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REVIEW

Adverse Reactions of COVID-19 Vaccines: A Scoping Review of Observational Studies

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Abstract: The COVID-19 pandemic had a severe global impact. A range of campaigns and activities, including vaccines, are being implemented to counteract this pandemic. Using observational data, the goal of this scoping review is to identify adverse events connected with COVID-19 vaccinations. We conduct a scoping study and searched three databases from the start of the COVID-19 pandemic in 2020 through June 2022. Based on our criteria and searched keywords, the review included eleven papers in total, with the majority of the studies being conducted in developed countries. The study populations varied and included general community populations, healthcare professionals, military forces, and patients with systemic lupus and cancer. This study includes vaccines from Pfizer-BioNTech, Oxford-AstraZeneca, Sinopharm, and Moderna. The COVID-19 vaccine-related adverse events were classified into three types: local side effects, systemic side effects, and other side effects such as allergies. The adverse reactions to COVID-19 vaccines are mild to moderate in severity, with no significant influence or interference in individual daily activities and no unique patterns in cause of death among vaccine-related deaths. According to the findings of these investigations, the COVID-19 vaccine is safe to administer and induces protection. It is vital to convey accurate information to the public about vaccination side effects, potential adverse responses, and the safety level of the vaccines supplied. Multiple strategies must be implemented at the individual, organizational, and population levels to eliminate vaccine hesitance. Future studies could investigate the vaccine's effect on people of various ages and medical conditions.

Keywords: adverse effect, COVID-19 vaccines, vaccine reactions, vaccination impact

Introduction

COVID-19, which has been declared a global pandemic by WHO, has already infected over 38 million people and claimed at least one million lives since the virus first emerged in late 2019 from Wuhan, China.[1,2] The global infection detection rate was close to 10%, and it is estimated that 66% of people have been infected at least once as of May 2022.[3] Based on these findings, the world has been dealing with a devastating COVID-19 pandemic.

A variety of campaigns and actions are being undertaken to combat this pandemic, beginning with the establishment of local lockdowns and mass testing.[4,5] Furthermore, as a new promising way, COVID-19 vaccine can be called hope to reduce the mortality rate of infected individuals and return to some forms of normal life.[6] The United States has approved the use of two COVID-19 vaccines, Pfizer-BioNTech and Moderna COVID-19 vaccines, both of which are to be administered in a two-dose sequence. Following Phase III clinical trials in ten countries worldwide, China and a few other countries approved the Sinopharm COVID-19 vaccine.[7] Because these vaccines were modeled using various processes and approaches, they differ in some aspects such as efficacy and storage conditions.[8]

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The side effects of the COVID-19 vaccine were reported by 50% to 90% of participants in randomized clinical trials of COVID-19 vaccines.[9] Another study conducted worldwide (US, Argentina, Brazil, South Africa, Germany, and Turkey) showed that more than 30% of participants had side effects.[10] Clinical trials conducted in Argentina, Brazil, Chile, Colombia, Mexico, Peru, South Africa, and the United States showed that the majority of participants had both local and systemic reactions to the COVID-19 vaccine.[11] Based on clinical trials, COVID-19 vaccines were found to be extremely safe;[9,10] however, there is less evidence comparing the safety of these vaccines in real-world settings.

Vaccine production is a difficult and lengthy. Rather than treating sick people, vaccines are given to large groups of healthy people to prevent sickness. Thus, the protection barrier for a new vaccination must be high and apply to the whole target population, regardless of age, gender, color, or ethnicity.[8] Some people may refuse to receive a vaccine due to potential side effects, while others may be apprehensive about adverse reactions due to allergies or comorbid diseases.[12] As a result, vaccine research and testing methodologies must be led carefully and deliberately by a primary focus on protection.

To date, no vaccine can be claimed to be completely free of adverse reactions, but the majority of them are either preventable or treatable.[13] In some vaccines, early side effects such as fever, pain, myalgias, headaches, and local or injection site effects are related to immune surge.[14] The adverse reactions to the COVID-19 vaccine are critical to public trust in the vaccination. The rates of vaccine hesitancy and rejection are still high, which is associated with more negative beliefs that the vaccination will cause adverse reactions;[15] was found as the most significant potential barriers to getting vaccinated against COVID-19.[16] Adverse reactions were the most important factors in individuals' vaccine choice decisions.[17] Aside from that, the possibility of a serious adverse reaction was discovered to be a variable cause of vaccination rejection.[18]

Therefore understanding the adverse effects will aid in increasing the vaccine's success rate. The majority of studies on vaccination adverse effects focused on clinical trials or pre-and post-intervention, with only a few focusing observational studies, particularly those that examined the impact of vaccine on daily living in a real-world environment. As a result, the aim of this study was to do analyze the adverse reactions to COVID-19 vaccines that have been reported in a number of observational studies.

Materials and Methods

Study Design

The current review was written using the Joanna Briggs Institute's scoping review method (JBI).[19] The concept of interest was the challenges to discover the adverse reactions of the COVID-19 vaccines especially that using the observational studies. We included only an observational quantitative study designs as most of the review were on clinical trials and pre- and post-intervention.[20,21] Observational studies has benefit for document the effects of naturally exposed outcomes, which in this case are any outcomes produced by an intervention or treatment that were not originally intended by the person who prescribed the intervention.[22] This scoping review protocol was following the PRISMA-P guidelines.[23]

Search Strategy

On June 2022, we conducted initial research using all identifier keywords and relevant terms in the electronic databases PubMed, Science Direct, and CINAHL. The search strategy for all databases was the same as shown in the PRISMA Flowchart (Appendix I). In the search, keywords with Boolean operators ("OR" and "AND") related to process development and trigger tool validation were used (Table 1). We did not search the grey literature because we are

Table 1 Search Terms

Population	Interest	Outcomes
COVID-19	Vaccine	Adverse Effect
COVID 19	Vaccination	Adverse Event
COVID		Adverse Reaction
		Complication

only interested in studies published in peer-reviewed journals that are based on scientific methods that use evidence to develop conclusions.

Eligibility Criteria and Data Selection

The inclusion criteria were observational studies that clearly described the adverse reactions to COVID-19 vaccines published in English between January 2020 and June 2022. Furthermore, studies were included if the outcome of the adverse reactions was defined objectively such as the impact on daily life or the severity of the reactions. Two reviewers assessed the eligibility of all studies (ID, AAS). Any conflicts or disagreements were handled and resolved by the third reviewer (AA).

Data Extraction and Synthesis

Relevant data were extracted from the included studies to answer the review question using the JBI methodology.[19] The authors' names, publication year, country of origin of the study, and characteristics (aim of study, vaccine types, population, study design, adverse reaction, impact) were all retrieved (Table 2). To map the included research, we extracted the key findings of the studies into the COVID-19's adverse reaction. We also extracted the measured outcomes of COVID-19 vaccine from all eleven studies.

Results

The initial search yielded 400 articles using the keywords in three databases. Mendeley Reference Manager identified duplicates automatically, resulting in a total of 320 articles being evaluated and those that did not fulfill the inclusion requirements being excluded. Eligibility was determined for a total of 55 full-text articles. Thirty-one publications were deleted because they were not observational studies, and another 13 were excluded because the outcome did not include adverse reactions to COVID-19 vaccinations. Finally, eleven articles were chosen after passing the eligibility criteria. Appendix 1 depicts the entire study flow (Appendix).

Study Characteristics

All of the research employed the observational study design. The 11 studies were undertaken the United States, the United Kingdom, Canada, Peru, the United Arab Emirates, and South Korea and most of the studies taking place in developed countries.[24–34] The majority of the studies had similar contexts, but the populations varied and were conducted in general community populations, with the remainder conducted in healthcare professionals, armed forces personnel, and patients with systemic lupus and cancer. The objectives of most of the studies were to investigate the adverse reactions after those populations vaccinated with COVID-19 vaccines.

Types of Adverse Reactions

Adverse reactions are classified into two types: vaccine-related events and allergic reactions. The majority of research has been on negative vaccination reactions, and also no allergic reactions. The most commonly reported COVID-19 vaccine-related adverse reactions include local injection and systemic side effects. Joint or muscle pain, tenderness, itching, and paresthesia in the injection site.[24–28,31,34] Local effects were also greater in previously infected individuals than in those who had never been infected. Fever, chills, fatigue, headache, nausea, myalgia, pyrexia, and dyspnea are among the systemic side effects.[24–29,31–34] Some cardiovascular side effects like sinus tachycardia, premature ventricular contractions, and right bundle branch block may occur.[33] The vast majority of patients who reported unfavorable cardiovascular events were men. Males reported more unfavorable effects than females, such as chest pain or discomfort, dyspnea and palpitation.[33]

Everyone in the community; health workers, students, and cancer or systemic lupus patients had the same adverse reactions based on the data. The adverse responses seen by participants following the first dose of COVID-19 vaccinations are modest, with local pain and fever, according to the studies included.[24–34] Another study, on the other hand, discovered that moderate to severe reactogenicity was more typically observed after immunization dose two.[27] These side effects were more common after the second dose than after the first.[29,31] Patients who visited the ER for

Table 2 Summary Table of Adverse Reactions of COVID-19 Vaccines

Author, Year	Country	Aim	Vaccine Types	Population	Study Design	Adverse Reaction	Impact
Menni, et al; 2021[24]	United Kingdom	To investigate the adverse effects and infection rate of people in UK community after vaccinated with COVID-19 Pfizer-BioNTech (BNT162b2) and Oxford-AstraZeneca ChAdOx1 nCoV-19) vaccines.	Pfizer-BioNTech (BNT162b2) and Oxford-AstraZeneca ChAdOx1 nCoV-19) vaccines.	All UK COVID-19 symptom study app participants who received at least one dose of COVID-19 vaccine.	Prospective observational study that examined the proportion and probability of self-reported systemic and local side effects within 8 days of vaccination in individuals using COVID Symptom Study app.	a. The most commonly reported systemic side-effects were fatigue (8.4% and 21.1%) and headache (7.8% and 22.8%) of both vaccines and were most frequently reported within the first 24 h after vaccination and lasted a mean of 1.01 days. b. Tenderness (57.2%; 49.3%) and local pain (29.2%; 19.1%) around the injection site were the most frequently reported local effects of both vaccines occurring most often on the day after injection and lasting a mean of 1·02 days. c. Other side-effects including allergic skin reactions such as skin burning, rashes, and red welts on the lips and face were reported by 1.7% of users across both types of vaccine. d. Local effects were less commonly reported after the second dose than after the first dose of both vaccines. e. Local effects were similarly higher in individuals previously infected than in those without past infection for both vaccines.	Both vaccines have moderately frequent and mildly severe side effects.
Perrota, et al; 2021[25]	The US	To investigate the side-effects of COVID-19 vaccines among healthcare professionals and armed forces personnel.	mRNA and AdV vaccine or ChAdOx1 Astra-Zeneca-Oxford.	Healthcare professionals (HCPs) and armed forces personnel (AFP) worldwide.	Descriptive cross-sectional survey, using data from an online email or WhatsApp survey form that sent to healthcare professionals (HCPs) and armed forces personnel (AFP).	a. After the first dose of mRNA COVID-19 vaccine/Moderna, 65.6% participants experienced mild to moderate side-effects, with a large prevalence of mild ones. The most common local side effects reported after the first and second dose of mRNA vaccine were pain and/or paresthesia in the injection site (80.6% and 100%). b. The most commonly reported systemic events within 7 days after the two doses of mRNA vaccine were headache, asthenia and myalgia, which were significantly most often reported after the second dose than after the first one. c. After the first dose of AdV vaccine or ChAdOx1 Astra-Zeneca-Oxford 31 (81.6%) participants experienced mild to moderate side-effects, with a large prevalence of mild ones. d. The commonly reported systemic events within 7 days after the first dose of AdV vaccine were headache, myalgia, fever, and asthenia, which were frequently observed compared to both after the first and second dose of mRNA vaccine. e. No participant reported severe local or systemic reactions, irrespective of vaccine.	Mostly, the side effects are minor and do not interfere with daily activities or tasks.
Ganesan, et al; 2022[26]	United Arab Emirates	To investigate the nature and severity of the adverse effects reported and the differences based on the type of vaccine received.	Sinopharm and Pfizer-BioNTech vaccine.	Adult COVID-19 vaccine recipients (≥18 years) in the United Arab Emirates.	An observational cross-sectional study was conducted among ≥ 18 years old COVID-19 vaccine recipients using an online survey and telephone interviews.	a. The major adverse effects reported by the COVID-19 vaccine recipients were pain at the site of injection (47%), fatigue and drowsiness (28.2%), and joint/muscle pain (23.1%), followed by headache (17.7%) and fever (14.4%). b. A total of 61% of the Sinopharm vaccine recipients reported adverse effects following vaccination and people with associated comorbidities reported a statistically significant higher percentage (63.6%) of adverse effects than the others. c. A total of 68.5% reported adverse effects following the Pfizer-BioNTech vaccination and individuals who had a history of previous infection with COVID-19 reported a statistically significant higher percentage (75.4%) of adverse effects than the others. d. No statistically significant difference was observed with the local adverse effects reported after the first and second dose of the Sinopharm and Pfizer vaccine recipients. e. The average number of adverse effects reported between individuals who had received the Sinopharm and Pfizer-BioNTech vaccine was statistically significant difference was observed among people in the 35–54-years age group and ≥ 55-years age group.	Most adverse effects following vaccination were mild in nature and self-limiting. Only 5% of the adverse effects required consultation with a doctor or treatment at the hospital.

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Rosenblum, et al; 2022[27]	The USA	To describe US surveillance data collected through the Vaccine Adverse Event Reporting System (VAERS) on two mRNA COVID-19 vaccines. (BNT162b2 [Pfizer-BioNTech]; and mRNA-1273 [Moderna])	Pfizer-BioNTech and Moderna.	US residents who report to VAERS following the receipt of a mRNA vaccine.	Observational study, using the data reported on the Vaccine Adverse Event Reporting System and V-Safe.	a. Among the reported cases, 3 92.1% were classified as non-serious; 6.6% were serious, not resulting in death; and 1.3% were deaths. b. The most common MedDRA preferred terms assigned to non-serious reports were headache (20.4%), fatigue (16.6%), pyrexia (16.3%), chills (15.7%), and pain (15.2%). c. The most common MedDRA preferred terms assigned to serious reports were dyspnea (15.4%), death (14.1%), pyrexia (11.0%), fatigue (9.7%), and headache (9.5%). d. The reporting rate to VAERS was 1049.2 non-serious reports per million vaccine doses, and 90.4 serious reports per million doses. e. Of the 4471 reports of deaths analyzed: 46.7% were reported following BNT162b2 and 53.3% following mRNA-1273. 42.6% deaths were in female vaccine recipients and 55.6% were in male recipients; the median age of participants who died was 76 years. f. Time to death following vaccination was available for 92.1% reports; median time was 10 days. The greatest number of death reports occurred on day 1 and day 2 following vaccination. g. Death certificates or autopsy reports were available for clinical review for 18.1% reports of deaths. Among these, causes of death were most commonly diseases of the heart and COVID-19. h. Among the rest of reports without a death certificate or autopsy, causes of death were 54.2%, most commonly unknown, 17.0% because of heart diseases and 8.7% COVID-19. i. Most reported symptoms were mild with participants reported moderate and severe reactogenicity most commonly on day 1 after dose two of either mRNA vaccine. Less than 1.0% reported receiving medical care after receiving either dose of either vaccine.	The effects of mRNA vaccination on daily-life activities among vaccine recipients were most frequently reported on day 1 after vaccination, with most side effects being mild.
Lee, et al; 2021[28]	South Korea	To assess the relationships of antibody level with age, sex, BMI, and adverse reactions to the ChAdOx1 nCoV-19 (AZD1222) vaccine.	ChAdOx1 nCoV-19 (AZD1222).	Healthcare workers in Hanyang University Hospital who received two doses of ChAdOx1 nCoV-19.	Prospective observational study, using the data of self-reported online adverse reaction survey after seven days of COVID-19 vaccination.	a. Most participants (n = 434, 97.1%) experienced at least one local or systemic adverse reaction during days 0–7 after either injection (first or second). b. The most frequently reported local AR was pain (91.8%), tenderness (86.3%), and induration (30.9%). c. The most frequently reported systemic AR was fatigue (87.5%), muscle pain (82.1%), chills (69.1%), and headache (69.1%). d. The most frequently reported grade 3 to grade 4 local AR was tenderness (26.8%), followed by pain (5.8%), and itching (4.4%), while the most frequently reported grade 3 to grade 4 systemic AR was chills (18.6%), followed by fatigue (18.2%), muscle pain (17%), and fever (6.1%). e. The ARs were less frequent after the second injection of the ChAdOx1 nCov-19 vaccine, both systemic (43.8%) and local (49.0%).	The majority of participants reported experiencing local or systemic effects (0–7 days after vaccination) with tenderness and chills symptoms.
Bsoul, et al; 2022[29]	The US	Evaluate the Pfizer COVID-19 vaccination experience related to safety, confidence levels, and side effects among United States-based dental students, staff, and faculty.	Pfizer COVID-19.	Students and staff at the School of Dentistry, UT Health San Antonio.	An observational online survey using the web-based survey platform.	a. The common adverse reactions after the COVID-19 vaccination were injection site pain (75.0%), and the following general side effects (66.7%) were fatigue/ tiredness, headache, muscle/ body ache, and chills/fever. b. About the 60% of participant reported the severity of side effects to be no worse than mild, and the vaccine did not interfere with their life activities. c. There were no differences in severity or impact of vaccine side effects on participant life activities.	a. Side effects after both doses of the vaccine were reported by 36% of all participants. b. All reported side effect were mild and did not interfere daily activities.
Flores, et al; 2021[30]	Peru	To identify post SARS-CoV-2 vaccine BNT162b2 (BioNTech and Pfizer) side effects in patients with systemic lupus erythematosus (SLE).	BioNTech and Pfizer.	SLE patients at the Immuno-Rheumatology Department of the Cayetano Heredia Hospital, Lima, Peru.	Descriptive observational study, using the data of patients with a diagnosis of systemic lupus erythematosus (SLE) who attended at the Immuno-Rheumatology Service of the Cayetano Heredia Hospital, Lima, Peru.	a. All patients received the vaccine presented symptoms within 10 days after immunization with pain at the inoculation site being the most frequent (87%) with mild intensity. b. The pre-dominant type of flare presented after vaccination was arthritis (85.1%) included synovitis, swelling, phlogosis, and followed by dermal (18.5%).	Following SARS-CoV-2 immunization, the majority have local symptoms of an adverse event with mild severity and did not interfere with daily activities.

(*Continued*)

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Table 2 (Continued).

Author, Year	Country	Aim	Vaccine Types	Population	Study Design	Adverse Reaction	Impact
Shulman et al; 2022[31]	The US	To records short-term adverse reactions of the COVID-19 vaccine in patients with cancer, compare these reactions to patients without cancer, and determine whether adverse reactions are associated with active cancer therapy.	mRNA Pfizer BNT162b2 vaccine.	Patients with two doses of the mRNA Pfizer BNT162b2 vaccine at the Comprehensive Cancer Center.	Prospective observational study using survey completed either by telephone or online approximately 2 weeks after the second dose of COVID-19 vaccine.	a. Local pain at the injection site was the most frequently reported symptom for all respondents and did not distinguish patients with cancer from those without cancer after either dose. b. Muscle pain after the first vaccination was more frequent in patients with cancer than in those without but was of shorter duration. c. Joint pain, fever, chills, headache, and nausea were unrelated to cancer status. d. For patients with cancer, adverse events that were reported more frequently after dose 2 included fatigue, joint pain, fever, chills, headache, and nausea.	Comparing patients with cancer to those without cancer revealed few differences in reported adverse events. Active cancer treatment had little effect on the profiles of adverse events.
Jeong, S et al; 2022[32]	South Korea	To investigate the clinical characteristics of older adults with self-reported COVID-19 post vaccination fever and/or febrile sensation or rigors.	Oxford/AstraZeneca (AZD1222), Pfizer BioNTech (BNT162b2) and Moderna (mRNA-1273).	Patients with fever and/or febrile sensation following COVID-19 vaccination in three South Korean hospitals.	A retrospective observational study in three hospitals in Korea, using the self-reported data of patients with suspected adverse reactions after COVID-19 vaccination.	a. The reported adverse reaction after the COVID-19 vaccination was a fever which more experienced among younger adults age than older adults (85.7% vs 75.5%, respectively). b. Post-vaccination fever symptoms most commonly occurred on days 0 and 1.	a. The number of patients who visited the ED with fever as a suspected COVID-19 vaccine-related adverse reaction was lower for older adults than for younger adults. b. Older adults did not require admission to the hospital due to vaccine-related adverse reactions.
Oh, et al; 2022[33]	South Korea	To investigate clinical features of patients who visited the ED for cardiovascular adverse reactions after COVID-19 m-RNA vaccination.	COVID-19 mRNA vaccine, Pfizer-BioNTech (BNT162b2) and Moderna (mRNA-1273).	People were 65 years of age or younger at Incheon and Daejeon hospitals with cardiovascular adverse reactions after the COVID-19 vaccine.	A Retrospective observational study, using the data reported from the Immunization Registry System (IRS) on any suspected COVID-19 vaccine-related adverse events.	a. (51%) out of 1397 patients who visited the ED after receiving the COVID-19 mRNA vaccine reported cardiovascular symptoms as adverse reactions. b. Most patients reported cardiovascular-adverse reactions within 7 days after vaccination, after both the first and second doses (81.9% and 86.4%). c. Males presented adverse reaction with more chest pain/discomfort than females (81.7% vs 70%), while females presented with more dyspnea and palpitation than males. d. Both males (70.8%) and females (65.7%) visited the ED after experiencing adverse reaction more frequently after the first vaccine dose than after the second dose, except for the 17–19 age group.	Most patients reported cardiovascular-adverse reactions within 7 days after vaccination, after both the first and second doses. Adverse reactions showed mild progression.
Park, et al; 2022[34]	Daegu, Republic of Korea	To determine the association between the vaccination and interference with work and daily life.	ChAdOx1 and BNT162b2 COVID-19 vaccine.	Hospital workers who received the first dose of ChAdOx1 at the University Hospital in Daegu, Republic of Korea.	Retrospective survey involving hospital workers that received ChAdOx1 and BNT162b2 COVID-19 vaccine.	a. Participants who experienced significant levels of interference with work (5–10 points) reported all side effects (except urticaria) more frequently with the ChAdOx1 vaccination, with the three most common adverse events being local pain (83.2%), myalgia (78.3%), and fever (73.3%). b. The three most common side events for ChAdOx1 vaccine participants who had severe levels of interference with everyday living were local pain (84.4%), myalgia (77.7%), and fever (70.9%). c. Myalgia, fever, chills, and local pain were the four most common side events among those who got the BNT162b2 vaccination in both the high interference with work and high interference with daily living groups.	The majority of the effects were visible within 24 hours of the vaccination. Individuals' length of unpleasant effects varied, with around 50% reporting that they were impacted for more than 24 hours. Effects on daily life activities were mild or low.

cardiovascular adverse events, on the other hand, did so more frequently after the first vaccine dose than after the second.[33] Some deaths were also reported, however an examination of death certificates found that the most common reasons of death were heart disease and COVID-19.[27]

Type of Vaccine Associated with Adverse Reactions

This study included reports indicating the type of vaccine used was linked to adverse reactions among participants. Types of vaccines included in this study are Pfizer-BioNTech, Oxford-AstraZeneca, Sinopharm, and Moderna.[24–34] According to the studies, the type of vaccine given was connected to adverse reactions among participants. Side effects are 2.9 times more prevalent in first-time Sinopharm vaccination recipients.[26] However, Pfizer-BioNTech vaccination recipients were 1.4 times more likely to suffer an adverse reaction following the second dosage.[26] According to Sinopharm vaccine recipients, people with connected comorbidities had a statistically significant higher percentage of adverse effects than others.[26] According to Pfizer-BioNTech vaccine recipients, individuals having a history of past infection with COVID-19 reported a statistically significant higher percentage of adverse effects than the others.[24,26]

Dyspnea, death, pyrexia, tiredness, and headache were the most prevalent serious reports of Pfizer-BioNTech.[27,29] Another study found that the majority of Pfizer-BioNTech users have mild-to-moderate negative effects.[30] Side effects of the Oxford-AstraZeneca (ChAdOx1 nCoV-19) vaccinations include fatigue, headache, tenderness, local discomfort, myalgia, fever, asthenia, induration, and allergic skin.[24,25,28] Local effects were observed less frequently after the second dosage of both vaccines than after the first dose, as was the case with Pfizer-BioNTech.[24,28]

Moderna, another mRNA vaccine, had similar adverse effects as Oxford-AstraZeneca (ChAdOx1 nCoV-19), including headache, asthenia, and myalgia.[25] However, no participant experienced serious local or systemic reactions after receiving both mRNA vaccines, chadOx1-ncov-19 (astraZeneca) and Moderna.[25] Another study revealed that persons who received Moderna vaccinations (who had heart disease and COVID-19) had serious outcomes, such as fatalities.[27] The majority of BNT162b2 [Pfizer-BioNTech] and mRNA-1273 [Moderna] mRNA vaccination patients experienced cardiovascular-adverse responses within 7 days of receiving both the first and second doses.[33]

Impact of the Adverse Reactions

We looked at the severity of the reactions or the impact of adverse reactions on daily life as vaccination side effects can impair one's capacity to conduct daily tasks. The majority of the reactions were mild to moderate in nature and did not affecting daily tasks,[27] appearing within 1–2 days following vaccination and dissipating within a few days. On the first day following vaccination, the impact of mRNA vaccination, BNT162b2 [Pfizer-BioNTech] and mRNA-1273 [Moderna], on everyday life activities was most often reported among vaccine recipients.[27] 60% of Pfizer vaccination participants experienced moderate side effects, and 75% felt the vaccine had little influence on their regular lives.[29] Another study described the effect of vaccines on work and daily life for participants who had received ChAdOx1 and BNT162b2 COVID-19, with the majority of adverse effects occurring within 24 hours of vaccination, with varying duration of symptoms, and approximately half indicating that they were impacted for more than 24 hours.[34] Women were more likely than males to experience moderate-to-severe side effects that interfered with their daily activities. However, the majority of individuals, regardless of gender, reported that the COVID-19 vaccine had no effect on their everyday activities and that any adverse effects were minor.[29]

Discussion

Several adverse reactions to COVID-19 vaccines have been identified in this review. Local and systemic side effects are among the most common adverse reactions to all COVID-19 vaccines, as previously stated in the studies included. Local side effects includes joint or muscle pain tenderness, itching, induration and paresthesia in the injection site.[24–28,30,31] Meanwhile fever, chills, fatigue, headache, nausea, myalgia, pyrexia, and dyspnea are among the systemic side effects.[24–29,31–34] Local and systemic adverse events occurred within 7 days of receiving COVID-19 vaccines, with fever, fatigue, and headache being the most common systemic adverse reactions.[35] This finding is consistent with other study that confirmed the incidence rate of frequent adverse effects among healthcare workers was 32.1% for fever, 69.1% for muscle ache, and 48.7% for headache.[36] While injection-site pain was the most common local adverse effect.[37]

Other adverse reactions previously mentioned were allergic, such as skin burning, rashes, and red welts on the lips and face also cardiovascular adverse reactions.[24,31,33] Severe allergic reactions following COVID-19 vaccination are extremely rare, but have garnered attention due to potentially fatal outcomes and a high level of uncertainty.[38] Other research indicates that cardiovascular side effects such as tachycardia, flushing, hypertension, hypotension, and peripheral coldness have also been reported.[39] Other studies found that people who received the Pfizer/BioNTech vaccine had a higher rate of cardiovascular adverse events than people who received other types of vaccines.[39] However, all reported adverse events were mostly mild, and did not following by hospital admission.

Vaccine type and dose were also linked to different patterns of interference with work and daily life.[34] There were fewer adverse reactions reported after the second dose of ChAdOx1 vaccination than after the first dose, and the effects on daily life and work were minor.[34] Another form of COVID-19 vaccine linked to mild or moderate severity adverse effects reported following Moderna vaccination, with no influence or interference in work-life activities.[40] Another study discovered that 79.7% of health workers who were immunized with the BNT162b2 mRNA vaccine were able to return to work.[41]

Previous study backs up our findings that COVID-19 vaccination adverse responses are modest and have no effect on the recipient's everyday life.[41] This finding is also supported by another study which described the efficacy of vaccines ranged from 60% to 90% which are always efficient against asymptomatic (SARS-CoV-2) infection, symptomatic COVID-19, COVID-19 hospitalization, severe or critical hospitalization, and death.[42] Deaths following COVID-19 vaccination, as reported in one study, have no connection to the vaccine, but rather to heart disease or COVID-19. The issue of excess death from COVID-19 immunization is a scientifically challenging matter that is influenced by the type of vaccines used, the age and health condition of the vaccinated population.[43] It can be interpreted that host immunity and the type of vaccine are known to influence COVID-19 vaccine adverse responses.

Inconsistencies in adverse reactions may also be caused by symptoms connected with culture or languages.[34] The majority of studies were conducted in developed countries where citizens have a greater understanding and awareness of vaccine adverse reactions therefore the adverse event reporting rate might be higher. Whereas the public may be perplexed by the disparities in results, which are dependent on the research design and subject studies. Therefore, as recommendation, it is critical to disseminate clear information to the public, about vaccine side effects, potential adverse reactions, and safety level of the vaccines provided. Multi-strategies at individual, organization and population level need to be employed to reduce vaccine hesitancy.

There are various limitations to this study. First, this analysis only gathered evidence from observational studies, which are prone to biases such as confounding, information, and selection bias. Observational studies, on the other hand, aid in finding adverse events or negative effects that demand a longer time of follow-up. Second, due to the limitations of the keywords and database, the findings may not have captured all of the evidence in the literature; however, this study did aid in mapping the available evidence in observational studies.

Conclusion

This study confirmed prior findings that the COVID-19 immunization caused mostly mild or non-severe side effects. This review discovered some adverse reactions to COVID-19 vaccinations with most prevalent adverse reactions to all COVID-19 vaccinations are local and systemic side effects. Other previously cited side events included allergic responses and cardiovascular problems. The type of vaccine and dose were linked to the various adverse reaction patterns. Individual daily activities are not severely influenced or interfered with. Deaths following COVID-19 vaccination have nothing to do with the vaccine, but rather with heart disease or COVID-19. It is critical to give the public with accurate information on vaccine side effects, probable adverse reactions, and the safety level of the vaccines provided. To reduce vaccine hesitancy, multiple measures must be implemented at the individual, organizational, and population levels. Future research could look into the impact of the vaccine on patients of various ages and medical conditions.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Wang J, Kaperak C, Sato T, Sakuraba A. COVID-19 reinfection: a rapid systematic review of case reports and case series. *J Invest Med*. 2021;69(6):1253–1255. doi:10.1136/jim-2021-001853
2. Rai P, Kumar BK, Deekshit VK, Karunasagar I, Karunasagar I. Detection technologies and recent developments in the diagnosis of COVID-19 infection. *Appl Microbiol Biotechnol*. 2021;105:441–455. doi:10.1007/s00253-020-11061-5/Published
3. IHME. COVID-19 results briefing Myanmar current situation trends in drivers of transmission. COVID-19 Results Brief; 2022. Available from: https://www.healthdata.org/sites/default/files/covid_briefs/15_briefing_Myanmar.pdf. Accessed October 27, 2022.
4. rawson T, Brewer T, Veltcheva D, Huntingford C, Bonsall MB. How and when to end the COVID-19 lockdown: an optimization approach. *Front Public Health*. 2020;8. doi:10.3389/fpubh.2020.00262
5. Shen M, Xiao Y, Zhuang G, Li Y, Zhang L. Mass testing—An underexplored strategy for COVID-19 control. *Innovation*. 2021;2(2):100114. doi:10.1016/j.xinn.2021.100114
6. Warren GW, Lofstedt R. COVID-19 vaccine rollout risk communication strategies in Europe: a rapid response. *J Risk Res*. 2021;24(3–4):369–379. doi:10.1080/13669877.2020.1870533
7. Paltiel AD, Schwartz JL, Zheng A, Walensky RP. Clinical outcomes of a COVID-19 vaccine: implementation over efficacy. *Health Aff*. 2021;40(1):42–52. doi:10.1377/hlthaff.2020.02054
8. Al Khames Aga QA, Alkhaffaf WH, Hatem TH. Safety of COVID-19 vaccines. *J Med Virol*. 2021;93(12):6588–6594. doi:10.1002/jmv.27214
9. Baden LR, El Sahly HM, Essink B, et al. Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. *N Engl J Med*. 2021;384(5):403–416. doi:10.1056/nejmoa2035389
10. Polack FP, Thomas SJ, Kitchin N, et al. Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine. *N Engl J Med*. 2020;383(27):2603–2615. doi:10.1056/nejmoa2034577
11. Sadoff J, Gray G, Vandebosch A, et al. Safety and efficacy of single-dose Ad26.COV2.S vaccine against Covid-19. *N Engl J Med*. 2021;384(23):2187–2201. doi:10.1056/nejmoa2101544
12. Beatty AL, Peyser ND, Butcher XE, et al. Analysis of COVID-19 vaccine type and adverse effects following vaccination. *JAMA Netw Open*. 2021;4(12):e2140364. doi:10.1001/jamanetworkopen.2021.40364
13. Spencer JP, Trondsen Pawlowski RH, Thomas S. Vaccine adverse events: separating myth from reality. *Am Fam Physician*. 2017;95(12):786–794.
14. Abu-Halaweh S, Alqassieh R, Suleiman A, et al. Qualitative assessment of early adverse effects of pfizer–biontech and sinopharm covid-19 vaccines by telephone interviews. *Vaccines*. 2021;9(9):950. doi:10.3390/vaccines9090950
15. Rabail R, Ahmed W, Ilyas M, et al. The side effects and adverse clinical cases reported after COVID-19 Immunization. *Vaccines*. 2022;10(4):1–25. doi:10.3390/vaccines10040488
16. Magadmi RM, Kamel FO. Beliefs and barriers associated with COVID-19 vaccination among the general population in Saudi Arabia. *BMC Public Health*. 2021;21(1). doi:10.1186/s12889-021-11501-5
17. Kreps S, Prasad S, Brownstein JS, et al. Factors associated with US Adults' likelihood of accepting COVID-19 vaccination. *JAMA Netw Open*. 2020;3(10):e2025594. doi:10.1001/jamanetworkopen.2020.25594
18. Cerda AA, García LY. Hesitation and refusal factors in individuals' decision-making processes regarding a coronavirus disease 2019 vaccination. *Front Public Health*. 2021;9. doi:10.3389/fpubh.2021.626852
19. Peters M, Godfrey C, McInerner P, Munn Z, Tricco A, Khalil H. Chapter 11: scoping reviews (2020 version). *JBI Man Evid Synth*. 2020. doi:10.46658/JBIMES-20-12
20. Pormohammad A, Zarei M, Ghorbani S, et al. Efficacy and safety of covid-19 vaccines: a systematic review and meta-analysis of randomized clinical trials. *Vaccines*. 2021;9(5):467. doi:10.3390/vaccines9050467
21. Chen J, Cai Y, Chen Y, Williams AP, Gao Y, Zeng J. Nervous and muscular adverse events after covid-19 vaccination: a systematic review and meta-analysis of clinical trials. *Vaccines*. 2021;9(8):939. doi:10.3390/vaccines9080939
22. Bosdriesz JR, Stel VS, van Diepen M, et al. Evidence-based medicine—When observational studies are better than randomized controlled trials. *Nephrology*. 2020;25(10):737–743. doi:10.1111/nep.13742
23. Kamioka H. Preferred reporting items for systematic review and meta-analysis protocols (prisma-p) 2015 statement. *Japanese Pharmacol Ther*. 2019;47(8):1177–1185.
24. Menni C, Klaser K, May A, et al. Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study. *Lancet Infect Dis*. 2021;21(7):939–949. doi:10.1016/S1473-3099(21)00224-3
25. Perrotta A, Biondi-Zoccai G, Saade W, et al. A snapshot global survey on side effects of cOvid-19 vaccines among healthcare professionals and armed forces with a focus on headache. *Panminerva Med*. 2021;63(3):324–331. doi:10.23736/S0031-0808.21.04435-9
26. Ganesan S, Al Ketbi LMB, Al Kaabi N, et al. Vaccine side effects following COVID-19 vaccination among the residents of the UAE—an observational study. *Front Public Health*. 2022;10. doi:10.3389/fpubh.2022.876336
27. Rosenblum HG, Gee J, Liu R, et al. Safety of mRNA vaccines administered during the initial 6 months of the US COVID-19 vaccination programme: an observational study of reports to the vaccine adverse event reporting system and v-safe. *Lancet Infect Dis*. 2022;22(6):802–812. doi:10.1016/S1473-3099(22)00054-8
28. Lee SW, Moon JY, Lee SK, et al. Anti-SARS-CoV-2 Spike Protein RBD antibody levels after receiving a second dose of ChAdOx1 nCov-19 (AZD1222) vaccine in healthcare workers: lack of association with age, sex, obesity, and adverse reactions. *Front Immunol*. 2021;12. doi:10.3389/fimmu.2021.779212
29. Bsoul EA, Loomer PM, Patel SKS. COVID-19 vaccination experience among United States dental professionals and students: safety, confidence, concerns, and side effects. *PLoS One*. 2022;17(2):e0264323. doi:10.1371/journal.pone.0264323
30. Zavala-Flores E, Salcedo-Matienzo J, Quiroz-Alva A, Berrocal-Kasay A. Side effects and flares risk after SARS-CoV-2 vaccination in patients with systemic lupus erythematosus. *Clin Rheumatol*. 2022;41(5):1349–1357. doi:10.1007/s10067-021-05980-5

31. Shulman RM, Weinberg DS, Ross EA, et al. Adverse events reported by patients with cancer after administration of a 2-dose mRNA COVID-19 vaccine. *J Natl Comprehen Cancer Netw*. 2022;20(2):160–166. doi:10.6004/jnccn.2021.7113
32. Jeong S, Hong S, Oh T, et al. Analysis of older adults visiting the emergency department with fever as a suspected Covid-19 vaccine-related adverse reaction: a retrospective multicenter study. *J Infect Chemother*. 2022;28(8):1159–1164. doi:10.1016/j.jiac.2022.04.022
33. Oh TH, Woo SH, Hong S, Lee C, Lee WJ, Jeong SK. Clinical features of patients presenting to the emergency department with cardiovascular adverse reactions after COVID-19 mRNA vaccination. *J Korean Med Sci*. 2022;37(9). doi:10.3346/jkms.2022.37.e73
34. Park C, Sakong J, Jo S, Kim M, Baek K. Adverse effects on work and daily life interference among healthcare workers after the first and second chadox1 and bnt162b2 covid-19 vaccine doses. *Vaccines*. 2021;9(8):926. doi:10.3390/vaccines9080926
35. Thomas SJ, Moreira ED, Kitchin N, et al. Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine through 6 months. *N Engl J Med*. 2021;385(19):1761–1773. doi:10.1056/nejmoa2110345
36. Lee YW, Lim SY, Lee JH, et al. Adverse reactions of the second dose of the BNT162b2 mRNA COVID-19 vaccine in healthcare workers in Korea. *J Korean Med Sci*. 2021;36(21):1–6. doi:10.3346/JKMS.2021.36.E153
37. Kim SH, Wi YM, Yun SY, et al. Adverse events in healthcare workers after the first dose of Chadox1 Ncov-19 Or Bnt162b2 mRNA Covid-19 vaccination: a single center experience. *J Korean Med Sci*. 2021;36(14):1–8. doi:10.3346/jkms.2021.36.e107
38. Klimek L, Bergmann KC, Brehler R, et al. Practical handling of allergic reactions to COVID-19 vaccines: a position paper from German and Austrian Allergy Societies AeDA, DGAKI, GPA and ÖGAI. *Allergo J Int*. 2021;30(3):79–95. doi:10.1007/s40629-021-00165-7
39. Kaur RJ, Dutta S, Charan J, et al. Cardiovascular adverse events reported from covid-19 vaccines: a study based on who database. *Int J Gen Med*. 2021;14:3909–3927. doi:10.2147/IJGM.S324349
40. Banerji A, Wickner PG, Saff R, et al. mRNA Vaccines to prevent COVID-19 disease and reported allergic reactions: current evidence and suggested approach. *J Allergy Clin Immunol*. 2021;9(4):1423–1437. doi:10.1016/j.jaip.2020.12.047
41. Kadali RAK, Janagama R, Peruru S, Malayala SV. Side effects of BNT162b2 mRNA COVID-19 vaccine: a randomized, cross-sectional study with detailed self-reported symptoms from healthcare workers. *Int J Infect Dis*. 2021;106:376–381. doi:10.1016/j.ijid.2021.04.047
42. Liu Y, Ye Q. Safety and Efficacy of the Common Vaccines against COVID-19. *Vaccines*. 2022;10(4):513. doi:10.3390/vaccines10040513
43. Liu JY, Chen TJ, Hou MC. Does COVID-19 vaccination cause excess deaths? *J Chin Med Assoc*. 2021;84(9):811–812. doi:10.1097/JCMA.0000000000000580