


Undesirable effects of COVID-19 vaccination on Saudi population: A descriptive study, Winter 2022

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ABSTRACT

Objective: The development of coronavirus disease 2019 (COVID-19) vaccines was a crucial preventative measure toward controlling the pandemic. Several side effects have been reported. This study investigated the long-term side effects reported by the Saudi population. post-COVID-19 vaccination.

Methods: The cross-sectional study involved Saudi participants of both genders, aged ≥ 16 years, and had received at least one dose of any of the available vaccines in Saudi Arabia. They were asked to fill out an online questionnaire divided into three sections: Demographics, medical history, and side effects that appeared post-COVID-19 vaccines.

Results: The findings indicated that the undesirable effects were reported by 82% of the participants. These side effects involve three categories: The most common, additional or reported, and persistent side effects. The most common side effects were pain at the site of injection (88.16%), bone pain/joint pain (68.7%), and fatigue (68.46%). Menstrual disorders ($n = 46$), hair loss ($n = 34$), and memory problems ($n = 19$) were reported by participants as additional side effects. Among all side effects, fatigue, joint pain, hair loss, and menstrual disorders were the most persistent side effects. Moreover, 190 participants reported that they were diagnosed with diseases soon after receiving the COVID-19 vaccine including COVID-19, thyroid gland disorder, and irritable bowel disease. The quality of life of some of the participants was affected by post-COVID-19 vaccines, as 25.28% had anxiety, 21.22% had depression, and 33.16% had discomfort.

Conclusion: These findings may contribute to understanding the effect of COVID-19 vaccines on the Saudi population's health and public opinion about these vaccines.

Keywords: Coronavirus, covid, covid-19, pandemic, vaccine

Introduction

Infectious diseases pose a formidable threat to global health and security, making them the leading cause of mortality worldwide. This presents a substantial challenge for the global community in terms of public health and overall well-being.^[1] Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2. The COVID-19 outbreak has led to major health, social, and economic burdens.^[2,3] Globally, health-care systems were not prepared for such a crisis; therefore, fast and effective solutions were needed urgently. Self-quarantine was obligatory worldwide, subsequently, Saudi Arabia implemented several preventative measures including partial and complete lockdown and travel restrictions.^[4,5] Repurposing of the already available drugs such as hydroxychloroquine,^[6] remdesivir,^[7] and favipiravir^[8] has also been investigated. However, these

drugs demonstrated ineffective therapeutic efficacies and safety profiles on severely affected COVID-19 patients. The development of COVID-19 vaccines to control the pandemic has been a worldwide priority.^[9] In 2020, Pfizer/BioNTech (BNT162b2) was the first COVID-19 vaccine that obtained authorization from the Food and Drug Administration (FDA) and granted World Health Organization (WHO) approval for emergency use.^[10] The approval of the Oxford/AstraZeneca vaccine was then released in January 2021 by the European Commission and obtained authorization for emergency use by the WHO in February 2021. Other vaccines that also obtained the emergency use listing by the WHO include Moderna (mRNA 1273) and Johnson and Johnson's Janssen Ad26. COV 2.S.

In Saudi Arabia, four vaccines were approved, including Pfizer/BioNTech, Oxford/AstraZeneca, Moderna, and Janssen

(Johnson and Jhonson).^[11] A two-dose regimen program of Pfizer/BioNTech or Oxford/AstraZeneca vaccines was first made available for high-risk candidates such as first-line health-care workers and citizens with chronic diseases. Shortly after, a two-dose regimen program of the available vaccines was mandatory for both Saudi citizens and residents, which was then followed by the booster-dose phase.^[12]

Although these vaccines are designed to prevent lethal complications related to COVID-19, a range of mild-to-severe side effects have been reported globally. Mild side effects include localized pain at the site of injection, tenderness, swelling, itching, tenderness, and swelling of armpit glands. Other mild systematic side effects include headache, fatigue, fever, chills, night sweats, muscle pain, joint pain, decreased appetite, nausea, and vomiting.^[13-17] Moreover, on October 12, 2022, updates issued by the Centers for Disease Control and Prevention reported several severe side effects post-COVID-19 vaccine administration. These include anaphylaxis, myocarditis and pericarditis, Guillain-Barré syndrome, thrombosis with thrombocytopenia syndrome, and death.^[18]

According to the Saudi Ministry of Statistics, 67,979,420 vaccine doses were administered to the Saudi Arabian population.^[19] There have been several studies examining short-term side effects of COVID-19, but data on long-term side effects of these vaccines within different regions of Saudi Arabia are limited. Furthermore, effective interventions will be developed with the understanding of COVID-19 vaccination side effects and public opinion of COVID-19 vaccinations. Herein, we aim to explore the most common long-term side effects acquired post-COVID-19 vaccination among the Saudi population and their effects on the overall quality of life.

Materials and Methods

Study design

This was a cross-sectional survey-based study completed between the 12th and 22nd of October 2022, to evaluate the effect of the COVID-19 vaccine on the health of the Saudi Arabian population, using a validated self-reporting questionnaire created on Google Forms, which was dispersed randomly through all social media applications. The study protocol was approved by the King Abdulaziz University Hospital Ethics Committee (reference no. 30-18, 5, 2022). All procedures were conducted in compliance with the institution's ethical guidelines.

Participants were directed to a link with a brief introduction to the aim, purpose of the study, and informed consent, which included statements about voluntary participation. In addition, our questionnaire guaranteed participants anonymity, and that our results were to be reported as grouped information and findings. All participants signed an online consent form. The

questionnaire also gave participants the choice to withdraw before submitting their answers and at any stage.

The design of the questionnaire was divided into four sections, shown in Appendix A, and was as follows: Section one was about participant's demographics, including gender, nationality, age, marital status, educational level, and employment status. The second section questions were about the participant's medical history: They were asked to specify any health problems, chronic diseases, comorbidities, smoking and exercising habits, number of COVID-19 vaccine doses, date of delivery of the final dose, and type/brand name of the vaccine/s, and the participant was asked to list the accompanying medications before and after receiving the vaccine. The list of medications includes and is not limited to paracetamol, non-steroidal anti-inflammatory drugs, or supplements such as Vitamin D, zinc, and multivitamins. In the third section, participants were asked about post-vaccination symptoms and diseases; when they appeared, how long the symptoms lasted, and whether they had been hospitalized due to these symptoms. If their lymph nodes have been removed surgically, and if they were diagnosed with any disease after receiving the COVID-19 vaccine, or if they have been treated with cupping. The last section covered the quality of life of the participant post-vaccination. The questions examined in this section include, but are not limited to: continuous monitoring of the participant's vital signs, whether the participant's overall well-being has been affected, whether the participant is willing to receive another annual seasonal vaccine dose, whether the participant believes the COVID-19 vaccination is safe and whether a family member of the participant contracted an infection or died after receiving the vaccination. In terms of persistent side effects, participants were asked whether side effects persisted longer than 2 months after the last dose received.

Inclusion criteria

Inclusion criteria included all adults, both genders, and aged 16 years and above that are nationals of the Kingdom of Saudi Arabia.

Exclusion criteria

Participants who were not Saudi nationals, those who were under 16 years of age, and who did not receive at least one COVID-19 vaccination shot.

Sample size

One thousand six hundred and sixty-two responses were received from different age groups, regions, and nationalities. The study sample included participants who received at least one vaccination dose at the Saudi Ministry of Health COVID-19 vaccination clinics with one of the three pharmaceutical brands which were Pfizer, AstraZeneca, and/or Moderna. The data sheet and results were exported to a Microsoft Excel

spreadsheet which was cleaned up, and accordingly, our final sample of participants that fit the exclusion/inclusion criteria dropped to 1503.

Statistical analysis

Microsoft Excel was used for statistical analysis to obtain descriptive analysis for the data collected, frequencies, and percentages to compare between variables. Graphpad prism was used to generate figures.

Results

Demographics and general characteristics

A total of 1662 participants filled in the questionnaire by October 12, 2022. However, one hundred and forty-eight participants were excluded, because they did not meet the inclusion criteria of this study. Around one-third of the participants (30.1%) were male ($n = 453$), whereas 69.9% ($n = 1050$) were female and both received at least one dose of the vaccines available in Saudi Arabia. The age of the participants ranged from 16 to >65 years old and they are from 12 different Saudi Arabia provinces. The majority of the participants were from Makkah ($n = 914$), Riyadh ($n = 302$), and Eastern ($n = 118$) provinces [Table 1].

The health status of the participants was determined according to information they provided on faintness, smoking habits, and mental and physical health [Table 2]. The vast majority of the participants ($n = 1090$) reported that they performed physical exercise. In addition, 80.8% of the participants were non-smokers and 80.8% did not suffer from any common health issues. However, 40.16% of the participants were affected by chronic diseases, including obesity (11.43%), diabetes (9.05%), hypertension (10.57%), high cholesterol (9.64%), thyroid gland disorder (8.39%), asthma (5.48%), heart diseases (2.25%), arthritis (2.11%), rheumatoid arthritis (1.85%), and other (20.61%). The minority of the participants have also reported that they have been suffering from several other health issues such as psychological issues (6.52%), behavioral disorders (0.79%), and physical disability (11%).

The participants were asked about the type of COVID-19 vaccine, the number of vaccine doses they have received, and how many times they have been infected with the virus [Table 3]. Most of the participants received only the Pfizer vaccine (68.7%), whereas 17.2% were vaccinated with Pfizer and AstraZeneca vaccines and 6.6% were vaccinated with AstraZeneca, Pfizer, and Moderna vaccines. Furthermore, over than three-quarters ($n = 1157$) of the participants received three doses of the COVID-19 vaccine with the last dose being administered within 9–12 months. Moreover, around half of the participants ($n = 700$) reported that they had not been diagnosed with COVID-19. In contrast, 53% of the participants reported that they had been infected with the virus at least once

Table 1: Demographics and general characteristics of the participants

Characteristics	Participants ($n=1503$)	$n=%$
Gender		
Female	1050	69.9
Male	453	30.1
Age		
16–24 years old	275	13.3
25–34 years old	309	20.6
35–44 years old	363	24.2
45–54 years old	266	17.7
55–64 years old	207	13.8
>65 years old	83	5.5
Place of residence		
Inside Saudi Arabia	1495	99.5
Outside Saudi Arabia	8	0.5
Saudi Arabia provinces		
Makkah	914	61.10
Madinah	40	2.67
Riyadh	302	20.19
Tabuk	32	2.14
Eastern	118	7.89
Al Baha	13	0.87
Northern Borders	11	0.74
Asir	23	1.54
Najran	2	0.13
Jazan	11	0.74
Hail	8	0.53
Al Qassim	21	1.40
Education		
Primary school	8	0.5
Intermediate	29	1.9
High school	250	16.6
Diploma	118	7.8
Bachelor’s degree	803	53.4
Master’s degree	171	11.4
PhD degree	124	8.2
Occupational status		
Employee	610	40.6
Unemployed	387	25.7
Retired	230	15.3
Student	276	18.4
Career field		
Education	374	24.88
Health care	67	4.46
Administration	124	8.25
Other	45	2.99

($n = 804$), 37% of which claimed that they were infected after receiving the vaccine.

Table 2: General health status of the participants

Variable	Outcome	Participants (n=1503)	n=%
Physical exercise	Yes	1090	72.52
	No	413	27.48
Smoking	Yes	289	19.2
	No	1214	80.8
Chronic diseases	Not applicable	906	59.84
	Obesity	173	11.43
	Diabetes	137	9.05
	Hypertension	160	10.57
	Multiple sclerosis	6	0.40
	Heart diseases	34	2.25
	Liver disease	6	0.40
	Kidney disease	5	0.33
	Asthma	83	5.48
	Anemia	5	0.33
	High cholesterol	146	9.64
	Thyroid gland disorder	127	8.39
	Hypothyroidism	3	0.20
	Hormonal disorder	1	0.07
	Hyperthermia	1	0.07
	Memory problems	1	0.07
	Hearing loss	1	0.07
	Rheumatoid arthritis	28	1.85
	Arthritis	32	2.11
	Knees roughness	3	0.20
	Muscle weakness	1	0.07
	Allergy	5	0.33
	Skin disease	1	0.07
	G6PD deficiency	2	0.13
	Alopecia	1	0.07
	Lupus	5	0.33
	Bowel inflammatory disease	6	0.40
	Intervertebral disc	2	0.13
	Foot clot	1	0.07
	Intraocular pressure	1	0.07
	Glaucoma	1	0.07
Cancer	14	0.92	
brain tumor resection	1	0.07	
Epilepsy	1	0.07	
Other health issues	Not applicable	1391	92.54
	Psychological issues	98	6.52
	Behavioral disorders	12	0.79
	Physical disability	11	0.73

Medications and supplements during vaccination

The participants have been asked about the medications and supplements that they may have been taken after receiving

Table 3: COVID-19 vaccination and infection status

Variable	Outcome	Participants (n=1503)	n=%
Type of vaccine	Pfizer	1033	68.7
	Pfizer+AstraZeneca	259	17.2
	Pfizer+Moderna	99	6.6
	(Pfizer+AstraZeneca+Moderna)	42	2.8
	AstraZeneca	41	2.7
	(AstraZeneca+Moderna)	21	1.4
Number of doses	Moderna	8	0.5
	Four doses	50	3.3
	Three doses	1157	77.0
	Two doses	282	18.8
Last dose within	One dose	14	0.9
	2 weeks	2	0.1
	1 month	9	0.6
	2 months	15	1.0
	3-4 months	90	6.0
	5-6 months	240	16.0
Infection frequency	7-8 months	327	21.8
	9-12 months	472	31.4
	Once	635	41.9
	Twice	147	9.7
	Thrice	22	1.5
Infection time	Have not had	700	46.2
	Before vaccination	213	14.2
	After vaccination	561	37.3
	Before and after vaccination	29	1.9
	Have not had	700	46.6

COVID-19: Coronavirus disease 2019

the COVID-19 vaccine [Table 4]. Most of the participants reported that they have not had any medication (61.74%) or supplements (40.59%) post-COVID-19 vaccination ($n = 928$) and ($n = 610$), respectively. In addition, 29.61% of the participants specified that they had had paracetamol ($n = 445$) and the rest of the participants reported that they had been taken a variety of medications [Table 4]. Vitamin D, C, and multivitamins were the most used supplements post-COVID-19 vaccine: 36.39%, 32%, and 23.75%, respectively. Some of the participants have also reported that they have had other supplements such as zinc ($n = 302$) and iron ($n = 205$).

Post-vaccine side effects

The participants were asked whether they suffered from any side effects after receiving the vaccine to document the common and specific side effects among the Saudi population. The results indicated that out of all participants ($n = 1503$), 1233 (82.04%) reported having side effects after the COVID-19 vaccine. The majority of them ($n = 845$) noted that these side

Table 4: Medications and supplements used during COVID-19 vaccination

Variable	Outcome	Participants (n=1503)	n=%
Medications	Not applicable	928	61.74
	Paracetamol	445	29.61
	Insulin	31	2.06
	Metformin	23	1.53
	Ozempic	1	0.07
	Asthma treatment	8	0.53
	Thyroxine	25	1.66
	Rheumatoid arthritis	6	0.40
	Anti-inflammatory	18	1.20
	IV dehydration saline	1	0.07
	Antiemetic	1	0.07
	Dizziness	1	0.07
	Bowel inflammatory medications (Stomach - Colon)	9	0.60
	Cholesterol-lowering medication	34	2.26
	Psychiatric medications	11	0.73
	Menstrual disorders medication	1	0.07
	Contraceptive pills	4	0.27
	Hypertension (blood pressure medications)	46	3.06
	Antiepileptic medications	4	0.27
	Antihistamine	13	0.86
	Allergy	2	0.13
	Skin treatment	1	0.07
	Cancer treatment	1	0.07
	Chemotherapy	1	0.07
	Anti-Estrogen	1	0.07
	Enlarged prostate	2	0.13
	Cough syrup	6	0.40
	Eye drops	1	0.07
	Sickle-cell medication (hydroxyurea)	2	0.13
	Antibiotic	10	0.67
	Nasal spray	2	0.13
	Muscle pain killer (muscle relaxers)	1	0.07
	Appetite stimulant	1	0.07
	Respiratory medications	1	0.07
	Nasal spray	2	0.13
	Anticoagulant	2	0.13
	Heart medications	9	0.60
	Osteoporosis treatment	1	0.07
	Anti-prolactin	1	0.07

(Contd...)

Table 4: (Continued)

Variable	Outcome	Participants (n=1503)	n=%
Supplements	Not applicable	610	40.59
	Vitamin D	547	36.39
	Vitamin C	481	32.00
	Vitamin B complex	5	0.33
	Cobalamin (Vit B12)	13	0.86
	Folic acid (Vit B9)	4	0.27
	Vitamin B6	1	0.07
	Zinc	302	20.09
	Iron	205	13.64
	Magnesium	3	0.20
	Multivitamins	357	23.75
	Omega 3	10	0.67
	Alpha lipoic acid	2	0.13

COVID-19: Coronavirus disease 2019

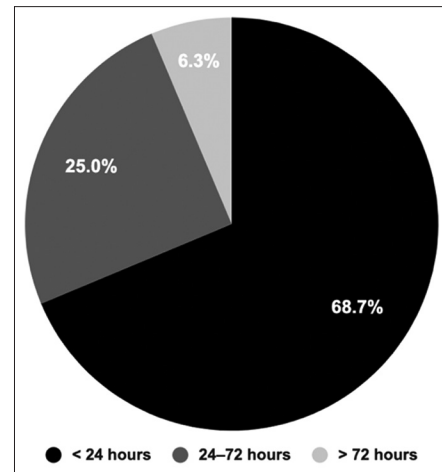


Figure 1: The onset of Coronavirus disease 2019 vaccination side effects. The participants were asked when the side effects started after receiving the vaccine. The pie chart is divided based on the onset of the side effects; black <24 h, dark grey 24–72 h, and >72 h

effects started soon after getting vaccinated and before 24 h had passed [Figure 1].

The participants identified the wide range of post-vaccination side effects. [Table 5] shows these side effects and their severity levels. The most common side effects were pain at the site of injection (88.16%), bone pain/joint pain (68.7%), fatigue (68.46%), headache (57.6%), hyperthermia (56.2%), numbness/angina (49.04%), sleep disorder (47.77%), and dizziness (33.5%).

Eleven percent of the participants (n = 165) reported they were suffering from additional side effects [Figure 2]; these were not mentioned in [Table 5]. Among these side effects, menstrual disorders, hair loss, and memory problems were mentioned by many individuals: n = 46, n = 34 and n = 19, respectively [Table 6].

Table 5: The side effects and their severity after COVID-19 vaccination

Side effects	Levels of pain			n=%
	Mild (%)	Moderate (%)	Severe (%)	
Pain at the site of injection	308 (20.49)	606 (40.32)	411 (27.35)	1325 (88.16)
Numbness/Angina	309 (20.56)	301 (20.03)	127 (8.45)	737 (49.04)
Fatigue	285 (18.96)	406 (27.01)	338 (22.49)	1029 (68.46)
Sleep disorder	255 (16.97)	280 (18.63)	183 (12.18)	718 (47.77)
Bone pain/joint pain	300 (20)	343 (22.8)	390 (25.9)	1033 (68.73)
Headache	278 (18.5)	310 (20.6)	277 (18.4)	865 (57.55)
Hyperthermia	269 (17.9)	303 (20.2)	272 (18.1)	844 (56.15)
Vomiting/nausea	175 (11.6)	106 (7.1)	76 (5.1)	357 (23.75)
Dizziness	245 (16.3)	150 (10)	108 (7.2)	503 (33.47)
Thyroid gland swelling	41 (2.7)	19 (1.3)	24 (1.6)	84 (5.59)
Armpit lump	82 (5.5)	80 (5.3)	76 (5.1)	238 (15.83)
Smell and taste weakness	165 (11)	89 (5.9)	69 (4.6)	323 (21.49)
Stomach	136 (9)	72 (4.8)	55 (3.7)	263 (17.50)
Sweating	156 (10.4)	118 (7.9)	94 (6.3)	368 (24.48)
Tremor of the extremities	151 (10)	104 (6.9)	77 (5.1)	332 (22.09)
Shortness of breath	161 (10.7)	104 (6.9)	55 (3.7)	320 (21.29)
Heart palpitations	188 (12.5)	102 (6.8)	83 (5.5)	373 (24.82)
Blood disorders or thrombocytopeny	44 (2.9)	22 (1.5)	22 (1.5)	88 (5.85)
Ecchymosis	111 (7.4)	68 (4.5)	43 (2.9)	222 (14.77)
Rash	45 (3)	37 (2.5)	25 (1.7)	107 (7.12)
Skin allergy/itching	99 (6.6)	61 (4.1)	60 (4)	220 (14.64)

COVID-19: Coronavirus disease 2019

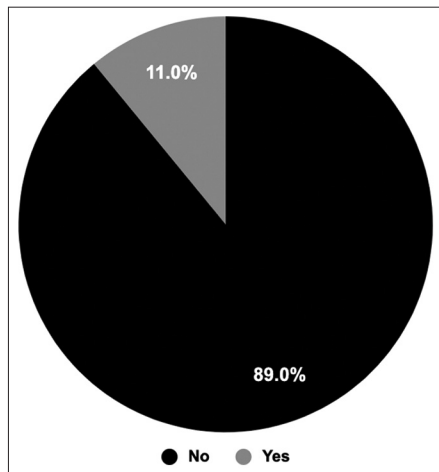


Figure 2: Additional side effects. The participants were asked whether they had any additional side effects. The pie chart shows the percentage of the participants who said yes, they had or no they had not

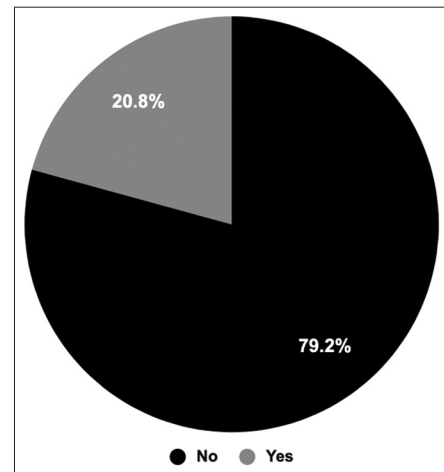


Figure 3: Persistent side effects post-Coronavirus disease 2019 vaccination. The pie chart shows the percentages of participants who had persistent side effects compared to the percentage of participants who did not have persistent side effects

Persistent side effects

The participants were asked if they had any persistent side effects post-COVID-19 vaccination to identify long-term side effects. The results showed that 312 out of 1503 participants reported that they had persistent side effects [Figure 3]. These include fatigue ($n = 52$), joint pain ($n = 44$), hair loss ($n = 42$),

and menstrual disorders ($n = 35$). In addition, less frequent persistent side effects such as headache ($n = 28$), muscle pain ($n = 23$), irritated skin ($n = 19$), shortness of breath ($n = 19$), pain at the injection site ($n = 19$), memory problems ($n = 17$), heart weakness ($n = 17$), and heart palpitation ($n = 17$) had been reported [Table 7].

Table 6: Additional side effects of COVID-19 vaccination reported by participants

Side effects	Participants (n=1503)	n=%
Not applicable	1339	89.02
Immune disorders	3	0.20
Food allergy	2	0.13
Panic attack	1	0.07
Sinusitis	2	0.13
Cough	2	0.13
menstrual disorders	46	3.06
Abortion	3	0.20
Hair loss	34	2.26
back pain	8	0.53
Loss of concentration	6	0.40
Brain fogginess	3	0.20
Hormonal disorder	4	0.27
Hyperglycemia	1	0.07
Vision problems	4	0.27
Influenza	2	0.13
Memory problems	19	1.26
Migraine	1	0.07
Inflammation of pituitary gland	1	0.07
Sleeping disorder	2	0.13
Throat congestion	3	0.20
Foot pain and swelling	3	0.20
Diarrhea	4	0.27
vein pain	2	0.13
Alopecia	2	0.13
Depression	3	0.20
Chest pain	5	0.33
Renal pain and disorders	3	0.20
Hypothyroidism	2	0.13
Difficulty breathing and talking	1	0.07
Premature birth	1	0.07
Sexual dysfunction	2	0.13
Loss of appetite	1	0.07
Arm and armpit pain	1	0.07
Swelling at the site of injection	1	0.07
Iron deficiency	1	0.07
shingles	1	0.07
Thrombosis	2	0.13
Heart muscle weakness	3	0.20
Myocardial infarction	1	0.07
Stroke	2	0.13
Slow heartbeat	1	0.07
Premature ventricular contraction (increased heartbeats)	1	0.07
Mouth dryness	1	0.07

(Contd...)

Table 6: (Continued)

Side effects	Participants (n=1503)	n=%
Polyuria	1	0.07
Pelvic inflammatory disease (uterus infection)	1	0.07
Hysterectomy (uterus removal)	1	0.07
Ear infection	1	0.07
ear buzzing	1	0.07
Tooth pain	1	0.07
Muscle tension-twitches (Tremor)	3	0.20
Pneumonia	1	0.07
Anxiety	1	0.07
Bleeding	1	0.07

COVID-19: Coronavirus disease 2019

Post-COVID-19 vaccination diseases

By the time they answered our study’s questionnaire, the majority of the participants had already gotten three doses. Therefore, the participants have been asked about diseases that may have appeared after vaccination. Around 12.64% of participants ($n = 190$) reported that they were diagnosed with a disease after receiving the vaccine [Figure 4].

Most of the participants who have been diagnosed with diseases post-COVID-19 reported that the disease appeared after the second dose ($n = 82$) and the third dose ($n = 72$) [Figure 5]. Moreover, the largest percentage ($n = 160$) of them were diagnosed with a disease after the vaccination with the Pfizer type [Figure 5].

Based on their participants’ ($n = 190$) reports, Table 8 presents the list of diseases noted post-COVID-19 vaccination. The most common diseases documented were COVID-19 ($n = 30$), influenza ($n = 29$), fever ($n = 24$), allergy ($n = 15$), thyroid gland disorder ($n = 11$), common cold ($n = 11$), and irritable bowel disease ($n = 8$).

Quality of life and COVID-19 vaccine

In this part, we assess whether the quality of life of individuals has been affected after receiving COVID-19 vaccines [Table 9]. The results show that the majority of the participants (62.1%) were worried about receiving COVID-19 vaccine. On the other hand, only 35.13% of individuals ($n = 528$) thought that COVID-19 vaccines were unsafe in the long term, whereas 64.87% of the participants ($n = 975$) felt safe. Moreover, nearly 55% disagreed to take the seasonal COVID-19 vaccine, whereas 17.7% and 27.2% of the participants agreed and selected “agree maybe,” respectively. Thirty-one percent of participants kept monitoring their vital signs frequently. Likewise, 30% of participants considered that their quality of life was affected after the vaccine. Therefore, regarding their participants’ psychological status, some of them felt anxiety,

Table 7: Persistent side effects post-COVID-19 vaccinations

Persistent side effects	Participants (n=1503)	% of total	% of n=312
Immune disorders	11	0.73	3.53
Food allergy	1	0.07	0.32
Sinusitis	4	0.27	1.28
Cough	3	0.20	0.96
Menstrual disorder	35	2.33	11.22
Muscle twitches	1	0.07	0.32
Hair loss	42	2.79	13.46
Back pain	5	0.33	1.60
Loss of concentration	4	0.27	1.28
Brain fogginess	5	0.33	1.60
Hormonal disorder	4	0.27	1.28
Hyperglycemia	1	0.07	0.32
Vision problems	6	0.40	1.92
Influenza	1	0.07	0.32
Memory problems	17	1.13	5.45
Common cold	5	0.33	1.60
Inflammation of pituitary gland	1	0.07	0.32
Sleeping disorder	11	0.73	3.53
Throat congestion and hoarseness	2	0.13	0.64
Foot pain and swelling	3	0.20	0.96
Diarrhea	1	0.07	0.32
Smell and taste weakness	13	0.86	4.17
Alopecia	1	0.07	0.32
Depression	3	0.20	0.96
Chest pain	9	0.60	2.88
Renal pain and disorders	3	0.20	0.96
Thyroid gland disorder	2	0.13	0.64
Skin allergy and itching	19	1.26	6.09
Shortness of breath	19	1.26	6.09
Sexual dysfunction	1	0.07	0.32
Loss of appetite	1	0.07	0.32
Armpit lump pain	6	0.40	1.92
pain at the site of injection	19	1.26	6.09
Fever	4	0.27	1.28
Shingles	1	0.07	0.32
Thrombosis	1	0.07	0.32
Heart muscle weakness	17	1.13	5.45
Myocardial infarction	1	0.07	0.32
Excessive Phlegm	1	0.07	0.32
Dizziness	13	0.86	4.17
Premature ventricular contraction (extra heartbeats)	1	0.07	0.32
Mouth dryness	1	0.07	0.32
Polyuria	2	0.13	0.64

(Contd...)

Table 7: (Continued)

Persistent side effects	Participants (n=1503)	% of total	% of n=312
Bruise	2	0.13	0.64
Ear buzzing	1	0.07	0.32
Tooth pain	2	0.13	0.64
Muscle tension – twitches (Tremor)	1	0.07	0.32
Anxiety	2	0.13	0.64
Lung disorder	1	0.07	0.32
Gain weight	5	0.33	1.60
Delay in pregnancy	1	0.07	0.32
Hand pain	3	0.20	0.96
Gland swelling	3	0.20	0.96
Nausea	4	0.27	1.28
Vomiting	1	0.07	0.32
Fatigue	52	3.46	16.67
Headache	28	1.86	8.97
Bone pain	15	1.00	4.81
Muscle pain	23	1.53	7.37
Joint pain	44	2.93	14.10
Numbness	6	0.40	1.92
Heart palpitation	16	1.06	5.13
Excessive sweating	8	0.53	2.56
Irritable bowel disease	5	0.33	1.60

COVID-19: Coronavirus disease 2019

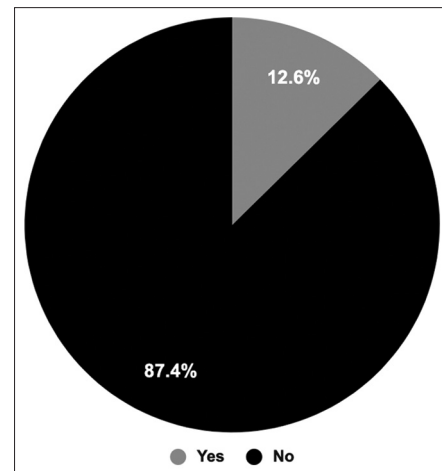


Figure 4: Coronavirus disease 2019 post-(COVID-19) diseases. The participants were asked whether they had been diagnosed with any disease after receiving the COVID-19 vaccine. The pie chart shows the percentage of participants who developed a disease after receiving COVID-19 vaccine compared to the participants who did not develop any diseases

depression, and discomfort (25.28%, 21.22%, and 33.16%, respectively).

Seventy-four percent ($n = 1112$) of the study participants in our study were satisfied with their health status after taking the

vaccine, whereas the other participants (26%) were unsatisfied [Figure 6].

Unsatisfied participants ($n = 391$) felt dissatisfied for a number of reasons, the most mentioned were fatigue ($n = 95$), immune disorders ($n = 80$), musculoskeletal pain ($n = 42$), hair loss ($n = 30$), memory problems ($n = 21$), menstrual disorder ($n = 20$), continuous common cold ($n = 16$), and sleeping disorder ($n = 10$) [Table 10].

The participants were asked if they had undergone cupping treatment after receiving the COVID-19 vaccine. The results showed that 91.8% of the participants had not undergone cupping treatment after the COVID-19 vaccine [Figure 7]. Participants reported a reduction in the side effects after treating with cupping (65.8%).

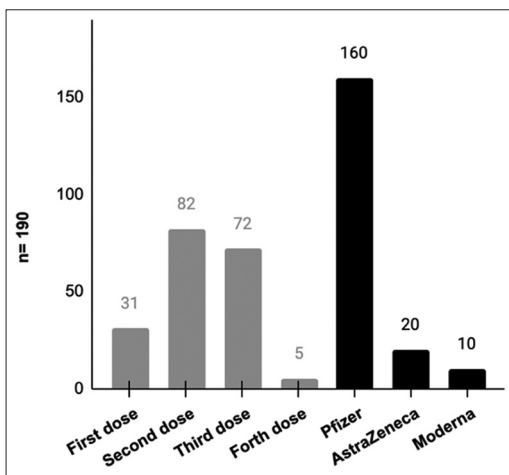


Figure 5: The disease appeared after any dose and which type of vaccine. Participants were asked to determine after which dose, they were diagnosed with the disease, as well as after any type of vaccine. The bar chart shows the comparison between the number of participants, who were diagnosed with diseases ($n = 190$) after each dose and the type of vaccine

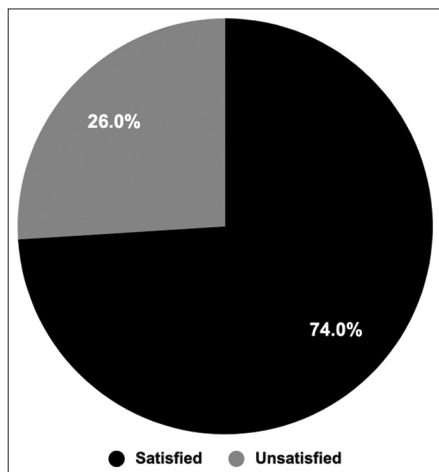


Figure 6: Participants' satisfaction with their health status. The participants were asked whether they were satisfied with their health status post-Coronavirus disease 2019 vaccination. The pie chart shows the percentage of satisfied participants compared to unsatisfied ones

Table 8: The diseases that appeared after receiving the COVID-19 vaccine

Diseases	Participants (n=1503)	% of total	% of n=190
Irritable bowel disease	8	0.53	4.21
Sinusitis	4	0.27	2.11
Type 2 diabetes	1	0.07	0.53
Diabetes insipidus	1	0.07	0.53
Vision problems	1	0.07	0.53
Influenza	29	1.93	15.26
Common cold	11	0.73	5.79
Alopecia	1	0.07	0.53
Depression	3	0.20	1.58
Acute renal failure	1	0.07	0.53
Thyroid gland disorder	11	0.73	5.79
Allergy	15	1.00	7.89
Food allergy	1	0.07	0.53
Shortness of breath	2	0.13	1.05
Asthma	4	0.27	2.11
Fever	24	1.60	12.63
shingles	3	0.20	1.58
Stroke	5	0.33	2.63
Heart muscle weakness	4	0.27	2.11
Myocardial infarction	1	0.07	0.53
Heart palpitation	5	0.33	2.63
Coronary artery disease	1	0.07	0.53
COVID-19	30	2.00	15.79
Viral infection	4	0.27	2.11
Bacterial infection	1	0.07	0.53
Chicken box	1	0.07	0.53
Anemia	3	0.20	1.58
Retinopathy	1	0.07	0.53
Ovarian insufficiency	1	0.07	0.53
Abortion	4	0.27	2.11
Hysterectomy (removal of uterus)	1	0.07	0.53
Spinal disc herniation	1	0.07	0.53
Pneumonia	5	0.33	2.63
Inflammatory myopathy	2	0.13	1.05
Low blood pressure	1	0.07	0.53
Hypertension	5	0.33	2.63
High cholesterol	1	0.07	0.53
Iron deficiency	1	0.07	0.53
Urticaria	1	0.07	0.53
Kidney stones	1	0.07	0.53
Gallstones	1	0.07	0.53
Pancreatitis	1	0.07	0.53
Muscle weakness	1	0.07	0.53
Breast cancer	1	0.07	0.53
Thyroid cancer	1	0.07	0.53

(Contd...)

Table 8: (Continued)

Diseases	Participants (n=1503)	% of total	% of n=190
Multiple myeloma	1	0.07	0.53
Facial nerve paralysis	1	0.07	0.53
Lymphadenitis	2	0.13	1.05
Prostatitis	1	0.07	0.53
Osteoporosis	1	0.07	0.53
Hemochromatosis	1	0.07	0.53
Sciatica	1	0.07	0.53

Table 9: The effect of the COVID-19 vaccine on the quality of life

Variable	Outcome	Participants (n=1503)	Percentage
Worrying about receiving COVID-19 vaccine	Yes	934	62.1
	No	569	37.9
COVID-19 vaccine is safe on long-term	I thought	975	64.87
	I did not think	528	35.13
The ability to take the COVID-19 vaccine seasonally	Yes	266	17.7
	No	828	55.1
	Maybe	409	27.2
Monitoring vital signs frequently post-COVID-19 vaccine	I did	470	31.27
	I did not	1033	68.73
Quality of life post-COVID-19 vaccine	Affected	448	29.81
	Non-affected	1055	70.19
Psychological status post-COVID-19 vaccine	Anxiety	380	25.28
	Depression	319	21.22
	Discomfort	498	33.16
	Nothing	811	53.96

COVID-19: Coronavirus disease 2019

Discussion

The globe is in the midst of perpetuating the COVID-19 pandemic affecting all nations. Experts are speculating that COVID-19 is going to keep oscillating worldwide infinitely.^[20] Furthermore, with the emerging new variants, of which a few are considered “variants of concerns” according to WHO,^[21] the only solution to prevent future surges in COVID-19 cases is to maintain a threshold of herd immunity through vaccination campaigns. However, people are becoming hesitant to be immunized due to the unpleasant side effects that follow. Therefore, it is crucial for vaccine manufacturers to continuously develop the available vaccinations by appraising the reported side effects in published research studies. Moreover, it is pivotal to address people’s concerns by creating a self-reporting system that is directly connected to an empathetic health-care system. As there is no self-reporting platform in Saudi Arabia, the only way to get people to report side effects is by means of questionnaires. In this study, people

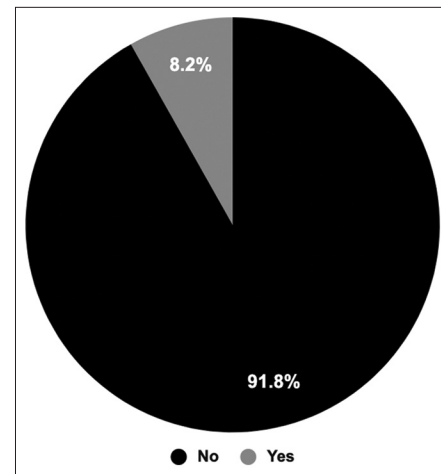


Figure 7: Cupping therapy (Hijama) among participants after receiving Coronavirus disease 2019 vaccines. The participants were asked if they were treated with cupping after vaccination. The pie chart shows the percentage of participants who had undergone cupping

are asked to report experiencing short-term side effects as well as long-term side effects post-COVID-19 vaccination.

Generally, side effects can be categorized based on the impacted site into two groups: Local reactions and systemic reactions. In this study, the majority of local side effects reported involve minor injection site’s reactions including injection site pain (1.3%) and swelling (0.3%). In addition, minor systematic symptoms described include fatigue (3.5%), fever (1.3%), headache (1.9%), muscle pain (1.5%), diarrhea (0.1%), vomiting (0.1%), and flu-like symptoms (0.19%). Our findings are in accordance with the recent study conducted in Italy.^[22] The majority of the side effects disappeared after 1–7 days (65.49%) whereas others reported recovery from side effects at longer duration from 1 month to 3–6 months (4.45%) and (2.26%), respectively. The previously mentioned side effects significantly impacted young ages between 18 and 44 (13.4%) compared to the <45 age groups (8.5%). Nevertheless, the aforementioned side effects were found to be the expected side effects announced by the FDA and also in alignment with age groups expected to be more susceptible.^[23]

Some of the self-reported long-term side effects are found to be frequently reported by female participants including menstrual irregularities (3.33%). The disturbance in menstrual included missed cycles, irregular cycles, and decreased or increased in menses. This is the first Saudi study to report such post-COVID-19 vaccine disorder among Saudi females. This report is in agreement with some research studies that examined disturbances in the menstrual cycle or in menses among females after COVID-19 vaccines.^[24,25] Similarly, to the later publications, most of the acquired menstrual disorders appeared after the booster dose (74.4%) and the second dose (23.5%). However, unlike aforesaid research studies, Saudi female participants did not retain normal menstrual patterns to the date of this study. Unfortunately, gender bias is common

Table 10: The reasons behind the unsatisfaction of the participants with their health status post-COVID-19 vaccine

Reason	Participants (n=1503)	% of total	% of n=391
Unspecified	115	7.65	29.41
Immune disorders	80	5.32	20.46
Food Allergy	1	0.07	0.26
Fatigue	95	6.32	24.30
Sinusitis	1	0.07	0.26
Cough	3	0.20	0.77
Menstrual disorder	20	1.33	5.12
Muscle twitches	1	0.07	0.26
Hair loss	30	2.00	7.67
Back pain	1	0.07	0.26
Loss of concentration	3	0.20	0.77
Brain fogginess	3	0.20	0.77
Hormonal disorder	4	0.27	1.02
Headache	5	0.33	1.28
Vision problems	1	0.07	0.26
Continuous common cold	16	1.06	4.09
Memory problems	21	1.40	5.37
Continuous musculoskeletal pain	42	2.79	10.74
Anxiety	7	0.47	1.79
Sleeping disorder	10	0.67	2.56
Throat congestion	2	0.13	0.51
Skin allergy	7	0.47	1.79
Asthma	1	0.07	0.26
Smell and taste weakness	8	0.53	2.05
Shortness of breath	7	0.47	1.79
Depression	2	0.13	0.51
Chest pain	2	0.13	0.51
Renal pain and disorders	2	0.13	0.51
Thyroid gland disorder	1	0.07	0.26
Enlarged prostate	1	0.07	0.26
Uterus diseases	2	0.13	0.51
Sexual dysfunction	1	0.07	0.26
Abortion	4	0.27	1.02
Delay in pregnancy	1	0.07	0.26
Fetal death	1	0.07	0.26
Armpit lump pain	1	0.07	0.26
Pain and swelling at the site of injection	2	0.13	0.51
Dizziness	2	0.13	0.51
shingles	1	0.07	0.26
Numbness	2	0.13	0.51
Heart diseases and palpitation	8	0.53	2.05
Migraine	1	0.07	0.26
Bruise	1	0.07	0.26

(Contd...)

Table 10:(Continued)

Reason	Participants (n=1503)	% of total	% of n=391
Neck pain along with lymph nodes	1	0.07	0.26
Cancer symptoms	1	0.07	0.26
Mouth dryness	1	0.07	0.26
Polyuria	1	0.07	0.26
Sciatica	1	0.07	0.26
Gain weight	2	0.13	0.51
Hypertension	1	0.07	0.26
Nausea	1	0.07	0.26
Inflammatory bowel disease	1	0.07	0.26

COVID-19: Coronavirus disease 2019

in many drug trials, COVID-19 vaccine manufacturers did not break this cycle and thus did not include side effects that occur due to gender differences during test trials.^[26] To bridge this gap, further clinical investigations are required to better understand the causative prognostic factor behind this physiological disorder among Saudi females. Supporting our results are the findings of Govindapala *et al.*, who found different responses in females toward COVID-19 vaccination.^[27] Another prevalent side effect reported in this study among Saudi females was telogen effluvium (4%) reported post-booster vaccine (76.47%) and second vaccine (17.64%). This manifestation includes hair shedding, excessive hair loss, and hair thinning. Although, to this date, there is no research study that examined hair loss among females post-COVID-19 vaccination. However, an abundance of data from research studies has reported telogen effluvium among patients post-COVID-19 infection.^[28] The latter research study proposed that the hair fall manifestation could be triggered due to psychological stress. However, patients with immune-compromised conditions such as Alpaca Areata reported hair shedding immediately after the COVID-19 vaccine. This could indicate an underlying immune-mediated response that could explain such conditions after COVID-19 immunization.^[29]

Other highly reported post-vaccination side effects that also persisted to the date of this study involve fatigue (6.25%), arthralgia (2.79%), headache (1.66%), memory problems (1.19%), shortness of breath (1.196%), and myalgia (1.26%). The priorly mentioned side effects were found to be the common denominator of the reported concerns in many other research studies.^[30,31] It seems that COVID-19 vaccines evoke an immune response that could be attributed to all these side effects. Subsequently, many studies embarked on investigations to detect possible immunological factors that got antagonized by these vaccines. In light of that, one study suggested that COVID-19 vaccines commence activation of the initial stages of the immune response causing a subsequent surge in cytokines production more specifically interferons type 1. This type of interferon has a ubiquitous range of actions throughout the whole body including the respiratory system.^[32]

Notably, many post-COVID-19 vaccine side effects are linked to cytokines production namely fatigue, fever, and shortness of breath. Strikingly, it was found that prolonged exposure to this type of cytokine as a therapy induces chronic fatigue, loss of concentration, and depression,^[33] which could indicate that COVID-19 vaccines might impose a similar harmful immune response.

Other side effects that reported are concerning the cardiovascular system include heart palpitations (1.1%), myocardial infarction (0.1%), cardiomyopathy (0.1%), thrombosis (0.1%), chest pain (0.6%), and premature ventricular contraction (0.1%). Many research studies delved into confirming cardiovascular dysfunction cases that arise from post-COVID-19 vaccines. Certainly, a direct link between COVID-19 immunizations and cardiovascular dysfunctions was proven clinically. Collectively, research studies suggested that COVID-19 vaccinations induce inflammatory responses that explain the pathological cardiovascular manifestations.^[34-37]

Other rare and major side effects that also self-reported by participants after vaccination were premature birth (0.1%), Bell's palsy (0.1%), shingles (0.1%), tooth pain (0.2%), swollen eyelids (0.1%), ear buzzing (0.1%), mouth dryness (0.1%), and vision problems (0.4%). Some participants reported non-communicable side diseases post-COVID-19 vaccine including breast cancer (0.1%), thyroid cancer (0.1%), blood cancer (0.1%), and acute kidney failure (0.1%). Although, the above-stated side effects are scarcely reported, nevertheless, clinicians must run vigilant examinations for patients who acquire new conditions post vaccines.

Cupping therapy is a common practice in traditional medicine, involving local suction of the skin by special cups. This therapy is believed to enhance blood flow and prompt swift healing of chronic pains in the neck and the lower back, according to the National Center for Complementary and Integrative Health.^[38] Many studies have demonstrated promising preventive and therapeutic benefits of cupping therapy. These studies investigated the therapeutic performance of the cupping procedure on pathological conditions such as pain and high fever due to infection of the upper respiratory tract,^[39] pulmonary dysfunctions in asthmatic children,^[40] type 2 diabetes mellitus,^[41] autoimmune diseases such as rheumatoid arthritis, hypertension,^[42] myocardial infarction, cardiac arrhythmias, and chronic fatigue syndrome.^[43] However, sparse studies have assessed the effects of cupping therapy in this new pandemic COVID-19.^[44] Cupping therapy may ameliorate the most common symptoms and signs of COVID-19 infection. This study showed a reduction in the side effects among people who were treated with cupping (65.8%).

In response to clinical infections caused by viruses from the influenza family, respiratory syncytial viruses, and rhinoviruses, the active metabolite of Vitamin D, 1,25-dihydroxy Vitamin

D (1,25 [OH] 2D), activates innate antiviral effector systems and controls inflammation. Vitamin D can be taken as a dietary supplement and is primarily produced by the skin as a result of exposure to sunshine.^[45]

Previous research that examined the effects of Vitamin D supplements on the efficiency of the COVID-19 vaccine and immunity, as well as the impact of Vitamin D on alleviating the symptoms of infection with COVID-19, has revealed several encouraging findings.^[46] Similarly to that, it was found to reduce the mortality risk among COVID-19 patients,^[47] On the contrary, according to Jolliffe *et al.*, Vitamin D has no effect on boosting immunity and does not improve the efficiency of the COVID-19 vaccine.^[48]

Overall, many adverse side effects were frequently reported by COVID-19 vaccine recipients and a few side effects were gender-dependent on the physiological differences reported by female participants mostly after the booster immunization.

The questionnaire created in this study pushed the boundaries by formulating difficult questions that were not tackled by all the previously reported Saudi publications. Participants are encouraged to disclose all experienced side effects. In addition, this study highlighted side effects that appeared among Saudi females that were not examined by other counterpart Saudi researchers. Nonetheless, the main limitation of this self-reporting study is recall bias by participants. Another limitation is that participants could have experienced a prior infection with the COVID-19 virus but did not prove it by COVID-19 test or got a false-negative. This is crucial as the reported adverse effects could be due to post-COVID-19 infection. In addition, this study eliminated survey entries from non-Saudis. In addition, Online surveys have their limitations and since a particular stratum of society takes part in online surveys, the findings may not be true representative of findings.

Further research is needed to evaluate the vaccine's effectiveness and potential side effects in specific populations, such as immunocompromised individuals, pregnant women, children, and older adults. These studies help tailor vaccine recommendations and identify any specific safety concerns. Future research will focus on developing strategies to manage and mitigate vaccine side effects effectively. This includes refining vaccination protocols, optimizing vaccine delivery methods, and developing interventions to address common and rare adverse events. Future studies may also investigate the relationship between vitamin supplementation and the magnitude and effectiveness of the immune response and reduction of undesirable effects following vaccination. It is important to note that the COVID-19 vaccine development and rollout have been rapid, and ongoing research aims to provide a comprehensive understanding of potential adverse events and optimize vaccination strategies to ensure public health and safety.

Ethical Approval and Consent to Participate

The study protocol was approved by the King Abdulaziz University Hospital Ethics Committee (reference no. 30-18, 5, 2022). All participants signed an online consent form indicating their informed consent.

Availability of Data and Material

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Competing Interests

The authors certify that there is no conflict of interest to declare.

Funding Statement

NA (no funding received for this study).

Authors' Contributions

SAA conceived the idea and designed the study. All authors participated in designing the questionnaire. EZR collected the data and analyzed the results. AHG, NHH ASG, AO, and KK performed the literature search and wrote the manuscript. AO translated the questionnaire and participants' answers. AHG and NHH created the graphical abstract. SAA supervised the project and reviewed the original manuscript. All authors have read and agreed to the published version of the manuscript.

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