BRITISH JOURNAL OF HOSPITAL MEDICINE

SYSTEMATIC REVIEW

A Systematic Review of COVID-19 Vaccination Side Effects, Acceptance, and Attitudes Among Healthcare Workers in Saudi Arabia

Ali Hassan Alshareefi[1,*], Maram Hassan Zaid[2], Hassan Ali Hamdi[3], Salma Yahya Zaylaee[4], Ibtisam Yahia Muthaffar[5], Abdulrhman Mohammad Salim[6], Eman Abkar Aqeely[7], Samira Meshaal Alaqi[8], Hind Abdu Madkhali[9], Ghadeer Fadel Hedari[10], Roqia Ali Hadadi[2], Safa Mohmmad Shajeri[11], Maryam Abdulhafith Harjah[12]

[1]Administration of Communicable Diseases Control, Jazan Health Cluster, Jazan, Saudi Arabia
[2]Department of Public Health, Jazan Health Cluster, Jazan, Saudi Arabia
[3]Primary Health Care Center in Jaradiya, Jazan Health Cluster, Jazan, Saudi Arabia
[4]Primary Care Center in Mokhata, Jazan Health Cluster, Jazan, Saudi Arabia
[5]Resources Control Center, Jazan Health Cluster, Jazan, Saudi Arabia
[6]Primary Care Center in Dabia, Jazan Health Cluster, Jazan, Saudi Arabia
[7]Jazan General Hospital, Jazan Health Cluster, Jazan, Saudi Arabia
[8]King Fahd Central Hospital, Jazan Health Cluster, Jazan, Saudi Arabia
[9]Primary Care Center in AlJadaa, Jazan Health Cluster, Jazan, Saudi Arabia
[10]Eidabi General Hospital, Jazan Health Cluster, Jazan, Saudi Arabia
[11]Primary Care Center in Al Dhabiyeh, Jazan Health Cluster, Jazan, Saudi Arabia
[12]General Directorate of Health Affairs, Jazan Health Cluster, Jazan, Saudi Arabia
*Correspondence: adebsh@moh.gov.sa (Ali Hassan Alshareefi)

Abstract

Aims/Background The coronavirus disease 2019 (COVID-19) pandemic has significantly impacted global health and the economy. Vaccination is crucial for controlling its spread, and healthcare workers (HCWs) in Saudi Arabia prioritize vaccination. This systematic review aimed to: (1) evaluate the reported side effects of COVID-19 vaccines among HCWs in Saudi, (2) assess vaccine acceptance rates and their temporal changes, and (3) identify the factors influencing vaccine uptake and hesitancy.

Methods We conducted a systematic review following preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. The protocol included: (1) systematic searching of five major databases (MEDLINE, Embase, PubMed, Scopus, and Web of Science) up to 25 November 2024; (2) independent screening and selection by three reviewers using predefined inclusion criteria; (3) quality assessment using the Joanna Briggs Institute (JBI) critical appraisal tool; and (4) standardized data extraction and synthesis focusing on vaccine side effects, acceptance rates, and influencing factors among healthcare workers in Saudi Arabia.

Results Of the 220 citations, 30 met the inclusion criteria. Studies have revealed predominantly mild to moderate side effects, with severity patterns varying by professional role and demographic factors. Vaccine acceptance showed significant improvement over time, which was attributed to public health campaigns, peer influence, and improved accessibility. Higher acceptance was correlated with professional experience and education levels, while hesitancy stemmed from safety concerns and efficacy doubts.

Conclusion Understanding these patterns supports the development of targeted interventions, suggesting a need for evidence-based communication and peer-led education programs. Healthcare institutions should focus on transparent safety communication and address specific misconceptions to enhance vaccine confidence among HCWs.

Key words: COVID-19 vaccine; acceptance; attitudes; adverse effects; Saudi Arabia

Submitted: 29 October 2024 Revised: 27 December 2024 Accepted: 31 December 2024

How to cite this article:
Alshareefi AH, Zaid MH, Hamdi HA, Zaylaee SY, Muthaffar IY, Salim AM, Aqeely EA, Alaqi SM, Madkhali HA, Hedari GF, Hadadi RA, Shajeri SM, Harjah MA. A Systematic Review of COVID-19 Vaccination Side Effects, Acceptance, and Attitudes Among Healthcare Workers in Saudi Arabia. Br J Hosp Med. 2025. https://doi.org/10.12968/hmed.2024.0837

Introduction

The coronavirus disease 2019 (COVID-19) pandemic, caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, has spread globally since its initial identification in China. This virus typically presents with a constellation of symptoms, including fever, cough, dyspnea, and respiratory complications (Huang et al, 2020), while also demonstrating the potential to affect multiple physiological systems (Anand et al, 2020; Brielle et al, 2020; Lu et al, 2020; Majrashi, 2023; Wu et al, 2020). The COVID-19 pandemic has had a profound and multifaceted negative impact on global public health and economy. While the implementation of rigorous hygiene practices and behavioral control measures has proven effective in mitigating disease transmission, the development and deployment of vaccines are widely regarded as the single most important intervention for providing protection and controlling the spread of this virus (Pogue et al, 2020). The World Health Organization estimates that routine childhood immunization programs prevent between 3.5 and 5 million deaths globally each year (Lynch and Marcuse, 2008).

The Kingdom of Saudi Arabia has been at the forefront of COVID-19 vaccination efforts, approving and deploying several effective vaccines to protect its population. The Saudi Food and Drug Authority (SFDA) (https://www.sfda.gov.sa/en) granted emergency use authorization to three prominent COVID-19 vaccines: Pfizer-BioNTech's (New York, NY, USA (Pfizer Inc.) and Mainz, Germany (BioNTech SE)), mRNA-based vaccine on 24 November 2020, the viral vector vaccine developed by AstraZeneca (Cambridge, UK), on 18 February 2021, and, most recently, Moderna's (Cambridge, MA, USA), mRNA-1273 vaccine on 30 April 2021, shortly after the World Health Organization (WHO) had given its seal of approval. As part of its strategic approach to combat the pandemic and safeguard the health and well-being of its citizens, Saudi Arabia has prioritized the early administration of these approved vaccines to key target groups, including healthcare workers (HCWs), the elderly, and individuals with chronic or autoimmune conditions (Althaqafi et al, 2023).

HCWs have been at the forefront of the pandemic response, providing care to COVID-19 patients and playing a crucial role in the effectiveness of immunization programs, as their own attitudes and knowledge about vaccinations can influence their intention to offer them and their personal decision to get vaccinated (Kabamba Nzaji et al, 2020). Research has shown that HCWs can sometimes be vaccine-apprehensive (Paterson et al, 2016), and this reluctance may contribute to public hesitancy and opposition to vaccination (Dubé et al, 2013; Verger et al, 2015). Additionally, healthcare professionals with unfavorable opinions about vaccines tend to recommend them infrequently to their patients (Arda et al, 2011).

The success of an immunization strategy relies heavily on the public's perception, acceptance, and use of a vaccine, even if it has been released on an emergency basis. Without this public confidence and readiness to be vaccinated, vaccine reluctance will be a significant challenge (Rhodes et al, 2021). Ensuring high COVID-19 vaccine acceptance and uptake among HCWs, including their experi-

ences and perceptions regarding vaccine side effects, is important for protecting them, their patients, and the broader community. This review explored the side effects of COVID-19 vaccines experienced by HCWs, as their perceived safety of the vaccines can influence their advocacy and recommendation of vaccines to the public. Understanding the factors influencing COVID-19 vaccine acceptance, attitudes, and experiences with side effects among HCWs in Saudi Arabia is crucial for informing targeted interventions and policies to improve vaccine uptake in this population. This systematic review aimed to address the following research questions:

(1) What are the reported side effects of COVID-19 vaccines among healthcare workers in Saudi Arabia and what factors influence their occurrence and severity?

(2) What is the overall level of COVID-19 vaccine acceptance among healthcare workers in Saudi Arabia and how has the acceptance rate changed from the early to later vaccination periods?

(3) Which demographic, professional, and psychosocial factors influence COV ID-19 vaccine acceptance and hesitancy among healthcare workers in Saudi Arabia?

(4) What are the prevailing attitudes and perceptions of COVID-19 vaccines among healthcare workers in Saudi Arabia, particularly regarding vaccine safety, efficacy, and booster dose?

(5) How do healthcare workers' knowledge and attitudes toward COVID-19 vaccines influence their overall vaccine acceptance and uptake?

Methods

We followed the recommendations from the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines to ensure high-quality reporting in this systematic review (Moher et al, 2009). The PRISMA flowchart (Fig. 1) outlines the selection process for the studies included in the review. The PRISMA chart was generated using Review Manager (RevMan) V5.4, manufactured by the Cochrane Collaboration, located in London, UK (https://training.cochrane.org/online-learning/core-software/revman). The PRISMA checklist was utilized as a framework for this systematic review and is provided as **Supplementary Table 1**.

Search Strategy

We conducted a comprehensive literature search of five major electronic databases: Embase Ovid (1974–25 November 2024; https://www.embase.com), MEDLINE Ovid (1946–25 November 2024; https://ovidsp.ovid.com), PubMed (inception–25 November 2024; https://pubmed.ncbi.nlm.nih.gov), Scopus (https://www.scopus.com), and Web of Science (https://www.webofscience.com). Additional citations found in Scopus and Web of Science were duplicates of articles already identified in the primary databases. The search terms were derived from MeSH (Medical Subject Headings) and included: "COVID-19" OR "SARS-CoV-2" OR "Coronavirus Disease 2019" AND "COVID-19 Vaccines" OR "SARS-CoV-2 Vaccines" OR "BNT162 Vaccine" OR "mRNA-1273 vaccine" OR "ChAdOx1 nCoV-19 vac-

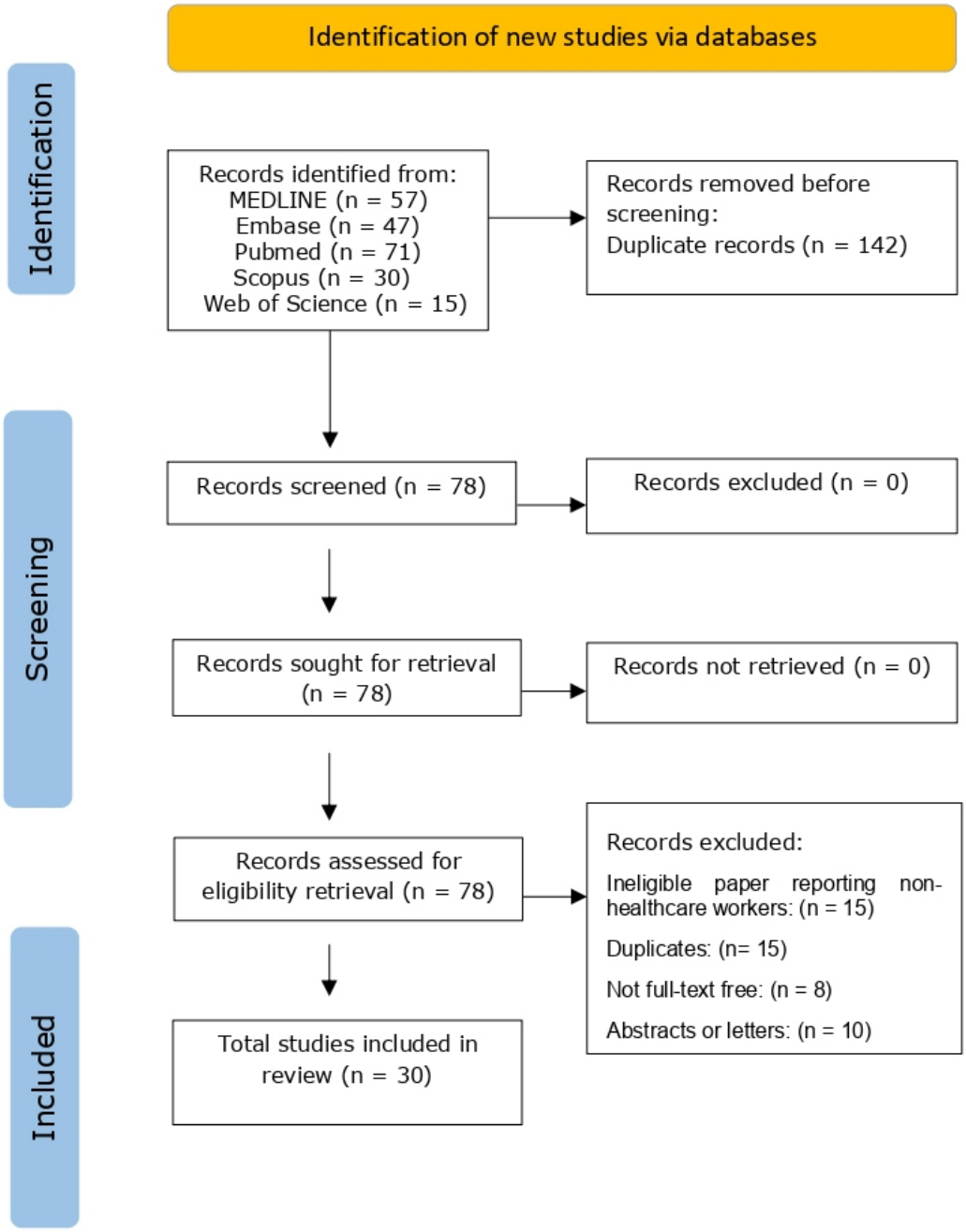

Fig. 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) flowchart for the selection process. The PRISMA chart was generated using Review Manager (RevMan), version 5.4, manufactured by Cochrane Collaboration, located in London, UK (https://training.cochrane.org/online-learning/core-software).

cine" OR "COVID-19 Vaccine, AstraZeneca" AND "Attitude to Health" OR "Health Knowledge, Attitudes, Practice" OR "Patient Acceptance of Health Care" OR "Adverse Effects" OR "Vaccination Hesitancy" OR "Drug-Related Side Effects and Adverse Reactions" AND "Health Personnel" OR "Healthcare Workers" OR "Medical Staff" OR "Hospital Personnel" OR "Physicians" OR "Nurses" OR "Allied Health Personnel" AND "Saudi Arabia". The search was limited to articles published in the English language. Relevant studies were saved for further review to extract the

key information. The inclusion and exclusion criteria outlined in the study protocol were used to evaluate eligibility of the identified studies.

Selection Criteria

The study selection process was conducted independently by three authors (MHZ, AHA, and SYZ). The titles, abstracts, and full texts of the identified articles were screened to assess their eligibility for inclusion in the systematic review. Any disagreements were resolved through discussions with other authors. Studies were included only if they met all the predefined inclusion criteria. Additionally, the reference lists of the included studies were checked to identify any other relevant articles that may have been missed during the initial database search. The systematic review was limited to published peer-reviewed articles. Full-text versions of the selected studies were then retrieved and thoroughly reviewed to extract the information necessary to address the primary objective and purpose of this study. For standardized assessment across studies, side effects were categorized based on severity. Mild side effects included local reactions, such as injection site pain or swelling, and systemic symptoms that did not interfere with daily activities. Medium side effects were defined as symptoms that affected daily activities but did not require medical attention. Severe side effects included those requiring medical intervention or hospitalization.

Inclusion and Exclusion Criteria

This systematic review included studies that met the following inclusion criteria: (a) original peer-reviewed research using quantitative methods, (b) study population consisting solely of healthcare workers in Saudi Arabia, (c) research examining COVID-19 vaccine side effects, acceptance, and/or attitudes, (d) articles published in English, and (e) studies published from 2 March, 2020 onwards.

Studies were excluded if they: (a) contained mixed populations where HCW data could not be separately analyzed, (b) focused solely on COVID-19 knowledge without addressing vaccination aspects, (c) presented only preliminary or interim results without complete data analysis, or (d) lacked adequate description of methodological approaches. This systematic approach ensured methodological rigor while acknowledging the rapid pace of pandemic-related publications.

Data Extraction

The title and abstract screening process was independently conducted by five authors (HAM, GFH, RAH, SMS, and SMA). The full-text versions of the identified articles were reviewed to determine their eligibility for inclusion in the study. Data were then systematically extracted from the selected studies, including the basic characteristics of the included literature, such as the author, publication date, research type, number of participants, and study design. The researchers also collected demographic information about the study subjects, such as average age and sex, as well as the key findings related to the side effects, acceptance, and attitudes toward COVID-19 vaccination among HCWs in Saudi Arabia. Other relevant data points were also recorded. Any disagreements or controversies that arose during

the data extraction process were resolved through thoughtful discussions among all the study authors. The data extraction process was then independently reviewed and verified by IMY. and AMS to ensure accuracy and completeness.

Quality Assessment

The quality assessments of the studies were conducted independently by two authors (MHZ and AHA) using the critical appraisal checklist for analytical cross-sectional studies, recommended by the Joanna Briggs Institute (JBI) and available at https://jbi.global/critical-appraisal-tools. Any discrepancies were resolved by consensus. The checklist consists of eight questions that were considered for each study. A score of one point was assigned to each affirmative response to the questions. Therefore, the scores assigned to each study ranged from 0 to 8. The scores for each domain were categorized as low, high, or unclear risk of bias. The risk of bias Figs. 2,3 were generated using RevMan V5.4, manufactured by the Cochrane Collaboration, located in London, UK (https://training.cochrane.org/online-learning/core-software/revman). Based on the overall score, the studies were classified as having low risk (score $\geq$7), medium risk (score 4–6), or high risk of bias (score $\leq$1–3). While quality assessment was performed for all included studies, formal weighting based on quality scores was not applied in the synthesis of the findings. However, the methodological quality of the studies was considered in the interpretation of the results and discussed as a limitation where relevant.

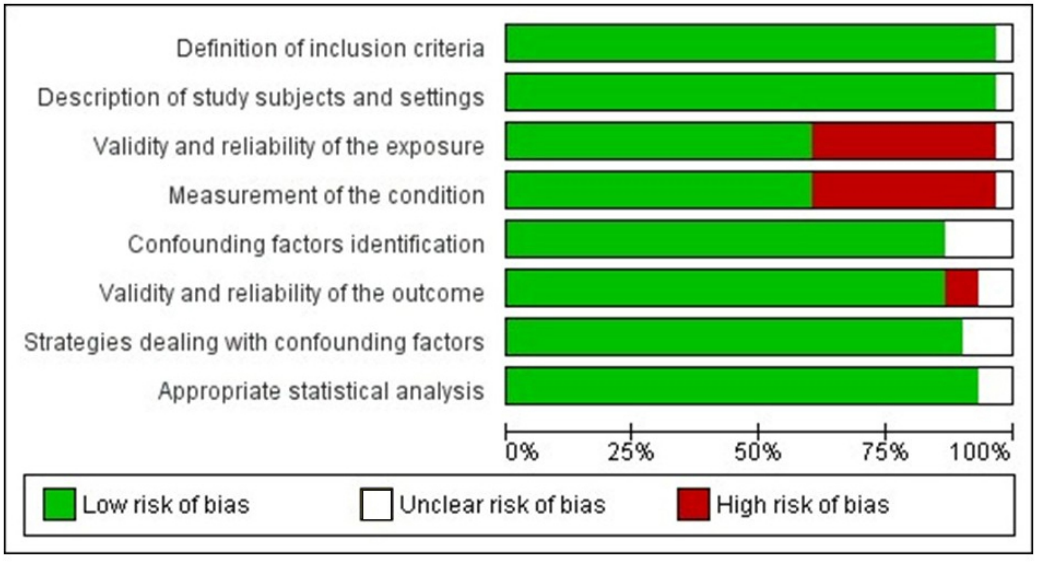

Fig. 2. Risk of bias of the included studies with low, high, and unclear concerns for each item.

Results

Study Selection

The initial electronic database searches of MEDLINE, Embase, PubMed, Scopus, and Web of Science yielded 220 citations. After removing 142 duplicate

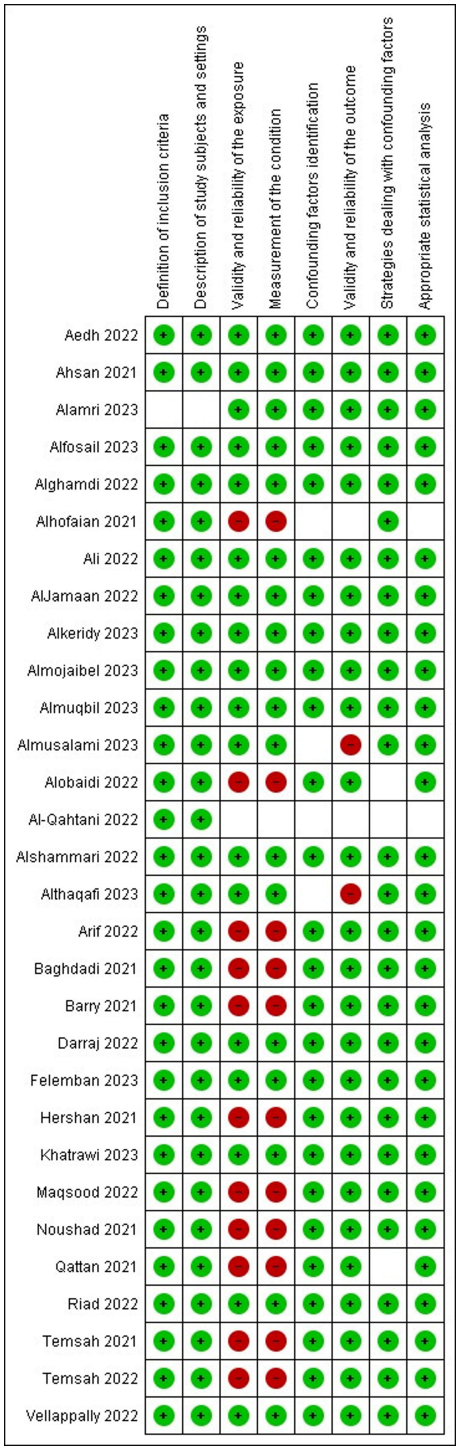

Fig. 3. Risk of bias summary of the included studies with low (+ green sign), high (- red sign), and unclear (empty space) concerns in each study.

records, 78 studies remained for title and abstract screening. During this screening process, 48 studies were excluded for the following reasons: 10 were abstracts or letters to the editor, 15 reported on non-HCW populations, 15 were duplicates, and eight were unavailable in a full-text format. Ultimately, 30 studies were considered eligible for inclusion in this analysis. Fig. 1 shows the PRISMA flow diagram illustrating the selection of 30 studies from the initial 220 citations. The PRISMA

flow diagram shows a systematic and thorough screening process with clear documentation of the excluded studies at each stage. The final inclusion of 30 studies from the 220 initial citations demonstrates the rigorous application of the selection criteria, thereby enhancing the reliability of the review.

Quality Assessment

The quality assessment and risk of bias for the included studies are presented in Figs. 2,3, and Table 1. Fig. 2 presents the overall risk assessment by domain, showing a predominantly low risk across the methodological criteria. Fig. 3 details the individual study quality assessments, highlighting that most studies maintained high methodological standards. Table 1 presents detailed quality scores across the eight JBI criteria, demonstrating that 26 studies achieved high-quality scores ($\geq$7), particularly in the study design and statistical analysis domains. Three of these studies (Almusalami et al, 2023; Alobaidi and Hashim, 2022; Qattan et al, 2021) showed medium risk of bias, and one study (Alhofaian et al, 2021) demonstrated high risk.

Characteristics (Overview) of Included Studies

Supplementary Table 2 summarizes the characteristics of the included studies. Studies were primarily conducted in major Saudi cities, with Riyadh (2 studies) and Jeddah (4 studies) contributing substantial portions. The sample sizes ranged from 173 to 2137 participants, totaling over 20,484 healthcare workers. All the studies employed cross-sectional designs and were published between 2020 and 2024.

Side Effects of COVID-19 Vaccination

Six of the studies (Ahsan et al, 2021; Alamri et al, 2023; Alghamdi et al, 2022; Ali et al, 2022; Darraj and Al-Mekhlafi, 2022; Riad et al, 2022) examined vaccine side effects among HCWs. Following the standardized severity classification:

- Mild effects (local reactions, no activity interference) were most common, including injection site pain and minor fatigue.
- Medium effects (affecting daily activities) included body pain, headache, and muscle pain.
- Severe effects (requiring medical attention) were rare.

Key findings showed a higher incidence of side effects among females, those with chronic diseases, and medical field workers (Ahsan et al, 2021; Alamri et al, 2023; Alghamdi et al, 2022; Ali et al, 2022; Darraj and Al-Mekhlafi, 2022; Riad et al, 2022). The HCW group had a 1.61-fold increased risk compared with non-medical personnel.

While understanding the physical impacts of vaccination through side effects is crucial, it is equally important to comprehend the behavioral aspects of vaccine acceptance rates and attitudes among HCWs.

Table 1. Quality assessment of included studies using the JBI tool for analytical cross-sectional studies.

Studies (Author/Date)	Alhofaian et al, 2021	Alobaidi and Hashim, 2022	Arif et al, 2022	Baghdadi et al, 2021	Barry et al, 2021	Alshammari et al, 2022	Hershan, 2021	Maqsood et al, 2022	Qattan et al, 2021	Temsah et al, 2021	Temsah et al, 2022	Althaqafi et al, 2023	Alamri et al, 2023	Alfosail and Alghamdi, 2023	Noushad et al, 2021
JBI criteria: (Yes, No, Unclear, NA)															
1. Were the criteria for inclusion in the sample clearly defined?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Were the study subjects and the setting described in detail?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the exposure measured in a valid and reliable way?	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	Yes	Yes	Yes	NA
4. Were objective, standard criteria used for measurement of the condition?	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	Yes	Yes	Yes	NA
5. Were confounding factors identified?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
6. Were strategies to deal with confounding factors stated?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
7. Were the outcomes measured in a valid and reliable way?	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes
8. Was appropriate statistical analysis used?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total score (out of 8)	3/8	5/8	6/8	6/8	6/8	8/8	6/8	6/8	5/8	6/8	6/8	6/8	8/8	8/8	6/8
Overall risk of bias (Low, Medium, High)	High	Medium	Low	Low	Low	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low

Table 1. Continued.

Studies (Author/Date)	Alkeridy et al, 2023	Almojaibel et al, 2023	Almuqbil et al, 2023	Almusalami et al, 2023	Khatrawi and Sayed, 2023	Al-Qahtani et al, 2022	Riad et al, 2022	Aedh, 2022	Vellappally et al, 2022	AlJamaan et al, 2022	Ali et al, 2022	Alghamdi et al, 2022	Darraj and Al-Mekhlafi, 2022	Ahsan et al, 2021	Felemban et al, 2023
JBI criteria: (Yes, No, Unclear, NA)															
1. Were the criteria for inclusion in the sample clearly defined?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Were the study subjects and the setting described in detail?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the exposure measured in a valid and reliable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Were objective, standard criteria used for measurement of the condition?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Were confounding factors identified?	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Were strategies to deal with confounding factors stated?	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Were the outcomes measured in a valid and reliable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total score (out of 8)	8/8	8/8	8/8	6/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8
Overall risk of bias (Low, Medium, High)	Low	Low	Low	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Scoring was based on the JBI critical appraisal checklist (eight questions). One point was assigned for each affirmative response (range 0–8). Risk categorization: low risk (score ≥7), medium risk (score 4–6), and high risk (score ≤1–3). JBI, Joanna Briggs Institute; NA, not applicable.

Vaccine Acceptance and Attitudes

Twenty-four studies (Aedh, 2022; Alfosail and Alghamdi, 2023; Alhofaian et al, 2021; AlJamaan et al, 2022; Alkeridy et al, 2023; Almojaibel et al, 2023; Almuqbil et al, 2023; Almusalami et al, 2023; Alobaidi and Hashim, 2022; Al-Qahtani et al, 2022; Alshammari et al, 2022; Althaqafi et al, 2023; Arif et al, 2022; Baghdadi et al, 2021; Barry et al, 2021; Felemban et al, 2023; Hershan, 2021; Khatrawi and Sayed, 2023; Maqsood et al, 2022; Noushad et al, 2021; Qattan et al, 2021; Temsah et al, 2021; Temsah et al, 2022; Vellappally et al, 2022) examined vaccine acceptance and/or attitudes. The overall acceptance rate was 72.6%, with higher rates among:

- Older HCWs;
- Female personnel (52.63% vs 25.5% male);
- Married individuals;
- More experienced staff;
- Those with higher education.

Acceptance increased by 40% between late 2020 and late 2021. The primary hesitancy factors included safety concerns and efficacy doubts. The booster dose intention reached 71.1%, influenced by perceived benefits and safety perceptions.

Figs. 2,3 show the overall high methodological quality of the included studies. The predominance of low-risk assessments across most quality domains, particularly in the study design and statistical analysis, supports the robustness of our findings. A few areas showing higher risk, mainly in exposure measurement and confounding factors, were considered when interpreting the results.

The findings from our systematic review provide important insights into the multifaceted nature of COVID-19 vaccination among HCWs in Saudi Arabia, with implications for both clinical practice and public health policies.

Discussion

This systematic review explored the side effects, acceptance, and attitudes regarding COVID-19 vaccination among HCWs in Saudi Arabia. The findings offer essential insights into the experiences and perceptions of healthcare professionals, guide strategies to enhance vaccination rates, and address related concerns. Beyond the physical manifestations of vaccination through side effects, the psychological and behavioral aspects reflected in acceptance rates and attitudes provide a comprehensive picture of HCWs' vaccination experiences.

The findings of this systematic review indicate that HCWs in Saudi Arabia have a high incidence of side effects following the COVID-19 vaccination. The most frequently observed side effects include body pain, injection site pain, headache, joint or bone pain, and muscle pain. These symptoms were more severe among HCWs than among non-medical personnel, with factors such as gender, pre-existing health conditions, and professional role influencing the likelihood of experiencing side effects (Barry et al, 2021). These findings underscore the need for effective communication and education to address concerns about vaccine safety and efficacy.

This review demonstrated substantial vaccine acceptance among HCWs in Saudi Arabia, with rates comparable to those in other countries such as Pakistan, Greece, China, and France. The factors contributing to this high acceptance rate include older age, female gender, marital status, extensive years of experience, affiliation with the healthcare profession, and higher educational attainment. This pattern mirrors findings from other countries: in Pakistan, 70.2% of HCWs accepted the vaccine; in Greece, the acceptance rate was 78.5%; in China, it was 76.98%; in France, 76.9% of HCWs were receptive to vaccination (Gagneux-Brunon et al, 2021; Malik et al, 2021; Papagiannis et al, 2021; Wang et al, 2021); and in South Africa, where structural inequities influenced hesitancy (Engelbrecht et al, 2022). Conversely, vaccine hesitancy was more common among non-HCWs, driven by concerns about potential side effects, doubts regarding the vaccine's efficacy, and general mistrust in government. Addressing these concerns through targeted communication and educational initiatives could further enhance acceptance of the vaccine.

Based on our findings, educational interventions (Barry et al, 2021) should specifically target (1) misconceptions about vaccine safety and DNA alteration, which 5.7% of HCWs believed possible; (2) concerns about rapid vaccine development, which decreased acceptance by 60%; and (3) understanding of vaccine efficacy, as approximately half held incorrect opinions. The observed increase in acceptance rates (40% higher in late 2021 than in late 2020) can be attributed to several factors: successful government public health campaigns, including transparent communication about vaccine safety data, positive peer experiences with vaccination (increasing odds by 0.30), improved vaccine accessibility (increasing odds ratio by 0.39), and accumulating real-world safety data. However, healthcare facilities' vaccine mandates showed a potentially negative effect, decreasing acceptance odds by 0.27. The higher acceptance rates among educated and experienced HCWs suggest that peer-led educational programs and the sharing of personal vaccination experiences could be particularly effective intervention strategies.

The findings also reveal a substantial increase in COVID-19 vaccine acceptance over time, with higher acceptance rates observed in the later period (September to October 2021) than in the earlier period (November to December 2020). This trend suggests that governmental initiatives and public health campaigns have successfully improved both acceptance and advocacy of the vaccine (Gagneux-Brunon et al, 2021; Malik et al, 2021; Papagiannis et al, 2021; Wang et al, 2021). Notably, there was a significant increase in the willingness to advocate the COVID-19 vaccine during the later period, reflecting a growing confidence in the vaccination process and its benefits. This increase in advocacy highlights the effectiveness of ongoing communication strategies and educational efforts aimed at fostering a positive perception of vaccines among the population.

The results of this systematic review offer several key insights into enhancing COVID-19 vaccination efforts among HCWs in Saudi Arabia. First, healthcare providers must recognize the common side effects of vaccines and engage in transparent communication and educational initiatives to mitigate concerns. Addressing these issues can effectively build trust and alleviate fear among HCWs.

Second, to tackle vaccine hesitancy among non-HCWs, targeted strategies should be implemented that specifically address their apprehensions about side effects and strengthen trust in governmental public health initiatives. Providing clear evidence-based information and fostering an environment of trust are essential for improving acceptance rates. Third, the review highlights that HCWs with higher educational levels and years of experience are more inclined to accept the vaccine. This underscores the need to focus vaccination campaigns on these demographics, leveraging their potential to encourage broader acceptance within the community. Finally, the observed increase in vaccine acceptance over time indicated that continuous and persistent efforts to promote vaccination and address concerns are effective. Sustained public health campaigns coupled with ongoing education and engagement can significantly enhance vaccine uptake and advocacy among healthcare professionals and the general public.

This systematic review had several limitations that should be considered. First, the review was limited to studies conducted in Saudi Arabia, which may limit the generalizability of the findings to other countries or to HCW populations. Second, the included studies were likely limited by their cross-sectional design, which precludes any causal inferences. The reliance on self-reported data regarding vaccine side effects and attitudes is another limitation, as this may be subject to recall or social desirability bias. Additionally, while quality assessment was conducted, formal weighting of the studies based on quality scores was not performed in the synthesis, which should be considered when interpreting the findings. Finally, the heterogeneity in the study populations, methods, and outcome measures across the included studies made it difficult to synthesize the findings in a quantitative meta-analysis. A key limitation is that all the included studies used cross-sectional designs, which cannot establish causal relationships between variables. While we identified associations between factors such as education level and vaccine acceptance or gender and side effects, we cannot determine causation. This limitation affects our ability to make strong recommendations about interventions and necessitates cautious interpretation of temporal relationships in vaccine acceptance patterns. Despite these limitations, this systematic review provides valuable insights into the current state of knowledge regarding COVID-19 vaccination side effects, acceptance, and attitudes among HCWs in Saudi Arabia, which can inform targeted interventions and policies to improve vaccine uptake in this critical population.

Conclusion

This systematic review sheds light on crucial aspects of COVID-19 vaccination among HCWs in Saudi Arabia, including side effects, acceptance, and attitudes. The findings underscore the necessity of addressing concerns about vaccine-related side effects through comprehensive education and transparent communication. Building trust in governmental health initiatives is essential for improving vaccine acceptance and addressing hesitancy. Additionally, the review suggests that targeted strategies aimed at HCWs with higher educational levels and extensive professional experience can be particularly effective in boosting vaccination

rates. By focusing on these groups and implementing tailored educational and advocacy efforts, public health authorities can enhance overall vaccine uptake, ultimately contributing to a more robust and well-protected healthcare workforce.

Key Points

- Healthcare workers in Saudi Arabia reported predominantly mild to moderate COVID-19 vaccine side effects, with severity influenced by gender, pre-existing conditions, and professional role.
- Overall vaccine acceptance rate reached 72.6%, with higher rates among older, female, married, and more experienced healthcare workers.
- Vaccine acceptance increased significantly over time, demonstrating effectiveness of public health campaigns and growing confidence in vaccine safety.
- Vaccine hesitancy was primarily driven by safety concerns and efficacy doubts, suggesting need for targeted educational interventions.
- Higher education levels and professional experience positively influenced vaccine acceptance, indicating the potential value of peer-led education programs.

Availability of Data and Materials

All data analyzed during this study are included in this published article and its supplementary information files. The complete search strategy, data extraction forms, and quality assessment tools are available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization: MHZ, SYZ, SMS. Methodology: EAA, HAM, GFH, HAH, AMS, SMA, MAH. Investigation: HAH, AMS, SMA. Data Curation: AHA, IYM, RAH, MAH. Writing – Original Draft: AHA, HAH, IYM. Writing – Review & Editing: RAH, HAM, GFH, MHZ, EAA, SMS. Supervision: SMA, MHZ. Project Administration: MHZ, EAA, SMS. Validation: All authors. All authors have made substantial contributions to study design, data analysis, or interpretation, participated in drafting or critically revising the manuscript, approved the final version for publication and agreed to be accountable for the work's integrity.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgement

The authors would like to thank the Ministry of Health, Saudi Arabia, for using the online facilities to complete this research. We acknowledge that our literature

search was extended beyond the initial submission date to 25 November 2024, following editorial guidance to ensure comprehensive coverage of the most current available evidence. This extended search was conducted during the revision process to enhance the robustness of our systematic review.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://www.magonlinelibrary.com/doi/suppl/10.12968/hmed.2024.0837.

References

Aedh AI. Parents'Attitudes, Their Acceptance of the COVID-19 Vaccines for Children and the Contributing Factors in Najran, Saudi Arabia: A Cross-Sectional Survey. Vaccines. 2022; 10: 1264. https://doi.org/10.3390/vaccines10081264

Ahsan W, Syed NK, Alsraeya AA, Alhazmi HA, Najmi A, Bratty MA, et al. Post-vaccination survey for monitoring the side effects associated with COVID-19 vaccines among healthcare professionals of Jazan province, Saudi Arabia. Saudi Medical Journal. 2021; 42: 1341–1352. https://doi.org/10.15537/smj.2021.42.12.20210576

Al-Qahtani AM, Mannasaheb BA, Shaikh MAK, Alajlan SA, Alayed MSZ, Shaikh IA, et al. Parental Willingness for COVID-19 Vaccination among Children Aged 5 to 11 Years in Riyadh City, Saudi Arabia: A Cross-Sectional Study. Vaccines. 2022; 10: 1979. https://doi.org/10.3390/vaccines10121979

Alamri T, Anwer F, Butt NS, Alganmi AH, Alotaibi SA, Alzibali KF, et al. Analyzing COVID-19 Vaccination Side Effects Among the Adult Population in Jeddah, Saudi Arabia. Cureus. 2023; 15: e47136. https://doi.org/10.7759/cureus.47136

Alfosail EK, Alghamdi M. Perception and Acceptance of COVID-19 Vaccine Among Healthcare Workers in Jeddah, Saudi Arabia. Cureus. 2023; 15: e35673. https://doi.org/10.7759/cureus.35673

Alghamdi AA, Alkazemi A, Alissa A, Alghamdi I, Alwarafi G, Waggas HA. Adverse Events following AstraZeneca COVID-19 Vaccine in Saudi Arabia: A Cross-Sectional Study among Healthcare and Non-healthcare Workers. Intervirology. 2022; 65: 104–109. https://doi.org/10.1159/000519456

Alhofaian A, Tunsi A, Alaamri MM, Babkair LA, Almalki GA, Alsadi SM, et al. Perception of Heath Care Providers About COVID-19 and Its Vaccination in Saudi Arabia: Cross-Sectional Study. Journal of Multidisciplinary Healthcare. 2021; 14: 2557–2563. https://doi.org/10.2147/JMDH.S327376

Ali MD, Almadan LZ, Alghamdi RA, Alghamdi AS, Almarhoon SA, Hassan YAM, et al. Evaluation of Prevalence of Side-Effects Associated with Booster Dose of mRNA-Based COVID-19 Vaccine Among Healthcare Workers in Eastern Province, Saudi Arabia: A Descriptive Cross-Sectional Study. Infection and Drug Resistance. 2022; 15: 4335–4346. https://doi.org/10.2147/IDR.S374265

AlJamaan F, Temsah MH, Alhasan K, Alenezi S, Alhaboob A, Alrabiaah A, et al. SARS-CoV-2 variants and the global pandemic challenged by vaccine uptake during the emergence of the Delta variant: A national survey seeking vaccine hesitancy causes. Journal of Infection and Public Health. 2022; 15: 773–780. https://doi.org/10.1016/j.jiph.2022.06.007

Alkeridy WA, Alquaydheb H, Almuhaidib S, Sindi NA, Aljasser A, Kushner Kow J, et al. Determinants of Vaccine Hesitancy among Home Health Care Service Recipients in Saudi Arabia. Vaccines. 2023; 11: 1436. https://doi.org/10.3390/vaccines11091436

Almojaibel AA, Ansari K, Alzahrani YA, Alessy SA, Farooqi FA, Alqurashi YD. Hesitancy towards the COVID-19 vaccine among health care practitioners in the Kingdom of Saudi Arabia: a cross-sectional study. F1000Research. 2023; 11: 24. https://doi.org/10.12688/f1000research.74575.6

Almuqbil M, Al-Asmi R, AlRamly S, Hijazi N, Alotaibi H, AlMubarak A, et al. Parental COVID-19 Vaccine Hesitancy for Children and Its Influencing Factors: A Riyadh-Based Cross-Sectional Study. Vaccines. 2023; 11: 518. https://doi.org/10.3390/vaccines11030518

Almusalami EM, Al-Bazroun MI, Alhasawi AI, Alahmed FS, Al-Muslim ZM, Al-Bazroun LI, et al. Acceptance, Advocacy, and Perception of Health Care Providers on COVID-19 Vaccine: Comparing Early Stage of COVID-19 Vaccination with Latter Stage in the Eastern Region of Saudi Arabia. Vaccines. 2023; 11: 488. https://doi.org/10.3390/vaccines11020488

Alobaidi S, Hashim A. Predictors of the Third (Booster) Dose of COVID-19 Vaccine Intention among the Healthcare Workers in Saudi Arabia: An Online Cross-Sectional Survey. Vaccines. 2022; 10: 987. https://doi.org/10.3390/vaccines10070987

Alshammari T, Alqahtani S, Al Jumaan M, Alameri R, Al Ghaseb A, Beovich B, et al. Saudi Healthcare Students' Perceptions and Beliefs About Immunizations: a Descriptive, Cross-Sectional Study. Medical Archives. 2022; 76: 458–463. https://doi.org/10.5455/medarh.2022.76.458-463

Althaqafi A, Munshi A, Mujalled MK, Munshi E, Alhouthali A, Alqalayta L, et al. COVID-19 Vaccine Knowledge and Attitude Among Healthcare Workers in Jeddah, Saudi Arabia. Cureus. 2023; 15: e41070. https://doi.org/10.7759/cureus.41070

Anand KB, Karade S, Sen S, Gupta RM. SARS-CoV-2: Camazotz's Curse. Medical Journal, Armed Forces India. 2020; 76: 136–141. https://doi.org/10.1016/j.mjafi.2020.04.008

Arda B, Durusoy R, Yamazhan T, Sipahi OR, Taşbakan M, Pullukçu H, et al. Did the pandemic have an impact on influenza vaccination attitude? A survey among health care workers. BMC Infectious Diseases. 2011; 11: 87. https://doi.org/10.1186/1471-2334-11-87

Arif SI, Aldukhail AM, Albaqami MD, Silvano RC, Titi MA, Arif BI, et al. Predictors of healthcare workers' intention to vaccinate against COVID-19: A cross sectional study from Saudi Arabia. Saudi Journal of Biological Sciences. 2022; 29: 2314–2322. https://doi.org/10.1016/j.sjbs.2021.11.058

Baghdadi LR, Alghaihb SG, Abuhaimed AA, Alkelabi DM, Alqahtani RS. Healthcare Workers' Perspectives on the Upcoming COVID-19 Vaccine in Terms of Their Exposure to the Influenza Vaccine in Riyadh, Saudi Arabia: A Cross-Sectional Study. Vaccines. 2021; 9: 465. https://doi.org/10.3390/vaccines9050465

Barry M, Temsah MH, Alhuzaimi A, Alamro N, Al-Eyadhy A, Aljamaan F, et al. COVID-19 vaccine confidence and hesitancy among health care workers: A cross-sectional survey from a MERS-CoV experienced nation. PLoS ONE. 2021; 16: e0244415. https://doi.org/10.1371/journal.pone.0244415

Brielle ES, Schneidman-Duhovny D, Linial M. The SARS-CoV-2 Exerts a Distinctive Strategy for Interacting with the ACE2 Human Receptor. Viruses. 2020; 12: 497. https://doi.org/10.3390/v12050497

Darraj MA, Al-Mekhlafi HM. Prospective Evaluation of Side-Effects Following the First Dose of Oxford/AstraZeneca COVID-19 Vaccine among Healthcare Workers in Saudi Arabia. Vaccines. 2022; 10: 223. https://doi.org/10.3390/vaccines10020223

Dubé E, Laberge C, Guay M, Bramadat P, Roy R, Bettinger J. Vaccine hesitancy: an overview. Human Vaccines & Immunotherapeutics. 2013; 9: 1763–1773. https://doi.org/10.4161/hv.24657

Engelbrecht M, Heunis C, Kigozi G. COVID-19 Vaccine Hesitancy in South Africa: Lessons for Future Pandemics. International Journal of Environmental Research and Public Health. 2022; 19: 6694. https://doi.org/10.3390/ijerph19116694

Felemban O, Al-Zahrani A, Alsharari A. Prevalence, Attitudes, and Factors Influencing Uptake of the COVID-19 Vaccine in Saudi Arabia. Healthcare. 2023; 11: 999. https://doi.org/10.3390/healthcare11070999

Gagneux-Brunon A, Detoc M, Bruel S, Tardy B, Rozaire O, Frappe P, et al. Intention to get vaccinations against COVID-19 in French healthcare workers during the first pandemic wave: a cross-sectional survey. The Journal of Hospital Infection. 2021; 108: 168–173. https://doi.org/10.1016/j.jhin.2020.11.020

Hershan AA. Awareness of COVID-19, Protective Measures and Attitude Towards Vaccination among University of Jeddah Health Field Community: A Questionnaire-Based Study. Journal of Pure and Applied Microbiology. 2021; 15: 604–612. https://doi.org/10.22207/JPAM.15.2.02

Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; 395: 497–506. https://doi.org/10.1016/S0140-6736(20)30183-5

Kabamba Nzaji M, Kabamba Ngombe L, Ngoie Mwamba G, Banza Ndala DB, Mbidi Miema J, Luhata Lungoyo C, et al. Acceptability of Vaccination Against COVID-19 Among Healthcare Workers in the Democratic Republic of the Congo. Pragmatic and Observational Research. 2020; 11: 103–109. https://doi.org/10.2147/POR.S271096

Khatrawi EM, Sayed AA. The Reasons behind COVID-19 Vaccination Hesitancy among the Parents of Children Aged between 5 to 11 Years Old in Saudi Arabia. International Journal of Environmental Research and Public Health. 2023; 20: 1345. https://doi.org/10.3390/ijerph20021345

Lu Y, Li X, Geng D, Mei N, Wu PY, Huang CC, et al. Cerebral Micro-Structural Changes in COVID-19 Patients - An MRI-based 3-month Follow-up Study. eClinicalMedicine. 2020; 25: 100484. https://doi.org/10.1016/j.eclinm.2020.100484

Lynch HJ, Marcuse Ek. 10 - Vaccines and Immunization. In Mayer KH, Pizer HF (eds.) The Social Ecology of Infectious Diseases (pp. 275–299). Academic Press: San Diego. 2008. https://doi.org/10.1016/B978-012370466-5.50015-7

Majrashi NAA. The value of chest X-ray and CT severity scoring systems in the diagnosis of COVID-19: A review. Frontiers in Medicine. 2023; 9: 1076184. https://doi.org/10.3389/fmed.2022.1076184

Malik A, Malik J, Ishaq U. Acceptance of COVID-19 vaccine in Pakistan among health care workers. PLoS ONE. 2021; 16: e0257237. https://doi.org/10.1371/journal.pone.0257237

Maqsood MB, Islam MA, Al Qarni A, Nisa ZU, Ishaqui AA, Alharbi NK, et al. Assessment of COVID-19 Vaccine Acceptance and Reluctance Among Staff Working in Public Healthcare Settings of Saudi Arabia: A Multicenter Study. Frontiers in Public Health. 2022; 10: 847282. https://doi.org/10.3389/fpubh.2022.847282

Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Medicine. 2009; 6: e1000097. https://doi.org/10.1371/journal.pmed.1000097

Noushad M, Nassani MZ, Alsalhani AB, Koppolu P, Niazi FH, Samran A, et al. COVID-19 Vaccine Intention among Healthcare Workers in Saudi Arabia: A Cross-Sectional Survey. Vaccines. 2021; 9: 835. https://doi.org/10.3390/vaccines9080835

Papagiannis D, Rachiotis G, Malli F, Papathanasiou IV, Kotsiou O, Fradelos EC, et al. Acceptability of COVID-19 Vaccination among Greek Health Professionals. Vaccines. 2021; 9: 200. https://doi.org/10.3390/vaccines9030200

Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ. Vaccine hesitancy and healthcare providers. Vaccine. 2016; 34: 6700–6706. https://doi.org/10.1016/j.vaccine.2016.10.042

Pogue K, Jensen JL, Stancil CK, Ferguson DG, Hughes SJ, Mello EJ, et al. Influences on Attitudes Regarding Potential COVID-19 Vaccination in the United States. Vaccines. 2020; 8: 582. https://doi.org/10.3390/vaccines8040582

Qattan AMN, Alshareef N, Alsharqi O, Al Rahahleh N, Chirwa GC, Al-Hanawi MK. Acceptability of a COVID-19 Vaccine Among Healthcare Workers in the Kingdom of Saudi Arabia. Frontiers in Medicine. 2021; 8: 644300. https://doi.org/10.3389/fmed.2021.644300

Rhodes A, Hoq M, Measey MA, Danchin M. Intention to vaccinate against COVID-19 in Australia. The Lancet. Infectious Diseases. 2021; 21: e110. https://doi.org/10.1016/S1473-3099(20)30724-6

Riad A, Alsaad SS, Almurikhi AA, Alzahrani FA, Alghamdi AM, Alzaid EH, et al. Side Effects of COVID-19 Vaccines Primer Doses: Experience of Saudi Healthcare Workers Participating in CoVaST-SA. Vaccines. 2022; 10: 2137. https://doi.org/10.3390/vaccines10122137

Temsah MH, Aljamaan F, Alenezi S, Alhasan K, Alrabiaah A, Assiri R, et al. SARS-CoV-2 Omicron Variant: Exploring Healthcare Workers' Awareness and Perception of Vaccine Effectiveness: A National Survey During the First Week of WHO Variant Alert. Frontiers in Public Health. 2022; 10: 878159.

https://doi.org/10.3389/fpubh.2022.878159

Temsah MH, Barry M, Aljamaan F, Alhuzaimi A, Al-Eyadhy A, Saddik B, et al. Adenovirus and RNA-based COVID-19 vaccines' perceptions and acceptance among healthcare workers in Saudi Arabia: a national survey. BMJ Open. 2021; 11: e048586. https://doi.org/10.1136/bmjopen-2020-048586

Vellappally S, Naik S, Alsadon O, Al-Kheraif AA, Alayadi H, Alsiwat AJ, et al. Perception of COVID-19 Booster Dose Vaccine among Healthcare Workers in India and Saudi Arabia. International Journal of Environmental Research and Public Health. 2022; 19: 8942. https://doi.org/10.3390/ijerph19158942

Verger P, Fressard L, Collange F, Gautier A, Jestin C, Launay O, et al. Vaccine Hesitancy Among General Practitioners and Its Determinants During Controversies: A National Cross-sectional Survey in France. eBioMedicine. 2015; 2: 891–897. https://doi.org/10.1016/j.ebiom.2015.06.018

Wang MW, Wen W, Wang N, Zhou MY, Wang CY, Ni J, et al. COVID-19 Vaccination Acceptance Among Healthcare Workers and Non-healthcare Workers in China: A Survey. Frontiers in Public Health. 2021; 9: 709056. https://doi.org/10.3389/fpubh.2021.709056

Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, et al. A new coronavirus associated with human respiratory disease in China. Nature. 2020; 579: 265–269. https://doi.org/10.1038/s41586-020-2008-3