A Comparative Analysis of Side Effects from the Third Dose of COVID-19 Vaccines in Palestine and Jordan

Jebril Al-Hrinat[1] , Aseel Hendi[2] , Abdullah M. Al-Ansi[3]*

[1] Faculty of Education, Arab American University, 12567 Hebron, Palestine
[2] Industrial Engineering Department, Hashemite University, 13133 Zarqa, Jordan
[3] College of Commerce and Business Administration, Dhofar University, 211 Salalah, Sultanate of Oman

* Correspondence: Abdullah M. Al-Ansi (aalansi@du.edu.om)

Abstract: In this cross-sectional study, the prevalence and characteristics of adverse effects following the administration of the third dose of the coronavirus disease 2019 (COVID-19) vaccines were compared between recipients in Palestine and Jordan. Data were collected via an online survey targeting random samples from both countries. In Palestine, the primary factors predisposing individuals to side effects after the third dose were prior adverse reactions to earlier vaccinations and a history of COVID-19 infection before vaccination. Minor contributing factors included food sensitivities, weight, and drug sensitivities. In Jordan, gender, smoking, and food sensitivities emerged as the most significant variables influencing the development of side effects, with age being a secondary factor. Weight, COVID-19 infection post-vaccination, and prior adverse reactions to earlier doses were less significant. In Palestine, individuals with diabetes and respiratory diseases were more prone to adverse effects, followed by those who are obese, and those with cardiovascular diseases, osteoporosis, thyroid disorders, immune diseases, cancer, arthritis, and hypertension. In Jordan, participants with arthritis were the most likely to develop side effects, followed by those who are obese, and those with respiratory conditions and thyroid disorders. These findings confirm that COVID-19 vaccines authorized for use are generally safe, and vaccination remains a crucial tool in curbing the spread of the virus. Acceptance of the third dose has been notable in both Palestine and Jordan, underscoring the value of booster doses in enhancing immunity.

Keywords: Side effects; COVID-19; Vaccines; COVID-19 booster; Third dose; Palestine; Jordan; Arab region

1. Introduction

COVID-19, a virus that baffled scientists, disrupted the balance of nations and killed the young before the old in all countries worldwide. Moreover, it isolated the world from each other. From this standpoint, the World Health Organization (WHO) declared the coronavirus pandemic a global epidemic (World Health Organization, 2020a). The highly transmissible respiratory disease outbreak in Wuhan, China in 2019 led to the discovery of a newly identified member of the human coronavirus family, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (Pal et al., 2020). The coronavirus has spread to more than 27 countries through flights (Du Toit, 2020). This pandemic has affected two countries, Jordan and Palestine.

Most importantly, several proactive measures have been taken by Jordanian and Palestinian health officials to reduce the spread of the disease, such as receiving vaccinations, quarantine, and isolation, suspending flights, launching electronic platforms, and avoiding crowded gatherings and poorly ventilated indoor places (World Health Organization, 2020b). This infectious disease has shaken the world and has become a dreaded disease for humans. On April 4, 2020, the total number of COVID-19 cases worldwide exceeded one million, including nearly 40,000 deaths (Daralammouri et al., 2020). Since the confirmation of the first case in Palestine and Jordan in early March 2020, the number of cases has exponentially increased, causing significant concern. This outbreak led to a health crisis and a decline in economic activity unprecedented in recent history (Guerrieri et al., 2022). In the twenty-first century, the COVID-19 pandemic is undeniably an unprecedented global public health threat. It has a

wide range of socioeconomic, political, and public health implications worldwide.

Many countries, including Palestine and Jordan, are lamenting the impact of COVID-19, which has resulted in economic declines, travel disruptions, and fatalities (Seirafianpour et al., 2022). Therefore, it is crucial to find vaccinations quickly to combat this virus; numerous companies have been racing to produce these vaccines, but they have resulted in side effects across all dosages (Casiday et al., 2006). Some studies dealt with side effects after the first and second doses of coronavirus. Still, according to the researcher's limitations, no study dealt with side effects after the third dose of vaccines.

As with any medical intervention, the COVID-19 vaccine has potential side effects that individuals should be aware of. Common side effects include pain and swelling at the injection site, fatigue, headaches, muscle aches, chills, fever, and nausea (Larson et al., 2018; Al-Ansi, 2022). These side effects are generally mild to moderate in severity and typically subside within a few days (Al-Ansi & Al-Ansi, 2020). It is important to note that these side effects are a sign that the vaccine is working to stimulate an immune response against the virus. Rare but more serious side effects may occur, such as allergic reactions or blood clotting disorders (Garad et al., 2021; Jaboob et al., 2024). However, the benefits of vaccination outweigh the risks of contracting COVID-19 which can lead to severe illness or death. Individuals should consult with their healthcare provider if they have concerns about potential side effects and report any adverse reactions through proper channels for monitoring and evaluation (Jaboob et al., 2023).

The COVID-19 vaccine gap in the Arab region has emerged as a pressing concern, with disparities in access and distribution leading to uneven vaccination rates across countries. While some affluent states have made significant strides in securing doses and administering vaccinations, less-developed nations within the region have struggled to procure an adequate supply of vaccines (Al-Hrinat et al., 2024). This divide raised concerns about achieving widespread immunity and effectively combating the spread of the virus throughout the region (Al-Ansi et al., 2023a; Awain et al., 2023). Addressing this gap required concerted efforts from both governments and international organizations to ensure equitable access to vaccines for all populations. Furthermore, collaboration among Arab nations was essential to streamline distribution channels and enhance vaccine deployment strategies. Failure to bridge this gap risks prolonging the pandemic's impact on public health and socioeconomic stability within the region.

Clinical trials have shown that third-dose vaccines have been associated with various mild to moderate side effects, such as pain, redness or swelling at the injection site, fatigue, headache, chills, muscle and joint pain, and fever (World Health Organization, 2020b). This study aims to compare the side effects of different COVID-19 vaccines after the third dose and evaluate the short-term side effects associated with the third dose among people in Jordan and Palestine. The other objectives include determining the food sensitivity, corona infection after eating, weight and drug sensitivity in addition to cardiovascular diseases, osteoporosis, and thyroid disorders. Other minor factors include immune diseases and cancer, followed by people who have arthritis and hypertension. By using data from both countries, the results of this study are expected to reveal the main differences between Jordan and Palestine regarding third dose side effects.

2. Methods and Material

2.1 Study Design and Participants

A simple randomized, cross-sectional online survey was performed from March 13 to May 11, 2022. Participants from Jordan and Palestine who received the third dose of a COVID-19 vaccine were invited to participate in this study by filling out a Question Pro Form-based questionnaire. The questionnaire was written in a smooth and easy-to-understand language and was designed for scientific purposes. A detailed and comprehensive description was provided, and the information was collected in the strictest confidence. The survey link was distributed via social media platforms (Telegram, Facebook, and WhatsApp) and email, along with sufficient information about the study.

2.2 Measures

The study used the questionnaire (an online survey) as the primary tool for obtaining data and information, depending on many literature reviews using Google Scholar, ProQuest, Midline, and Research Gate as it is considered an organized tool for collecting research data by formulating a model for the questions directed to the individuals in the research sample. The study tool was developed through a literature review, and experts in the scientific research field verified the questionnaire's validity. Their comments were taken and modified upon their request. Also, the internal consistency method, Cronbacks Alpha, was used to verify the validity and reliability of the study.

2.3 Sample Size

According to data from "Our World in Data (OWID)," approximately 1,016,797 people in Jordan and Palestine had received a COVID-19 booster dose by August 21, 2022 (Kerr et al., 2021). The minimum representative sample size of 666 was determined using the calculator website for the calculated sample size (Omeish et al., 2022). The questionnaire was given to the participants in the study with a 99% confidence interval, a 50% response rate, and a 5% margin of error. The sample size is considered sufficient regarding the repeating of the same answers in the determined sample. The results of the research could be generalized to both countries, namely Jordan and Palestine. The exclusion criteria included that all questions should be answered and the answers should also be rational.

In conducting research, potential limitations and sources of bias were carefully addressed to uphold the credibility and validity of the study. Limitations of this research include small sample sizes, which may not accurately represent the larger population being studied, leading to biased or inconclusive results. Furthermore, the absence of randomization or convenience sampling methods can lead to selection bias, thereby distorting the findings. Additionally, reliance on self-report measures may introduce social desirability bias where participants provide responses, they believe are socially acceptable rather than truthful ones. To mitigate these limitations and biases, researchers strive for larger and more diverse samples, randomize participant selection processes, utilize objective measures whenever possible, and employ rigorous data analysis techniques to ensure the accuracy and reliability of their findings.

2.4 Statistical Analysis

The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 28; frequencies and percentages were measured and used as descriptive statistics. A correlation test was performed to assess potential correlations between predisposing factors. The chi-square test investigated the statistical associations between predisposing factors and post-vaccination side effects. The association was considered statistically significant if the p-value was less than 0.05 to obtain the most significant associations.

The predisposing factors include educational level, gender, weight, suffering from chronic diseases, being a smoker, types of smoking, suffering from food and drug allergies, experiencing COVID-19 infection before receiving any vaccine dose, experiencing COVID-19 illness after receiving a third vaccine dose, the type of COVID-19 vaccine, a sense of protection increased by the third dose, and still wearing a mask after receiving the third dose. The post-vaccination side effects include fever, headache, fatigue, insomnia, joint pain, muscle pain, abdominal pain, anorexia, diarrhea, nausea, epistaxis, skin allergies, chills, hyperhidrosis, hair loss, poor memory, blurred vision or eye redness, hyperosmia.

3. Results

3.1 Demographic Data

Table 1. The classification of participants based on their demographic data

Variable		Palestine		Jordan	
		Number	Percentage (%)	Number	Percentage (%)
Age (years)	18-29	210	52.5	130	32.5
	30-39	90	22.6	153	38.3
	40-49	33	8.3	60	15.0
	50-59	44	11.1	41	10.3
	>=60	23	5.8	16	4.0
Gender	Female	179	45.0	263	34.3
	Male	221	55.3	137	65.8
Educational level	High school or less	60	15.1	86	21.5
	Diploma	35	8.8	62	15.5
	Bachelor	215	53.9	207	51.8
	Postgraduate	90	22.6	45	11.3
Weight	Slim	76	19.0	87	21.75
	Average	303	76.1	274	68.5
	Fat	21	5.3	39	9.75

This section covers demographic data from 800 people in Palestine and Jordan. Data was classified based on percentages for age, gender, educational level, and professional qualification. According to Table 1, most participants (55.3% and 65.8%) were men from Palestine and Jordan. The education level is high, as most

participants in each country have a bachelor's degree, accounting for approximately 53.9% and 51.8% of each country's research sample, respectively. In Palestine, the 18-29 age group accounts for 52.5%, whereas in Jordan, the 30-39 age group accounts for 38.3%. The data also reveals that most participants in each country (76.1% and 68.5%) are of average weight.

3.2 Participants' Health Information

Table 2 shows that the most popular vaccination type for the third dosage is Pfizer BioNtech (67.8% and 62%), followed by Sinopharm (28.5% and 21.3%). In Palestine and Jordan, the percentage of participants infected with COVID-19 was 24.4% and 51.9% before receiving the vaccines, and it increased to 39.5% and 82.5% after the third dose vaccination. 39.0% and 60.8% of the participants started to wear masks after receiving the third dose. In addition, 54.8% and 52.0% of them showed symptoms after receiving the third dose, which were less severe than those of the first and second doses, respectively. After receiving the third dose, 34.4% and 91.4% suffered from drug or food sensitivity. The majority of the participants do not smoke. 80.8% of the participants did not suffer from allergies to any food in Palestine and the percentage is 5.8% in Jordan. 90.8% and 6.25% of the participants are not allergic to any medication in Palestine or Jordan. It seems that most of the participants did not suffer from chronic diseases.

Table 2. Participants' health information

Receiving the Third (Booster) Dose of the COVID-19 Vaccine		Palestine		Jordan		Health Information		Palestine		Jordan	
		Number	Percentage (%)	Number	Percentage (%)			Number	Percentage (%)	Number	Percentage (%)
Did you have COVID-19 before being immunized with the coronavirus vaccines?	Yes	97	24.4	206	51.9	Do you smoke?	No	277	69.3	176	44
	No	303	75.8	191	48.1		Cigarettes	72	18.1	66	16.5
Did you get COVID-19 after the third dose of vaccination?	Yes	158	39.5	330	82.5		Hookah	48	12	95	23.75
	No	242	60.8	70	17.5		Electronic cigarettes	3	0.8	29	7.25
Would you advise others to receive the booster dose?	Yes	144	36	174	43.5	Do you suffer from any chronic diseases?	No	253	63.3	315	79.1
	No	256	64.3	226	56.5		Diabetes	12	3	24	6
Did the third dose increase your sense of protection?	Yes	138	34.5	187	46.8		High blood pressure	61	15.3	28	7

Question		Count	%	Count	%
	No	262	65.5	213	53.3
Are you still wearing a mask after receiving the third dose?	Yes	156	39	243	60.8
	No	244	61.3	157	39.3
Did your drug or food sensitivity increase after receiving the third dose?	Yes	137	34.4	363	91.4
	No	261	65.6	34	8.6
Were the symptoms after receiving the third dose less than those of the first and second doses?	Yes	119	54.8	208	52
	No	281	70.3	192	48

Types of vaccine recipients				
Pfizer BioNtech	245	62	271	67.8
Sinopharm	85	21.3	114	28.5
AstraZeneca	19	4.8	4	1
Moderna	17	4.3	4	1
Sputnik In	30	7.6	6	1.5
Johnson & Johnson	4	1	1	0.3

Condition / Question		Count	%	Count	%
Cardiovascular disease		9	2.3	5	1.3
Chronic respiratory diseases		22	5.5	12	3
Obesity		13	3.3	13	3.3
Arthritis		12	3	16	4
Osteoporosis		7	1.8	8	2
Autoimmune diseases		5	1.3	4	1
Thyroid disorder		5	1.3	23	5.8
Cancer		1	0.3	2	0.5
Do you suffer from an allergy to any foods?	Yes	77	19.3	377	94.5
	No	323	80.8	23	5.8
Do you suffer from an allergy to any kind of medication?	Yes	37	9.3	375	93.8
	No	363	90.8	25	6.25

3.3 Association of Predisposing Factors and Chronic Diseases with Side Effects from the Third-Dose Vaccination

Table 3 shows the correlation between the side effects from the third-dose vaccination and the predisposing factors in Palestine and Jordan. The x2 tests conducted in Palestine show significant correlations ($\alpha = 0.05$) between fever and the following risk factors: educational level, sensitivity to food and medication, infection with corona before vaccination, and illness with symptoms following the third dose. In terms of headaches, there is a strong association between age, food sensitivity, corona infection before vaccination, and symptoms following the third dose. Regarding fatigue, a significant correlation exists between educational level, age, food sensitivity, a disease with corona before vaccination, and infection with symptoms following the third dose of the vaccination.

In terms of insomnia, there is a significant correlation between coronavirus infection before and after immunization and the development of symptoms after the third dose. Age, education level, food sensitivity, corona infection before immunization, and symptoms following the third vaccination dose are all associated with muscular pain. In addition, there is a significant correlation between joint pain and gender, age, education level, weight, sensitivity to food and medication, infection with corona before vaccination, and condition with symptoms following the third dose of immunization. Regarding abdominal pain, there is a strong association between disease with symptoms following the third immunization dosage, and sickness with a half before and after vaccination. As for anorexia, there is a significant association between Corona infection before and after immunization and infection with symptoms following the third dose of the vaccine. Regarding diarrhea, there is a strong link between disease with symptoms following the third dose of the vaccine and sickness with Corona before and after vaccination. Finally, in terms of nausea, there is a strong association between age, food sensitivity, corona disease before immunization, and infection with symptoms following the third dose of the vaccine.

Regarding epistaxis, there is a significant association between gender, age, educational level, food sensitivity, infection with the corona following immunization, and disease with symptoms following the third dose of the vaccine. Regarding skin allergies, there is a strong association between educational level, food sensitivity, corona illness following immunization, and infection with symptoms following the third dose of the vaccine. Chills, food sensitivity, corona status before immunization, and disease with symptoms following the third vaccination are all significantly correlated. With hyperhidrosis, there is a significant correlation between coronavirus infection following immunization and infection with symptoms following the third vaccine. In addition, age, education level, food sensitivity, a disease with corona following immunization, and an illness with symptoms following the third vaccine all significantly correlate with hair loss. In terms of poor memory, there is a direct link between corona disease before immunization and infection with symptoms following the third dose of the vaccine. Gender, age, educational level, corona following vaccination, and sickness with symptoms after the third immunization all significantly correlate with blurred vision. As for hyperosmia, there is a significant correlation between educational level, sensitivity to eating, infection with corona after the third vaccine, and illness with symptoms after the third vaccine.

In Jordan, there is a strong association between fever and the following predisposing factors: gender, age, level of education, and smoking. Age and weight significantly affect the frequency of headaches. Age and gender both significantly affect feelings of fatigue. Regarding insomnia, there is a significant correlation between smoking, gender, and educational level. In addition, age and smoking have a significant relationship with muscle pain. Food sensitivity and corona infection before immunization have been linked to joint pain. There is an essential link between smoking, food sensitivity, and corona disease before vaccination and abdominal pain. In addition, there is a strong link between food sensitivity and anorexia. In terms of diarrhea, there is no meaningful connection. There is a significant connection between food sensitivity and nausea. Regarding epistaxis, smoking, and corona infection following vaccination are significantly correlated. There is a strong link between food sensitivity and skin allergies. Chills don't significantly correlate, either. In hyperhidrosis, there is a statistically significant relationship between gender and the frequency of symptoms following the third dose. There is a strong link between gender and hair loss. There is no apparent connection between hyperosmia and poor memory.

Table 4 shows the correlation between the side effects of those who received the third dosage and chronic diseases in Palestine and Jordan. In Palestine, the $\chi2$ test reveals a significant (P<0.05) association between fever and diabetes mellitus. In terms of headaches, there is no significant correlation. There is a strong correlation between fatigue and diabetes. As for insomnia, there is no significant association with anything. When it comes to muscle pain, there is a considerable correlation with joint pain. In addition, there is a significant association with diabetes, hypertension, cardiovascular diseases, respiratory diseases, obesity, arthritis, osteoporosis, and autoimmune diseases. There is a significant correlation between thyroid disease and abdominal pain. There is no conclusive link between the following: nausea, diarrhea, or loss of appetite. Regarding epistaxis, there is a significant association between several conditions: osteoporosis, obesity, diabetes, and respiratory illnesses. As for skin sensitivity, there is a substantial correlation with diabetes, respiratory diseases, and thyroid disorders. There is a direct relationship between chills and cancer. Regarding hyperhidrosis, there is a significant link to cancer. Regarding hair loss, there is a strong correlation with obesity, autoimmune diseases, and thyroid disorders.

There's no statistically significant link between poor memory and anything. Regarding impaired vision, there is a strong correlation between diabetes and respiratory and cardiovascular disorders. There is a strong correlation between hyperosmia and osteoporosis, diabetes, cardiovascular disease, and many other conditions.

In Jordan, there is a sizable correlation between obesity, arthritis, fever, and headaches. In addition, there is a strong connection between respiratory illnesses and muscle pain. Thyroid conditions have a strong correlation with hyperhidrosis. There is a strong correlation between poor memory and arthritis. However, there is no correlational link between the other side effects and chronic diseases.

Table 3. Statistical relationships between predisposing factors and the side effects of the third dose evaluated using χ^2 tests

Statistical Value	Country	Fever χ^2	Fever df	Fever p	Headache χ^2	Headache df	Headache p	Fatigue χ^2	Fatigue df	Fatigue p	Insomnia χ^2	Insomnia df	Insomnia p	Muscle pain χ^2	Muscle pain df
Gender	PA	0.31	1.00	0.58	0.01	1.00	0.92	0.61	1.00	0.44	1.29	1.00	0.26	1.51	1.00
Gender	JO	41.6	1.00	0.00	0.64	1.00	0.43	12.6	1.00	0.00	9.85	1.00	0.00	14.6	1.00
Age	PA	4.26	4.00	0.37	12.1	4.00	0.02	18.0	4.00	0.00	5.14	4.00	0.27	10.3	4.00
Age	JO	22.4	4.00	0.00	16.3	4.00	0.00	19.1	4.00	0.00	3.44	4.00	0.49	5.32	4.00
Education Level	PA	8.46	3.00	0.04	5.27	3.00	0.15	10.4	3.00	0.02	1.31	3.00	0.73	9.96	3.00
Education Level	JO	15.3	3.00	0.00	3.59	3.00	0.31	3.94	3.00	0.27	11.8	3.00	0.01	1.32	3.00
Wight	PA	6.04	2.00	0.05	1.16	2.00	0.56	3.61	2.00	0.16	0.13	2.00	0.94	0.75	2.00
Wight	JO	3.86	2.00	0.15	8.40	2.00	0.01	0.04	2.00	0.98	12.6	2.00	0.00	0.09	2.00
Being a Smoker	PA	0.02	1.00	0.89	0.96	1.00	0.33	1.30	1.00	0.26	0.68	1.00	0.41	2.38	1.00
Being a Smoker	JO	8.06	1.00	0.01	0.15	1.00	0.70	3.62	1.00	0.06	6.33	1.00	0.01	5.41	1.00
Suffering from an Allergy to any Foods	PA	4.71	1.00	0.03	4.81	1.00	0.03	9.39	1.00	0.00	0.02	1.00	0.89	10.0	1.00
Suffering from an Allergy to any Foods	JO	10.3	8.00	0.24	13.5	8.00	0.09	11.3	8.00	0.18	14.7	8.00	0.06	10.3	8.00
Suffering from an Allergy to any Drugs	PA	5.37	1.00	0.02	0.00	1.00	0.98	0.07	1.00	0.79	0.03	1.00	0.87	0.12	1.00
Suffering from an Allergy to any Drugs	JO	12.2	6.00	0.06	11.6	6.00	0.07	6.40	6.00	0.38	2.57	6.00	0.86	1.85	6.00
Did you receive COVID-19 vaccines?	PA	20.2	1.00	0.00	22.3	1.00	0.00	20.2	1.00	0.00	4.22	1.00	0.04	19.7	1.00
Did you receive COVID-19 vaccines?	JO	1.16	1.00	0.28	0.05	1.00	0.83	0.09	1.00	0.77	0.81	1.00	0.37	2.68	1.00
Did you get COVID-19 after the third dose of vaccination?	PA	2.35	1.00	0.13	0.47	1.00	0.49	1.54	1.00	0.21	5.65	1.00	0.02	0.85	1.00
Did you get COVID-19 after the third dose of vaccination?	JO	0.05	1.00	0.83	0.98	1.00	0.32	0.33	1.00	0.57	0.08	1.00	0.77	1.87	1.00
Did you develop symptoms after receiving the third dose?	PA	75.5	1.00	0.00	56.6	1.00	0.00	56.6	1.00	0.00	20.8	1.00	0.00	33.3	1.00
Did you develop symptoms after receiving the third dose?	JO	0.44	1.00	0.51	.634	1.00	0.43	0.63	1.00	0.43	0.51	1.00	0.48	1.01	1.00

Chills χ²	Chills df	Chills p	Skin allergy χ²	Skin allergy df	Skin allergy p	Epistaxis χ²	Epistaxis df	Epistaxis p	Nausea χ²	Nausea df	Nausea p	Diarrhea χ²	Diarrhea df	Diarrhea p	Anorexia χ²	Anorexia df	Anorexia p	Abdominal pain χ²	Abdominal pain df	Abdominal pain p	Joints pain χ²	Joints pain df	Joints pain p	p
2.31	1.00	0.13	0.78	1.00	0.38	3.79	1.00	0.05	2.81	1.00	0.09	0.16	1.00	0.69	1.44	1.00	0.23	0.06	1.00	0.80	14.6	1.00	0.00	0.22
0.01	1.00	0.93	0.11	1.00	0.74	3.38	1.00	0.07	0.03	1.00	0.86	1.35	1.00	0.25	1.24	1.00	0.27	0.60	1.00	0.44	2.62	1.00	0.11	0.00
7.61	4.00	0.11	6.71	4.00	0.15	22.0	4.00	0.00	14.5	4.00	0.01	6.53	4.00	0.16	2.33	4.00	0.68	8.23	4.00	0.08	61.4	4.00	0.00	0.04
2.14	4.00	0.71	3.48	4.00	0.48	9.29	4.00	0.05	2.91	4.00	0.57	1.96	4.00	0.74	3.29	4.00	0.51	2.09	4.00	0.72	4.57	4.00	0.33	0.26
5.31	3.00	0.15	7.89	3.00	0.05	9.46	3.00	0.02	1.07	3.00	0.78	0.97	3.00	0.81	2.24	3.00	0.51	0.82	3.00	0.85	53.0	3.00	0.00	0.02
2.43	3.00	0.49	1.36	3.00	0.72	1.12	3.00	0.77	6.30	3.00	0.10	0.69	3.00	0.88	1.92	3.00	0.59	0.15	3.00	0.99	0.26	3.00	0.97	0.72
0.70	2.00	0.71	0.90	2.00	0.64	0.04	2.00	0.98	1.29	2.00	0.53	2.03	2.00	0.36	0.24	2.00	0.89	1.83	2.00	0.40	8.90	2.00	0.01	0.69
1.79	2.00	0.41	4.17	2.00	0.12	4.09	2.00	0.13	4.57	2.00	0.10	2.84	2.00	0.24	4.33	2.00	0.12	2.20	2.00	0.33	0.29	2.00	0.87	0.96
0.44	1.00	0.51	2.49	1.00	0.12	0.10	1.00	0.75	0.76	1.00	0.38	1.59	1.00	0.21	0.41	1.00	0.52	0.13	1.00	0.72	2.04	1.00	0.15	0.12
1.28	1.00	0.26	0.12	1.00	0.73	7.04	1.00	0.01	0.00	1.00	0.97	2.42	1.00	0.12	0.09	1.00	0.77	3.91	1.00	0.05	0.08	1.00	0.78	0.02
4.85	1.00	0.03	17.5	1.00	0.00	15.2	1.00	0.00	4.91	1.00	0.03	0.70	1.00	0.40	0.61	1.00	0.44	2.53	1.00	0.11	0.61	1.00	0.44	0.00
7.91	8.00	0.44	21.1	8.00	0.01	20.4	8.00	0.01	18.2	8.00	0.02	10.0	8.00	0.26	20.2	8.00	0.01	20.1	8.00	0.01	20.2	8.00	0.01	0.25
1.43	1.00	0.23	0.05	1.00	0.82	1.92	1.00	0.17	1.02	1.00	0.31	1.06	1.00	0.30	0.44	1.00	0.51	0.44	1.00	0.51	8.11	1.00	0.00	0.73
4.08	6.00	0.67	1.66	6.00	0.95	0.93	6.00	0.99	2.54	6.00	0.87	2.62	6.00	0.86	1.76	6.00	0.94	2.59	6.00	0.86	4.46	6.00	0.62	0.93
14.3	1.00	0.00	0.99	1.00	0.32	0.13	1.00	0.72	26.5	1.00	0.00	4.29	1.00	0.04	5.08	1.00	0.02	6.47	1.00	0.01	13.1	1.00	0.00	0.00
1.41	1.00	0.24	0.54	1.00	0.46	0.15	1.00	0.70	3.46	1.00	0.06	0.06	1.00	0.80	1.84	1.00	0.18	4.60	1.00	0.03	4.58	1.00	0.03	0.10
0.01	1.00	0.95	14.8	1.00	0.00	19.2	1.00	0.00	0.06	1.00	0.81	14.4	1.00	0.00	4.08	1.00	0.04	11.1	1.00	0.00	195.	1.00	0.00	0.36
0.68	1.00	0.41	1.50	1.00	0.22	6.46	1.00	0.01	0.06	1.00	0.81	2.54	1.00	0.11	0.04	1.00	0.84	0.42	1.00	0.52	0.20	1.00	0.65	0.17
45.6	1.00	0.00	21.8	1.00	0.00	15.4	1.00	0.00	16.3	1.00	0.00	23.6	1.00	0.00	28.4	1.00	0.00	29.4	1.00	0.00	254.	1.00	0.00	0.00
1.36	1.00	0.24	0.33	1.00	0.57	0.10	1.00	0.75	0.08	1.00	0.77	0.26	1.00	0.61	0.92	1.00	0.34	0.09	1.00	0.77	1.26	1.00	0.26	0.32

χ²: chi square; df: degree of freedom; p: p-value (significant at p<0.05); PA: Palestine; JO: Jordan.

Table 4. Statistical relationships between chronic diseases and the side effects of the third dose evaluated using χ2 tests

Side Effects Post-third dose vaccination	Country	Fever df	Fever χ²	Hyperhidrosis χ²	Hyperhidrosis df	Hyperhidrosis p	Hair loss χ²	Hair loss df	Hair loss p	Poor memory χ²	Poor memory df	Poor memory p	Blurred vision or χ²	Blurred vision or df	Blurred vision or p	Hyperosmia χ²	Hyperosmia df	Hyperosmia p
Diabetes Mellitus	PA	1.00	3.99	0.31	1.00	0.58	0.69	1.00	0.41	0.96	1.00	0.33	4.54	1.00	0.03	0.22	1.00	0.64
	JO	1.00	0.54	7.13	1.00	0.01	5.67	1.00	0.02	4.69	1.00	0.03	2.59	1.00	0.11	0.00	1.00	0.98
Hypertension	PA	1.00	0.06	2.37	4.00	0.67	15.9	4.00	0.00	2.59	4.00	0.63	18.3	4.00	0.00	8.30	4.00	0.08
	JO	1.00	0.63	4.60	4.00	0.33	3.40	4.00	0.49	3.95	4.00	0.41	2.08	4.00	0.72	1.61	4.00	0.81
Cardiovascular Diseases	PA	1.00	1.08	0.80	3.00	0.85	13.2	3.00	0.00	4.91	3.00	0.18	11.3	3.00	0.01	10.2	3.00	0.02
	JO	1.00	1.88	5.62	3.00	0.13	4.48	3.00	0.21	4.04	3.00	0.26	1.23	3.00	0.75	2.58	3.00	0.46
Chronic Respiratory Diseases	PA	1.00	0.05	0.96	2.00	0.62	2.28	2.00	0.32	3.85	2.00	0.15	3.98	2.00	0.14	0.47	2.00	0.79
	JO	1.00	0.26	2.08	2.00	0.35	3.56	2.00	0.17	4.13	2.00	0.13	0.44	2.00	0.80	1.18	2.00	0.56
Obesity	PA	1.00	0.34	0.05	1.00	0.82	3.13	1.00	0.08	0.07	1.00	0.80	1.27	1.00	0.26	1.27	1.00	0.26
	JO	1.00	6.25	0.78	1.00	0.38	0.19	1.00	0.66	5.50	1.00	0.02	1.63	1.00	0.20	0.58	1.00	0.45
Arthritis	PA	1.00	1.45	0.26	1.00	0.61	6.91	1.00	0.01	3.05	1.00	0.08	9.89	1.00	0.00	9.89	1.00	0.00
	JO	1.00	5.00	8.73	8.00	0.37	11.6	8.00	0.17	7.59	8.00	0.48	11.8	8.00	0.16	11.6	8.00	0.17
Osteoporosis	PA	1.00	0.84	0.65	1.00	0.42	3.55	1.00	0.06	3.66	1.00	0.06	0.05	1.00	0.82	0.88	1.00	0.35
	JO	1.00	1.40	4.56	6.00	0.60	1.93	6.00	0.93	2.52	6.00	0.87	1.76	6.00	0.94	3.16	6.00	0.79
Autoimmune Diseases	PA	1.00	0.59	0.57	1.00	0.45	1.41	1.00	0.24	7.82	1.00	0.01	0.87	1.00	0.35	2.00	1.00	0.16
	JO	1.00	1.88	0.83	1.00	0.36	0.13	1.00	0.72	2.56	1.00	0.11	0.04	1.00	0.84	0.46	1.00	0.50
Thyroid Disorders	PA	1.00	0.59	11.0	1.00	0.00	29.3	1.00	0.00	0.20	1.00	0.66	11.7	1.00	0.00	9.06	1.00	0.00
	JO	1.00	2.32	1.48	1.00	0.22	3.27	1.00	0.07	0.86	1.00	0.36	3.61	1.00	0.06	1.93	1.00	0.17
Cancer	PA	1.00	1.53	45.6	1.00	0.00	28.4	1.00	0.00	10.1	1.00	0.00	21.8	1.00	0.00	21.8	1.00	0.00
	JO	1.00	0.94	4.85	1.00	0.03	1.30	1.00	0.25	0.94	1.00	0.33	0.40	1.00	0.53	3.24	1.00	0.07

Anorexia		Abdominal pain			Joints pain			Muscle pain			Insomnia			Fatigue			Headache			
df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p	df	χ^2	p
1.00	1.18	0.32	1.00	0.99	0.00	1.00	82.07	0.01	1.00	7.34	0.70	1.00	0.15	0.00	1.00	12.45	0.61	1.00	0.26	0.05
1.00	1.15	0.28	1.00	1.15	0.76	1.00	0.09	0.33	1.00	0.95	0.63	1.00	0.23	0.69	1.00	0.16	0.15	1.00	2.06	0.46
1.00	0.00	0.99	1.00	0.00	0.01	1.00	7.87	0.91	1.00	0.01	0.11	1.00	2.50	0.85	1.00	0.04	0.85	1.00	0.04	0.80
1.00	0.00	0.06	1.00	3.63	0.39	1.00	.73	0.65	1.00	0.21	0.43	1.00	0.63	0.68	1.00	0.18	0.10	1.00	2.64	0.43
1.00	2.53	0.75	1.00	.100	0.00	1.00	11.84	0.33	1.00	0.94	0.44	1.00	0.59	0.21	1.00	1.59	0.55	1.00	0.35	0.30
1.00	0.86	0.49	1.00	0.49	0.17	1.00	1.90	0.25	1.00	1.35	0.38	1.00	0.77	0.32	1.00	0.99	0.46	1.00	0.55	0.17
1.00	0.04	0.35	1.00	0.89	0.00	1.00	29.93	0.43	1.00	0.61	0.12	1.00	2.41	0.17	1.00	1.93	0.23	1.00	1.43	0.82
1.00	2.62	0.78	1.00	0.08	0.47	1.00	0.53	0.04	1.00	4.12	0.39	1.00	0.75	0.55	1.00	0.37	0.48	1.00	0.50	0.61
1.00	0.23	0.34	1.00	0.90	0.00	1.00	9.12	0.84	1.00	0.04	0.79	1.00	0.07	0.47	1.00	0.53	0.68	1.00	0.17	0.56
1.00	0.13	0.72	1.00	0.13	0.92	1.00	0.01	0.63	1.00	0.24	0.95	1.00	0.00	0.76	1.00	0.09	0.04	1.00	4.25	0.01
1.00	0.00	0.99	1.00	0.00	0.00	1.00	11.54	0.26	1.00	1.26	0.73	1.00	0.12	0.14	1.00	2.14	0.85	1.00	0.04	0.23
1.00	0.35	0.16	1.00	2.01	0.09	1.00	2.91	0.24	1.00	1.39	0.28	1.00	1.18	0.04	1.00	4.08	0.04	1.00	4.08	0.03
1.00	.382	0.56	1.00	0.34	0.00	1.00	9.16	0.39	1.00	0.73	0.35	1.00	0.87	0.27	1.00	1.23	0.50	1.00	0.45	0.36
1.00	.983	0.32	1.00	0.98	0.74	1.00	0.11	0.41	1.00	0.68	0.48	1.00	0.49	0.99	1.00	0.00	0.29	1.00	1.11	0.24
1.00	.440	0.50	1.00	0.46	0.01	1.00	6.51	0.47	1.00	0.52	0.57	1.00	0.32	0.35	1.00	0.88	0.22	1.00	1.50	0.44
1.00	6.49	0.36	1.00	0.86	0.17	1.00	1.90	0.25	1.00	1.35	0.62	1.00	0.24	0.99	1.00	0.00	0.20	1.00	1.66	0.17
1.00	.99	0.01	1.00	6.74	0.46	1.00	0.54	0.47	1.00	0.52	0.57	1.00	0.32	0.35	1.00	0.88	0.28	1.00	1.17	0.44
1.00	0.11	0.09	1.00	2.94	0.53	1.00	0.39	0.39	1.00	0.75	0.12	1.00	2.47	0.29	1.00	1.10	0.20	1.00	1.63	0.13
1.00	0.09	0.76	1.00	0.09	0.26	1.00	1.29	0.75	1.00	0.10	0.80	1.00	0.06	0.68	1.00	0.17	0.63	1.00	0.23	0.22
1.00	0.24	0.62	1.00	0.24	0.58	1.00	0.30	0.41	1.00	0.67	0.54	1.00	0.38	0.99	1.00	0.00	0.22	1.00	1.53	0.33

Hair loss			Hyperhidrosis			Chills			Skin allergy			Epistaxis			Nausea			Diarrhea			
p	**df**	**χ^2**	**p**	**df**	**χ^2**	**p**	**df**	**χ^2**	**p**	**df**	**χ^2**	**p**	**df**	**χ^2**	**p**	**df**	**χ^2**	**p**	**df**	**χ^2**	**p**
0.00	1.00	13.32	0.84	1.00	.04	0.20	1.00	1.68	0.00	1.00	12.64	0.00	1.00	12.43	0.06	1.00	3.59	0.95	1.00	0.00	0.28
0.67	1.00	0.19	0.70	1.00	0.15	0.47	1.00	0.52	0.71	1.00	0.14	0.18	1.00	1.77	0.22	1.00	1.48	0.32	1.00	0.99	0.28
0.30	1.00	1.08	0.39	1.00	0.73	0.96	1.00	0.00	0.13	1.00	2.29	0.52	1.00	0.42	0.55	1.00	0.35	0.16	1.00	1.93	0.97
0.96	1.00	0.00	0.49	1.00	0.48	0.30	1.00	1.08	0.93	1.00	0.01	0.98	1.00	0.00	0.83	1.00	0.05	0.60	1.00	0.27	1.00
0.11	1.00	2.53	0.36	1.00	0.85	0.62	1.00	0.24	0.54	1.00	0.37	0.33	1.00	0.94	0.50	1.00	0.46	0.60	1.00	0.28	0.11
0.48	1.00	0.50	0.39	1.00	0.73	0.35	1.00	0.89	0.50	1.00	0.46	0.70	1.00	0.15	0.46	1.00	0.55	0.42	1.00	0.66	0.36
0.32	1.00	1.01	0.64	1.00	0.22	0.91	1.00	0.01	0.00	1.00	17.56	0.03	1.00	4.52	0.96	1.00	0.00	0.19	1.00	1.75	0.85
0.22	1.00	1.53	0.89	1.00	0.02	0.38	1.00	0.78	0.82	1.00	0.05	0.50	1.00	0.45	0.61	1.00	0.26	0.27	1.00	1.24	0.11
0.04	1.00	4.15	0.23	1.00	1.47	0.35	1.00	0.86	0.17	1.00	1.91	0.00	1.00	10.79	0.61	1.00	0.26	0.21	1.00	1.59	0.63
0.70	1.00	0.15	0.44	1.00	0.59	0.33	1.00	0.97	0.54	1.00	0.39	0.49	1.00	0.49	0.63	1.00	0.24	0.14	1.00	2.19	0.72
0.97	1.00	0.00	0.67	1.00	0.18	0.96	1.00	0.00	0.13	1.00	2.29	0.52	1.00	0.42	0.43	1.00	0.62	0.34	1.00	0.90	0.97
0.15	1.00	2.06	0.31	1.00	1.05	0.06	1.00	3.66	0.17	1.00	1.90	0.44	1.00	0.60	0.13	1.00	2.27	0.36	1.00	0.83	0.55
0.43	1.00	0.62	0.32	1.00	1.00	0.22	1.00	1.49	0.49	1.00	0.48	0.00	1.00	9.61	0.55	1.00	0.36	0.42	1.00	0.64	0.54
0.89	1.00	0.02	0.23	1.00	1.47	0.18	1.00	1.79	0.17	1.00	1.93	0.59	1.00	0.30	0.97	1.00	0.00	0.25	1.00	1.33	0.32
0.01	1.00	7.05	0.40	1.00	0.71	0.87	1.00	0.03	0.20	1.00	1.63	0.63	1.00	0.24	0.62	1.00	0.25	0.55	1.00	0.37	0.51
0.48	1.00	0.50	0.39	1.00	0.73	0.71	1.00	0.13	0.33	1.00	0.96	0.70	1.00	0.15	0.42	1.00	0.65	0.52	1.00	0.41	0.01
0.01	1.00	7.05	0.40	1.00	0.71	0.30	1.00	1.06	0.00	1.00	9.84	0.63	1.00	0.24	0.62	1.00	0.25	0.55	1.00	0.37	0.32
0.72	1.00	0.13	0.04	1.00	4.39	0.23	1.00	1.43	0.34	1.00	0.92	0.35	1.00	0.89	0.25	1.00	1.35	0.17	1.00	1.89	0.74
0.77	1.00	0.09	0.01	1.00	7.18	0.03	1.00	4.81	0.80	1.00	0.07	0.83	1.00	0.05	0.82	1.00	0.05	0.79	1.00	0.07	0.77
0.62	1.00	0.25	0.55	1.00	0.36	0.51	1.00	0.44	0.63	1.00	0.23	0.79	1.00	0.07	0.60	1.00	0.27	0.57	1.00	0.33	0.62

Poor memory			Blurred vision or eye			Hyperosmia		
p	df	χ²	p	df	χ²	p	df	χ²
0.14	1.00	2.23	0.00	1.00	8.88	0.00	1.00	8.88
0.94	1.00	0.01	0.78	1.00	0.08	0.27	1.00	1.22
0.54	1.00	0.38	0.76	1.00	0.09	0.13	1.00	2.29
0.26	1.00	1.29	0.06	1.00	3.58	0.96	1.00	0.00
0.59	1.00	0.29	0.05	1.00	4.01	0.00	1.00	11.53
0.31	1.00	1.03	0.36	1.00	0.86	0.48	1.00	0.50
0.40	1.00	0.72	0.02	1.00	5.66	0.02	1.00	5.66
0.75	1.00	0.10	0.50	1.00	0.45	0.12	1.00	2.48
0.52	1.00	0.42	0.83	1.00	0.05	0.17	1.00	1.91
0.66	1.00	0.20	0.72	1.00	0.13	0.61	1.00	0.26
0.54	1.00	0.38	0.76	1.00	0.09	0.36	1.00	0.83
0.04	1.00	4.23	0.55	1.00	0.35	0.15	1.00	2.06
0.64	1.00	0.22	0.38	1.00	0.79	0.01	1.00	6.06
0.74	1.00	0.11	0.87	1.00	0.03	0.20	1.00	1.63
0.69	1.00	0.16	0.20	1.00	1.63	0.56	1.00	0.34
0.31	1.00	1.03	0.36	1.00	0.86	0.48	1.00	0.50
0.69	1.00	0.16	0.56	1.00	0.34	0.56	1.00	0.34
0.05	1.00	3.82	0.72	1.00	0.13	0.72	1.00	0.13
0.86	1.00	0.03	0.80	1.00	0.07	0.80	1.00	0.07
0.48	1.00	0.51	0.62	1.00	0.24	0.62	1.00	0.25

χ²: chi-square; df: degree of freedom; p: p-value (significant at p<0.05); PA: Palestine; JO: Jordan.

Table 5 shows a significant relationship between types of vaccines and side effects in Jordan, such as insomnia (p = 0.04) and no significant relationship between them in Palestine. This indicates the following aspects: first, third-dose vaccination of all types is effective, successful, and beneficial to the body; second, it reduces a large percentage of corona infection; third, there is no fear of taking the third dose; and fourth, the proportion of side effects after taking the third dose is very low.

Table 5. Side effects of the third dose associated with types of vaccines

Symptoms		Type of Third Vaccination Dose														
		Palestine								Jordan						
		Pfizer-BioNTech N=425	Sinopharm N=159	AstraZeneca N=6	Moderna N=7	Sponik v N= 13	Jonsson & Jonsson N= 4	Chi-square	p-value	Pfizer-BioNTech N=425	Sinopharm N=159	AstraZeneca N=6	Moderna N=7	Sponik v N= 13	Jonsson & Jonsson N= 4	Chi-square	p-value
		N	N	N	N	N	N			N	N	N	N	N	N		
Infected after the third dose of vaccination	No	113	27	11	8	16	2	6.40	0.27	47	22	1	0	0	0	2.75	0.74
	Yes	132	53	8	9	14	2			224	92	3	4	6	1		
Fever	No	221	71	16	17	24	4	6.01	0.30	177	82	4	3	6	1	6.99	0.22
	Yes	24	9	3	0	6	0			94	32	0	1	0	0		

Symptom		1	2	3	4	5	6	x^2	p	1	2	3	4	5	6	x^2	p
Headache	No	202	67	14	15	20	3	6.11	0.30	145	74	3	3	2	0	8.00	0.16
	Yes	43	13	5	2	10	1			126	40	1	1	4	1		
Fatigue	No	210	69	16	17	21	3	8.84	0.12	126	68	2	3	2	0	8.24	0.14
	Yes	35	11	3	0	9	1			145	46	2	1	4	1		
Insomnia	No	229	77	19	17	26	4	6.41	0.27	230	96	4	3	3	0	11.57	0.04
	Yes	16	3	0	0	4	0			41	18	0	1	3	1		
Joints pain	No	136	36	13	12	21	3	9.58	0.09	182	80	2	4	4	0	4.94	0.42
	Yes	109	44	6	5	9	1			89	34	2	0	2	1		
Muscle pain	No	223	75	16	17	24	3	8.79	0.12	199	88	3	3	6	1	2.98	0.70
	Yes	22	5	3	0	6	1			72	26	1	1	0	0		
Abdominal pain	No	224	74	19	16	26	3	4.38	0.50	241	103	4	4	5	0	9.66	0.09
	Yes	21	6	0	1	4	1			30	11	0	0	1	1		
Anorexia	No	227	73	16	17	27	3	4.92	0.43	239	104	4	4	5	1	2.08	0.84
	Yes	18	7	3	0	3	1			32	10	0	0	1	0		
Diarrhea	No	224	77	19	17	27	4	5.76	0.33	233	99	3	4	5	0	7.29	0.20
	Yes	21	3	0	0	3	0			38	15	1	0	1	1		
Nausea	No	233	78	19	16	27	3	7.27	0.20	237	102	4	4	4	1	4.12	0.53
	Yes	12	2	0	1	3	1			34	12	0	0	2	0		
Epistaxis	No	235	75	19	17	27	4	4.61	0.47	260	112	4	4	5	1	4.69	0.46
	Yes	10	5	0	0	3	0			11	2	0	0	1	0		
Skin allergy	No	231	75	18	16	26	4	2.95	0.71	243	103	4	4	4	1	4.55	0.47
	Yes	14	5	1	1	4	0			28	11	0	0	2	0		
Chills	No	208	60	17	14	24	3	5.03	0.41	220	96	3	4	5	0	6.07	0.30
	Yes	37	20	2	3	6	1			51	18	1	0	1	1		

								Mean	p							Mean	p
Hyperhidrosis	No	215	68	18	16	26	3	2.67	0.75	230	96	4	4	4	1	3.17	0.67
	Yes	30	12	1	1	4	1			41	18	0	0	2	0		
Hair loss	No	226	69	18	17	29	4	6.44	0.27	242	102	4	4	3	1	10.49	0.06
	Yes	19	11	1	0	1	0			29	12	0	0	3	0		
Poor memory	No	239	79	18	16	28	3	9.83	0.08	213	94	4	3	4	1	2.70	0.75
	Yes	6	1	1	1	2	1			58	20	0	1	2	0		
Blurred vision or eye redness	No	230	73	19	17	27	4	4.19	0.52	242	102	3	4	5	1	1.67	0.89
	Yes	15	7	0	0	3	0			29	12	1	0	1	0		
Hyperosmia	No	228	76	18	17	28	3	3.94	0.56	241	103	4	4	3	1	10.65	0.06
	Yes	17	4	1	0	2	1			30	11	0	0	3	0		

4. Discussion

The COVID-19 pandemic caused many obstacles to life in many countries, which forced us to take effective protection procedures to dominate the spread by producing effective and safe vaccinations (Jaboob et al., 2024). Palestine and Jordan were the first countries to start early vaccination and have taken the essential preventive measures to deal with COVID-19 (World Health Organization, 2020b). Despite the vaccine being available to populations in Jordan and Palestine, there is a variation in people's willingness to take it, likely due to the vaccines' rapid development compared to previously approved vaccines that typically take years to approve. Another possible explanation for this variance is that some COVID-19 vaccinations use a newly developed technology (Kerr et al., 2021; Omeish et al., 2022).

Furthermore, spreading rumors about the efficacy of COVID-19 vaccines raises questions about their effectiveness. Given the limited information about what happens after the vaccine, more research is needed to understand what to expect after vaccination, reduce rumors, and reduce doubts about COVID-19 vaccines (Hatmal et al., 2021; Algaissi et al., 2020; Almufty et al., 2021; Saeed et al., 2021; Abu-Halaweh et al., 2021). It appears that the most common symptoms, primarily in the post-vaccination period, are generalized weakness, myalgia, headache, fever and chills, joint pain, nausea, and diarrhea (Our World in Data, 2020). The previous studies for the first and second doses show that side effects are significantly associated with the types of quantities, the number of doses, and the age of recipients of the first and second doses of COVID-19 vaccines (Al-Ansi, 2021; Calculator, 2022; Al Ghafri et al., 2021; Elgendy et al., 2022). In this study, the reported side effects of recipients of the third dose in Palestine are higher and significantly more associated with male participants. Still, for Jordan, the side effects for females are greater than those for males (Table 1). The level of education in Palestine and Jordan has significant associations with the side effects of bachelor's degrees (Table 1).

Similar to previous studies (Table 6), participants experienced more side effects after receiving the AstraZeneca, Pfizer-BioNTech and Sinopharm vaccines. Most participants in these studies received the AstraZeneca and Pfizer-BioNTech vaccines, while the minority received the Sinopharm vaccine (Adam et al., 2021). The results in Table 2 of this study align with those of previous studies, i.e., the highest percentage of those who received the Pfizer-BioNTech and AstraZeneca vaccines. In contrast, the Sinopharm vaccine ranked third in terms of the number of

people vaccinated (Katmal et al., 2021; de Lusignan et al., 2020), which does not align with the results.

Table 6. List of studies on the side effects of the COVID-19 vaccination in Arab countries

Country	Population	Sample Size	Vaccines (%)	Reference
UAE	Individuals in the UAE	1,080	Sinopharm (77.3)	Al-Hrinat et al. (2024)
Jordan	Jordanian population	1,086	Pfizer–BioNTech (40. 6) AstraZeneca (33.0) Sinopharm (26.4)	Al Ansi & Al Ansi (2020)
Iraq	General population	1,012	AstraZeneca (60.1) Pfizer-BioNTech (29.2) Sinopharm (10.7) Sinopharm (38.2) AstraZeneca (31)	Jaboob et al. (2023)
Jordan	Jordanian adults	1,004	Pfizer-BioNTech (48.9) AstraZeneca (46.3) Sinopharm (51.1)	Al-Ansi et al. (2023a)
KSA	General population	18,543	Pfizer-BioNtech (2.3) AstraZeneca (97.8)	Awain et al. (2023)
Oman	General population	753	AstraZeneca (78) Pfizer-BioNTech (22)	Omeish et al. (2022)
Egypt	Egyptian population	168	Sinopharm AstraZeneca Pfizer BioNTech	Hatmal et al. (2021)
KSA	General population	330	Pfizer-BioNTech (49.4) AstraZeneca (50.6)	Algaissi et al. (2020)

KSA: Kingdom of Saudi Arabia; UAE: United Arab Emirates.

This study shows that infection with side effects after the third dose of vaccination in Palestine is the most predisposing factor affecting people, followed by corona infection before vaccination, food sensitivity and corona infection after vaccination, and the least significant factors are weight and drug sensitivity. In Jordan, gender, smoking, and food sensitivity are the most important factors affecting people, followed by age, and the least important factors are weight, infection with corona after vaccination, and infection with symptoms after the third dose of vaccination.

This study shows that the participants in Palestine who have diabetes and respiratory diseases are more likely to have side effects after the third dose of vaccination, followed by obese people, people with cardiovascular diseases, osteoporosis and thyroid disorders, people with immune diseases and cancer, and people with arthritis and hypertension. Participants in Jordan with arthritis are more likely to develop side effects after the third dose of vaccination, followed by obese people, people with respiratory diseases, and people with thyroid disorders. The results are consistent with the findings of previous studies, which stated that many chronic diseases, such as cardiovascular disease and respiratory disease, were found to be significantly associated with post-vaccination infection after a single dose in older adults. Several of these comorbidities increase the risk of COVID-19-related mortality, hospitalization, ventilators, and severe diseases (Williamson et al., 2020; Al-Ansi & Fatmawati, 2023).

A study conducted by the Centers for Disease Control and Prevention (CDC) shows that the side effects experienced by people who received a third dose of either the Pfizer-BioNTech or Moderna COVID-19 vaccine are typically mild and similar to those experienced after a second dose (Pal et al., 2020). The most commonly reported side effects involved reactions at the injection site, such as pain or swelling. 79.4% of people reported this after their third shot, while 77.6% reported it after a second dose. Following their booster shot, 74.1% of people reported fever or headache, compared to 76.5% after a second dose (Al-Ansi, 2021).

Another study conducted by the CDC shows that most of the adverse reactions after an additional dose of the COVID-19 vaccine are mild or moderate. Local (74.9%) and systemic (69.9%) reactions were frequently reported

during the week after an additional dose of the COVID-19 vaccine, most commonly on the day after vaccination. Frequently reported reactions are injection site pain (71.0%), fatigue (56.0%), and headache (Antonelli et al., 2022; Adavisory Board, 2021).

In general, COVID-19 vaccines can cause mild side effects after the first or second dose, including pain, redness, or swelling where the shot was given, fever, fatigue, headache, muscle pain, chills, joint pain, nausea and vomiting, swollen lymph nodes, and feeling unwell. Most side effects go away in a few days (Al-Ansi et al., 2023b; Al-Ansi & Al-Ansi, 2023; Hause et al., 2021; Mayoclicnic, 2023).

As for the side effects of corona vaccine doses, the results of these studies are consistent with the results of this study.

5. Implications and Limitations

This study has many strengths and limitations. This study is the first comparative study for COVID-19 vaccines between Palestine and Jordan, which includes data from both countries and provides a comprehensive overview of the side effects of the third dose. The questionnaire was distributed online, which is easily accessible and covers all aspects. The results of this study can be used as a proper standard to increase awareness about COVID-19 vaccination, which may reduce anxiety due to lack of information and may help enhance people's trust in the safety of vaccines, thereby encouraging people to take vaccines by eliminating false concepts about their side effects. However, this study has limitations. No long-term follow-up data was included in the study, leading to less information on the differences in long-term side effects between Palestine and Jordan. The lack of control groups leads to less insight into the vaccines' side effects in different populations. Furthermore, the exclusion of other countries or regions from this study limited the understanding of the diverse responses to the vaccines.

Although some people may experience mild symptoms or be asymptomatic carriers, others can suffer from severe respiratory distress and require hospitalization. This variation complicates both diagnosis and treatment, making it challenging to implement universal guidelines for managing the virus effectively. Additionally, comorbidities such as heart disease, diabetes, and obesity have been identified as significant risk factors for developing severe complications from COVID-19. These underlying health conditions can further complicate the disease's clinical presentation and influence outcomes.

6. Conclusion

COVID-19 and its effects on human health are still a problem for Palestine and Jordan. According to the study, more people are getting their third dose of various vaccinations. Most people received the Sinopharm, AstraZeneca and Fizer-BioNTech vaccines. The third dose of the corona vaccine is safe and effective but also brings various side effects. Various predisposing factors, such as gender, age, educational qualification, weight, infection with corona before and after vaccination, infection with symptoms after the third dose, etc., are associated with the frequency of side effects of the third dose. Moreover, chronic diseases, such as diabetes, high blood pressure, immune diseases, cardiovascular diseases, respiratory diseases, cancer, arthritis, osteoporosis, and obesity, are associated with the side effects of the third dose.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

References

Abu-Halaweh, S., Alqassieh, R., Suleiman, A., Al-Sabbagh, M. Q., Abu-Halaweh, M., AlKhader, D., & Alwreikat, M. (2021). Qualitative assessment of early adverse effects of Pfizer-BioNTech and Sinopharm COVID-19 vaccines by telephone interviews. *Vaccines, 9,* 950. https://doi.org/10.3390/vaccines9090950.

Adam, M., Gameraddin, M., Alelyani, M., Alshahrani, M. Y., Gareeballah, A., Ahmad, I., & Musa, A. (2021). Evaluation of post-vaccination symptoms of two common COVID-19 vaccines used in Abha, Aseer Region, Kingdom of Saudi Arabia. *Patient Prefer. Adher., 15,* 1963-1970. https://doi.org/10.2147/PPA.S330689.

Adavisory Board. (2021). *What are the side effects of a third COVID-19 shot? Here's what CDC found.* Adavisory Board. https://www.advisory.com/daily-briefing/2021/09/29/boosters

Al Ghafri, T. S., Al Balushi, L., Al Balushi, Z., Al Hinai, F., Al Hasani, S., Anwar, H., & Al Harthi, S. (2021). Reporting at least one adverse effect post-COVID-19 vaccination from primary health care in Muscat. *Cureus,*

13(8). https://doi.org/10.7759/cureus.17055.

Al-Ansi, A. (2022). Investigating characteristics of learning environments during the COVID-19 pandemic: A systematic review. *Can. J. Learn. Technol.*, *48*(1), n1.

Al-Ansi, A. M. (2021). Students' anxiety and recruitment during COVID-19 pandemic: Role of university, specialization and employment expectation. *Perspect. Sci. Educ.*, *49*(1), 403-413. https://doi.org/10.32744/pse.2021.1.27.

Al-Ansi, A. M. & Al-Ansi, A. (2020). Future of education post COVID-19 pandemic: Reviewing changes in learning environments and latest trends. *Solid State Technol.*, *63*(6), 201584-201600.

Al-Ansi, A. M. & Al-Ansi, A. (2023). An overview of artificial intelligence (AI) in 6G: Types, advantages, challenges and recent applications. *Buletin Ilmiah Sarjana Teknik Elektro*, *5*(1), 67-75. https://doi.org/10.12928/biste.v5i1.7603.

Al-Ansi, A. M., Almadi, M., Ryabtsev, V., & Utkina, T. (2023a). Identification of brain tumors based on digitized parameters from magnetic resonance imaging results. *Examples Counterexamples, 4*, 100125. https://doi.org/10.1016/j.exco.2023.100125.

Al-Ansi, A. M. & Fatmawati, I. (2023). Integration of ICT in higher education during COVID-19 pandemic: A case study. *Int. J. Learn. Change*, *15*(4), 430-442. https://doi.org/10.1504/IJLC.2023.132132.

Al-Ansi, A. M., Hazaimeh, M., Hendi, A., & Adwan, G. (2023b). How do social media influencers change adolescents' behavior? An evidence from middle east countries. *Heliyon*, *9*(5). e15983. https://doi.org/10.1016/j.heliyon.2023.e15983.

Algaissi, A. A., Alharbi, N. K., Hassanain, M., & Hashem, A. M. (2020). Preparedness and response to COVID-19 in Saudi Arabia: Building on MERS experience. *J. Infect. Public Health, 13*(6), 834-838. https://doi.org/10.1016/j.jiph.2020.04.016.

Al-Hrinat, J., Al-Ansi, A. M., Hendi, A., Adwan, G., & Hazaimeh, M. (2024). The impact of night shift stress and sleep disturbance on nurses quality of life: Case in Palestine Red Crescent and Al-Ahli Hospital. *BMC Nurs.*, *23*(1), 24.

Almufty, H. B., Mohammed, S. A., Abdullah, A. M., & Merza, M. A. (2021). Potential adverse effects of COVID-19 vaccines among Iraqi population; A comparison between the three available vaccines in Iraq; A retrospective cross-sectional study. *Diabetes Metab. Syndr. Clin. Res. Rev.*, *15*(5), 102207. https://doi.org/10.1016/j.dsx.2021.102207.

Antonelli, M., Penfold, R. S., Merino, J., Sudre, C. H., Molteni, E., Berry, S., & Steves, C. J. (2022). 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.*, *22*(1), 43-55. https://doi.org/10.1016/S1473-3099(21)00460-6.

Awain, A. B., Al-Ansi, A. M., & Jaboob, M. (2023). Green supply chain management: A comprehensive review of research, applications and future directions. *Manage. Prod. Eng. Rev., 14*(3), 118-133. https://doi.org/10.24425/mper.2023.147194.

Calculator. (2022). *Online Sample Size Calculator.* Calculator. https://www.calculator.net/sample-size-calculator.html

Casiday, R., Cresswell, T., Wilson, D., & Panter-Brick, C. (2006). A survey of UK parental attitudes to the MMR vaccine and trust in medical authority. *Vaccine*, *24*(2), 177-184. https://doi.org/10.1016/j.vaccine.2005.07.063.

Daralammouri, Y., Azamtta, M., Hamayel, H., Jaber, D. A., Adas, A., Hussein, I. E., & Nasr, M. (2020). Recommendations for safe and effective practice of interventional cardiology during COVID-19 pandemic: Expert opinion from Jordan and Palestine. *Palestin. Med. Pharm. J.*, *5*(1), 7. https://doi.org/10.59049/2790-0231.1053.

de Lusignan, S., Dorward, J., Correa, A., Jones, N., Akinyemi, O., Amirthalingam, G., & Hobbs, F. R. (2020). Risk factors for SARS-CoV-2 among patients in the Oxford Royal College of General Practitioners Research and Surveillance Centre primary care network: A cross-sectional study. *Lancet Infect. Dis.*, *20*(9), 1034-1042. https://doi.org/10.1016/S1473-3099(20)30371-6.

Du Toit, A. (2020). Outbreak of a novel coronavirus. *Nat. Rev. Microbiol., 18*(3), 123. https://doi.org/10.1038/s41579-020-0332-0.

Elgendy, M. O., El-Gendy, A. O., Mahmoud, S., Mohammed, T. Y., Abdelrahim, M. E., & Sayed, A. M. (2022). Side effects and efficacy of COVID-19 vaccines among the Egyptian population. *Vaccines*, *10*(1), 109. https://doi.org/10.3390/vaccines10010109.

Garad, A., Budiyanto, G., & Ansi, A. M. (2021). Impact of COVID-19 pandemic on the global economy and future prospects: A systematic review of global reports. *J. Theor. Appl. Inf. Technol., 99*(4), 1-15.

Guerrieri, V., Lorenzoni, G., Straub, L., & Werning, I. (2022). Macroeconomic implications of COVID-19: Can negative supply shocks cause demand shortages? *Am. Econ. Rev.*, *112*(5), 1437-1474. https://doi.org/10.1257/aer.20201063.

Hatmal, M. M. M., Al-Hatamleh, M. A., Olaimat, A. N., Hatmal, M., Alhaj-Qasem, D. M., Olaimat, T. M., &

Mohamud, R. (2021). Side effects and perceptions following COVID-19 vaccination in Jordan: A randomized, cross-sectional study implementing machine learning for predicting severity of side effects. *Vaccines, 9*(6), 556. https://doi.org/10.3390/vaccines9060556.

Hause, A. M., Baggs, J., Gee, J., Marquez, P., Myers, T. R., Shimabukuro, T. T., & Shay, D. K. (2021). Safety monitoring of an additional dose of COVID-19 vaccine—US August 12–September 19, 2021. *Morb. Mortal. Wkly. Rep., 70*(39), 1379.

Jaboob, M., Hazaimeh, M., & Al-Ansi, A. M. (2024). Integration of generative AI techniques and applications in student behavior and cognitive achievement in Arab higher education. *Int. J. Hum. -Comput. Interact.*, 1-14. https://doi.org/10.1080/10447318.2023.2300016.

Jaboob, M., Salim Ba Awain, A. M., Al-Ansi, A. M. (2023). Sustaining employees' creativity through the organizational justice: The mediating role of leadership styles. Soc. Sci. Humanit. Open, 8(1), 100693. https://doi.org/10.1016/j.ssaho.2023.100693.

Kerr, J. R., Freeman, A. L., Marteau, T. M., & van der Linden, S. (2021). Effect of information about COVID-19 vaccine effectiveness and side effects on behavioural intentions: Two online experiments. *Vaccines*, *9*(4), 379. https://doi.org/10.3390/vaccines9040379.

Katmal, V., Alshazly, H., Idris, S. A., & Bourouis, S. (2021). Evaluating the impact of COVID-19 on society, environment, economy, and education. *Sustainability, 13*(24), 13642. https://doi.org/10.3390/su132413642.

Larson, H. J., Clarke, R. M., Jarrett, C., Eckersberger, E., Levine, Z., Schulz, W. S., & Paterson, P. (2018). Measuring trust in vaccination: A systematic review. *Hum. Vaccin. Immunother.*, *14*(7), 1599-1609. https://doi.org/10.1080/21645515.2018.1459252.

Mayoclicnic. (2023). *COVID-19 vaccines: Get the facts.* Mayoclicnic. https://www.mayoclinic.org/coronavirus-covid-19/vaccine-side-effects

Omeish, H., Najadat, A., Al-Azzam, S., Tarabin, N., Abu Hameed, A., Al-Gallab, N., & Aldeyab, M. A. (2022). Reported COVID-19 vaccines side effects among Jordanian population: A cross sectional study. *Hum. Vaccin. Immunother.*, *18*(1), 1981086. https://doi.org/10.1080/21645515.2021.1981086.

Our World in Data. (2020). *Coronavirus Pandemic (COVID-19).* Our World in Data. https://ourworldindata.org/coronavirus

Pal, M., Berhanu, G., Desalegn, C., & Kandi, V. (2020). Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2): An update. *Cureus, 12*(3), e7423. https://doi.org/10.7759/cureus.7423.

Saeed, B. Q., Al-Shahrabi, R., Alhaj, S. S., Alkokhardi, Z. M., & Adrees, A. O. (2021). Side effects and perceptions following Sinopharm COVID-19 vaccination. *Int. J. Infect. Dis., 111*, 219-226. https://doi.org/10.1016/j.ijid.2021.08.013.

Seirafianpour, F., Pourriyahi, H., Gholizadeh Mesgarha, M., Pour Mohammad, A., Shaka, Z., & Goodarzi, A. (2022). A systematic review on mucocutaneous presentations after COVID-19 vaccination and expert recommendations about vaccination of important immune-mediated dermatologic disorders. *Dermatol. Ther.*, *35*(6), e15461. https://doi.org/10.1111/dth.15461.

Williamson, E. J., Walker, A. J., Bhaskaran, K., Bacon, S., Bates, C., Morton, C. E., & Goldacre, B. (2020). Factors associated with COVID-19-related death using OpenSAFELY. *Nature*, *584*(7821), 430-436. https://doi.org/10.1038/s41586-020-2521-4.

World Health Organization. (2020a). Coronavirus disease (COVID-19) outbreak situation. World Health Organization. https://www.who.int/emergencies/diseases/novel-coronavirus-2019

World Health Organization. (2020b). *Responding to community spread of COVID-19.* World Health Organization. https://www.who.int/publications/i/item/responding-to-community-spread-of-covid-19