Shoulder injury related to vaccine administration following COVID-19 vaccination: Insights from a cross-sectional study in Northern Jordan

Naser Obeidat, MD* Ruba Khasawneh, MD* Ahmad Alrawashdeh, PhD** Yahya Alshgerat, MD*** Leen Walid Sawalha, MD**** Dimah Jiad, MD***** Ahmad Al Hanini, MD****** Bayan Ibrahim Al Mashaleh, MD******* Ammar Al-Tawarh, MD******** Majed M. Aljarrah, MD********

ABSTRACT

To examine the clinical presentation, risk factors, and management strategies of shoulder injury related to vaccine administration (SIRVA) following COVID-19 vaccination. A cross-sectional study was undertaken in Northern Jordan from May 2021 to May 2022. Adults with new-onset shoulder symptoms post-COVID-19 vaccination were included. Demographic, clinical, and vaccination-related data were collected via medical records and a structured survey. Symptom characteristics, severity, duration, and treatment modalities were analysed. Sixty-three participants were enrolled. Pain at the injection site (46.0%) and limited range of motion (46.0%) were most commonly reported. Overall, 84.2% experienced moderate to severe symptoms, and 34.9% noted symptoms persisting beyond one month. AstraZeneca recipients reported higher rates of adverse events than those receiving Pfizer or Sinopharm. Conservative management, involving analgesics (44.4%) and physical therapy (42.9%), was prevalent, whereas invasive interventions were rarely necessary. Notably, 87.3% of participants expressed reluctance to receive future vaccines. SIRVA after COVID-19 vaccination can present with prolonged moderate to severe symptoms and substantial vaccine hesitancy. Emphasising proper injection technique, enhanced provider training, and early intervention is crucial to reducing the burden of SIRVA and maintaining public trust in vaccination.

Keywords: SIRVA, COVID-19, vaccine, Shoulder, Jordan

INTRODUCTION

An adverse event following immunisation (AEFI) is any untoward medical occurrence that happens after vaccination, which may not necessarily have a causal relationship with the vaccine[1]. Among the significant AEFIs is shoulder injury related to vaccine administration (SIRVA). SIRVA is characterised by persistent shoulder dysfunction, including pain, stiffness, and weakness, in a previously healthy shoulder, typically starting within 48 hours of vaccination and poorly responsive to conventional analgesics[2,3]. This condition can be debilitating and may contribute to vaccine hesitancy among patients[4].

Historically, SIRVA has been most commonly associated with influenza vaccinations[5,6]. However, the mass immunisation efforts against the SARS-CoV-2 pandemic have led to a noticeable increase in reported SIRVA cases following COVID-19 vaccine administration[4-10]. The rapid scale-up of vaccination programs may have involved healthcare workers with varying levels of experience in vaccine administration, potentially contributing to improper injection techniques[11].

The exact pathogenesis of SIRVA is not fully understood. It is hypothesised that SIRVA results from mechanical injury to shoulder structures due to improper injection technique, and/or an immune-mediated inflammatory reaction to vaccine components or adjuvants within the shoulder joint[3,12]. Improper techniques, such as high needle placement, incorrect needle angle, or using inappropriate needle length relative to the patient's BMI, can lead to overpenetration and injury to underlying structures like the subdeltoid bursa or axillary nerve[3].

* Department of Diagnostic Radiology and Nuclear Medicine, Faculty of Medicine, Jordan University of Science and Technology, Irbid, 22110, Jordan.
Email: nmobeidat8@just.edu.jo
** Department of Allied Medical Sciences, Jordan University of Science and Technology, Irbid, 22110, Jordan.
*** Surgery Department, Princess Basma Hospital, Irbid, Jordan.
**** King Abdullah University Hospital, Irbid, 22110, Jordan.
***** Department of Obstetrics and Gynaecology, Jordan Hospital, Amman, Jordan.
****** Department of Internal Medicine, King Abdullah University Hospital, Irbid, 22110, Jordan.
******* Department of Neurology, King Abdullah University Hospital, Irbid, 22110, Jordan.
******** Department of Surgery, Abdali Hospital, Amman, Jordan.

Given the increase in SIRVA cases and their potential impact on public health, there is a need to better understand their clinical presentation, risk factors, and management. This study aims to describe the symptoms and clinical course of SIRVA following COVID-19 vaccination and to identify probable risk factors associated with its occurrence. Additionally, we evaluate the effectiveness of various treatment modalities to contribute to establishing a standardised management approach for SIRVA.

METHODS

Study Design and Setting: This cross-sectional study was conducted at the orthopedic shoulder clinic of a tertiary care center located in Irbid, Northern Jordan. The study targeted patients who presented with shoulder complaints following COVID-19 vaccination between May 2021 and May 2022. Data collection occurred from October 23, 2023, to December 29, 2023.

Participants: Eligible participants were patients aged 18 years and older who developed shoulder symptoms after receiving a COVID-19 vaccine during the study period. Patients with pre-existing shoulder conditions unrelated to vaccination were excluded from the study.

Participant selection: Patients' contact information was obtained from the clinic's electronic medical records. All eligible patients were contacted by telephone to introduce the study and invite them to participate. Those who agreed were sent an informed consent form and the survey via WhatsApp messaging. Participation was voluntary, and confidentiality was assured.

Data Sources and Measurement: Data was collected from two primary sources: medical records and patient self-reports. Medical records provided clinical diagnoses, treatment information, and contact details. The survey collected information on demographics, vaccination details, symptom characteristics, medical history, treatment outcomes, and any missing data not available in medical records. Symptom severity and progression were assessed based on patient self-reporting using standardized questions. Efforts were made to aid recall by providing specific time frames and definitions within the survey.

Data Collection and Variables: A structured questionnaire was developed based on previous literature and input from orthopedic specialists[3-6]. The questionnaire was pilot-tested on a small group of patients to ensure clarity and validity. The survey collected data on demographic information, including age, gender, weight, height, and occupation. Clinical information gathered included the type of COVID-19 vaccine received (Pfizer, Sinopharm, AstraZeneca, or others), the number of doses, the arm of injection (same arm, different arm, or not remembered), the dominance of the injected arm, and details about the place and administrator of the vaccine.

Symptom characteristics were also collected, encompassing the types of adverse events experienced, such as pain at the injection site, limited range of motion, numbness in the arm, or other symptoms. Symptom severity was subjectively categorized by patients as mild, moderate, or severe. The timing of symptom onset was recorded as immediate, less than 24 hours, one day to one week, or more than one week after vaccination. The duration of symptoms was categorized as one or two days, less than one week, one week to one month, or more than one month. Participants were asked about symptom progression, whether symptoms improved, remained the same, or worsened over time, and whether they experienced complete recovery, intermittent symptoms, or no improvement.

Information on medical interventions and outcomes was collected, including any interventions undertaken such as the use of analgesics, physical therapy, steroid injections, oral steroids, surgical interventions, or none. Radiological imaging performed was documented, including X-ray, CT scan, MRI, ultrasound, or none. Participants were also asked about vaccine hesitancy and their reluctance to receive future vaccines due to their experience.

Ethical Considerations: The study was approved by the Institutional Review Board of the involved hospital (Approval No. 9/177/2024). Written informed consent was obtained electronically from all participants before survey completion. Confidentiality was maintained by assigning unique identifiers to each participant, and all data were stored securely and accessed only by authorized research personnel.

Statistical Analysis: Statistical analyses were performed using Stata Statistical Software version 16.0 (StataCorp LLC, College Station, TX). Descriptive statistics were calculated for all variables. Continuous variables were presented as means and standard deviations (SD), while categorical variables were expressed as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test when appropriate. A p-value of less than 0.05 was considered statistically significant. Missing data were handled by excluding cases with incomplete responses for specific variables; no imputation was performed.

RESULTS

A total of 63 participants were included in the study. The demographic and vaccine characteristics are summarized in Table 1. Participants were almost equally distributed between females (n = 31, 49.2%) and males (n = 32, 50.8%). The most common age group was 35-45 years (n=19, 30.2%), followed by those over 55 years (n=17, 27.0%). Almost two-thirds of the participants were overweight (n=22, 43.1%) or obese (n=13, 20.6%).

The most prevalent chronic condition was cervical herniated disc (n=18, 28.6%), followed by hypertension (n = 15, 23.8%) and diabetes mellitus (n = 12, 19.0%). Over one-third of the participants (n = 23, 36.5%) reported no chronic diseases. About one-third of the participants reported exercising (n=19, 30.2%).

Table 1. Demographic and vaccine characteristics of included participants.

Characteristics	**Total,** n (%)
Demographics	
Sex	
Female	31 (49.2)
Male	32 (50.8)
Age group	
18-25	6 (9.5)
25-35	7 (11.1)
35-45	19 (30.2)
45-55	14 (22.2)
>55	17 (27.0)
Weight (mean, SD)	75.7 (14.2)
Height (mean, SD)	167.8 (9.4)
BMI Category	
Normal weight (18.5 to 24.9 kg/m²)	23 (36.5)
Overweight (25 to 29.9 kg/m²)	27 (42.9)
Obesity (>29.9 kg/m²)	13 (20.6)

Chronic disease	
DM	12 (19.0)
HTN	15 (23.8)
Cervical herniated disc	18 (28.6)
Peripheral neuropathy	8 (12.7)
Rheumatism	3 (4.8)
Other	10 (15.9)
None	23 (36.5)
Exercise	
No	44 (69.8)
Yes	19 (30.2)
Vaccination characteristics	
Vaccine doses	
1	3 (4.8)
2	52 (82.5)
>2	8 (12.7)
Vaccine type	
Pfizer	42 (66.7)
Sinopharm	11 (17.5)
AstraZeneca	8 (12.7)
Others	2 (3.2)
Arm of vaccine	
In the same arm	35 (55.6)
Do not remember	20 (31.8)
In different arms	8 (12.7)
Dominant arm	
Yes	21 (33.3)
No	27 (42.9)
Do not remember	15 (23.8)
Vaccine place	
Certified Clinic	52 (82.5)
Hospital	9 (14.3)
Other	2 (3.2)
Vaccine administrator	
Nurse	46 (73.0)
Do not know	11 (17.5)
Physician	3 (4.8)
Other	3 (4.8)
Symptom after Dose	
After first dose	14 (22.2)
After second dose	17 (27.0)
After two doses	32 (50.8)

Most participants (82.5%, n=52) had received two doses of the COVID-19 vaccine. The majority received the Pfizer vaccine (n = 42, 66.7%), followed by Sinopharm (n = 11, 17.5%), and AstraZeneca (n = 8, 12.7%). Vaccines were primarily administered by nurses (n = 46, 73.0%). A proportion of 55.6% (n = 35) received the vaccine in the same arm for all doses, while 12.7% (n = 8) received it in different arms, and 31.8% (n = 20) did not remember.

Table 2 presents the symptom characteristics of the included participants. The most frequently reported symptoms were pain at the injection site (n=29, 46.0%), and limited range of motion (n=29, 46.0%). Numbness in the arm was reported by 22.2% (n=14) of participants, and other symptoms were reported by 36.5% (n=23).

More than 40% of the included participants reported either moderate or severe symptoms, while only 16% reported mild symptoms. The onset of symptoms majority occurred within one week after vaccination (n=46, 73.0%). The duration of symptoms varied, with 34.9% (n = 22) experiencing symptoms for more than one month. Regarding symptom progression, 57.1% (n = 36) reported that their symptoms improved over time, 23.8% (n = 15) stated that symptoms worsened. Complete

Table 2. Symptom Characteristics of Participants

Characteristics	**Total** n (%)
Adverse Events	
Pain in the injection site	29 (46.0)
Limited ROM	29 (46.0)
Numbness in the arm	14 (22.2)
Others	23 (36.5)
Symptom severity	
Mild	10 (15.9)
Moderate	27 (42.9)
Severe	26 (41.3)
Time to Symptoms	
Immediate	9 (14.3)
Less than 24 hours	20 (31.7)
One day to one week	17 (27.0)
More than one week	17 (27.0)
Symptom duration	
One or two days	13 (20.6)
Less than one week	15 (23.8)
One week to one month	13 (20.6)
More than one month	22 (34.9)
Symptom improvement	
Improve	36 (57.1)
Same	12 (19.1)
Worsen	15 (23.8)
Completely cured	
Yes	27 (42.9)
On\off	26 (41.3)
No	10 (15.9)
Correct injection site	
No, he/she gave it to me too high	2 (3.2)
Yes, he/she gave it to me in the correct place	12 (19.1)
Do not remember	49 (77.8)
Symptom intervention	
No	43 (68.3)
Yes	20 (31.7)
Radiology imaging	
X-Ray	12 (19.0)
CT scan	5 (7.9)
MRI	22 (34.9)
Ultrasound	10 (15.9)
None	25 (39.7)
Medical intervention	
Analgesics	28 (44.4)
Physical therapy	27 (42.9)
Steroid injection	9 (14.3)
Steroid oral	3 (4.8)
Surgical intervention	1 (1.6)
None	17 (27.0)
Hesitant receiving vaccines	
No	8 (12.7)
Yes	55 (87.3)

Table 3. Symptom and medical intervention characteristics stratified by vaccine type

Characteristics	**Pfizer n=42 n (%)**	**Sinopharm n=11 n (%)**	**AstraZeneca n=8 n (%)**	**P-value**	**P-value2**
Hesitant receiving vaccines				0.901	1.000
Yes	36 (85.7)	10 (90.9)	7 (87.5)		
No	6 (14.3)	1 (9.1)	1 (12.5)		
Symptom after Dose				0.314	0.336
After first dose	11 (26.2)	0 (0.0)	1 (12.5)		
After second dose	12 (28.6)	3 (27.3)	2 (25.0)		
After two doses	19 (45.2)	8 (72.7)	5 (62.5)		
Adverse Events					
Pain in injection site	19 (45.2)	7 (63.6)	3 (37.5)	0.459	0.494
Limited ROM	22 (52.4)	4 (36.4)	1 (12.5)	0.097	0.095
Numbness in the arm	9 (21.4)	3 (27.3)	2 (25.0)	0.909	0.899
Others	15 (35.7)	2 (18.2)	6 (75.0)	**0.037**	**0.044**
Symptom severity				0.571	0.604
Mild	6 (14.3)	3 (27.3)	1 (12.5)		
Moderate	17 (40.5)	5 (45.5)	5 (62.5)		
Severe	19 (45.2)	3 (27.3)	2 (25.0)		
Time to symptoms				0.963	0.966
Immediate	6 (14.3)	2 (18.2)	1 (12.5)		
Less than 24 hours	14 (33.3)	2 (18.2)	3 (37.5)		
One day to one week	10 (23.8)	4 (36.4)	2 (25.0)		
More than one week	12 (28.6)	3 (27.3)	2 (25.0)		
Symptom duration				0.483	0.462
One or two days	9 (21.4)	3 (27.3)	1 (12.5)		
Less than one week	8 (19.1)	4 (36.4)	3 (37.5)		
One week to one month	11 (26.2)	0 (0.0)	1 (12.5)		
More than one month	14 (33.3)	4 (36.4)	3 (37.5)		
Completely cured				0.264	0.284
Yes	16 (38.1)	7 (63.6)	3 (37.5)		
On\off	18 (42.9)	2 (18.2)	5 (62.5)		
No	8 (19.1)	2 (18.2)	0 (0.0)		
Symptom intervention				0.212	0.267
No	26 (61.9)	9 (81.8)	7 (87.5)		
Yes	16 (38.1)	2 (18.2)	1 (12.5)		
Medical intervention					
Analgesics	16 (38.1)	4 (36.4)	7 (87.5)	**0.030**	**0.035**
Physical therapy	21 (50.0)	3 (27.3)	3 (37.5)	0.369	0.419
Steroid injection	7 (16.7)	1 (9.1)	1 (12.5)	0.805	1
Steroid oral	2 (4.8)	1 (9.1)	0 (0.0)	0.662	0.681
Surgical intervention	1 (2.4)	0 (0.0)	0 (0.0)	0.795	1
None	11 (26.2)	4 (36.4)	1 (12.5)	0.506	0.547

p-value2 denotes exact Fisher's test p-value

recovery was achieved by 42.9% (n = 27) of participants, while 41.3% (n = 26) experienced intermittent symptoms, and 15.9% (n = 10) reported no improvement.

The most frequent medical interventions were receiving analgesics (n=28, 44.4%) and physical therapy (n=27, 42.9%). Notably, 27.0% (n = 17) of participants did not receive any medical intervention. Radiological imaging was performed in 60.3% (n = 38) of participants, with MRI being the most common modality (34.9%, n = 22), followed by X-ray (19.0%, n = 12), ultrasound (15.9%, n = 10), and CT scan (7.9%, n = 5). Vaccine hesitancy was high among participants, with 87.3% (n = 55) expressing reluctance to receive future vaccines due to their experience.

Table 3 summarizes symptom characteristics and medical interventions across different vaccine types. AstraZeneca recipients reported a significant (p = 0.037) higher incidence of unusual adverse events (n=6, 75.0%) compared to Pfizer (n=15, 35.7%) and Sinopharm (n=2, 18.2%) recipients. AstraZeneca recipients were also more likely to use analgesics (n=7, 87.5%) compared to Pfizer (n=16, 38.1%) or Sinopharm (n=4, 36.4%) recipients (p = 0.030). No other significant differences were observed across vaccine types regarding symptom severity, time to symptom onset, symptom duration, or medical interventions.

Table 4 shows the characteristics of symptoms and medical interventions stratified by adverse event types. It is important to note that several

Table 4. Characteristics of Symptoms and Medical Interventions Stratified by Adverse Events

Characteristics	Pain n=29		Limited ROM n=29		Numbness n=14		Others n=23	
	n (%)	p value	n (%)	p value	n (%)	p value	n (%)	p value
Symptom severity		0.003		0.124		0.828		0.020
Mild	9 (31.0)		2 (6.9)		2 (14.3)		0	
Moderate	13 (44.8)		12 (41.4)		7 (50.0)		10 (43.5)	
Severe	7 (24.1)		15 (51.7)		5 (35.7)		13 (56.5)	
Time to symptoms		0.002		0.095		0.028		0.651
Immediate	5 (17.2)		4 (13.8)		3 (21.4)		2 (8.7)	
Less than 24 hours	13 (44.8)		6 (20.7)		4 (28.6)		7 (30.4)	
One day to one week	10 (34.5)		7 (24.1)		7 (50.0)		6 (26.1)	
More than one week	1 (3.5)		12 (41.4)		0		8 (34.8)	
Symptom duration		0.002		0.009		0.651		0.336
One or two days	10 (34.5)		4 (13.8)		2 (14.3)		3 (13.0)	
Less than one week	10 (34.5)		3 (10.3)		5 (35.7)		4 (17.4)	
One week to one month	5 (17.2)		6 (20.7)		3 (21.4)		5 (21.7)	
More than one month	4 (13.8)		16 (55.2)		4 (28.6)		11 (47.8)	
Vaccine doses		0.210		0.363		0.373		0.532
1	0		2 (6.9)		0		2 (8.7)	
2	26 (89.7)		25 (86.2)		11 (78.6)		18 (78.7)	
>2	3 (10.3)		2 (6.9)		3 (21.4)		3 (13.0)	
Symptom improvement		0.041		<0.001		0.003		0.559
Improve	21 (72.4)		13 (44.8)		6 (42.9)		12 (52.2)	
Same	5 (17.2)		2 (6.9)		7 (50.0)		6 (26.1)	
Worsen	3 (10.3)		14 (48.3)		1 (7.1)		5 (21.7)	
Completely cured		0.013		0.203		0.034		0.171
Yes	18 (62.1)		10 (34.5)		3 (21.4)		7 (30.4)	
On\off	9 (31.0)		12 (41.4)		10 (71.4)		13 (56.5)	
No	2 (6.9)		7 (24.1)		1(7.1)		3 (13.0)	
Symptom intervention		0.082		0.330		0.718		0.340
No	23 (79.3)		18 (62.1)		9 (64.3)		14 (60.9)	
Yes	6 (20.7)		11 (37.9)		5 (35.7)		9 (39.1)	
Medical intervention								
Analgesics	14 (48.3)	0.572	11 (73.9)	0.337	9 (64.3)	0.090	14 (60.9)	**0.047**
Physical therapy	10 (34.5)	0.215	18 (62.1)	**0.004**	6 (42.9)	1.000	9 (39.1)	0.650
Steroid injection	3 (10.3)	0.409	4 (13.8)	0.918	2 (14.3)	1.000	4 (17.4)	0.593
Steroid oral	0	0.101	2 (6.9)	0.462	0	0.343	1 (4.3)	0.907
Surgical intervention	0	0.352	0	0.352	1 (7.1)	0.059	0	0.445
Did not need any interventions	11 (37.9)	0.071	6 (20.7)	0.299	3 (21.4)	0.595	4 (17.4)	0.193
Radiology imaging								
X-Ray	5 (17.2)	0.736	4 (13.8)	0.327	5 (35.7)	0.072	5 (21.7)	0.680
CT scan	2 (6.9)	0.778	2 (6.9)	0.778	1 (7.1)	0.901	1 (4.4)	0.424
MRI	10 (34.5)	0.946	11 (37.9)	0.643	2 (14.3)	0.066	7 (30.4)	0.571
Ultrasound	4 (13.8)	0.677	4 (13.8)	0.677	4 (28.6)	0.140	6 (26.1)	0.093
None	14 (48.3)	0.198	7 (24.1)	**0.020**	6 (42.9)	0.783	9 (39.1)	0.946
Hesitant receiving vaccines		0.317		0.810		0.479		0.469
Yes	24 (82.8)		25 (86.2)		13 (92.9)		21 (91.3)	
No	5 (17.2)		4 (13.8)		1 (7.1)		2 (8.7)	
Symptom after Dose		0.922		0.878		0.172		0.129
After first dose	7 (24.1)		7 (24.1)		1 (7.1)		5 (21.7)	
After second dose	8 (27.6)		7 (24.1)		6 (42.9)		3 (13.0)	
After two doses	14 (48.3)		15 (51.7)		7 (50.0)		15 (65.2)	

p-value2 denotes exact Fisher's test p-value

participants reported multiple adverse events; thus, the analysis treats each adverse event as a separate variable (dummy variable). The difference in symptom severity among those who had pain or other adverse events was statistically significant compared to those who had no pain or other adverse events. Participants who reported pain were more likely to experience mild symptoms (31.0%) and less likely to experience severe symptoms (24.1%). Participants who reported other adverse events had the highest proportion of severe symptoms (56.5%).

Participants reporting pain were more likely to experience symptoms within less than 24 hours after vaccination (44.8%, p=0.002), while those with numbness were more likely to have symptoms onset between one day and one week (50.0%, p = 0.028). Most participants who reported pain had a short symptom duration (69.0%) compared to those who did not report pain. Symptom duration of more than one month was more frequent among participants reporting limited ROM (55.2%, p=0.009) compared to those reporting pain (13.8%) or numbness (28.6%).

Participants reporting pain were also more likely to report symptom improvement (72.4%) than those without pain (p=0.041). While participants reporting limited ROM were also more likely to report symptom worsening (48.3%) compared to those without limited ROM (p<0.001). Conversely, participants with numbness were more likely to report that their symptoms remained the same (50.0%) compared to those without numbness (p = 0.003).

In terms of medical interventions, participants reporting limited ROM were more likely to have received physical therapy (62.1%) compared to those without limited ROM (p = 0.004). Those reporting other symptoms were more likely to have used analgesics (60.9%, p = 0.047). Participants reporting limited ROM had a higher likelihood of undergoing radiological imaging (75.9%, p = 0.020).

Table 5 presents the relationship between symptom severity and various vaccine and symptom characteristics. Vaccine hesitancy showed a trend towards significance with increased symptom severity. Among participants with severe symptoms, 96.2% (n = 25) were hesitant to receive future vaccines, compared to 70.0% (n = 7) of those with mild symptoms (p = 0.098).

Medical interventions were more frequently required by participants with severe symptoms. Half of those with severe symptoms (50.0%, n = 13) required symptom intervention, compared to 20.0% (n = 2) of

Table 5. Vaccine and symptom characteristics stratified by symptom severity

Characteristics	**Symptom Severity**			**P-value**	**P-value2**
	Mild N=10 **n (%)**	**Moderate n=2** **n (%)**	**Severe n=2** **n (%)**		
Hesitant receiving vaccines				0.098	0.479
Yes	7 (70.0)	23 (85.2)	25 (96.2)		
No	3 (30.0)	4 (14.8)	1 (3.8)		
Symptom after Dose				0.126	0.095
After first dose	4 (40.0)	2 (7.4)	8 (30.8)		
After second dose	3 (30.0)	9 (33.3)	5 (19.2)		
After two doses	3 (30.0)	16 (59.3)	13 (50.0)		
Adverse Events					
Pain in injection site	9 (90.0)	13 (48.2)	7 (26.9)	**0.003**	**0.003**
Limited ROM	2 (20.0)	12 (44.4)	15 (57.7)	0.124	0.139
Numbness in the arm	2 (20.0)	7 (25.9)	5 (19.2)	0.828	0.918
Others	0	10 (37.0)	13 (50.0)	**0.020**	**0.014**
Time to symptoms				0.267	0.337
Immediate	1 (10.0)	2 (7.7)	6 (23.1)		
Less than 24 hours	6 (60.0)	7 (25.9)	7 (26.9)		
One day to one week	2 (20.0)	9 (33.3)	6 (23.1)		
More than one week	1 (10.0)	9 (33.3)	7 (26.9)		
Symptom duration				0.013	0.015
One or two days	6 (60.0)	4 (14.8)	3 (11.5)		
Less than one week	3 (30.0)	8 (29.6)	4 (15.4)		
One week to one month	1 (10.0)	6 (22.2)	6 (23.1)		
More than one month	0 (0.0)	9 (33.3)	13 (50.0)		
Completely cured				0.073	0.069
Yes	8 (80.0)	12 (44.4)	7 (26.9)		
On\off	1 (10.0)	11 (40.7)	14 (53.8)		
No	1 (10.0)	4 (14.8)	5 (19.2)		
Symptom intervention				0.033	0.044
No	8 (80.0)	22 (81.5)	13 (50.0)		
Yes	2 (20.0)	5 (18.5)	13 (50.0)		
Medical intervention					
Analgesics	3 (30.0)	13 (48.2)	12 (46.2)	0.599	0.700
Physical therapy	1 (10.0)	10 (37.0)	16 (61.5)	**0.014**	**0.014**
Steroid injection	0	5 (18.5)	4 (15.4)	0.352	0.549
Steroid oral	1 (10.0)	1 (3.7)	1 (3.9)	0.698	0.549
Surgical intervention	0	0	1 (3.9)	0.485	0.571
Did not need any interventions	6 (60.0)	6 (22.2)	5 (19.2)	**0.036**	0.054

p-value2 denotes exact Fisher's test p-value

those with mild symptoms (p = 0.033). The need for physical therapy was significantly linked to severe symptoms, with 61.5% (n = 16) of participants with severe symptoms undergoing physical therapy, compared to 10.0% (n = 1) of those with mild symptoms (p = 0.014). Participants who did not require any medical interventions were more likely to report mild symptoms (n = 6, 60.0%, p = 0.036).

Table 6 shows the symptom characteristics and medical interventions stratified by symptom progression: improved, remained the same, or worsened. Limited ROM was significantly more common among participants whose symptoms worsened (93.3%, n = 14) compared to those whose symptoms improved (36.1%, n = 13) (p < 0.001). Severe symptoms were more prevalent among participants with worsening symptoms (80.0%, n = 12), while mild symptoms were mostly reported by participants whose symptoms improved (25.0%, n = 9) (p = 0.006).

Participants who did not undergo any radiological imaging were more likely to experience symptom improvement (55.6%, n = 20) compared to those whose symptoms remained the same (25.0%, n = 3) or worsened (13.3%, n = 2) (p = 0.010). Symptoms appearing more than one week post-vaccination were more likely to worsen (53.3%, n = 8) compared to those appearing immediately or within 24 hours (p = 0.014). Symptoms lasting over one month were strongly linked to worsening (80.0%, n = 12), whereas symptoms lasting one or two days were more likely to improve (36.1%, n = 13) (p < 0.001).

Regarding medical interventions, participants whose symptoms worsened were more likely to have received physical therapy (73.3%, n = 11) compared to those whose symptoms improved (25.0%, n = 9) (p = 0.003). Steroid injections were more common among participants whose symptoms remained the same (41.7%, n = 5) (p = 0.003). Participants who did not require any medical interventions were more likely to report symptom improvement (38.9%, n = 14) (p = 0.047).

DISCUSSION

To the best of our knowledge, this study represents the largest investigation of Shoulder Injury Related to Vaccine Administration (SIRVA) within a tertiary hospital, including 63 patients. Previous

Table 6. Symptom characteristics and medical interventions of symptoms stratified by symptom progression

Characteristics	**Improved n=36 n (%)**	**Same n=12 n (%)**	**Worsen n=15 n (%)**	**p-value**	**p-value2**
Adverse Events					
Pain in injection site	21 (58.3)	5 (41.6)	3 (20.0)	0.041	0.038
Limited ROM	13 (36.1)	2 (16.7)	14 (93.3)	<0.001	<0.001
Numbness in the arm	6 (16.7)	7 (58.3)	1 (6.7)	**0.003**	**0.005**
Others	12 (33.3)	6 (50.0)	5 (33.3)	0.559	0.558
Radiology imaging					
X-Ray	4 (11.1)	5 (41.7)	3 (20.0)	**0.034**	0.031
CT scan	1 (2.8)	2 (16.7)	2 (13.3)	0.206	0.121
MRI	10 (27.8)	5 (41.7)	7 (46.7)	0.375	0.393
Ultrasound	3 (8.3)	4 (33.3)	3 (20.0)	0.107	0.094
None	20 (55.6)	3 (25.0)	2 (13.3)	**0.010**	**0.009**
Symptom severity				0.006	0.006
Mild	9 (25.0)	1 (8.3)	0 (0.0)		
Moderate	17 (47.2)	7 (58.3)	3 (20.0)	`	
Severe	10 (27.8)	4 (33.3)	12 (80.0)		
Time to symptoms				0.014	0.021
Immediate	7 (19.4	0	2 (13.3)		
Less than 24 hours	15 (41.7)	2 (16.7)	3 (20.0)		
One day to one week	8 (22.2)	7 (58.3)	2 (13.3)		
More than one week	6 (16.7)	3 (25.0)	8 (53.3)		
Symptom duration				<0.001	<0.001
One or two days	13 (36.1)	0 (0.0)	0 (0.0)		
Less than one week	11 (30.6)	2 (16.7)	2 (13.3)		
One week to one month	7 (19.4)	5 (41.7)	1 (6.7)		
More than one month	5 (13.9)	5 (41.7)	12 (80.0)		
Symptom intervention				0.012	0.010
No	30 (82.3)	6 (50.0)	7 (46.7)		
Yes	6 (16.7)	6 (50.0)	8 (53.3)		
Medical intervention					
Analgesics	12 (33.3)	8 (66.7)	8 (53.3)	0.096	0.112
Physical therapy	9 (25.0)	74 (58.3)	11 (73.3)	**0.003**	0.003
Steroid injection	1 (2.8)	5 (41.7)	3 (20.0)	**0.003**	**0.002**
Steroid oral	2 (5.6)	0 (0.0)	1 (6.7)	0.680	1
Surgical intervention	0 (0.0)	1 (8.3)	0 (0.0)	0.115	0.190
Did not need any interventions	14 (38.6)	1 (8.3)	2 (13.3)	**0.047**	0.059

p-value2 denotes exact Fisher's test p-value

studies, such as Atanasoff et al.[2], involved 13 cases of SIRVA, Bancsi et al.[13], and Cross et al.[14], each involved fewer than 30 cases. More recent studies, including Bass et al.[5] with 61 cases and Petrakis et al.[4] with 23 cases, have discussed the incidence of SIRVA following mass COVID-19 vaccinations, but were also limited in scale. Our study thus provides a more extensive analysis of SIRVA's clinical presentations and outcomes in a large cohort.

Recent studies by Bass et al.[5] and Yuen et al.[10] have linked increased SIRVA cases to incorrect vaccine administration during COVID-19 vaccination campaigns, though they analysed smaller, less diverse populations compared to our study. Bass et al.[5] analysed 61 cases of SIRVA, primarily focusing on the Pfizer and Moderna vaccines. While Petrakis et al.[4] reported only 23 cases of SIRVA across multiple centres. Our study, by contrast, examines a larger, more diverse cohort and includes AstraZeneca, Pfizer, and Sinopharm vaccines, providing a more comprehensive view of SIRVA's epidemiology and clinical progression across different vaccine types.

Our cohort offers new insights into SIRVA demographics in younger individuals aged 35-45, who comprise about 30.2% of our sample. Atanasoff et al.[2], contrary to our study, focused on older patients. This younger age group has not been thoroughly studied in prior SIRVA studies, highlighting a gap in literature. Unlike Atanasoff et al.[2], who found that SIRVA was more common in women, our cohort had an almost equal gender distribution (49.2% female, 50.8% male), suggesting factors, like BMI and pre-existing conditions, may play a larger role in SIRVA's risk. Notably, 43.1% of our participants were overweight. In addition, pre-existing conditions like cervical herniated discs and hypertension were noted in 28.6% and 23.8% of patients, respectively. These findings align with those of Cook[15], who emphasised the importance of individual patient factors in SIRVA risk.

Our study uniquely contributes to the literature by comparing AstraZeneca, Pfizer, and Sinopharm vaccine adverse event rates. We found that 75.0% of AstraZeneca recipients reported adverse events, significantly higher than the 35.7% for Pfizer and 18.2% for Sinopharm. Bass et al.[5] and Petrakis et al.[4], on the other hand, focused on mRNA vaccines (Pfizer and Moderna) and did not assess potential adverse outcomes associated with viral vector vaccines like AstraZeneca. Furthermore, our findings highlight the importance of proper injection technique, as incorrect needle placement remains the primary cause of SIRVA, aligning with the conclusions drawn by Cross et al.[14] and Cook[15].

The clinical presentation of SIRVA in our cohort is comparable to the symptoms reported in smaller studies, but with a wider range of severity and stability. In our study, 46.0% of patients reported pain at the injection site and 46.0% had a restricted range of motion, with 83.8% experiencing moderate to severe symptoms. These figures surpass those reported by Yuen et al.[10], where moderate symptoms were observed in approximately 60% of cases. Additionally, 34.9% of our patients experienced symptoms lasting over a month, echoing the prolonged recovery times observed by Hexter et al.[16]. This higher incidence of long-lasting symptoms may reflect the delayed diagnosis and intervention, emphasising the need for early recognition and treatment of SIRVA to prevent chronic adverse outcomes like adhesive capsulitis[12,16].

Our study supports previous findings that conservative management, including physical therapy and analgesics, is effective for SIRVA (6,17). In our cohort, 44.4% of patients received analgesics, and 42.9% underwent physical therapy, which aligns with the treatment modalities reported by Wood and Ilyas[12] and Cook[15]. The low rates of corticosteroid injections (14.3%) and the single case of surgical intervention (1.6%) underscore the importance of timely diagnosis in preventing more invasive interventions[12]. This aligns with Petrakis et al.[4], who also reported a low rate of surgical intervention in their smaller cohort.

A key finding of our study is the high vaccine hesitancy rate of 87.1% among participants, presenting significant challenges for public health efforts aimed at improving vaccination awareness and coverage. This rate is notably higher than the 30-40% reported by Clothier et al.[18], who attributed vaccine hesitancy to adverse outcomes following immunisation. The impact of SIRVA on public perception of vaccination, particularly during mass immunisation campaigns, underscores the necessity for enhanced training for healthcare providers, as advocated by Mackenzie et al.[18], to reduce vaccine-related injuries and restore public confidence in vaccination programs.

Despite having a relatively small sample size, which may limit the statistical power to detect moderate or small effect sizes, this is considered the largest single-centre study on SIRVA to date. Unlike smaller studies that focus on isolated cases or specific vaccines, our research provides a comprehensive understanding of the risk factors, clinical presentations, and treatment outcomes associated with SIRVA across various COVID-19 vaccines. However, the single-centre design may limit the generalizability of our findings, particularly in populations with different vaccination protocols or healthcare settings. Future multi-centre studies are needed to confirm these findings and further explore the epidemiology of SIRVA in diverse populations and among other vaccines, such as influenza or pneumococcal vaccines. One additional limitation of this study is the absence of a control group comprising vaccinated individuals without symptoms. However, this study was intended as an exploratory analysis rather than a comparative evaluation. Lastly, potential bias may have arisen from the use of phone surveys—particularly due to self-reporting inaccuracies—which, despite mitigation efforts (such as employing standardised questionnaires to ensure consistency and aiding recall through defined time frames and clear definitions), remains a possible source of bias in data collection.

CONCLUSION

This study aimed to describe the symptoms, progression, and risk factors associated with Shoulder Injury Related to Vaccine Administration (SIRVA) following COVID-19 vaccinations, and to evaluate various treatment modalities to establish a standardised management approach. Findings revealed that a substantial portion of participants experienced moderate to severe symptoms, with pain at the injection site and limited range of motion being the most prevalent. Additionally, nearly 87% of participants expressed vaccine hesitancy.

These results highlight the urgent need for improved injection techniques to reduce SIRVA incidence and enhance patient outcomes. This study is one of the few to systematically analyse SIRVA cases related to COVID-19 vaccinations, contributing valuable insights to the existing literature on vaccine-related adverse events. The findings suggest that healthcare providers require better training in proper injection techniques to prevent SIRVA and improve overall vaccination safety.

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Methodology, Resources, Ahmad Alrawashdeh: Writing- original draft, Conceptualization, Methodology, Formal analysis, Yahya Alshgerat: Writing – review & editing, Resources, Leen Walid Sawalha: Writing – review & editing, Resources, Dimah Jiad: Writing – review & editing, Investigation, Ahmad Al Hanini: Writing – review & editing, Investigation, Bayan Ibrahim Al Mashaleh: Writing – review & editing, Investigation, Ammar Al-Tawarh: Writing – review & editing, Investigation, Majed M. Aljarrah: Writing – review & editing, Investigation.

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