Dose	1.13	0.51, 2.29	0.7
Vaccines (%)	Sputnik.V	0.88	0.70, 1.12	0.3
	Sputnik.Light	2.95	2.31, 3.80	<0.001
	Sinopharm	0.18	0.15, 0.22	<0.001
	AstraZeneca	1.76	1.49, 2.07	<0.001
	Abdala (Cuba)	0.25	0.03, 2.11	0.2
	The.Pfizer BioNTech	0.81	0.52, 1.31	0.4
	Johnson&Johnson	1.16	0.59, 2.55	0.7
Need to visit doctor after taking COVID-19 vaccine (%)	No	Ref		
	No symptoms	0	[0.00; Inf]	0.9851
	Yes	1	[0.00; Inf]	1
Taking vaccine for travel policiy (%)	No	Ref		
	Yes	0.83	0.69, 1.00	0.042

OR = Odds Ratio, CI = Confidence Interval

We found that the most common side effects reported were sleepiness and lethargy, fever and chills, and pain and swelling at the injection site. However, the type and frequency of side effects varied according to the type of COVID-19 vaccine received with the highest number of side effects reported by participants who received the AstraZeneca vaccine. These finding are consistent with previous studies that reported similar reactions after COVID-19 vaccination (Dreyer et al., 2022; Gee et al., 2021). These reactions are also expected as part of the immune response to the vaccine and indicate that the vaccine is working (Side Effects of COVID-19 Vaccines, 2023).

The majority of these side effects were resolved within three days, which is also in line with previous findings (Zahid, 2021; Nassar et al., 2022; Almufty et al., 2021). Only a small proportion of our sample required medical attention i.e. visiting the doctor because of the side effects, indicating that COVID-19 vaccines are generally safe and well tolerated among our studied population. A systematic review of 47 published papers identified 11 potential factors influencing the acceptance and rejection of COVID-19 vaccines. Among these factors, both the

Table 5
Factors associated with COVID-19 vaccine side effects.

		Univariate analysis			Multivariate analysis		
		OR	CI	P value	OR	CI	P value
Age (years) (%)	**18–24**	Ref	Ref				
	25–44	0.82	0.68, 0.98	0.028	0.88	0.71, 1.08	0.2
	45–65	0.46	0.37, 0.58	<0.001	0.53	0.40, 0.70	<0.001
	65+	0.45	0.28, 0.75	0.002	0.6	0.34, 1.08	0.079
Gender (%)	**Female**	Ref	Ref				
	Male	0.63	0.54, 0.74	<0.001	0.57	0.48, 0.68	<0.001
Residency (%)	**City inside Syria**	Ref					
	Countryside in Syria	0.73	0.61, 0.89	0.001	0.87	0.71, 1.07	0.2
Education Specialty (%)	**Did not go to university**	Ref	Ref				
	Medical sector	1.81	1.40, 2.32	<0.001	0.97	0.69, 1.35	0.9
	Other	1.32	1.01, 1.70	0.038	0.89	0.65, 1.20	0.5
Health insurance (%)	**No**	Ref	Ref				
	Yes	0.82	0.68, 0.98	0.027	0.97	0.79, 1.19	0.8
IS COVID-19 a threat to the world? (%)	**I do not know**	Ref	Ref				
	No Risk at all	0.49	0.32, 0.75	<0.001	0.68	0.41, 1.14	0.15
	There is a high risk	1.38	1.04, 1.80	0.021	0.87	0.62, 1.22	0.4
	There is a small risk	1.13	0.84, 1.50	0.4	0.97	0.69, 1.37	0.9
Is COVID-19 a threat to your personal life?(%)	**I do not know**	Ref	Ref				
	No Risk at all	0.83	0.60, 1.13	0.2	1	0.69, 1.47	>0.9
	There is a high risk	1.64	1.23, 2.18	<0.001	1.74	1.22, 2.46	0.002
	There is a small risk	1.37	1.04, 1.78	0.022	1.33	0.96, 1.82	0.083
Vaccine-related Information Sources	**Social media (%)**	1.29	1.09, 1.51	0.003	1.24	1.03, 1.49	0.026
	Internet search.engines (Google) (%)	1.34	1.13, 1.60	<0.001	1.12	0.92, 1.36	0.3
	Publications of refereed scientific journals and societies (%)	1.52	1.27, 1.83	<0.001	1.35	1.09, 1.69	0.006
	Do not search about COVID-19 vaccines (%)	0.62	0.50, 0.78	<0.001	0.74	0.57, 0.98	0.036
Do you think that the country of manufacture of the vaccine affect the degree of confidence in the vaccine? (%)	**No**	Ref	Ref				
	Not sure	1.09	0.86, 1.38	0.5	1.01	0.78, 1.31	>0.9
	Yes	1.33	1.11, 1.59	0.002	1.14	0.94, 1.39	0.2
Vaccines (%)	**Sputnik.Light**	2.95	2.31, 3.80	<0.001	2.52	1.85, 3.46	<0.001
	Sinopharm	0.18	0.15, 0.22	<0.001	0.3	0.23, 0.39	<0.001
	AstraZeneca	1.76	1.49, 2.07	<0.001	1.61	1.26, 2.05	<0.001
Taking vaccine for travel policiy (%)	**No**	Ref	Ref				
	Yes	0.83	0.69, 1.00	0.042	1.04	0.85, 1.29	0.7

OR = Odds Ratio, CI = Confidence Interval

safety of the vaccine and its side effects were prominently highlighted by 28 and 22 papers respectively (Roy et al., 2022). In another review, a scoping review encompassing 11 articles, it was reported that the side effects of COVID-19 vaccines did not significantly impact the routine activities of vaccine recipients (Dhamanti et al., 2023). A paper from Ethiopia studied Astra-Zeneca vaccine among 672 participants related to health care sector; nearly (76 %) of them reported local side effects at the injection site especially pain (65.48 %). Moreover, a total of (70.98 %) participants reported mild side effects where headache and lethargy were the most frequently reported side effects (Solomon et al., 2021).

The study also identified several factors that influenced the prevalence of side effects, such as gender, age, and the perceived threat of Covid-19. Women were more likely to report pain at the injection site, fatigue, and headache, which may reflect biological or behavioral factors, such as hormonal influences, immune responses, or reporting biases (Himmelstein and Sanchez, 2016; Potluri et al., 2019; Green et al., 2022). Previous studies have also reported higher rates of side effects among women (Gee et al., 2021; Green et al., 2022; Beatty et al., 2021). Age differences in side effects may be explained by the decline of

Table 6
Differences between participants who vaccinated with AstraZeneca vaccine regarding symptoms and doctor visits.

		AstraZeneca vaccine						
	Female	Male	p-value	OR (95%CI)	≤ 44 years	>44 years	p-value	OR (95%CI)
Sleepiness and lethargy	570 (60.0)	380 (40.0)	0.007	0.77 (0.63, 0.93)	827 (87.1)	123 (12.9)	0.002	1.52 (1.17, 1.97)
Pain and swelling at the injection site	383 (63.9)	216 (36.1)	<0.001	0.65 (0.53, 0.79)	527 (88.0)	72 (12.0)	0.005	1.53 (1.14, 2.04)
Shortness of breath or difficulty breathing	80 (70.8)	33 (29.2)	0.003	0.53 (0.35, 0.80)	104 (92.0)	9 (8.0)	0.032	2.20 (1.10, 4.40)
Disorder (high or low) in blood pressure	91 (68.9)	41 (31.1)	0.005	0.57 (0.39, 0.84)	117 (88.6)	15 (11.4)	0.216	1.47 (0.84, 2.55)
Blurred vision	21 (65.6)	11 (34.4)	0.414	0.69 (0.33, 1.44)	29 (90.6)	3 (9.4)	0.473	1.79 (0.54, 5.91)
Blood clotting accidents	4 (44.4)	5 (55.6)	0.671	1.66 (0.44, 6.20)	8 (88.9)	1 (11.1)	>0.9	1.47 (0.18, 11.79)
Allergy and itching of the skin	31 (64.6)	17 (35.4)	0.352	0.72 (0.40, 1.31)	36 (75.0)	12 (25.0)	0.1	0.54 (0.28, 1.05)
Fever and chills	534 (57.9)	389 (42.1)	0.467	0.93 (0.77, 1.12)	831 (90.0)	92 (10.0)	<0.001	2.48 (1.89, 3.25)
Headache	12 (60.0)	8 (40.0)	0.962	0.88 (0.36, 2.17)	19 (95.0)	1 (5.0)	0.321	3.51 (0.47, 26.36)
Nausea and Vomiting	145 (64.4)	80 (35.6)	0.019	0.70 (0.52, 0.94)	196 (87.1)	29 (12.9)	0.291	1.27 (0.84, 1.93)
Abdominal pain and dyspepsia	97 (61.0)	62 (39.0)	0.322	0.83 (0.60, 1.16)	143 (89.9)	16 (10.1)	0.062	1.71 (1.00, 2.91)
Other Symptoms	32 (56.1)	25 (43.9)	>0.9	1.04 (0.61, 1.76)	52 (91.2)	5 (8.8)	0.215	1.94 (0.77, 4.90)
No symptoms	132 (47.5)	146 (52.5)	0.001	1.58 (1.22, 2.04)	205 (73.7)	73 (26.3)	<0.001	0.44 (0.32, 0.59)
Need to visit doctor after taking COVID-19 vaccine [Yes] (%)	58 (58.0)	42 (42.0)	0.002	0.96(0.64, 1.47)	75 (75.0)	25 (25.0)	<0.001	0.43(0.27,0.71)

Table 7
Differences between participants who vaccinated with Sputnik light vaccine regarding symptoms and doctor visits.

		Sputnik. Light vaccine						
	Female	Male	p-value	OR (95 %CI)	≤ 44 years	>44 years	p-value	OR (95 %CI)
Sleepiness and lethargy	284 (60.9)	182 (39.1)	0.838	0.96 (0.73, 1.27)	435 (93.3)	31 (6.7)	0.01	1.92 (1.19, 3.11)
Pain and swelling at the injection site	274 (66.5)	138 (33.5)	0.001	0.61 (0.46, 0.80)	375 (91.0)	37 (9.0)	>0.9	1.01 (0.63, 1.62)
Shortness of breath or difficulty breathing	27 (79.4)	7 (20.6)	0.034	0.38 (0.17, 0.89)	32 (94.1)	2 (5.9)	0.728	1.61 (0.38, 6.87)
Disorder (high or low) in blood pressure	23 (74.2)	8 (25.8)	0.162	0.52 (0.23, 1.18)	30 (96.8)	1 (3.2)	0.407	3.06 (0.41, 22.75)
Blurred vision	5 (62.5)	3 (37.5)	>0.9	0.92 (0.22, 3.87)	7 (87.5)	1 (12.5)	>0.9	0.69 (0.08, 5.70)
Blood clotting accidents	2 (66.7)	1 (33.3)	>0.9	0.77 (0.07, 8.48)	3 (100.0)	0 (0.0)	>0.9	NaN (NaN, NaN)
Allergy and itching of the skin	2 (25.0)	6 (75.0)	0.089	4.67 (0.94, 23.27)	7 (87.5)	1 (12.5)	>0.9	0.69 (0.08, 5.70)
Fever and chills	278 (64.4)	154 (35.6)	0.023	0.72 (0.54, 0.95)	415 (96.1)	17 (3.9)	<0.001	4.15 (2.37, 7.26)
Headache	3 (30.0)	7 (70.0)	0.097	3.63 (0.93, 14.16)	10 (100.0)	0 (0.0)	0.655	NaN (NaN, NaN)
Nausea and Vomiting	44 (69.8)	19 (30.2)	0.15	0.64 (0.37, 1.12)	60 (95.2)	3 (4.8)	0.317	2.07 (0.63, 6.76)
Abdominal pain and dyspepsia	29 (61.7)	18 (38.3)	0.987	0.95 (0.52, 1.74)	44 (93.6)	3 (6.4)	0.697	1.48 (0.45, 4.90)
Other Symptoms	10 (47.6)	11 (52.4)	0.317	1.71 (0.72, 4.07)	21 (100.0)	0 (0.0)	0.282	NaN (NaN, NaN)
No symptoms	36 (46.2)	42 (53.8)	0.009	1.91 (1.19, 3.04)	65 (83.3)	13 (16.7)	0.023	0.45 (0.23, 0.86)
Need to visit doctor after taking COVID-19 vaccine [Yes] (%)	12 (70.6)	5 (29.4)	0.018	1.48(0.54, 4.69)	16 (94.1)	1 (5.9)	0.044	1.45(0.29, 26.31)

NaN (NaN, NaN) means not applicable as there are no reported cases in age group > 44 years.

immune function with aging, which may affect the response to vaccination and the production of antibodies (Tosun et al., 2022). Older adults may also have more comorbidities and medications that could interact with the vaccine and increase the risk of side effects (Antonelli et al., 2022). Therefore, it is important to monitor the safety and efficacy of COVID-19 vaccines among different age groups and to provide appropriate information and guidance to older adults.

The perceived threat of COVID-19 was positively associated with

side effects, which may indicate a higher level of anxiety or stress among those who felt more vulnerable to the disease (Antonelli et al., 2022). Psychological factors may influence the perception and reporting of side effects, as well as the immune system and inflammatory responses (Antonelli et al., 2022). Thus, it is essential to address the mental health needs of people concerned about COVID-19 and enhance their coping skills and resilience.

The type of vaccine was also a significant factor in side effects, with Sputnik Light, Sinopharm, and AstraZeneca showing higher odds ratios than other vaccines. This may reflect differences in vaccine composition, dosage, administration, or storage conditions (Side Effects of COVID-19 Vaccines, 2023). It may also be influenced by media coverage, public perception, or the availability of vaccines in different regions.

Our data suggest that there may be some differences in the immunogenicity and reactogenicity of the different covid-19 vaccines, which could be related to their different mechanisms of action, formulations, dosages, and administration schedules (Rief, 2021; COVID-19 Vaccines, 2023). For instance, Sputnik.V and Sputnik Light are both based on adenoviral vectors, which may induce stronger immune responses than inactivated vaccines like Sinopharm (Vanaparthy et al., 2021; Jones and Roy, 2021; Shuja et al., 2021). However, Sputnik Light is a single-dose vaccine, which may explain why it caused more fever and chills than Sputnik.V, which is a two-dose vaccine (Vanaparthy et al., 2021). AstraZeneca is also based on an adenoviral vector and it has been associated with a rare but serious adverse event of blood clotting (Cari et al., 2021; Scully et al., 2021; Mascellino et al., 2021; Greinacher et al., 2021); In contrast to this studies that found a relationship between these events, we could not detect a significant relationship between the AstraZeneca vaccine and blood clots in our study.

The study's main strength is being the first study that evaluates all available vaccines' side effects in Syria, and the broad geographic representation of the study population across the major governorates in Syria. The study also tried to eliminate selection bias by using random sampling and face-to-face interview-based data collection through trained collaborators.

However, the study has some limitations that should be acknowledged. First, we relied on self-reported data that may be subject to recall bias, social desirability bias, or underreporting. Second, we did not follow up with the participants to assess the long-term side effects or efficacy of COVID-19 vaccines. The study had a very small sample size for Pfizer (BioNTech), Johnson&Johnson, and Abdallah (Cuba) (2.7 %, 1.3 %, and 0.1 % respectively) compared to the overall population, which limits the generalizability and comparability of the results. Also, it is important to keep in mind that the citizens of Syria could not choose which vaccine to receive, instead, they received what is available at the health center, this may have biased the receivers' proportion of each vaccine as it does not reflect a general attitude toward vaccines' types or trust of specific vaccine over other types. Nonetheless, the study's findings could help inform vaccination strategies in Syria and other similar settings, which is essential for mitigating the impact of the pandemic on public health. Therefore, cautions should be exercised when extrapolating our findings in the other parts as well as beyond the Syrian public. Future studies should address the limitations of this study to provide more robust evidence on the safety and efficacy of Covid-19 vaccines in Syria.

5. Conclusion

Our study showed that COVID-19 vaccines are generally well tolerated by the Syrian population and cause short-term side effects that resolve within a few days. AstraZeneca vaccine was associated with more side effects than other vaccines in our study population. Providing clear and accurate information about the expected side effects and their management may help to increase public confidence and acceptance of COVID-19 vaccines. Longitudinal studies should be conducted to investigate the long-term safety and efficacy of the vaccines and compare different vaccines in terms of their cost-effectiveness, acceptability, and accessibility in different settings and populations.

6. Transparency statement

Authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Ethics approval

The study was approved by the University of Aleppo, Faculty of Medicine, and performed as per Helsinki Declaration principles.

8. Informed consent statement

All authors have read and approved the final version of the manuscript corresponding author had full access to all of the data in this study and takes complete responsibility for the integrity of the data.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Mohamad Klib: Conceptualization, Investigation, Project administration, Supervision, Visualization, Writing – review & editing. **Osama Alazki:** Investigation, Data curation, Writing – original draft, Writing – review & editing. **Ayman Issa Nabhan:** Investigation, Project administration, Validation, Writing – review & editing. **Aml M. Brakat:** Formal analysis, Writing – original draft. **Bana Zuhair Alafandi:** Investigation, Methodology, Writing – original draft. **Fatima Abdulmoain Idres:** Writing – original draft. **Ruba Almenchaf:** Writing – original draft. **Farah Albakkar:** Writing – original draft. **Munir Ghandour:** Methodology, Writing – original draft. **Jaafar Zahlout:** Methodology, Validation, Writing – original draft. **Somayya Tabsho:** Writing – original draft. **Samar Mouazen:** Supervision, Methodology, Writing – review & editing. **Data Collection Group:** Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

Almufty, H.B., Mohammed, S.A., Abdullah, A.M., Merza, M.A., 2021. Potential adverse effects of COVID19 vaccines among Iraqi population; a comparison between the three available vaccines in Iraq; a retrospective cross-sectional study. Sep 1 [cited 2023 Jun 19];15(5). Available from: Diabetes Metab. Syndr. [Internet] https://pubmed.ncbi.nlm.nih.gov/34280733/.

Antonelli, M., Penfold, R.S., Merino, J., Sudre, C.H., Molteni, E., Berry, S., et al., 2022 Jan 1. Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study. Lancet Infect. Dis. [Internet]. [cited 2023 Jun 20];22(1), 43–55. Available from: https://pubmed.ncbi.nlm.nih.gov/34480857/.

Syrian Arab Republic: WHO Coronavirus Disease (COVID-19) Dashboard With Vaccination Data | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data [Internet]. [cited 2023 Feb 13]. Available from: https://covid19.who.int/region/emro/country/sy.

Beatty, A.L., Peyser, N.D., Butcher, X.E., Cocohoba, J.M., Lin, F., Olgin, J.E., et al., 2021. Analysis of COVID-19 Vaccine Type and Adverse Effects Following Vaccination. Dec 22 [cited 2023 Jun 20];4(12). Available from: JAMA Netw. Open [Internet] https://pubmed.ncbi.nlm.nih.gov/34935921/.

Bloom, D.E., Canning, D., Weston, M., 2005. The Value of Vaccination. World Econ [Internet]. [cited 2023 Feb 13];6(3), 15–39. Available from: https://ideas.repec.org/a/wej/wldecn/213.html.

Cari, L., Fiore, P., Naghavi Alhosseini, M., Sava, G., Nocentini, G., 2021. Blood clots and bleeding events following BNT162b2 and ChAdOx1 nCoV-19 vaccine: An analysis of European data. Aug 1 [cited 2023 Jun 20];122. Available from: J. Autoimmun. [Internet] https://pubmed.ncbi.nlm.nih.gov/34174723/.

COVID-19 vaccines [Internet]. [cited 2023 Jun 19]. Available from: https://www.who.int/westernpacific/emergencies/covid-19/covid-19-vaccines.

COVID-19: operational guidance for maintaining essential health services during an outbreak: interim guidance, 25 March 2020 [Internet]. [cited 2023 Feb 13]. Available from: https://apps.who.int/iris/handle/10665/331561.

Dhamanti, I., Suwantika, A.A., Adlia, A., Yamani, L.N., Yakub, F., 2023. Adverse Reactions of COVID-19 Vaccines: A Scoping Review of Observational Studies. Int. J. Gen. Med. [internet] [cited 2023 Aug 15];16:609. Available from: /pmc/articles/PMC9951602/.

Dreyer, N., Reynolds, M.W., Albert, L., Brinkley, E., Kwon, T., Mack, C., et al., 2022 Mar 15. How frequent are acute reactions to COVID-19 vaccination and who is at risk? Vaccine [Internet]. [cited 2023 Jun 19];40(12), 1904–1912. Available from: https://pubmed.ncbi.nlm.nih.gov/35177299/.

Side Effects of COVID-19 Vaccines [Internet]. [cited 2023 Jun 19]. Available from: https://www.who.int/news-room/feature-stories/detail/side-effects-of-covid-19-vaccines.

Gee, J., Marquez, P., Su, J., Calvert, G.M., Liu, R., Myers, T., et al., 2021. First Month of COVID-19 Vaccine Safety Monitoring — United States, December 14, 2020–January 13, 2021. MMWR Morb Mortal Wkly Rep [Internet]. [cited 2023 Jun 19];70(8), 283–288. Available from: https://www.cdc.gov/mmwr/volumes/70/wr/mm7008e3.htm.

Green, M.S., Peer, V., Magid, A., Hagani, N., Anis, E., Nitzan, D., 2022. Gender Differences in Adverse Events Following the Pfizer-BioNTech COVID-19 Vaccine. Feb 1 [cited 2023 Jun 20];10(2). Available from: Vaccines [Internet] https://pubmed.ncbi.nlm.nih.gov/35214694/.

Greinacher, A., Thiele, T., Warkentin, T.E., Weisser, K., Kyrle, P.A., Eichinger, S., 2021 Jun 3. Thrombotic Thrombocytopenia after ChAdOx1 nCov-19 Vaccination. N Engl J Med [Internet]. [cited 2023 Feb 13];384(22), 2092–2101. Available from: https://www.nejm.org/doi/full/10.1056/NEJMoa2104840.

Hatmal, M.M., Al-Hatamleh, M.A.I., Olaimat, A.N., Mohamud, R., Fawaz, M., Kateeb, E. T., et al., 2022. Reported Adverse Effects and Attitudes among Arab Populations Following COVID-19 Vaccination: A Large-Scale Multinational Study Implementing Machine Learning Tools in Predicting Post-Vaccination Adverse Effects Based on Predisposing Factors. Vaccines [Internet]. Mar 1 [cited 2023 Aug 21];10(3). Available from: /pmc/articles/PMC8955470/.

Himmelstein, M.S., Sanchez, D.T., 2016 Jul 1. Masculinity impediments: Internalized masculinity contributes to healthcare avoidance in men and women. J. Health Psychol. [Internet]. [cited 2023 Jun 19];21(7), 1283–1292. Available from: https://pubmed.ncbi.nlm.nih.gov/25293967/.

Jones, I., Roy, P., 2021 Feb 20. Sputnik V COVID-19 vaccine candidate appears safe and effective. Lancet [Internet]. [cited 2023 Jun 21];397(10275), 642–643. Available from: http://www.thelancet.com/article/S0140673621001914/fulltext.

Mascellino, M.T., Di Timoteo, F., De Angelis, M., Oliva, A., 2021. Overview of the Main Anti-SARS-CoV-2 Vaccines: Mechanism of Action, Efficacy and Safety. Infect. Drug Resist. [Internet] [cited 2023 Jun 20];14:3459. Available from: /pmc/articles/PMC8418359/.

Nassar, R.I., Alnatour, D., Thiab, S., Nassar, A., El-Hajji, F., Basheti, I.A., 2022. Short-term side effects of COVID-19 vaccines: A cross-sectional study in Jordan [cited 2023 Jun 19];18(5). Available from: Hum. Vaccin. Immunother. [Internet] https://pubmed.ncbi.nlm.nih.gov/35759219/.

Nikoloski, Z., Aliyev, E., Bain, R.E.S., Menchini, L., Hegazi, S., Zalkha, M., et al., 2023 Jun 16. COVID-19 Vaccination Personas in Syria: Evidence from a Cross-Sectional Survey. Vaccines, 11, 1109 [Internet]. [cited 2023 Aug 15];11(6):1109. Available from: https://www.mdpi.com/2076-393X/11/6/1109/htm.

Potluri, T., Fink, A.L., Sylvia, K.E., Dhakal, S., Vermillion, M.S., vom Steeg, L., et al., 2019. Age-associated changes in the impact of sex steroids on influenza vaccine responses in males and females. Dec 1 [cited 2023 Jun 19];4(1). Available from: NPJ Vaccines [Internet] https://pubmed.ncbi.nlm.nih.gov/31312529/.

Qunaibi, E., Basheti, I., Soudy, M., Sultan, I., 2021. Hesitancy of arab healthcare workers towards covid-19 vaccination: A large-scale multinational study. May 1 [cited 2023 Aug 21];9(5):446. Available from: Vaccines [Internet] https://www.mdpi.com/2076-393X/9/5/446/htm.

Qunaibi, E.A., Helmy, M., Basheti, I., Sultan, I., 2021 May. A high rate of covid-19 vaccine hesitancy in a large-scale survey on arabs. Elife 1, 10.

Rief, W., 2021 Apr 1. Fear of Adverse Effects and COVID-19 Vaccine Hesitancy: Recommendations of the Treatment Expectation Expert Group. JAMA Heal Forum [Internet]. [cited 2023 Jun 21];2(4):e210804–e210804. Available from: https://jamanetwork.com/journals/jama-health-forum/fullarticle/2779081.

Roy, D.N., Biswas, M., Islam, E., Azam, M.S., 2022. Potential factors influencing COVID-19 vaccine acceptance and hesitancy: A systematic review. Mar 1 [cited 2023 Aug 15];17(3):e0265496. Available from: PLoS One [Internet] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0265496.

Roy, D.N., Huda, M.N., Azam, M.S., 2022 Nov 30. Factors influencing COVID-19 vaccine acceptance and hesitancy among rural community in Bangladesh: A cross-sectional survey based study. Hum Vaccin Immunother [Internet]. [cited 2023 Sep 19];18(5). Available from: https://www.tandfonline.com/doi/abs/10.1080/21645515.2022.2064685.

Scully, M., Singh, D., Lown, R., Poles, A., Solomon, T., Levi, M., et al., 2021 Jun 10. Pathologic Antibodies to Platelet Factor 4 after ChAdOx1 nCoV-19 Vaccination. N Engl J Med [Internet]. [cited 2023 Jun 20];384(23):2202–11. Available from: https://www.nejm.org/doi/full/10.1056/nejmoa2105385.

Shibani, M., Alzabibi, M.A., Mouhandes, A.E.F., Alsuliman, T., Mouki, A., Ismail, H., et al., 2021 Dec 1. COVID-19 vaccination acceptance among Syrian population: a nationwide cross-sectional study. BMC Public Health [Internet]. [cited 2023 Aug 15];21(1). Available from: https://pubmed.ncbi.nlm.nih.gov/34789229/.

Shuja, S.H., Asad, D., Parekh, A.S., 2021. Sinopharm! An Unavoidable Contender in the Struggle Against COVID [Letter] [cited 2023 Jun 21];14:3899–900. Available from: Infect. Drug Resist. [Internet] https://pubmed.ncbi.nlm.nih.gov/34588785/.

Solomon, Y., Eshete, T., Mekasha, B., Assefa, W., 2021. COVID-19 Vaccine: side effects after the first dose of the Oxford Astrazeneca vaccine among health professionals in low-income country: Ethiopia. J. Multidiscip. Healthc. [Internet] [cited 2023 Sep 20];14:2577. Available from: /pmc/articles/PMC8454213/.

Tosun, F., Bulbul, M., Tosun, İ., 2022 May 25. Comparison of severe acute respiratory syndrome coronavirus 2 (COVID-19) vaccine side effects by age groups. Rev Assoc Med Bras [Internet]. [cited 2023 Jun 20];68(4):476–81. Available from: https://www.scielo.br/j/ramb/a/3zBgY7Fk8FZTnJj5GL88pLp/?lang=en.

Vanaparthy, R., Mohan, G., Vasireddy, D., Atluri, P., 2021. Review of COVID-19 viral vector-based vaccines and COVID-19 variants. Le Infez Med [Internet]. [cited 2023 Jun 20];29(3):328–38. Available from: https://pubmed.ncbi.nlm.nih.gov/35146337/.

von Elm, E., Altman, D.G., Egger, M., Pocock, S.J., Gøtzsche, P.C., Vandenbroucke, J.P., 2007 Oct 20. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet [Internet]. [cited 2023 Aug 15];370(9596):1453–7. Available from: http://www.thelancet.com/article/S014067360761602X/fulltext.

Zahid, M.N., 2021. Unfolding the Mild to Moderate Short-Term Side Effects of Four COVID-19 Vaccines Used in Bahrain: A Cross-Sectional Study. Nov 1 [cited 2023 Jun 19];9(11). Available from: Vaccines [Internet] https://pubmed.ncbi.nlm.nih.gov/34835300/.