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## Prevalence of COVID-19 Vaccines Side Effects in Libya: Post-vaccination Survey (Vaxzevria, Sputnik V, and Sinovac)

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### انتشار الآثار الجانبية للقاحات كوفيد-19 في ليبيا: مسح ما بعد التطعيم (فاكسيفريا وسبوتنيك V وسينوفاك)

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#### Abstract:

Background: Vaccination is considered one of the principal effective preventive measures to mitigate the risk of transmission of epidemic, pandemic, and infectious diseases among the population. Vaccine safety and efficacy are a great concern worldwide during the COVID-19 pandemic to produce a safe, effective, and well-tolerated vaccine in a finite period. Aims: The study was conducted to determine and assess the side effects of COVID-19 vaccines (AstraZeneca, sputnik V, and Sinovac) among the vaccinated Libyan population during the first COVID-19 vaccination campaign. Methods: During this study survey, one thousand well-designated structure questionnaires were distributed among participants in different Libyan municipalities' health service units (vaccination units). Results: The COVID-19 vaccines received during the first campaign were as follows: (27.2%) Vaxzevria, (58.7%) Sputnik V, and (14.1%) Sinovac. The COVID-19 vaccines had a significant ( $p=0.004$ ) influence on age classes. Regarding the tender swelling, the results showed 8.67%, 4.85%, and 21.3% for AstraZeneca, Sputnik, and Sinovac, respectively, and there was no statistical significance ( $p=0.57$ ). Compared ( $P=0.00001$ ), fatigue is the most prevalent (20.88%) side effect among the participants. The bleeding disorders were reported among participants who had received AstraZeneca (0.88%) and Sputnik V

(0.14%) vaccines. Conclusion: The overall prevalence of the most common side effects reported during this survey was mild, moderate, and severe. Tender swelling or redness, fever, fatigue, and headaches are the most prevalent side effects among the participants who received AstraZeneca and Sputnik V. The study reported a significant difference in the frequency of side effects among the age categories. Further studies are strongly recommended on the vaccine's side effects to provide more consolidated data that is required to reinforce public confidence in the vaccine.

**Keywords:** COVID-19 vaccines, Side effects, COVID-19, Libya.

### الملخص

الخلفية: يعتبر التطعيم أحد التدابير الوقائية الفعالة الرئيسية للتخفيف من خطر انتقال الأوبئة والأمراض المعدية بين السكان. تشكل سلامة اللقاح وفعالته مصدر قلق كبير في جميع أنحاء العالم أثناء جائحة كوفيد-19 لإنتاج لقاح آمن وفعال وجيد التحمل في فترة زمنية محدودة. الأهداف: أجريت الدراسة لتحديد وتقييم الآثار الجانبية للقاحات كوفيد-19 (أسترازينيكا وسبوتنيك V وسينوفاك) بين السكان الليبيين الذين تم تطعيمهم خلال حملة التطعيم الأولى ضد كوفيد-19. الطرق: خلال مسح الدراسة هذا، تم توزيع ألف استبيان هيكلي جيد التصميم بين المشاركين في وحدات الخدمة الصحية (وحدات التطعيم) التابعة لبلديات ليبية مختلفة. النتائج: كانت لقاحات كوفيد-19 التي تم تلقيها خلال الحملة الأولى على النحو التالي: (27.2%) فاكسيفريا، (58.7%) سبوتنيك V، و (14.1%) سينوفاك. كان للقاحات كوفيد-19 تأثير كبير ( $P=0.004$ ) على الفئات العمرية. وفيما يتعلق بالتورم المؤلم، أظهرت النتائج 8.67% و 4.85% و 21.3% لأسترازينيكا وسبوتنيك وسينوفاك على التوالي، ولم تكن هناك أهمية إحصائية ( $P=0.57$ ). وبالمقارنة ( $P=0.00001$ )، فإن التعب هو الأثر الجانبي الأكثر انتشاراً (20.88%) بين المشاركين. وتم الإبلاغ عن اضطرابات النزيف بين المشاركين الذين تلقوا لقاح أسترازينيكا (0.88%) وسبوتنيك V (0.14%). الاستنتاج: كان الانتشار العام لأكثر الآثار الجانبية شيوعاً المبلغ عنها خلال هذا الاستطلاع خفيفاً ومتوسطاً وشديداً. التورم المؤلم أو الاحمرار والحمى والتعب والصداع هي الآثار الجانبية الأكثر انتشاراً بين المشاركين الذين تلقوا لقاح أسترازينيكا وسبوتنيك V. وأفادت الدراسة بوجود فرق كبير في تواتر الآثار الجانبية بين الفئات العمرية. يوصى بشدة بإجراء المزيد من الدراسات حول الآثار الجانبية للقاح لتوفير المزيد من البيانات الموحدة المطلوبة لتعزيز ثقة المجتمع في اللقاح.

**الكلمات المفتاحية:** لقاحات كوفيد-19، الآثار الجانبية، كوفيد-19، ليبيا.

### Introduction

Coronavirus disease (COVID-19) was the last pandemic reported for the first time in Wuhan, China in 2019. COVID-19 is caused by severe acute respiratory syndrome Coronavirus-2 (SARS-CoV-2) [1]. Coronaviruses are divided into four genera: Alpha-, Beta-, Gamma-, and Delta-coronavirus. SARS-CoV-2 is a  $\beta$  coronavirus of group 2B with at least 70% similarity in its genetic sequence to SARS-CoV [2,3]. Similar to all RNA viruses, SARS-CoV-2 is disposed to make random errors in its genetic code while replicating. However, as the virus continues to spread across the globe, advantageous sequence variations are beginning to accumulate. Many of these mutations are corrected by proofreading mechanisms [4].

The SARS-CoV-2 variants have been labeled "variants of concern" (VOCs) by the World Health Organization (WHO) as of August 2021: Alpha (B.1.1.7, first detected in the UK), Beta (B.1.351, first detected in South Africa), Gamma (P.1, first detected in Brazil), and Delta (B.1.617.2, first detected in India) [5], while the omicron variant B.1.1.529 was discovered for the first time in Botswana and South Africa [6]. Regarding the existing COVID-19 vaccines, they are less effective at blocking infection with the omicron variant than at blocking infection with previous variants [7], however, protection against severe disease, hospitalization, and death from all current COVID-19 variants remains largely preserved. On the other hand, few vaccinated individuals still become mildly diseased from COVID-19 because no vaccine is completely effective [8].

Vaccination is considered one of the principal effective preventive measures to mitigate the risk of transmission of epidemic, pandemic, and infectious diseases among the population. COVID-19 is one of the worst pandemics reported in human history and has led to high rates of morbidity and mortality across the entire globe. Therefore, the impacts of the virus on public health (mortality and morbidity), and socioeconomic were great concerns and priorities and challenges for the World Health Organization (WHO) and global public health for the prevention and control of the COVID-19 pandemic.

Vaccine safety and efficacy are a great concern worldwide and have been in the debate between many organizations and companies involved in the manufacture of the vaccines that faced great challenges during the COVID-19 pandemic to produce safe, effective, and well-tolerated vaccines in a short period, scientist worldwide in challenges due to highly It's well-known that vaccines production need to undergo in clinical trials [9].

The vaccine evaluation should have passed through a multistage of experiments that involved clinical trials (pre-clinical, phase I, phase II, phase III, and phase IV: ongoing safety checks) including stages of evaluation and continuous monitoring (post-licensure monitoring of vaccines). It's well known that, the safety of COVID-19 vaccines has been tested, evaluated, and monitored on large scales with multistage randomized clinical trials that include stages of evaluation and continuous monitoring for vaccine safety and efficacy [9,10]. The study was conducted to determine and assess the side effects of COVID-19 vaccines (AstraZeneca, sputnik V, and Sinovac) among the vaccinated Libyan population during the first COVID-19 vaccination (first shot) campaign.

## **Material and methods**

### **Study area and study design**

During this study survey, about one thousand questionnaires were distributed among the participants, and only 680 valid questionnaires were obtained during this survey. All the participants were kept on observation after receiving the vaccine for at least 15–30 minutes at the vaccination units. The follow-up and communication with participants over some time intervals, within 24 hours, 48 hours, 72 hours, 5 days, and over one week.

### **Questionnaire survey**

Well well-designated structure questionnaire was distributed among the participants during the first COVID-19 campaign. The questionnaire data collection tool was prepared in both, English and Arabic languages. The questionnaire was composed of three parts, part I (General information or demographics), part II (Clinical aspects), and part III (vaccine side effects).

### **Statistical analysis**

Descriptive analyses frequency and percent were measured for numerical data, number, and percent for qualitative data by using SPSS version 22. The chi-square test was used to investigate the level of association among variables at the significance level of  $p < 0.05$ .

### **Ethical respects**

Throughout our study, we obtained informed consent from all participants to follow all criteria related to basic ethical principles.

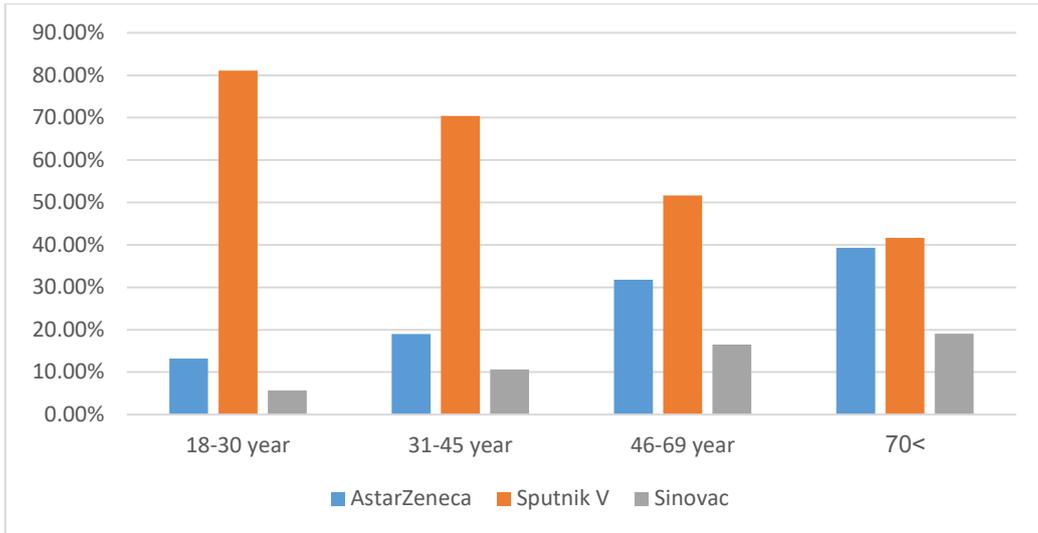
## **Results**

1-Demographic characteristics: Of the (1000) participants, a total of 680 participants were involved in this study. The overall response rate (68%). This study enrolled (55.1%) and (44.9%) of participants male and female respectively. Considering the age classes, the results revealed that (7.8%, 18-30 years), (31.8%, 31-45 years), (48.8%, 46-69 years) and (12.4%, >70 years). Regarding the nationalities of participants, Libyans represented (97.9%), while (1.9 %) and (0.1%) were from Arabian and other nationalities respectively.

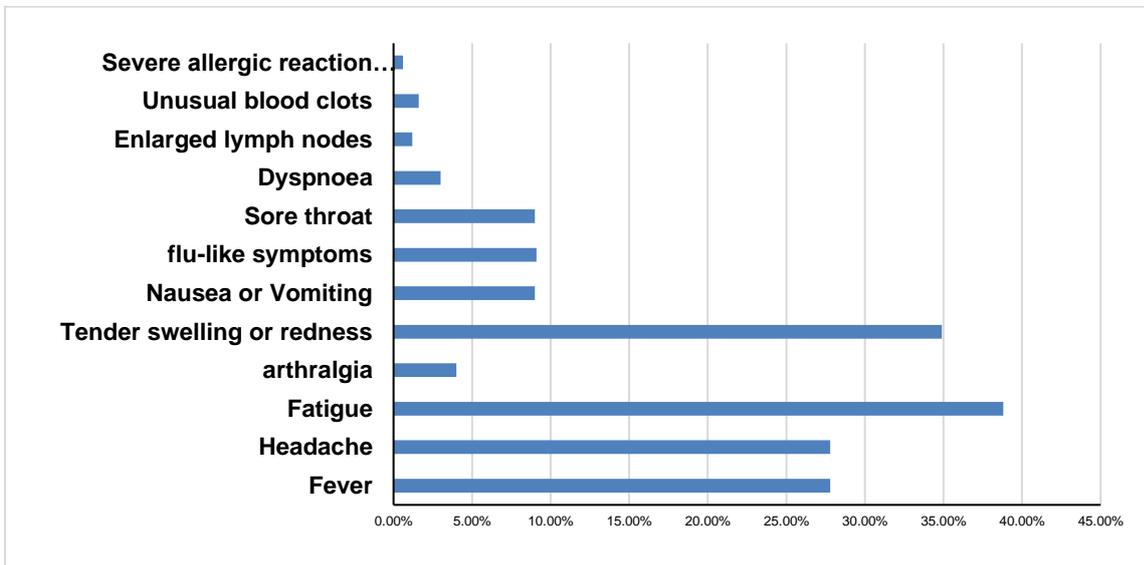
2-Clinical aspect: Considering the health status of the participants, (1.9%) and (98.1%) were unhealthy (respiratory signs) and healthy respectively. The results reported that (20.3%), (29.6%) and (50.1%) of the vaccinated individuals have received once, or twice, and have not been infected with COVID-19 respectively. The results showed that (7.9%) had a history of allergy whereas (92.1%) had not received it, while (6.6%) of the vaccinated individual had a therapeutic allergy, and (93.4%) had not received it. The results revealed that (5%) and (95%) of vaccinated individuals were diabetic and non-diabetic respectively. The results reported that (2.9%), (1.2%), (1%), and (0.4%) of the vaccinated individuals were asthmatic, heart disease, bleeding disorders, and vaccination allergies respectively. Approximately, (36.2%) of the participants received the flu vaccine last season before the COVID-19 vaccination campaign. Considering the COVID-19 infection, the results reported that 143 (21%) of the participants had been infected with COVID-19.

3-COVID-19 vaccine side effects: The COVID-19 vaccines received during the first campaign were as follows (27.2%) AstraZeneca, (58.7%) Sputnik V, and (14.1%) Sinovac. The distribution of vaccines according to age classes was as follows; (18-30) year was (13.20%), (81.13%) and (5.66%) of AstraZeneca, Sputnik V, and Sinovac respectively. In the age class (31-45) year was (18.98%), (70.37%) and (10.64%) of AstraZeneca, Sputnik V, and Sinovac respectively. In age class 46-69 year: 31.80% AstraZeneca, 51.68% Sputnik V and 16.51% Sinovac while in age class >70 years: 39.28% AstraZeneca, 41.66% Sputnik V and 19.04% Sinovac (Figure 1). Fever (temperature of 38 degrees Celsius or above) and headaches were reported among 189 (27.8%) of the participants, while fatigue 261 (38.8%) was the most prevalent side effect reported among participants (Figure 2).

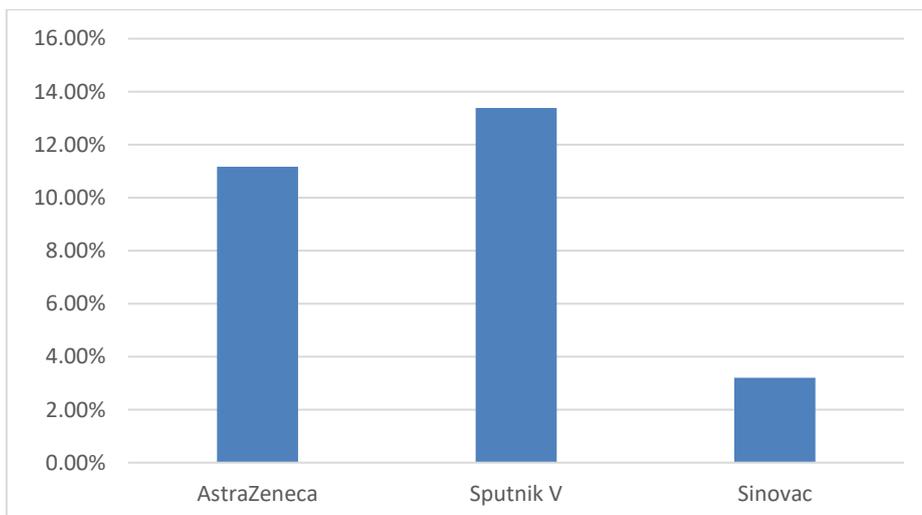
Considering the vaccine candidates, fever was reported among (11.17%), (13.38%) and (3.2%) who had received AstraZeneca, Sputnik V, and Sinovac respectively (Figure 3). Comparatively ( $P = .00001$ ),



**Figure 1: Percent of COVID-19 vaccines shoot among different age classes.**

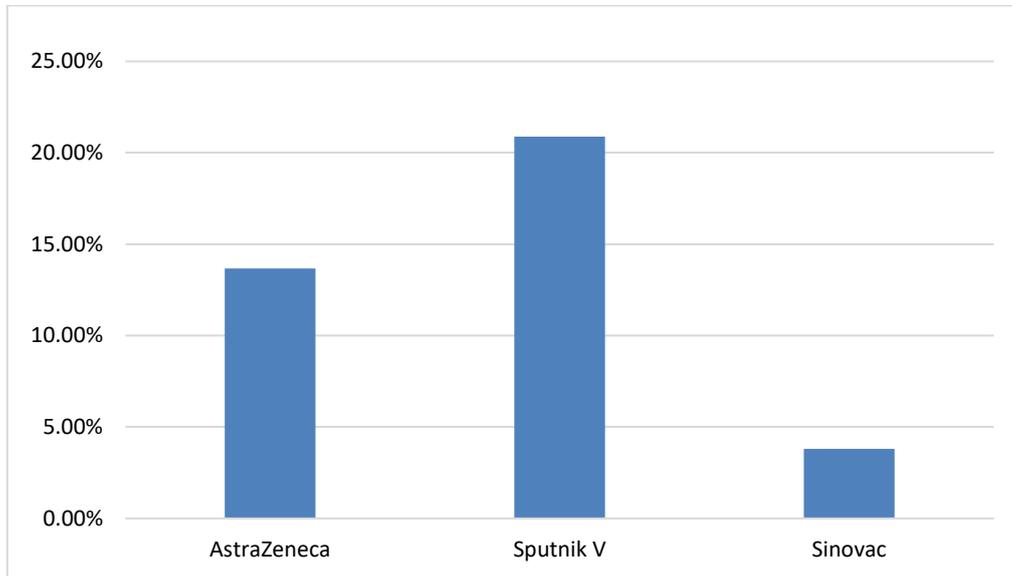


**Figure 2: Overall, COVID-19 vaccine side effects.**



**Figure 3: Percent of fever based on COVID-19 vaccine.**

fatigue is the most prevalent (20.88%) side effects among the participants who have received Sputnik V (Figure 4). Similarly, tenderness, swelling, or redness were the most prevalent side effects (21.3%) associated with Sputnik V vaccinations. However, fatigue was reported among (20.88%), (13.67%) and (3.82%) who had received AstraZeneca, Sputnik V, and Sinovac respectively, and there was a significant difference ( $p=0.0001$ ) (Table 1).



**Figure 4:** Percent of fatigue based on COVID-19 vaccine

The arthralgia was reported only among participants who had AstraZeneca and Sputnik vaccines, and results showed a statistical difference ( $p=0.001$ ) for both vaccines (Table 1). Regarding the tender swelling or redness, the results showed of 8.67%, 4.85%, and 21.3% for AstraZeneca, Sputnik, and Sinovac respectively, and there was no statistical significance ( $p=.57$ ). Comparatively, the flu-like symptoms were significantly (0.004) different among individuals who have received AstraZeneca (4.10%), Sputnik V (0.88%), and Sinovac (4.55%) (Table 1).

The results reported severe side effects due to AstraZeneca and Sputnik V, which include dyspnoea, unusual blood clots, and anaphylaxis. While enlarged lymph nodes were reported only among participants who have received the AstraZeneca vaccine.

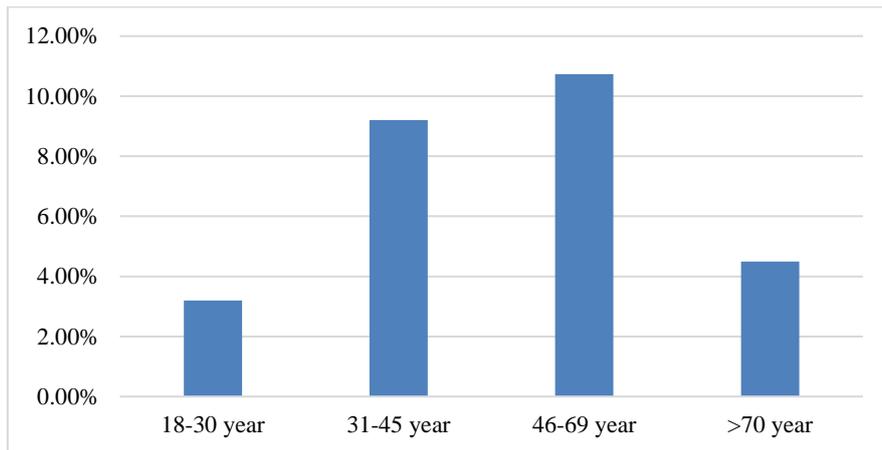
#### **The side effects according to age categories**

The results reported a significant difference in the frequency of side effects among the age categories. Fever was reported a significant difference ( $p=0.0001$ ) in four age groups, as follows (18-30 years: 11.6%), (31-45 years: 33.3%), (46-69 years: 38.6%) and (>70 years: 16.4%). Also, fatigue, arthralgia, nausea, flu-like symptoms, and lymphadenopathy were reported as significant differences among different age groups (Table 2). The age-wise prevalence was significantly influenced by COVID-19 vaccine side effects. The prevalence of fever according to age categories was as follows, (18-30 years: 3.2%), (31-45 years: 9.2%), (46-69 years: 10.73%) and (>70 years: 4.5%) (Figure 5). Significantly ( $p=.004$ ), age classes influenced with COVID-19 vaccines. The fever was reported in 11.17%, 13.38%, and 3.23% of vaccinated individuals with AstraZeneca, Sputnik, and Sinovac respectively. The fever was statistically significant ( $p=0.0001$ ).

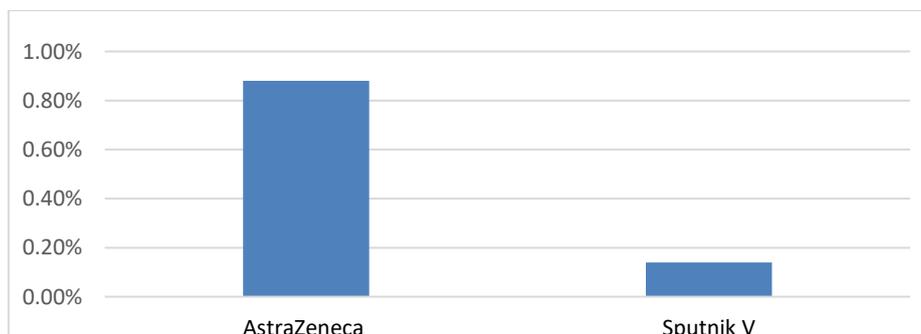
**Table 1:** COVID-19 vaccines (AstraZeneca, Sinovac, and Sputnik V) side effects.

Side effects	Percent of vaccines used			P<0.05
	AstraZeneca	Sinovac	Sputnik V	
Fever	11.17%	3.23%	13.38%	<b>0.0001</b>
Headache	9.7%	2.7%	15.29%	<b>0.009</b>
Fatigue	13.67%	3.8%	20.88%	<b>0.0001</b>
Arthralgia	2.2%	0%	1.7%	<b>0.001</b>
Tenderness swelling or redness	8.67%	4.85%	21.3%	0.57
Nausea or Vomiting	3.52%	0.88%	4.55%	0.074
flu-like symptoms	4.10%	0.88%	4.10%	<b>0.004</b>
Sore throat	0.29%	0%	0.58%	0.605
Dyspnoea	0%	0%	0.29	0.493
Enlarged lymph nodes	0.14%	0%	0%	0.231
Unusual blood clot (bleeding disorders)	0.88%	0%	0.14%	0.083
Severe allergic reaction (anaphylaxis)	0.14%	0%	0.44%	0.685

The headache was reported among (9.7%), (15.29%), and (2.7%) of the individuals who have received AstraZeneca, Sputnik, and Sinovac respectively. The results reported a significant difference (P=0.009). The bleeding disorders due to the vaccine's side effects were reported only in age classes 46-69 years (0.74%) and >70 years (0.39%), and the age category was not significantly (P= 0.061) influenced by bleeding disorders. The bleeding disorders were reported among participants who had received AstraZeneca (0.88%) and Sputnik V (0.14%) vaccines (Figure 6), and the p-value is 0.187279. Not significant at p<0.05, considering Sex, unusual blood clots were reported in 0.88% and 0.73% of males and females respectively, and no statistical significance (P=0.60)



**Figure 5:** The prevalence of fever according to age categories.



**Figure 6:** The percent of unusual blood clots.

**The side effects based on Sex**

The fever was reported in (26.6% and 29.18%) of males and females respectively, and there was no statistical significance reported. The tender swelling was the only side effect reported statistically significant (P=0.033) among males (31.2%) and females (39.3%) (Table 3). Generally, the results reported a higher prevalence of side effects in females than in males.

**Table 2.** The side effects of COVID-19 vaccines (AstraZeneca, Sputnik V, Sinovac) based on age categories.

Side effects	Age classes (year)				AstraZeneca	Sputnik V	Sinovac	P<0.05
	18-30 Y	31-45 Y	46-69 Y	>70 Y				
Fever	11.6%	33.3%	38.6%	16.4%	40.2%	48.2%	11.6%	<b>0.0001*</b>
Headache	7.9%	36.5%	39.6%	15.8%	34.9%	55.02	10.05	0.099
Fatigue	10.7%	38.6%	38.3%	12.26%	35.6%	54.4%	9.9%	<b>0.0001*</b>
Arthralgia	11.11%	44.4%	33.3%	11.11%	55.5%	44.4%	0%	<b>0.029*</b>
Tender swelling or redness	7.17%	43.4%	41.7%	7.5%	24.8%	61.18%	13.9%	0.166
Nausea or Vomiting	9.8%	39.3%	36.1	14.7%	39.3%	50.8%	9.8%	<b>0.013*</b>
flu-like symptoms	4.8%	46.7%	33.8%	14.5%	45.1%	45.1%	9.6%	<b>0.0001*</b>
Sore throat	16.6%	66.6%	16.6%	0%	3.2%	66.6%	0%	0.472
Dyspnoea	-	50%	50%	0%	0%	100%	0%	-
Enlarged lymph nodes	12.5%	50%	25%	12.5%	25%	87.5%	0%	<b>0.046*</b>
Unusual blood clots	0%	36.3%	54.5%	9.09%	54.5	45.4%	0%	0.273
Severe allergic reaction (anaphylaxis)	0%	75%	25%	0%	25%	75%	0%	<b>0.046</b>

**Table 3:** COVID-19 vaccine side effects based on the Sex

Side effects	Sex		P<0.05
	Male	Female	
Fever	26.6%	29.18%	0.521
Fatigues	36.5%	40.6%	0.308
Headaches	25.6%	30.4%	0.183
Tender swelling or redness	31.2%	39.3%	<b>0.033</b>
Nausea	8.8%	9.1%	0.970
Flu-like symptoms	5.6%	13.44%	<b>0.0001</b>
Sore throat	0.53%	1.3%	0.252
Dyspnoea	0	0.65	0.201
arthralgia	3.4%	1.6%	0.583
Lymphadenopathy	0.53%	1.9%	0.172
bleeding disorders	1.6%	1.6%	0.968
Severe allergic reaction	0.26%	0.98%	0.477

### COVID-19 side effects based on the clinical history

#### The side effects of COVID-19 vaccines among previously infected and non-infected

The results reported no statistical difference between previously infected and non-infected participants. The high-frequency side effects were documented among the previously infected experienced as compared with non-infected participants (Table 4).

**Table 4:** The side effects of COVID-19 vaccines among previously infected and non-infected participants

Side effects	Diabetic (%)	Non-Diabetic (%)	AstraZeneca	Sputnik V	Sinovac	P<0.05
Fever	23.52%	28.02%	40.2%	48.1%	11.64%	0.057
Headache	23.5%	28.02%	34.92%	55.02%	10.05%	<b>0.002</b>
Fatigue	32.4%	38.69%	35.6%	54.40%	9.96%	<b>0.012</b>
Arthralgia	0%	4.1%	55.55%	44.44%	0%	-
Tender swelling or redness	38.23%	34.67%	24.8%	61.18%	13.92%	0.223
Nausea or Vomiting	11.76%	8.82%	39.34%	50.81%	9.81%	0.430
flu-like symptoms	8.8%	9.1%	45.16%	45.16%	9.6%	0.168
Sore throat	0%	0.96	33.33%	66.66%	0%	-
Dyspnoea	0%	0.30	0%	100%	0%	-
Severe allergic reaction (anaphylaxis)	0%	0.62%	25%	75%	0%	-
Unusual blood clots	2.94%	1.54%	54.5%	45.5%	0%	<b>0.012</b>

### COVID-19 vaccine side effects among diabetic and non-diabetic participants

The frequency of side effects was higher in the case of diabetic than in the non-diabetic participants. Headaches, fatigue, and unusual blood clots was reported with significant differences, while sore throat, dyspnea, and anaphylaxis were reported only among non-diabetic participants (Table 5).

**Table 5:** COVID-19 vaccine side effects among diabetic and non-diabetic participants.

Side effects	VTE	Non-VTE	AstraZeneca	Sputnik V	Sinovac	P<.05
Fever	28.6%	27.8%	40.02%	48.14%	11.64%	0.569
Headache	28.6%	4.14%	34.92%	54.49%	10.05%	0.963
Fatigue	57.14%	38.18%	35.63%	54.40%	9.96%	0.244
arthralgia	0%	4.01%	55.55%	44.44%	0%	-
Tender swelling or redness	42.85%	34.76%	24.89%	61.18%	13.92%	<b>0.012</b>
Nausea or Vomiting	28.57%	8.76%	39.34%	50.81%	9.83%	0.114
flu-like symptoms	28.57%	8.91%	45.16%	45.16%	9.69%	0.072
Enlarged lymph nodes	14.2%	1.04%	12.5%	87.5%	0%	<b>0.008</b>
Sore throat	0%	0.89%	33.33%	66.66%	0%	-
Dyspnoea	0%	0.29%	0%	100%	0%	-
Severe allergic reaction (anaphylaxis)	0%	0.59%	25%	75%	0%	-
Unusual blood clots	14.28%	1.4%	54.54%	45.45%	0%	0.361

### Side Effects of COVID-19 vaccines among participants with a history of venous thromboembolism (VTE) and non-VTE

The results reported highly prevalent side effects among participants with a history of VTE and non-VTE including unusual blood clots, lymphadenopathy, flu-like symptoms, nausea, fever, and fatigue, however, the results showed a statistical significance only among participants experiencing tender swelling and lymphadenopathy (Table 6).

### The side effects of COVID-19 vaccines among hypertensive (HTN) and non-hypertensive (non-HTN) participants

The results showed a significant difference in the side effects of COVID-19 among HTN and non-HTN participants which includes fatigue, headaches, arthralgia, nausea, flu-like symptoms and lymphadenopathy, with significant differences among participants who experienced a fever, fatigue, nausea or vomiting, flu-like symptoms, and enlarged lymph nodes (Table 7).

**Table 6:** Side Effects of COVID-19 vaccines among participants with a history of VTE and non-VTE.

Side effects	HTN	Non-HTN	AstraZeneca	Sputnik V	Sinovac	P<.05
Fever	37.17%	26.5%	21.7%	11.5%	3.8%	<b>0.049</b>
Headache	34.6%	26.9%	16.6%	16.6%	1.28%	0.15
Fatigue	56.4%	36.04	45.4%	45.4%	9.09%	<b>0.027</b>
Arthralgia	5.12%	3.8%	55.5%	44.4%	0%	0.053
Tender swelling or redness	34.6%	34.8%	24.8%	61.18%	13.9%	0.299
Nausea or Vomiting	115.3%	8.13%	75%	8.33%	16.66%	<b>0.027</b>
flu-like symptoms	10.2%	8.97%	87.5%	12.5%	0%	<b>0.035</b>
Sore throat	1.28%	0.83%	0%	0%	100%	0.705
Enlarged lymph nodes	2.5%	0.99%	12.5%	87.5%	0%	<b>0.027</b>
Unusual blood clots	2.5%	1.49%	54.54%	45.45%	0%	0.154

**Table 7:** The side effects of COVID-19 vaccines among hypertensive (HTN) and non-hypertensive (non-HTN) participants.

Side effects	Influenza vaccine	Non-Influenza vaccine	AstraZeneca	Sputnik V	Sinovac	P<.05
Fever	30.8%	26.03%	40.2%	48.1%	11.6%	0.160
Headache	28.8%	27.18%	34.9%	55.02%	10.05%	0.084
Fatigue	0.2%	37.3%	35.6%	54.4%	9.9%	0.221
Arthralgia	2.8%	4.6%	55.5%	44.4%	0%	0.298
Tenderness swelling or redness	47.9%	27.4%	24.8%	61.8%	7.6%	<b>0.001</b>
Nausea or Vomiting	12.6%	6.9%	39.3%	50.85	9.8%	0.711
flu-like symptoms	11.7%	7.6%	45.1%	45.1%	9.6%	0.854
Sore throat	1.2%	0.69%	33.3%	66.6%	0%	0.800
Dyspnoea	0.40%	0.23%	0%	100	0%	0.060
Enlarged lymph nodes	2.03%	0.69	12.5%	87.5%	0%	0.625
Unusual blood clots	1.6%	1.6%	54.5%	45.4%	0%	0.652

## The side effects of COVID-19 vaccines among vaccinated and non-vaccinated participants with the influenza vaccine

The results reported relatively high side effects among influenced vaccinated participants as compared with influenced non-vaccinated, where tender swelling, fatigue, and fever are the most experienced side effects among influenced vaccinated participants. Only tender swelling reported a significant difference (P=0.001) (Table 8).

**Table 8:** The side effects of COVID-19 vaccines among vaccinated and non-vaccinated participants with the influenza vaccine.

Side effects	Previous Infected	Non-infected	AstraZeneca	Sputnik V	Sinovac	P<0.05
Fever	28.67%	27.56%	40.2%	48.14%	11.64%	0.795
Headache	32.16%	26.62%	34.9%	55.02%	10.05%	0.177
Fatigue	46.15%	36.31%	35.63%	54.40%	9.96%	.0218
Arthralgia	2.79%	4.28%	55.55%	44.44%	0%	0.216
Tender swelling or redness	41.95%	32.96%	24.89%	61.18%	13.92%	0.199
Nausea or Vomiting	11.18%	8.37%	39.3%	50.81%	9.8%	0.392
flu-like symptoms	10.48%	8.75%	45.16%	45.16%	9.6%	0.224
Sore throat	0.69%	0.93%	33.3%	66.6	0%	0.121
Dyspnoea	0%	0.37%	0%	100%	0%	
Enlarged lymph nodes	2.1%	0.93%	12.5%	87.5%	0%	0.168
Unusual blood clots (bleeding disorders)	2.1%	1.5%	54.5%	45.5%	0%	0.387
Severe allergic reaction (anaphylaxis)	0%	0.74%	25%	75%	0%	0.179

## Discussion

This preliminary study reports the primary outcome measure, incidence, and most side effects and safety of COVID-19 vaccines used during the first COVID-19 vaccination campaign in Libya. The Libyan Government of National Unity received the first shipment of 101250 doses of Sputnik V vaccines on April 4, 2021, and the second shipment with 100000 doses of Sputnik V vaccines was received on the 9th of April. The only vaccine that was sent to Libya through the COVAX Facility was the AstraZeneca vaccine on the 8th of April with a total of 57600 doses. A shipment of a total of 150000 doses of the Sinovac vaccine was received as a gift to Libya from the Turkish government on the 14th of April. The vaccination campaign started on the 10th of April and up to the 10th of May, a total of about 100000 people have been vaccinated with a single dose [11], Sputnik V constituted the most vaccines received among the participants followed by AstraZeneca and Sinovac. The Sputnik V vaccine is a heterologous recombinant adenovirus (rAd)-based vaccine, Gam-COVID-Vac (rAd26-S and rAD5-S), and is one of COVID-19 vaccines made by a Russian company evaluated and approved by the Russian authorities as early as other types of vaccine implemented in the emergence use contain the glycoprotein S gene of the SARS-CoV-2 virus. This vaccine's first and second doses are based on two different types of adenoviruses. Phase 1/2 studies indicated that both formulations of this vaccine (rAd26-S and rAD5-S) were safe showed 91-6% efficacy against COVID-19 and were well tolerated in a large cohort [10]. The Oxford–AstraZeneca COVID-19 vaccine (chimpanzee adenovirus ChAdOx1), is one of the adenoviral viral vector vaccines that deliver genetic material (mRNA) coding for the desired antigen into the recipient's host cells. The vaccine was developed by the Jenner Institute of Oxford University and the British-Swedish Company AstraZeneca [12]. The Sinovac vaccine is a whole-inactivated virus COVID-19 vaccine developed by a Chinese biopharmaceutical company. During this study, the overall prevalence of the most common side effect reported during this survey was as follows mild, moderate, and severe side effects [13, 14]. The mild side effects include fever, fatigue, and headache, and these side effects are considered grade one. Moderate side effects (grade two) include sore throat, arthralgia, tenderness swelling, redness, and nausea or vomiting. While severe side effect (grade three) includes, flu-like symptoms, dyspnoea, enlarged lymph nodes (Lymphadenopathy), and severe allergic reaction (anaphylaxis). Generally, in the current study, fever was reported for all three candidates of vaccines. In line with other previous studies, fever was reported among most participants who had received AstraZeneca and Sputnik V [15]. While with the Sinovac vaccine, fever was reported in a relative number of the participants. Many works of literature reported low adverse events with the Sinovac vaccine [16, 17]. Frequently, fever is considered one of the most prevalent signs during any vaccination as a result of immune system defense responses against any foreign bodies. Like all vaccines, fever is very common after COVID-19 vaccinations [15].

Headache was the most common side effect reported in three studied vaccines. Our results showed a statistically significant difference among the participants who received three studies vaccines, and headaches reported a high frequency with Sputnik V vaccines compared to Sinovac and AstraZeneca. In agreement with a previous study that reported headaches as the most common adverse event of COVID-19 vaccines (Gam-COVID-Vac, Sputnik V) [10]. In the current study, the overall severe (systemic) side effects are dyspnoea (3%), enlarged lymph nodes (Lymphadenopathy) (1.2%) unusual blood clots (bleeding disorders) (0.58%), and severe allergic reaction (anaphylaxis) (6%). Comparatively, the severe side effects were reported only with AstraZeneca and Sputnik V vaccines, while with Sinovac vaccines, none of the participants experienced severe side effects, and therefore AstraZeneca and Sputnik V vaccines have more severe side effects than Sinovac, The side effects of COVID-19 vaccines reported in this survey were significantly influenced by age classes. However, based on the distribution of the vaccines among the age groups involved in this survey, the results revealed a significant difference among the age groups who had received different types of vaccines. Sputnik V has constituted the most vaccines received among different age classes followed by AstraZeneca and Sinovac. The age-wise prevalence of vaccine side effects significantly influences three studied vaccines. The age group 31-45 years was the most age group that experienced high side effects for the three studied vaccines. In the context of the side effects, many works of literature reported significant differences among age groups during conducting COVID-19 vaccination campaigns, and the side effects were potentially influenced among different age groups [18,19,20]. Fatigue (mild side effect) and tender swelling (moderate side effect) was the most prevalent side effects among the participants who had received Sputnik V. However, the study showed a significant difference in the prevalence of fatigue and tenderness swell among the different age groups. Similarly, arthralgia, nausea, flu-like symptoms, and lymphadenopathy were significantly different among age groups. In concordance with other study a higher frequency among females compared to males (16.8% vs. 10.6%), young adults compared to old adults (17.3% vs. 15.1%) [14]. Interestingly, bleeding disorders were reported among participants belonging to age groups 46-69 years and >70 years who had received AstraZeneca and Sputnik V vaccines, however, a relative number of the participants had bleeding problems after the vaccination with both vaccines, in spite of thoroughly tested of both vaccines, evaluated, and monitored on large scales with multistage randomized clinical trials [10,12, 21, 22]. Therefore, this adverse side effect (blood clots) is extremely rare to develop as a consequence of the vaccine, however, our survey reports bleeding disorders due to COVID-19 vaccines (AstraZeneca and Sputnik V). Blood clots after the vaccination don't necessarily mean that due to side effects from the vaccine and might be linked to other pathogenic disorders like thrombocytopenia [23,24]. The flu-like symptoms were reported among (4.10%) of the participants who received AstraZeneca and Sputnik V vaccines, and only (0.88%) of participants who had received Sinovac vaccines. Our study reported more adverse effects in females than in males, however, tender swelling was the only side effect reported as statistically significant ( $p=0.033$ ) among males and females. In agreement with other studies, females experienced more side effects than males [14,15]. The difference in the prevalence of injection site pain between males and females might be attributable to the variance in the intolerance and immune response [14,15,25]. Regarding COVID-19 vaccine side effects among previously infected and non-infected, the results reported highly prevalent side effects among previously infected participants, however, no significant difference was reported. In agreement with other studies reported a high frequency of COVID-19 vaccine side effects with a history of previously infected individuals [20,26,27,28]. COVID-19 vaccine side effects in diabetic and non-diabetic participants were reported with significant differences: headache ( $P=0.002$ ) and fatigue ( $P=0.012$ ), which were more frequent with Sputnik V among non-diabetic participants [14]. In contrast, the unusual blood clot was reported mainly among diabetic participants who had received the AstraZeneca vaccine, which might be related to the pathophysiology of diabetes mellitus as a risk factor in coincidence with COVID-19 vaccines, while in non-diabetic participants, the prevalence was considerably lower (1.54%). Considering the side effects of COVID-19 vaccines among vaccinated and non-vaccinated participants with the influenza vaccine, the vaccinated participants with the influenza vaccine reported more adverse effects as compared with non-vaccinated participants, however, the results reported no significant difference in the side effects between vaccinated influenza vaccines and non-vaccinated, and only tender swelling reported a significant difference ( $p=0.001$ ).

### **Conclusion**

Our results reported side effects ranging from moderate to severe side effects among the participants. Tender swelling or redness, fever, fatigue, and headaches are the most prevalent side effects among the participants who received AstraZeneca and Sputnik V. The study reported a significant difference in the frequency of side effects among the age categories. Further studies are strongly recommended

on the vaccine's side effects in the long term for the second dose of vaccines and include the children, and other vaccines that are allowed to be used during and after this study to provide more consolidated data that is required to reinforce public confidence in the vaccine. The study not funded and the authors have not received any fund.

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