Vaccine: X 15 (2023) 100405

Contents lists available at ScienceDirect

Vaccine: X

journal homepage: www.elsevier.com/locate/jvacx

# Unraveling the association between vaccine attitude, vaccine conspiracies and self-reported side effects following COVID-19 vaccination among nurses and physicians in Jordan

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A R T I C L E I N F O

*Keywords:*
Vaccine mandate
Compulsory vaccination
Vaccine policy
Vaccine promotion
Attitude

A B S T R A C T

*Background:* The negative impact of vaccine conspiracies is linked with negative health behavior. The aim of the current study was to examine the association between attitudes toward booster COVID-19, influenza, and monkeypox (mpox) vaccinations with post-COVID-19 vaccine side effects, vaccine conspiracies, and attitude towards mandatory vaccination among nurses and physicians in Jordan.
*Methods:* A structured closed-ended questionnaire was used to collect data on demographics, COVID-19 history, COVID-19 vaccine type and doses received, self-reported side effects post-COVID-19 vaccination, acceptance of booster COVID-19, seasonal influenza, and mpox vaccinations, attitudes towards mandatory vaccination, and beliefs in vaccine conspiracies.
*Results:* The study sample comprised a total of 341 participants. Acceptance of yearly booster COVID-19 vaccination was expressed by 46.6% of the sample, while 73.3% accepted seasonal influenza vaccination, and only 37.0% accepted mpox vaccination. A higher frequency of self-reported side effects following the first COVID-19 vaccine dose was associated with embrace of vaccine conspiracies and vaccine type. For the second vaccine dose, a higher frequency of self-reported side effects was associated with the embrace of vaccine conspiracies, older age, and affiliation to private sector. In multinomial logistic regression analyses, the lower embrace of vaccine conspiracies was associated with lower odds of reporting side effects post-COVID-19 vaccination. The lower embrace of vaccine conspiracies and favorable attitude towards mandatory vaccination were associated with the willingness to get COVID-19, influenza, and mpox vaccinations.
*Conclusion:* The study findings highlighted the negative impact of embracing vaccine conspiracies on health-seeking behavior among nurses and physicians. The findings indicated that the willingness to get vaccinated was associated with lower endorsement of vaccine conspiracies. Additionally, the lower embrace of vaccine conspiracies was associated with a lower frequency of self-reported side effects following COVID-19 vaccination. These results emphasize the importance of addressing vaccine misinformation and promoting accurate information to ensure optimal vaccine uptake and public health outcomes.

## Introduction

The coronavirus disease (2019) COVID-19 pandemic has highlighted the critical role of vaccination as a central public health protective measure [1,2]. The positive effect of COVID-19 vaccination was manifested in reducing the transmission, severity, and mortality of the

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https://doi.org/10.1016/j.jvacx.2023.100405
Received 8 August 2023; Received in revised form 25 October 2023; Accepted 1 November 2023
Available online 8 November 2023
2590-1362/

disease [3–7]. However, exploiting the full potential of COVID-19 vaccination campaigns was jeopardized by the dissemination of vaccine-related misinformation with the prominent emergence of COVID-19-specific conspiracies coupled with reluctance to receive the vaccine [8–11]. Specifically, several claims that lacked credible scientific evidence were circulating widely during different phases of the pandemic resulting in an accompanying infodemic [9,12–14].

Investigating the negative impact of COVID-19 misinformation on attitudes and behaviors towards COVID-19 vaccination is essential for developing effective public health control strategies [11,15]. This aim appears increasingly important as COVID-19 transitions into an endemic state, potentially requiring booster vaccinations [16,17]. Careful consideration of the value of booster COVID-19 vaccination is necessary in light of the evident short-term immunity following natural infection by severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) and its vaccination, combined with the emergence of virus variants having immune escape properties [18–22].

The safety and effectiveness of the currently approved COVID-19 vaccines have been shown through extensive clinical trials and rigorous scientific studies coupled with meticulous regulatory scrutiny [6,23–28]. However, COVID-19 vaccine hesitancy remains notable with concerns regarding side effects of vaccination, despite the extensive scientific evidence showing the high safety and efficacy profiles of the authorized COVID-19 vaccines [29–33]. Extensive literature showed that the reported side effects following COVID-19 vaccination were mostly mild-to-moderate, localized and innocuous which included localized pain at the injection site, fever, fatigue, headache, nausea, myalgia, arthralgia, dyspnea, and diarrhea [34–38]. Nevertheless. the frequency of self-reported side effects following COVID-19 vaccination was widely variable across different studies [39–42]. Additionally, the occurrence of serious adverse events related to COVID-19 vaccination remains rare [35,36,43].

Vaccine resistance and hesitancy defined as the rejection or reluctance to receive a vaccine despite the availability of vaccination services were reported widely during the COVID-19 pandemic [29,30,44,45]. The hesitancy or rejection of vaccination can be linked to multiple factors. First, the lack of confidence in vaccine safety and efficacy besides lack of trust in health institutions was reported widely as a major factor driving vaccination hesitancy [9,29,30,46–48]. Additionally, high levels of complacency towards the risks of infectious diseases can be linked to vaccine hesitancy, which was prominent during the recent monkeypox (mpox) outbreak [46,49]. Other factors linked to vaccination hesitancy include the low levels of collective responsibility, calculation of the benefits vs. risks of vaccination, as well as the embrace of vaccine conspiracy beliefs [9,46–49]. The phenomenon of COVID-19 vaccine hesitancy/resistance was remarkable in the Arab countries of the Middle East, with several studies highlighting its association with widespread embrace of conspiracies about SARS-CoV-2 and its vaccines [9,30,47,50]. In Jordan for example, COVID-19 vaccination hesitancy was reported at rates exceeding 60% in various studies [9,29,30]. Additionally, only 45% of the Jordanian population were fully vaccinated against COVID-19 as of 13 March 2023 [51,52].

The harmful influence of embracing vaccine conspiracies can extend beyond less willingness to get vaccinated to possibly involve higher perceived side effects following COVID-19 vaccine uptake [53]. This can be manifested among individuals who received the vaccine due to enforced measures while personally being hesitant or resistant to receive the vaccine [54]. The implementation of vaccine mandates carries the potential for evoking psychological reactance, which involves the expressions of negative cognitive responses due to perceived loss of freedom [55]. Subsequently, vaccine mandates may reinforce the preexisting vaccine hesitancy/resistance undermining the intended goals of public health initiatives [56,57].

Enforcing COVID-19 vaccine mandates was perceived as a controversial strategy akin to a double-edged sword [58–61]. On the positive side, COVID-19 vaccine mandates can provide a clear message about the importance of vaccination, enhancing vaccine coverage [62]. Additionally, the implementation of COVID-19 vaccine mandates may have contributed to the establishment of safer environments within various settings, including schools, universities, healthcare facilities, among other workplaces [63]. Conversely, COVID-19 vaccine mandates can be viewed as an infringement of the personal autonomy and individual rights [64]. Thus, striking the right balance between individual freedoms and collective responsibility is crucial when implementing vaccine mandates, to ensure the safety of public health while respecting individual rights and reinforcing public trust in healthcare systems [65].

In Jordan, the Defence Order No. 35 of 2021 mandated that employees in the public and private sectors must be fully vaccinated with two doses of a COVID-19 vaccine to return to work [66]. Failure to comply resulted in deducted annual leave, followed by unpaid leave without salary or allowances. Additionally, individuals aged 18 years and above were prohibited from visiting government ministries, public departments, or private sector institutions without complete vaccination. Non-compliance carried legal penalties as specified by the order [67]. Three vaccine types were approved and widely used in Jordan, namely Pfizer-BioNTech COVID-19 vaccine, Sinopharm BBIBP COVID-19 vaccine, and Oxford–AstraZeneca COVID-19 vaccine [52].

Nurses and physicians represent crucial stakeholders in the fight against COVID-19 among other infectious diseases, such as seasonal influenza and the recent mpox outbreak [48,49,68,69]. It is important to emphasize that the vaccination experience can markedly vary markedly across different vaccines [44]. For example, the profound impact of the recent COVID-19 pandemic especially among nurses and physicians has the potential to exert a fundamentally distinct influence on vaccination intentions when compared to, mpox (particularly in regions like Jordan where only a single case has been reported so far) [70]. Moreover, the context surrounding influenza vaccination differs significantly, notably due to its non-mandatory status among health professionals in contrast to COVID-19 vaccination [71,72]. Therefore, it is essential to acknowledge that these vaccination experiences are not directly equivalent across all dimensions for COVID-19, influenza, and mpox vaccination. However, it is noteworthy to emphasize that general attitudes and behaviors towards vaccination may be subject to common influencing factors, including the issues of confidence, complacency, and constraints [44]. It is also important to emphasize that the role of nurses and physicians is indispensable in supporting the initiatives aimed at promoting vaccination [54,73]. Consequently, vaccination hesitancy can pose a greater challenge among healthcare professionals, given their ethical responsibility to recommend vaccination within diverse communities [74].

A previous study by Khouri *et al.*, showed the association between embracing conspiracies with heightened perception of side effects following vaccination [53]. Additionally, a recent pilot study among university students and academics in Saudi Arabia showed that the lower embrace of COVID-19 vaccine conspiracies and lower reporting of side-effects following COVID-19 vaccination [75]. Therefore, the current study aimed to investigate the possible link between embracing vaccine conspiracies and self-reported side effects post-COVID-19 vaccination among nurses and physicians in Jordan. Additionally, the current study aimed to assess the attitudes of this key group of health professionals towards yearly booster COVID-19, yearly seasonal influenza, and mpox vaccinations and its possible association with embracing vaccine conspiracies and attitude to mandatory vaccination.

## Material and methods

### *Study design*

This study employed a cross-sectional survey design and conducted between September 2022 and May 2023. The questionnaire used in the study was developed based on a comprehensive review of the existing literature [34–38,76,77]. The survey instrument was produced in

Arabic, the native language in Jordan, and it was pilot tested among four physicians and nurses with minor modifications to improve the clarity, with these responses excluded from final analysis. The questionnaire was distributed both in-person using a barcode to be scanned on mobile phones and electronically among the contacts of the authors to facilitate a broad participation among the target population.

Given the study objectives, a deliberate decision was made to focus on nurses and physicians in Jordan. This specific demographic group was chosen due to their higher likelihood of COVID-19 vaccine uptake, driven by priority and vaccine mandates besides the potential better recall of side effects among this group [78]. The inclusion criteria included: 1) age 22 years or older; (2) currently working as a nurse or physician in Jordan; and (3) good reading and understanding of Arabic language. The exclusion criteria included: (1) not currently working in Jordan; and (2) lack of good reading and understanding of Arabic language.

*Ethical considerations*

The current study followed the principles outlined in the Declaration of Helsinki and obtained approval from the Scientific Research Committee at the School of Medicine, the University of Jordan (reference No. 4550/2022/67). Informed consent was obtained from all participants through a mandatory agreement question in the survey, wherein they were asked, "Do you agree to participate in the current study?".

*Sample size calculation*

To determine the minimum sample size for this study *a priori*, we relied on the latest estimates of the number of health professionals in Jordan [79]. Using an estimated proportion of 0.50 and aiming for a precision of estimate at 5% with a 90% confidence level, we calculated that a minimum sample size of 271 was required. To calculate the sample size using the estimated proportion (p) of 0.50, desired precision (d) of 5%, and confidence level (Z) of 90%, we used the following formula for estimating the sample size for a proportion: Sample size=$(Z^2 \times p \times (1 - p))/d^2 = 271$.

*Data collection*

The self-administered questionnaire was created in Google Forms, and it was distributed both in person (using a bar code) and online using WhatsApp instant messaging service aiming for the professional nurses and physicians groups in Jordan. This approach was justified by the attempt to reach a diverse and geographically dispersed sample with convenience aiming to facilitate the ease of participation, and to enable a more diverse pool of respondents [80]. The self-administered nature of the questionnaire reduced the potential for interviewer bias, ensuring that participants provided responses in a private and unbiased manner [81]. Following a brief introduction that introduced the aims of the study which also clearly included the assurance of full confidentiality and privacy of the participants, the informed consent item was introduced.

*Participant demographics*

The following demographic variables were assessed in the questionnaire: (1) age as a scale variable; (2) sex (male vs. female), (3) nationality (Jordanian vs. non-Jordanian), (4) educational level (undergraduate (diploma or bachelor's degrees) vs. postgraduate (master's, doctorate, higher specialization, or fellowship qualifications)), (5) occupation (nurse vs. physician), (6) seniority level (junior positions comprised nursing assistants, interns, and resident physicians vs. senior level which included registered nurses, specialists, and consultant physicians), (7) employment sector (public vs. private), (8) history of COVID-19 (none vs. once vs. twice vs. three times or more), and (9) COVID-19 vaccine uptake (number of doses and types of vaccine type received for each dose).

*Self-reported side effects post-COVID-19 vaccine uptake*

The Self-Reported Vaccination Side Effects Score (SERVASE) was conceived to measure self-reported side effects following COVID-19 vaccination for each administered dose based on extensive literature review.[34–42] The scoring system was structured as follows: A score of zero was assigned if no side effect was reported within seven days of vaccination or if it was deemed not applicable. Mild side effects, lasting for one day or less, were scored as 1, while more persistent side effects lasting beyond one day received a score of 2. The SERVASE encompassed 13 specific side effects, including pain at the injection site, fatigue, fever, headache, myalgia, arthralgia, gastrointestinal symptoms (vomiting, diarrhea), dizziness, allergy, respiratory symptoms, diagnosed cardiovascular system complications, work absenteeism, and menstrual irregularities in females. Each participant's final SERVASE score was derived by summing the scores for the aforementioned 13 side effects. The assessment of SERVASE was conducted separately for each vaccine dose: SERVASE-1 following the first dose (n = 341), SERVASE-2 following the second dose (n = 336), and SERVASE-3 following the third dose (n = 117).

*Embrace of vaccine conspiracies*

The assessment of vaccine conspiracy beliefs was carried out using a miniaturized version of the Vaccine Conspiracy Beliefs Scale (VCBS) conceived by Shapiro *et al.* [82]. This miniaturized scale (mini-VCBS) consisted of three items: (1) pharmaceutical companies cover up the dangers of vaccines, (2) people are deceived about vaccine efficacy, and (3) the international organizations try to cover up the link between vaccines and serious side effects. Participants responded to these items using a 5-point Likert scale, with scores ranging from 1 (disagree) to 5 (agree). The sum of these scores represented the mini-VCBS score with higher scores indicating higher endorsement of vaccine conspiracy beliefs.[9,82] The internal consistency of the mini-VCBS was confirmed by a Cronbach alpha value of 0.819. The decision to shorten the VCBS was based on the attempt to reduce the possible effect of respondent fatigue based on the exhaustive nature of the items assessing vaccine side effects [83].

*Acceptance of booster COVID-19, seasonal influenza, and mpox vaccinations*

The acceptance of booster COVID-19, seasonal influenza, and mpox vaccinations was evaluated through a 5-point Likert scale, consisting of three items: (1) I am willing to get a yearly booster dose of COVID-19 vaccination; (2) I am willing to get a yearly seasonal influenza vaccination; and (3) I am willing to get mpox vaccination upon its availability. The participants' responses were classified into three groups: vaccine acceptance group (those who responded with "agree" or "somewhat agree"), vaccine hesitancy group (respondents with a "neutral/no opinion" response), and vaccine resistance group (those who answered "disagree" or "somewhat disagree").

*Attitude to mandatory vaccination*

The assessment of the attitude towards mandatory vaccination was conducted using a 5-point Likert scale comprising three items: (1) In Jordan, COVID-19 and influenza vaccination should be compulsory; (2) In Jordan, a financial penalty should be imposed on persons who reject vaccination such as COVID-19 and influenza vaccines; and (3) In Jordan, an occupational penalty (such as denying promotions) should be imposed on persons who reject vaccination such as COVID-19 and influenza vaccines. These items formed the Score for Mandatory

Vaccination (SMV). The responses were scored ranging from 1 (agree) to 5 (disagree). The SMV was obtained by summing the scores of the three items, and with an acceptable internal consistency ensured with a Cronbach alpha value of 0.784. The total SMV scores were subsequently categorized into three groups: <9 (indicating a favorable attitude towards compulsory vaccination), 9 (representing a neutral attitude), and >9 (reflecting an unfavorable attitude towards compulsory vaccination).

*Data analysis*

The statistical analysis was conducted using IBM SPSS Statistics for Windows, Version 26.0. The association between categorical variables was done using the chi-squared ($\chi^2$) test, while the Mann-Whitney *U* test (M−W) or Kruskal-Wallis test (K-W) were applied to compare dichotomous or trichotomous variables with scale variables, respectively. The normality of the scale variables was assessed through the Kolmogorov-Smirnov test (K-S).

Following the completion of the univariate analysis, variables exhibiting a *p* value below 0.200 were incorporated into multinomial logistic regression analyses. Nagelkerke $R^2$ values were used to check the models' goodness of fit. A statistical significance level of $p$-value $< 0.050$ was established, indicating that results yielding *p*-values below this threshold were regarded as statistically significant.

In this study, the primary study measures consisted of participants' attitudes towards COVID-19, seasonal influenza, and mpox vaccinations, as well as their self-reported side effects using the SERVASE scores. The willingness to receive booster doses was assessed using a 5-point Likert scale, categorized as "vaccine acceptance" group for those who agreed or somewhat agreed to receive the vaccine, "vaccine hesitant" group for those who answered neutral/no opinion, or "vaccine resistance" group for those who disagreed or somewhat disagreed to receive the vaccine. The SERVASE scores were dichotomized based on dose-specific medians (SERVASE 1 $\leq$ 4 vs. SERVASE 1 $>$ 4; SERVASE 2 or 3 $\leq$ 3 vs. SERVASE 2 or 3 $>$ 3). Secondary study measures included the embrace of vaccine conspiracies assessed by the mini-VCBS, trichotomized into "disagreement" category for mini-VCBS $<$ 9, "neutral attitude" category for mini-VCBS $=$ 9, and "agreement" category for mini-VCBS $>$ 9. Attitude to mandatory vaccination was evaluated through a 5-point Likert scale, with the SMV trichotomized into "agreement" category for SMV $<$ 9, "neutral attitude" category for SMV $=$ 9, and "disagreement" category for SMV $>$ 9.

## Results

*Study sample*

The final study sample comprised a total of 341 respondents. Table 1 summarizes the characteristics of the study participants, stratified by occupational category (nurses vs. physicians). The results showed significant differences between the two groups in terms of sex, age, nationality, educational level, seniority, and sector of employment. Male participants constituted a higher proportion of physicians compared to nurses (46.8% vs. 22.9%, $p < 0.001$). Additionally, a larger percentage of physicians were aged 32 years or younger (66.1% vs. 52.4%, $p = 0.010$) and held postgraduate qualifications (47.4% vs. 18.8%, $p < 0.001$) compared to nurses. Seniority levels were also markedly different, with 11.8% of the participant nurses categorized as junior participants compared to 52.6% of physicians ($p < 0.001$). Additionally, more nurses worked in the public sector compared to physicians (90.6% vs. 83.0%, $p = 0.040$). Remarkably, there was a notable discrepancy in the uptake of the third COVID-19 vaccine doses, with a higher prevalence observed among physicians in comparison to nurses (48.5% vs. 20.0%, $p < 0.001$). Regarding the COVID-19 history and vaccination status, no significant differences were observed between nurses and physicians.

**Table 1**
Characteristics of the study participants stratified per occupational category.

| Variable | Category | Occupation | | *p*-value, $\chi^2$ |
|---|---|---|---|---|
| | | Nurse N (%) | Physician N (%) | |
| **Sex** | Male | 39 (22.9) | 80 (46.8) | <0.001, 21.331 |
| | Female | 131 (77.1) | 91 (53.2) | |
| **Age** | ≤32 years | 89 (52.4) | 113 (66.1) | 0.010, 6.654 |
| | >32 years | 81 (47.6) | 58 (33.9) | |
| **Nationality** | Jordanian | 170 (100.0) | 161 (94.2) | 0.001, 10.242 |
| | Non-Jordanian | 0 | 10 (5.8) | |
| **Educational level** | Undergraduate | 138 (81.2) | 90 (52.6) | <0.001, 31.350 |
| | Postgraduate | 32 (18.8) | 81 (47.4) | |
| **Seniority** | Junior | 20 (11.8) | 90 (52.6) | <0.001, 65.153 |
| | Senior | 150 (88.2) | 81 (47.4) | |
| **Sector** | Public | 154 (90.6) | 142 (83.0) | 0.040, 4.239 |
| | Private | 16 (9.4) | 29 (17.0) | |
| **History of COVID-19** | None | 38 (22.4) | 58 (33.9) | 0.106, 6.108 |
| | Once | 87 (51.2) | 70 (40.9) | |
| | Twice | 39 (22.9) | 38 (22.2) | |
| | Three times or more | 6 (3.5) | 5 (2.9) | |
| **COVID-19 vaccine doses received** | 1 | 4 (2.4) | 1 (0.6) | <0.001, 31.565 |
| | 2 | 132 (77.6) | 87 (50.9) | |
| | 3 | 34 (20.0) | 83 (48.5) | |

**Notes:** Educational level was classified as follows, undergraduate included participants with a diploma or bachelor's degree, while postgraduate included those with master's, doctorate, higher specialization, or fellowship qualifications. Seniority level was classified as follows, junior positions comprised nursing assistants, interns, and resident physicians, while senior roles included registered nurses, specialists, and consultant physicians.
**Abbreviations:** N, Number.

A majority of participants reported receiving the Pfizer-BioNTech COVID-19 vaccine, followed by the Sinopharm BBIBP COVID-19 vaccine for all three doses. However, no statistically significant differences were found between nurses and physicians (Fig. 1).

*Self-reported side effects post-COVID-19 vaccination*

The self-reported side effects reported by participants following each dose of the COVID-19 vaccine is presented in (Fig. 2). The most commonly reported side effects were pain at the injection site, fatigue, headache, myalgia, and arthralgia. The prevalence of side effects tended to decrease with subsequent doses, with a mean SERVASE score for the first dose being 4.4 ± 4.6, and a mean SERVASE score for the second dose being 4.0 ± 3.7, and a mean score for the third dose being 4.1 ±

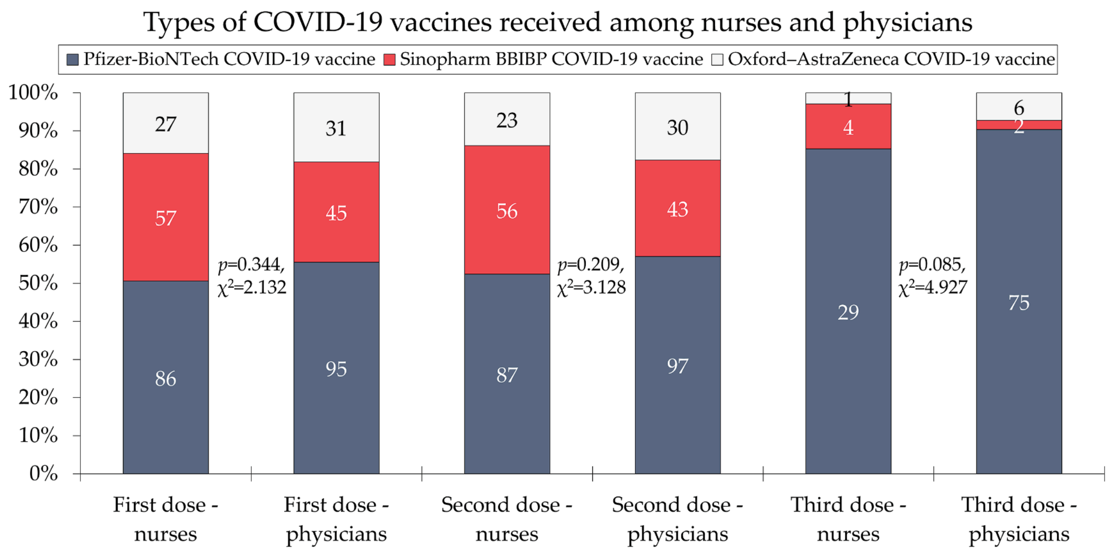


**Fig. 1. Distribution of COVID-19 vaccine types among the study participants stratified based on dose and occupation.** COVID-19: Coronavirus disease 2019.


**Fig. 2. Self-reported side effects following each dose of COVID-19 vaccination as reported by the study participants.** GI: Gastrointestinal; CVS: Cardiovascular system.

3.4.

A summary of the SERVASE scores for each COVID-19 vaccine dose, stratified by different study variables is presented in (Table 2). The results indicated that there are differences in SERVASE scores for certain variables across different COVID-19 vaccine doses, which were taken into consideration in multinomial logistic regression analyses. The factors linked to higher SERVASE scores for the first dose included vaccine type and a history of COVID-19. For the second dose, age as well as the vaccine type were associated with higher SERVASE scores. For the third dose, sex was the only variable to show a statistically significant difference in SERVASE score.

*Attitude to COVID-19, seasonal influenza, mpox, mandatory vaccination, and the embrace of vaccine conspiracies*

As illustrated in (Fig. 3), the overall willingness to receive vaccination was the highest for seasonal influenza vaccine (n = 250, 73.3%), followed by booster COVID-19 vaccine (n = 159, 46.6%), and mpox vaccine (n = 126, 37.0%). The whole study sample showed an inclination to disagree with mandatory vaccination reflected in a mean SMV score of 10.3 ± 3.8 (median: 11.0, IQR: 8.0–13.0). Additionally, the whole study sample showed a slight inclination to endorse vaccine conspiracies reflected in a mean mini-VCBS score of 9.8 ± 3.6 (median: 10.0, IQR: 7.0–13.0).

**Table 2**
Summary of the self-reported COVID-19 vaccination side effects (SERVASE) scores per dose comparing different study variables.

| Variable | SERVASE dose 1 median (IQR) | *p*-value | SERVASE dose 2 median (IQR) | *p*-value | SERVASE dose 3 median (IQR) | *p*-value |
|---|---|---|---|---|---|---|
| *Sex* | | | | | | |
| Male | 3.0 (1.0–6.0) | 0.239 | 2.0 (1.0–5.0) | 0.202 | 1.0 (0–3.0) | 0.029 |
| Female | 3.5 (1.0–7.0) | | 3.0 (1.0–5.3) | | 2.0 (1.0–7.0) | |
| *Age* | | | | | | |
| ≤32 years | 3.0 (1.0–6.0) | 0.118 | 2.0 (1.0–5.0) | 0.002 | 1.5 (0–5.0) | 0.430 |
| >32 years | 4.0 (1.0–8.0) | | 3.0 (1.0–6.3) | | 2.0 (1.0–6.0) | |
| *Nationality* | | | | | | |
| Jordanian | 3.0 (1.0–7.0) | 0.673 | 2.0 (1.0–5.0) | 0.601 | 2.0 (0–5.0) | 0.870 |
| Non-Jordanian | 2.5 (1.8–5.8) | | 1.0 (1.0–5.5) | | 1.5 (0.8–5.3) | |
| *Education* | | | | | | |
| Undergraduate | 3.0 (1.0–7.0) | 0.907 | 2.0 (1.0–5.0) | 0.084 | 1.5 (0–5.3) | 0.522 |
| Postgraduate | 3.0 (1.0–6.5) | | 3.0 (1.0–6.0) | | 2.0 (1.0–5.0) | |
| *Occupation* | | | | | | |
| Nurse | 3.0 (1.0–8.0) | 0.545 | 2.5 (1.0–5.3) | 0.206 | 2.0 (0–6.0) | 0.850 |
| Physician | 3.0 (1.0–6.0) | | 2.0 (1.0–5.0) | | 2.0 (1.0–5.0) | |
| *Seniority* | | | | | | |
| Junior | 3.0 (1.0–6.0) | 0.326 | 2.0 (0–4.0) | 0.001 | 1.0 (0–4.5) | 0.293 |
| Senior | 3.0 (1.0–7.0) | | 3.0 (1.0–6.0) | | 2.0 (0.3–5.8) | |
| *Sector* | | | | | | |
| Public | 3.0 (1.0–6.0) | 0.091 | 2.0 (1.0–5.0) | 0.003 | 2.0 (0–5.0) | 0.993 |
| Private | 5.0 (2.0–7.5) | | 5.0 (2.0–8.0) | | 2.0 (0–6.8) | |
| *History of COVID-19* | | | | | | |
| No | 2.0 (1.0–5.0) | 0.003 | 2.0 (1.0–5.0) | 0.146 | 2.0 (1.0–4.0) | 0.705 |
| Yes | 4.0 (2.0–8.0) | | 3.0 (1.0–6.0) | | 2.0 (0–6.0) | |
| *Vaccine type* | | | | | | |
| Pfizer-BioNTech | 4.0 (2.0–7.0) | <0.001 | 3.0 (1.0–6.0) | <0.001 | 2.0 (0–6.0) | 0.281 |
| Sinopharm BBIBP | 1.0 (0–4.0) | | 2.0 (0–4.0) | | 1.0 (0–2.5) | |
| Oxford–AstraZeneca | 5.0 (2.0–12.0) | | 2.0 (0.5–4.5) | | 1.0 (0–2.0) | |
| *Mini-VCBS* | | | | | | |
| <9 | 3.0 (1.0–5.0) | 0.074 | 2.0 (1.0–5.0) | 0.157 | 2.0 (0.8–5.0) | 0.736 |
| 9 | 2.0 (1.0–6.0) | | 2.0 (1.0–4.0) | | 2.0 (0.5–4.5) | |
| >9 | 4.0 (1.0–8.0) | | 3.0 (1.0–6.3) | | 2.0 (0–8.3) | |
| *SMV* | | | | | | |
| <9 | 3.0 (2.0–6.0) | 0.613 | 2.0 (1.0–5.0) | 0.540 | 2.0 (0.3–7.5) | 0.545 |
| 9 | 3.0 (1.0–5.0) | | 2.0 (0–5.0) | | 1.0 (0–3.5) | |
| >9 | 3.0 (1.0–7.0) | | 2.5 (1.0–5.0) | | 2.0 (0–5.0) | |

**Notes:** Educational level was classified as follows, undergraduate included participants with a diploma or bachelor's degree, while postgraduate included those with master's, doctorate, higher specialization, or fellowship qualifications. Seniority level was classified as follows, junior positions comprised nursing assistants, interns, and resident physicians, while senior roles included registered nurses, specialists, and consultant physicians. Mini-VCBS: miniaturized version of the Vaccine Conspiracy Beliefs Scale with higher scores indicating higher embrace of vaccine conspiracies. SMV: the Score for Mandatory Vaccination with higher scores indicating disagreement towards mandatory vaccination.
**Abbreviations:** COVID-19, Coronavirus disease 2019, Mini-VCBS, Miniaturized version of the Vaccine Conspiracy Beliefs Scale, IQR, Interquartile range, *p*-values, calculated using the Mann–Whitney *U* test or the Kruskal Wallis test, SMV, the Score for Mandatory Vaccination.

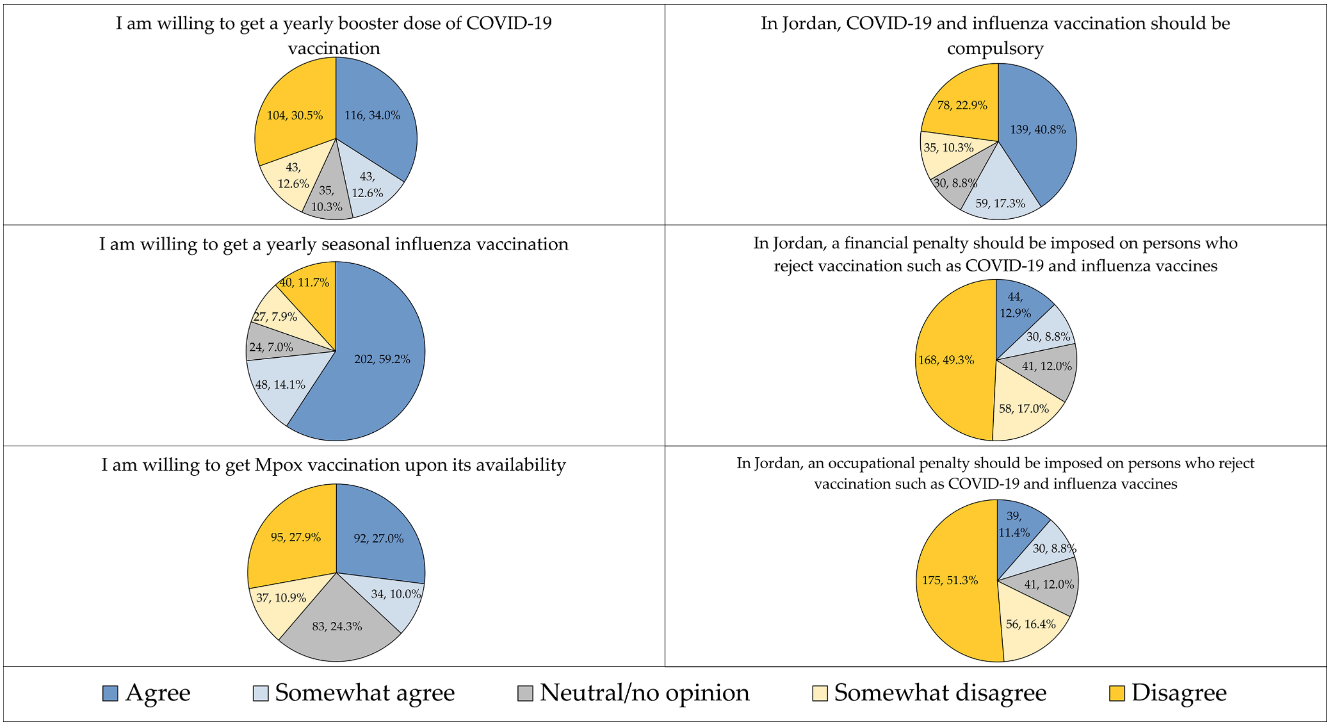


**Fig. 3. Attitude to yearly booster COVID-19, seasonal influenza, mpox vaccination, and to mandatory vaccination.** COVID-19: Coronavirus disease 2019: Mpox: Monkeypox.

The attitude to yearly booster COVID-19 vaccination was associated with the following variables: sex, occupation, vaccine conspiracies, and attitude to mandatory vaccination (Table 3), while the later two factors were the only variables linked to attitude towards seasonal influenza vaccination. For attitude towards mpox vaccination, age, occupation, vaccine conspiracies, and attitude to mandatory vaccination were the significantly associated factors (Table 3).

*The lower embrace of vaccine conspiracies was associated with lower odds of reporting side effects post-COVID-19 vaccination*

The results of multinomial logistic regression analyses investigating the factors influencing the prevalence of self-reported side effects following COVID-19 vaccination are presented in (Table 4). For the first COVID-19 vaccine dose, participants who received Sinopharm BBIBP COVID-19 vaccine had significantly higher odds of reporting fewer side effects (aOR = 3.95, 95% CI: 1.91–8.17, $p < 0.001$, Table 4) compared to those who received Oxford–AstraZeneca COVID-19 vaccine. Additionally, individuals who disagreed with vaccine conspiracies were less likely to experience side effects following the first dose (aOR = 1.96, 95% CI: 1.16–3.33, $p = 0.012$, Table 4) than those who agreed with vaccine conspiracies. Nagelkerke $R^2$ values indicated the models' goodness of fit, explaining 15.3% of the variance.

For the second COVID-19 vaccine dose, participants affiliated to the public sector had lower odds of experiencing side effects (aOR = 2.32, 95% CI: 1.17–4.61, $p = 0.015$, Table 4) compared to those in the private sector. Additionally, lack of a history of COVID-19 was associated with lower odds of experiencing side effects (aOR = 1.73, 95% CI: 1.01–2.96, $p = 0.045$, Table 4) compared to those with a previous history of COVID-19. Additionally, participants with a neutral position on vaccine conspiracies were less likely to report post-COVID-19 vaccination side effects (aOR = 2.21, 95% CI: 1.11–4.37, $p = 0.024$, Table 4) compared to those who agreed with vaccine conspiracies.

*The lower embrace of vaccine conspiracies, younger age, and favorable attitude towards mandatory vaccination were associated with willingness to get COVID-19, influenza, and mpox vaccination*

Stratified per vaccine acceptance group (acceptance vs. hesitancy vs. resistance), the results of multinomial logistic regression analyses investigating the factors influencing the participants' attitude towards booster COVID-19, influenza, and mpox vaccination are presented in (Table 5). For the booster COVID-19 vaccination, the following variables were significantly associated with acceptance as opposed to resistance: male sex, age ≤32 years, disagreement or neutral attitude to vaccine conspiracies, and agreement or neutral attitude towards mandatory vaccination (Table 5). The following variables were significantly associated with acceptance of seasonal influenza vaccine acceptance as opposed to resistance: age ≤32 years, disagreement to vaccine conspiracies, and agreement towards mandatory vaccination (Table 5). For mpox vaccination, the following variables were significantly associated with acceptance as opposed to resistance: age ≤32 years, disagreement to vaccine conspiracies, and agreement or neutral attitude towards mandatory vaccination (Table 5).

Compared to vaccine resistance, individuals with a neutral attitude towards vaccine conspiracies were more likely to exhibit vaccine hesitancy rather than resistance towards COVID-19 vaccination. Similarly, having a neutral attitude towards mandatory vaccination was associated with higher odds of hesitancy towards seasonal influenza vaccination rather than resistance, compared to having a disagreement towards mandatory vaccination. In the case of mpox vaccination, vaccine hesitancy was associated with younger age and either agreement or a neutral attitude towards mandatory vaccination, rather than vaccine resistance (Table 5).

## Discussion

The study findings emphasized the adverse impact of endorsing vaccine conspiracies, which was associated with less willingness to get booster COVID-19, seasonal influenza, and mpox vaccines. Additionally,

**Table 3**
Variables associated with the willingness to receive booster COVID-19, seasonal influenza, and mpox vaccination in univariate analysis.

| Variable | Category | I am willing to get a yearly booster dose of COVID-19 vaccination | | | | I am willing to get a yearly seasonal influenza vaccination | | | | I am willing to get mpox vaccination upon its availability | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Accept | Hesitate | Resist | $p$, $\chi^2$ | Accept | Hesitate | Resist | $p$, $\chi^2$ | Accept | Hesitate | Resist | $p$, $\chi^2$ |
| **Sex** | Male | 68 (57.1) | 15 (12.6) | 36 (30.3) | 0.002, 12.319 | 95 (79.8) | 4 (3.4) | 20 (16.8) | 0.070, 5.321 | 49 (41.2) | 32 (26.9) | 38 (31.9) | 0.170, 3.541 |
| | Female | 91 (41.0) | 20 (9.0) | 111 (50.0) | | 155 (69.8) | 20 (9.0) | 47 (21.2) | | 77 (34.7) | 51 (23.0) | 94 (42.3) | |
| **Age** | ≤32 years | 105 (52.0) | 19 (9.4) | 78 (38.6) | 0.057, 5.723 | 156 (77.2) | 15 (7.4) | 31 (15.3) | 0.055, 5.808 | 92 (45.5) | 50 (24.8) | 60 (29.7) | <0.001, 20.326 |
| | >32 years | 54 (38.8) | 16 (11.5) | 69 (49.6) | | 94 (67.6) | 9 (6.5) | 36 (25.9) | | 34 (24.5) | 33 (23.7) | 72 (51.8) | |
| **Nationality** | Jordanian | 154 (46.5) | 33 (10.0) | 144 (43.5) | 0.500, 1.387 | 245 (74.0) | 23 (6.9) | 63 (19.0) | 0.216, 3.064 | 121 (36.6) | 80 (24.2) | 130 (39.3) | 0.463, 1.542 |
| | Non-Jordanian | 5 (50.0) | 2 (20.0) | 3 (30.0) | | 5 (50.0) | 1 (10.0) | 4 (40.0) | | 5 (50.0) | 3 (30.0) | 2 (20.0) | |
| **Educational level** | Undergraduate | 99 (43.4) | 21 (9.2) | 108 (47.4) | 0.076, 5.157 | 172 (75.4) | 16 (7.0) | 40 (17.5) | 0.373, 1.975 | 83 (36.4) | 53 (23.2) | 92 (40.4) | 0.646, 0.873 |
| | Postgraduate | 60 (53.1) | 14 (12.4) | 39 (34.5) | | 78 (69.0) | 8 (7.1) | 27 (23.9) | | 43 (38.1) | 30 (26.5) | 40 (35.4) | |
| **Occupation** | Nurse | 61 (35.9) | 13 (7.6) | 96 (56.5) | <0.001, 24.697 | 120 (70.6) | 13 (7.6) | 37 (21.8) | 0.523, 1.295 | 47 (27.6) | 37 (21.8) | 86 (50.6) | <0.001, 21.221 |
| | Physician | 98 (57.3) | 22 (12.9) | 51 (29.8) | | 130 (76.0) | 11 (6.4) | 30 (17.5) | | 79 (46.2) | 46 (26.9) | 46 (26.9) | |
| **Seniority** | Junior | 57 (51.8) | 14 (12.7) | 39 (35.5) | 0.128, 4.105 | 84 (76.4) | 8 (7.3) | 18 (16.4) | 0.574, 1.110 | 50 (45.5) | 25 (22.7) | 35 (31.8) | 0.069, 5.344 |
| | Senior | 102 (44.2) | 21 (9.1) | 108 (46.8) | | 166 (71.9) | 16 (6.9) | 49 (21.2) | | 76 (32.9) | 58 (25.1) | 97 (42.0) | |
| **Sector** | Public | 135 (45.6) | 28 (9.5) | 133 (44.9) | 0.162, 3.645 | 216 (73.0) | 21 (7.1) | 59 (19.9) | 0.933, 0.138 | 108 (36.5) | 69 (23.3) | 119 (40.2) | 0.301, 2.399 |
| | Private | 24 (53.3) | 7 (15.6) | 14 (31.1) | | 34 (75.6) | 3 (6.7) | 8 (17.8) | | 18 (40.0) | 14 (31.1) | 13 (28.9) | |
| **History of COVID-19** | No | 51 (53.1) | 12 (12.5) | 33 (34.4) | 0.121, 4.225 | 74 (77.1) | 2 (2.1) | 20 (20.8) | 0.081, 5.015 | 44 (45.8) | 21 (21.9) | 31 (32.3) | 0.100, 4.609 |
| | Yes | 108 (44.1) | 23 (9.4) | 114 (46.5) | | 176 (71.8) | 22 (9.0) | 47 (19.2) | | 82 (33.5) | 62 (25.3) | 101 (41.2) | |
| **Mini-VCBS** | <9 | 78 (69.0) | 8 (7.1) | 27 (23.9) | <0.001, 55.087 | 93 (82.3) | 4 (3.5) | 16 (14.2) | 0.020, 11.649 | 57 (50.4) | 27 (23.9) | 29 (25.7) | <0.001, 23.203 |
| | 9 | 29 (50.9) | 12 (21.1) | 16 (28.1) | | 42 (73.7) | 7 (12.3) | 8 (14.0) | | 25 (43.9) | 14 (24.6) | 18 (31.6) | |
| | >9 | 52 (30.4) | 15 (8.8) | 104 (60.8) | | 115 (67.3) | 13 (7.6) | 43 (25.1) | | 44 (25.7) | 42 (24.6) | 85 (49.7) | |
| **SMV** | <9 | 70 (70.7) | 9 (9.1) | 20 (20.2) | <0.001, 47.911 | 85 (85.9) | 3 (3.0) | 11 (11.1) | <0.001, 20.429 | 59 (59.6) | 25 (25.3) | 15 (15.2) | <0.001, 55.057 |
| | 9 | 18 (58.1) | 6 (19.4) | 7 (22.6) | | 22 (71.0) | 6 (19.4) | 3 (9.7) | | 14 (45.2) | 12 (38.7) | 5 (16.1) | |
| | >9 | 71 (33.6) | 20 (9.5) | 120 (56.9) | | 143 (67.8) | 15 (7.1) | 53 (25.1) | | 53 (25.1) | 46 (21.8) | 112 (53.1) | |

**Notes:** Educational level was classified as follows, undergraduate included participants with a diploma or bachelor's degree, while postgraduate included those with master's, doctorate, higher specialization, or fellowship qualifications. Seniority level was classified as follows, junior positions comprised nursing assistants, interns, and resident physicians, while senior roles included registered nurses, specialists, and consultant physicians. Mini-VCBS: miniaturized version of the Vaccine Conspiracy Beliefs Scale with higher scores indicating higher embrace of vaccine conspiracies. SMV: the Score for Mandatory Vaccination with higher scores indicating disagreement towards mandatory vaccination.
**Abbreviations:** COVID-19, Coronavirus disease 2019, Mini-VCBS, Miniaturized version of the Vaccine Conspiracy Beliefs Scale, IQR, Interquartile range, *p* values, calculated using chi-squared test, SMV, the Score for Mandatory Vaccination.

the study findings unraveled an association between the higher endorsement of vaccine conspiracies with heightened perception of side effects following COVID-19 vaccination. The awareness of COVID-19 vaccines' side effects on individuals' reporting of side effects is an important point to be considered. This comes in light of the well-documented side effects associated with COVID-19 vaccination, such as thrombosis with thrombocytopaenia syndrome events associated with the Oxford–AstraZeneca and Janssen COVID-19 vaccines [84,85,86].

**Table 4**
Factors associated with higher prevalence of self-reported side effects following COVID-19 vaccination in multinomial logistic regression analyses.

| Model | aOR (95% CI) [6] | *p*-value |
|---|---|---|
| **SERVASE 1 ≤ 4 vs. SERVASE 1 > 4** | | |
| **Nagelkerke $R^2$ = 0.153** | | |
| Age ≤ 32 years | 1.47 (0.92–2.36) | 0.110 |
| Age > 32 years | Ref. | |
| Public sector | 1.80 (0.92–3.52) | 0.088 |
| Private sector | Ref. | |
| No history of COVID-19 | 1.64 (0.95–2.82) | 0.074 |
| History of COVID-19 | Ref. | |
| Mini-VCBS < 9 | 1.96 (1.16–3.33) | **0.012** |
| Mini-VCBS = 9 | 1.92 (0.99–3.72) | 0.055 |
| Mini-VCBS > 9 | Ref. | |
| Pfizer-BioNTech COVID-19 vaccine | 1.21 (0.65–2.25) | 0.543 |
| Sinopharm BBIBP COVID-19 vaccine | 3.95 (1.91–8.17) | **<0.001** |
| Oxford–AstraZeneca COVID-19 vaccine | Ref. | |
| **SERVASE 2 ≤ 3 vs. SERVASE 2 > 3** | | |
| **Nagelkerke $R^2$ = 0.118** | | |
| Age ≤ 32 years | 1.68 (0.99–2.86) | 0.054 |
| Age > 32 years | Ref. | |
| Undergraduate education | 0.93 (0.51–1.70) | 0.822 |
| Postgraduate education | Ref. | |
| Junior | 1.22 (0.67–2.20) | 0.521 |
| Senior | Ref. | |
| Public sector | 2.32 (1.17–4.61) | **0.015** |
| Private sector | Ref. | |
| No history of COVID-19 | 1.73 (1.01–2.96) | **0.045** |
| History of COVID-19 | Ref. | |
| Mini-VCBS < 9 | 1.57 (0.92–2.67) | 0.097 |
| Mini-VCBS = 9 | 2.21 (1.11–4.37) | **0.024** |
| Mini-VCBS > 9 | Ref. | |
| Pfizer-BioNTech COVID-19 vaccine | 0.59 (0.30–1.14) | 0.114 |
| Sinopharm BBIBP COVID-19 vaccine | 1.06 (0.51–2.21) | 0.877 |
| Oxford–AstraZeneca COVID-19 vaccine | Ref. | |

**Notes:** Educational level was classified as follows, undergraduate included participants with a diploma or bachelor's degree, while postgraduate included those with master's, doctorate, higher specialization, or fellowship qualifications. Seniority level was classified as follows, junior positions comprised nursing assistants, interns, and resident physicians, while senior roles included registered nurses, specialists, and consultant physicians. Mini-VCBS: miniaturized version of the Vaccine Conspiracy Beliefs Scale with higher scores indicating higher embrace of vaccine conspiracies and a score of 9 indicated a neutral attitude. SMV: the Score for Mandatory Vaccination with higher scores indicating disagreement towards mandatory vaccination and a score of 9 indicated a neutral attitude.
**Abbreviations:** COVID-19, Coronavirus disease 2019, SMV, the Score for Mandatory Vaccination, SERVASE, Self-Reported Vaccination Side Effects Score, SERVASE-1: Self-Reported Vaccination Side Effects Score following the first dose (n = 341), SERVASE-2, Self-Reported Vaccination Side Effects Score following the second dose (n = 336), Mini-VCBS, miniaturized version of the Vaccine Conspiracy Beliefs Scale, aOR, Adjusted odds ratio, CI, confidence interval.

Thus, awareness of these side effects may have influenced participants' perceptions and reporting of side effects in our study [87].

The current study revealed a remarkable 98.5% COVID-19 vaccine uptake for the primary series among participating nurses and physicians, likely influenced by COVID-19 vaccine mandates and priority vaccination of health professionals in Jordan, reflecting a global trend [66,67,78,88]. As anticipated based on the extensive review of literature, the reported side effects in this study were predominantly localized and mild, with pain at the injection site, fatigue, headache, myalgia, and arthralgia being the most frequently reported [34–43]. Additionally, the overall scores for side effects following the first three doses were low indicating the limited nature of these side effects. Taken together, these findings underlined the overall favorable safety profiles of the currently approved COVID-19 vaccines, which is consistent with extensive literature on this study subject [6,23–28,89–92].

Besides the attitude to vaccine conspiracy beliefs, the factors associated with higher frequency of self-reported side effects post-COVID-19 vaccination fathomably included the vaccine type. For the first vaccine dose, the participants who received the Oxford–AstraZeneca COVID-19 vaccine reported the side effects at a higher rate compared to those who received the Sinopharm BBIBP COVID-19 vaccine. Therefore, the vaccine type appeared to have a major role in the frequency and magnitude of side effects [40,93–96]. Consistent with prior studies, higher reporting of side effects following the first dose of COVID-19 vaccination was observed in this study, especially for the Sinopharm BBIBP COVID-19 vaccine [34,40,93,97].

For the second vaccine dose, working in the private sector was linked to higher frequency of self-reported side effects, possibly due to lower uptake of the Sinopharm BBIBP COVID-19 vaccine among this group. Similarly, the previous history of COVID-19 was associated with marginally higher odds of side-effects possibly due to prior COVID-19 exposure with the pre-existing immunity leading to a more vigorous reaction to the vaccine components [98]. Subsequently, this can lead to a higher frequency of side effects, which was reported widely in literature [99–101]. Nevertheless, it is imperative to interpret both observations cautiously due to the limitations imposed by the small sample size and the possibility of confounding effects, highlighting the necessity for further evidence to assess the validity of such a finding.

Notably, the current study revealed three major findings. Firstly, the participants displaying lower embrace of vaccine conspiracies exhibited reduced likelihood of reporting side effects after receiving the initial COVID-19 vaccine dose. For the second vaccine dose, participants with a neutral conspiratorial attitude were less likely to report side effects compared to those endorsing vaccine conspiracies. This finding aligns with the results of a previous large study conducted among the general public in France by Khouri *et al.* and a recent study in Saudi Arabia [53,75].

Possible explanations of this noteworthy association could be complex and multifaceted. For example, the endorsement of vaccine conspiracy beliefs may lead the individuals to interpret normal sensations or mild side effects as an evidence of vaccine harm due to confirmation bias leading to an attempt to find supportive evidence that aligns with preconceived beliefs of possible vaccine harm [102,103]. Another possible explanation could be the triggered fear and anxiety among individuals who hold vaccine conspiracy beliefs, subsequently leading to an exaggerated perception of side effects post-vaccination [104,105]. Thus, embracing vaccine conspiracies may amplify the pre-existing negative expectations and fears about vaccine side effects, potentially inducing the so-called "nocebo effect" with associated symptoms unrelated to vaccination [106–109]. Additionally, higher level of alertness among individuals endorsing conspiracy beliefs may also lead to increased reporting of minor symptoms as side effects due to cognitive bias [110]. Moreover, the recall bias may cause these individuals to attribute any discomfort post-vaccination to side effects, exaggerating their reported negative experiences [111]. Furthermore, it is conceivable that reporting side effects serves as a way to justify pre-existing beliefs that vaccines are harmful, particularly among those mandated to receive the vaccine, potentially exaggerating the vaccine side effects reporting rates [106,111–113]. In spite of that, it is important to emphasize that a comprehensive understanding of the observed correlation between the lower endorsement of vaccine conspiracies with lower reporting of post-vaccination side effects necessitates further rigorous investigations. Such investigations should be conducted with impartiality, in order to delineate the underlying factors that may influence the reporting of vaccine-related side effects.

Secondly, the current study revealed the pervasiveness of vaccination hesitancy among healthcare professionals in Jordan, a group presumed to be well-informed with moral responsibility towards the general public [74]. In this study, although vaccine hesitancy/resistance was less evident for seasonal influenza vaccination, the phenomenon was more notable for booster COVID-19 and mpox vaccines. Specifically, seasonal influenza vaccination was accepted by 73% of the study

**Table 5**
Factors associated with acceptance of yearly booster COVID-19, seasonal influenza, and mpox vaccination in multinomial logistic regression analyses.

| Model | aOR (95% CI) | *p*-value | Model | aOR (95% CI) | *p*-value |
|---|---|---|---|---|---|
| **Yearly booster COVID-19 vaccine acceptance vs. resistance** | | | **Yearly booster COVID-19 vaccine hesitancy vs. resistance** | | |
| **Nagelkerke $R^2 = 0.344$** | | | | | |
| Male | 2.18 (1.22–3.92) | **0.009** | Male | 1.75 (0.75–4.06) | 0.196 |
| Female | Ref. | | Female | Ref. | |
| Age ≤ 32 years | 1.99 (1.06–3.75) | **0.033** | Age ≤ 32 years | 0.86 (0.32–2.29) | 0.757 |
| Age > 32 years | Ref. | | Age > 32 years | Ref. | |
| Undergraduate | 0.60 (0.24–1.45) | 0.254 | Undergraduate | 0.51 (0.13–2.06) | 0.344 |
| Postgraduate | Ref. | | Postgraduate | Ref. | |
| Nurse | 0.94 (0.41–2.13) | 0.880 | Nurse | 0.92 (0.29–2.90) | 0.882 |
| Physician | Ref. | | Physician | Ref. | |
| Public | 0.82 (0.36–1.86) | 0.639 | Public | 0.54 (0.18–1.61) | 0.272 |
| Private | Ref. | | Private | Ref. | |
| Junior | 1.11 (0.44–2.79) | 0.819 | Junior | 2.65 (0.69–10.11) | 0.155 |
| Senior | Ref. | | Senior | Ref. | |
| No history of COVID-19 | 1.13 (0.61–2.07) | 0.697 | No history of COVID-19 | 1.56 (0.65–3.74) | 0.315 |
| History of COVID-19 | Ref. | | History of COVID-19 | Ref. | |
| Mini-VCBS < 9 | 5.19 (2.78–9.66) | **<0.001** | Mini-VCBS < 9 | 1.61 (0.59–4.37) | 0.353 |
| Mini-VCBS = 9 | 2.46 (1.13–5.34) | **0.023** | Mini-VCBS = 9 | 3.70 (1.37–10.02) | **0.010** |
| Mini-VCBS > 9 | Ref. | | Mini-VCBS > 9 | Ref. | |
| SMV < 9 | 5.82 (2.78–9.66) | **<0.001** | SMV < 9 | 2.21 (0.84–5.81) | 0.106 |
| SMV = 9 | 3.05 (1.11–8.39) | **0.031** | SMV = 9 | 3.26 (0.91–11.63) | 0.069 |
| SMV > 9 | Ref. | | SMV > 9 | Ref. | |
| **Seasonal influenza vaccine acceptance vs. resistance** | | | **Seasonal influenza vaccine hesitancy vs. resistance** | | |
| **Nagelkerke $R^2 = 0.156$** | | | | | |
| Male | 1.40 (0.76–2.57) | 0.286 | Male | 0.46 (0.13–1.62) | 0.228 |
| Female | Ref. | | Female | Ref. | |
| Age ≤ 32 years | 1.91 (1.08–3.38) | **0.025** | Age ≤ 32 years | 1.89 (0.69–5.14) | 0.215 |
| Age > 32 years | Ref. | | Age > 32 years | Ref. | |
| No history of COVID-19 | 0.74 (0.39–1.39) | 0.342 | No history of COVID-19 | 0.23 (0.05–1.10) | 0.065 |
| History of COVID-19 | Ref. | | History of COVID-19 | Ref. | |
| Mini-VCBS < 9 | 2.02 (1.04–3.91) | **0.037** | Mini-VCBS < 9 | 0.80 (0.22–3.99) | 0.745 |
| Mini-VCBS = 9 | 1.59 (0.67–3.79) | 0.291 | Mini-VCBS = 9 | 2.48 (0.70–8.83) | 0.161 |
| Mini-VCBS > 9 | Ref. | | Mini-VCBS > 9 | Ref. | |
| SMV < 9 | 2.65 (1.29–5.44) | **0.008** | SMV < 9 | 0.96 (0.23–4.01) | 0.956 |
| SMV = 9 | 2.04 (0.57–7.29) | 0.274 | SMV = 9 | 5.76 (1.18–28.08) | **0.030** |
| SMV > 9 | Ref. | | SMV > 9 | Ref. | |
| **Mpox vaccine acceptance vs. resistance** | | | **Mpox vaccine hesitancy vs. resistance** | | |
| **Nagelkerke $R^2 = 0.293$** | | | | | |
| Male | 1.33 (0.71–2.47) | 0.375 | Male | 1.35 (0.71–2.54) | 0.361 |
| Female | Ref. | | Female | Ref. | |
| Age ≤ 32 years | 3.74 (1.92–7.28) | **<0.001** | Age ≤ 32 years | 2.17 (1.12–4.21) | **0.022** |
| Age > 32 years | Ref. | | Age > 32 years | Ref. | |
| Nurse | 0.56 (0.28–1.12) | 0.099 | Nurse | 0.50 (0.25–1.00) | 0.051 |
| Physician | Ref. | | Physician | Ref. | |
| Junior | 0.69 (0.32–1.49) | 0.340 | Junior | 0.56 (0.25–1.27) | 0.163 |
| Senior | Ref. | | Senior | Ref. | |
| No history of COVID-19 | 1.19 (0.63–2.24) | 0.589 | No history of COVID-19 | 0.82 (0.41–1.64) | 0.583 |
| History of COVID-19 | Ref. | | History of COVID-19 | Ref. | |
| Mini-VCBS < 9 | 3.22 (1.65–6.30) | **0.001** | Mini-VCBS < 9 | 1.58 (0.78–3.19) | 0.203 |
| Mini-VCBS = 9 | 1.74 (0.78–3.90) | 0.179 | Mini-VCBS = 9 | 0.95 (0.40–2.27) | 0.913 |
| Mini-VCBS > 9 | Ref. | | Mini-VCBS > 9 | Ref. | |
| SMV < 9 | 7.88 (3.90–15.92) | **<0.001** | SMV < 9 | 3.87 (1.83–8.18) | **<0.001** |
| SMV = 9 | 4.18 (1.34–13.04) | **0.014** | SMV = 9 | 4.91 (1.57–15.34) | **0.006** |
| SMV > 9 | Ref. | | SMV > 9 | Ref. | |

**Notes:** Educational level was classified as follows, undergraduate included participants with a diploma or bachelor's degree, while postgraduate included those with master's, doctorate, higher specialization, or fellowship qualifications. Seniority level was classified as follows, junior positions comprised nursing assistants, interns, and resident physicians, while senior roles included registered nurses, specialists, and consultant physicians. Mini-VCBS: miniaturized version of the Vaccine Conspiracy Beliefs Scale with higher scores indicating higher embrace of vaccine conspiracies and a score of 9 indicated a neutral attitude. SMV: the Score for Mandatory Vaccination with higher scores indicating disagreement towards mandatory vaccination and a score of 9 indicated a neutral attitude.
**Abbreviations:** COVID-19, Coronavirus disease 2019, SMV, the Score for Mandatory Vaccination, Mini-VCBS, miniaturized version of the Vaccine Conspiracy Beliefs Scale, aOR, Adjusted odds ratio, CI, confidence interval.

sample, followed by the yearly booster COVID-19 vaccination which was accepted at a rate of 47%, while mpox vaccination was accepted only by 37% of the participants. Possible explanation of the relatively high rate of influenza vaccine acceptance could be related to the concerns about its resurgence post-COVID-19 [114–116]. The study result was consistent with the latest estimates of influenza vaccine acceptance among health professionals in Jordan, which was reported at a rate of 63% over the influenza season of 2021/2022 [48].

In this study, the acceptance of a yearly booster COVID-19 vaccination dose was relatively low, which was also reflected in the observation of only 34% participants who have already received a booster dose. The high rate of booster COVID-19 vaccine hesitancy/rejection observed among the majority of participants could reflect the place-, and context-specific nature of vaccination hesitancy, with Jordan being among the countries with high rates of COVID-19 vaccine hesitancy worldwide [9,29,30,32]. Other possible factor for this unfavorable attitude towards booster COVID-19 vaccination could be related to high levels of complacency towards the disease risks among the participants who have already received the primary vaccination series or having experienced the natural infection themselves [117]. The high level of complacency was possibly more pronounced in the case of mpox. Lower concern regarding mpox could be attributed to the disease rarity in Jordan and the declining number of cases globally [118]. Our estimate of mpox vaccine acceptance of only 37% is slightly higher than the most recent estimate among health professional in Jordan, which was reported at 29% [49].

A noteworthy finding in this study was the correlation between lower embrace of vaccine conspiracies, younger age, and a favorable attitude towards mandatory vaccination with a greater willingness to receive COVID-19, influenza, and mpox vaccines. This finding could highlight the importance of addressing vaccine conspiracies as an intervention measure to promote a favorable attitude towards vaccination irrespective of the disease to which the vaccine is directed [119–122].

Third and lastly, the current study findings indicated that the disagreement with vaccine mandates could be associated with negative attitudes towards vaccination [49,123]. This was manifested in higher likelihood of vaccine resistance for the three vaccines among participants who displayed an unfavorable attitude to mandatory vaccination. Thus, the controversial nature of mandatory vaccination as a measure to scale up vaccine coverage should be approached carefully, and preferably reserving it as a last resort for vaccine promotion [112,124–127].

Finally, limitations of this study were inevitable and included the potential inaccuracies in participants' recall of post-vaccination side effects due to memory limitations, social desirability bias, and personal interpretations, which may introduce self-reporting and recall biases confounded by the lack clinical registry confirmation. Additionally, the relatively small sample size, albeit sufficient could have resulted in limited representation of nurses and physicians in Jordan; therefore, sampling bias attributed to the convenience sampling approach should be considered in the interpretation of the results. The timing of the study post-COVID-19 pandemic with subsequent survey fatigue, may have contributed to the small sample size despite the efforts made to recruit more participants [128]. Additionally, the length of the questionnaire could have resulted in respondent fatigue further limiting the sample size [83]. Moreover, the cross-sectional design of the current study precludes establishing causality between vaccine conspiracy beliefs, self-reported side effects, and attitudes towards mandatory vaccination. Furthermore, the measurement bias linked to abbreviating of the VCBS could potentially influence the results despite the acceptable internal consistencies of the survey scales. Finally, it is imperative to address a significant limitation within the scope of this study, particularly with regard to the measurement and potential cognitive biases. It is worth noting that pharmaceutical companies may not always have been entirely transparent in their data disclosures from clinical trials, and there exists a perspective that the real-world effectiveness of COVID-19 vaccines could potentially be lower than initially anticipated [129–131]. Therefore, it is crucial to acknowledge that the terminology utilized, particularly the reference to "vaccine conspiracy beliefs" carries the potential to introduce a subtle cognitive bias. This warrants thoughtful consideration to prevent excessively unfavorable interpretations of these beliefs.

## Conclusions

The conspicuous correlation between the lower embrace of vaccine conspiracies and positive attitude towards vaccination as unraveled in the current study highlights the significance of dispelling vaccine conspiracies and promoting accurate information to enhance vaccine acceptance. Additionally, the implementation of vaccine mandates should be accompanied by efforts to address vaccine hesitancy/resistance promoting a positive vaccine attitude to achieve successful vaccination campaigns.

The study findings could highlight the potential adverse impact of vaccine conspiracies on the health-seeking behavior of healthcare professionals in Jordan, which was manifested in higher frequency of perceived side effects following COVID-19 vaccination, besides a lower willingness to receive booster COVID-19, influenza, and mpox vaccinations. Follow-up studies are recommended to validate and build upon the current study findings and to mitigate the negative impact of vaccine conspiracies among health professionals.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## CRediT authorship contribution statement

**Malik Sallam:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Hiba Abbasi:** Data curation, Investigation, Methodology, Writing – review & editing. **Rawan J. Obeidat:** Data curation, Methodology, Writing – review & editing. **Reham Badayneh:** Data curation, Investigation, Methodology, Writing – review & editing. **Farah Alkhashman:** Data curation, Investigation, Methodology, Writing – review & editing. **Aseel Obeidat:** Data curation, Investigation, Methodology, Writing – review & editing. **Dana Oudeh:** Data curation, Investigation, Writing – review & editing. **Zena Uqba:** Data curation, Investigation, Methodology, Writing – review & editing. **Azmi Mahafzah:** Investigation, Methodology, Supervision, Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The data presented in this study are available on request from the corresponding author (M.S.).

## Acknowledgements

We would like to thank all the participating physicians and nurses who participated in this study.

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