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Assessment of the relationship between COVID-19 risk perception and vaccine acceptance: a cross-sectional study in Jordan

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ABSTRACT

Background: In the absence of definitive treatment, vaccination against COVID-19 emerged as an effective solution to the spread of the pandemic. This study aimed to investigate the factors impacting the rates of COVID-19 vaccine acceptance in Jordan, in addition to examining the relationship between COVID-19 risk perception and vaccine acceptance among the Jordanian population.

Methods: This cross-sectional study was conducted among a sample of adults (aged ≥18) residing in Jordan. Data were collected using an online questionnaire disseminated using social media platforms between December 2nd and December 29th, 2020.

Results: A total of 2,268 (72.3%) participants demonstrated willingness to receive the COVID-19 vaccine. The mean COVID-19 risk perception score among the participants was 4.65 out of 10 (median 5; IQR 3–6). Higher risk perception scores were significantly associated with being female ($p = .001$), young ($p < .001$), or a smoker ($p = .005$). A significant positive correlation was identified between COVID-19 vaccine acceptance and risk perception scores (OR = 1.319, 95%, CI = 1.261–1.380, $p < .001$). Moreover, male participants (75%, OR = 1.220, 95% CI = 1.007–1.479, $p = .043$), participants aged 18–24 years (78.1%, OR = 1.635, 95% CI = 1.189–2.246, $p = .002$), and participants with children aged under 18 years (73.9%, OR = 1.210, 95% CI = 1.010–1.450, $p = .039$) were more willing than their counterparts to get vaccinated.

Conclusion: COVID-19 risk perception and certain sociodemographic characteristics (i.e., being male, being young, and having children aged under 18 years) were found to be significantly associated with vaccine acceptance. Policymakers are recommended to develop public educational campaigns to enhance people's trust in and willingness to take the COVID-19 vaccine.

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COVID-19; vaccine acceptance; vaccine hesitancy; risk perception; Jordan

Introduction

The emergence and spread of the coronavirus disease 2019 (COVID-19) came with negative impacts and unprecedented challenges that affected the physical and mental well-being of people worldwide.[1] Although COVID-19 was announced a global pandemic over a year ago, survivors of the disease are still healing from its devastating effects, whilst others are battling active infective episodes of circulating variants of severe acute respiratory syndrome coronavirus 2 (SARS-COV2).[2,3]

In the absence of definitive treatment, vaccination against COVID-19 emerged as an effective solution to the spread of the pandemic.[4] In Jordan, rollout of COVID-19 vaccines began in December 2020 following the Jordan Food and Drug Administration's (JFDA) approval of both BNT162b2 (Comirnaty, Pfizer-BioNtech) and BBIBP-CorV (Sinopharm, Beijing CNBG) for emergency use.[5] By March 2021, three more vaccines had been approved by the JFDA for emergency use (AZD1222, Oxford-AstraZeneca; JNJ-78436735, Johnson & Johnson; and Gam-COVID-Vac, Sputnik V). Although the approval of multiple COVID-19 vaccines has provided hope for controlling the pandemic, other multi-dimensional factors may impact COVID-19 vaccine uptake among the Jordanian population.[4,5]

Risk perception is an estimate of person's future probability of contracting certain diseases in light of behavioral and temporal factors.[6] In terms related to COVID-19, a person with lower perceived risk of getting infected with COVID-19 is expected to be reluctant to undertake any precautionary measures leading, ultimately, to lower odds of vaccine uptake compared to counterparts.[6,7] With risk perception considered a major driver of behaviors, COVID-19 risk perception may be a core factor in the low level of vaccine acceptance (i.e., vaccine hesitancy) among the Jordanian population despite the availability of the vaccine.[6,7] Unfortunately, vaccine hesitancy can be pervasive, misguided, and contagious.[8,9] Moreover, vaccine hesitancy has been suggested to impede herd immunity against COVID-19, which has been defined as immunity that is achieved when around 70% of the population have been vaccinated against COVID-19 and developed protective antibodies against future infection.[10] It is worth noting that with the development of the Delta variant of Coronavirus, experts have suggested that 90% of the population should be vaccinated to achieve herd immunity.[11]

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Understanding the factors that influence people's acceptance toward taking the COVID-19 vaccine is critical, especially given the vaccine-related rumors and conspiracy theories that have been spreading on social media and other online platforms.[12] The spread of misinformation can negatively impact people's confidence in taking the vaccine, hence disrupting national and international efforts to control the spread of the disease.[13] Moreover, the active involvement of healthcare providers, including pharmacists, in leading public awareness campaigns and their involvement in administrating the COVID-19 vaccine have been proposed as potential strategies for promoting vaccine acceptance.[14] Therefore, the current study aimed to investigate the factors impacting the rates of COVID-19 vaccine acceptance in Jordan, in addition to examining the relationship between COVID-19 risk perception and vaccine acceptance among the Jordanian population.

Methods

Study design

The current study used a cross-sectional design among a sample of adults (aged ≥18) residing in Jordan. An online questionnaire via SurveyMonkey® was disseminated using social media platforms, including Facebook, Twitter, and WhatsApp, and the enrollment of participants lasted between December 2nd and December 29th, 2020. Data collection was initiated after the authorization of the BNT162b2 (Comirnaty, Pfizer-BioNtech) and BBIBP-CorV (Sinopharm, Beijing CNBG) COVID-19 vaccines for emergency use by the JFDA and prior to the beginning of the COVID-19 vaccination campaign in Jordan (i.e., January 13, 2021). Approval to conduct this study was obtained from the Institutional Review Board at King Abdullah University Hospital (IRB number: 3/137/2020).

Survey instrument

The study questionnaire was adapted (with permission) from previous work[15,16] and translated into Arabic following ISPOR's Principles of Good Practice for Translation and Cultural Adaptation.[17] The adapted questionnaire consisted of four parts. The first part aimed to collect the participants' basic sociodemographic information (i.e., age, gender, education, and employment status). The second part was a COVID-19 risk perception scale that comprised 10 items scored on a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The third part of the questionnaire aimed to assess participants' views on COVID-19 vaccine administration and enforcement, whilst the fourth part aimed to assess the factors related to COVID-19 vaccine hesitancy. The questionnaire also included a question about whether the participants had received the influenza vaccine in the preceding five years.

Sample size

The online sample size calculator Rao Soft® was used to calculate the minimum sample size. The number of adults (i.e., aged 18 years or over) in Jordan is approximately 3,500,000. The sample size generated by the software was 601 adults using a margin of error of 4% and a confidence interval of 95%.

Statistical analysis

Responses to the online questionnaire were exported to the Statistical Package for the Social Sciences (IBM SPSS) version 25 (IBM Corporation, Armonk, NY, USA), with incomplete responses excluded from the final analyses. Descriptive statistics (i.e., percentages and frequencies) were used to analyze the demographic characteristics of the participants. Responses to the risk perception scale were dichotomized (0 = strongly disagree/disagree/neutral; 1 = agree/strongly agree), and the risk perception score was calculated by summing the participants' dichotomized responses. The total possible risk perception score ranged from 0 to 10, with higher scores indicating higher COVID-19 risk perception. Chi-square analysis and one-way ANOVA were performed to compare the mean risk perception, COVID-19 vaccine acceptance, and previous influenza vaccine uptake scores based on the different sociodemographic variables. Moreover, binary logistic regression with a stepwise backward model was used to assess the association of participants' intention (i.e., binary variable) to take COVID-19 vaccine (i.e.,dependent variable) with the sociodemographic variables and risk perception scores (i.e., independent variables).

Results

A total of 3,121 participants completed the questionnaire, of whom 2,304 (73.8%) were female and 1,521 (48.7%) aged between 18–24 years (Table 1). The majority of the participants were unemployed (n = 1,846; 59.1%), and 77% (n = 2,404) had completed post-secondary education (Table 1). The mean COVID-19 risk perception score was 4.65 SD 1.9: median 5; IQR 3–6). Risk perception scores were significantly higher ($p < .001$) among participants who had COVID-19 vaccine acceptance (median 5; IQR 4–6) than among participants who did not have COVID-19 vaccine acceptance (median 4; IQR 3–5). Further, younger participants, female participants, and smokers had significantly higher risk perception scores than did older participants ($p < .001$), male participants ($p = .001$), and nonsmokers ($p = .005$), respectively (Table 1).

Most of the participants reported a willingness to take the COVID-19 vaccine (n = 2,268, 72.3%), among whom 94.1% (n = 2,134) reported that they would accept to take the vaccine if it was recommended by a physician and 28.2% (n = 639) if recommended by a pharmacist. Moreover, 2,658 participants (85.2%) reported that they believed that physicians should administer the vaccines, whilst 945 reported (30.3%) that pharmacists should also be authorized to administer the vaccines (Table 2). Over two-thirds of the participants did not agree that governments and employers should enforce COVID-19 vaccination on citizens and employees, and this disagreement was significantly higher among participants who were unwilling to take the vaccine ($p = .001$).

Upon exploring the differences in attitudes toward the COVID-19 vaccine (Table 3), there were statistically significant differences in responses to the items within all domains ($p < .001$) except for the domain related to the cost of the vaccine ($p = .784$). As compared to participants who were willing to take the vaccine, participants who refused to take the vaccine had higher mean scores for the items related to the potential of side effects precipitation (3.0 (0.92) vs. 2.5 (0.78)) and liability to

Table 1. COVID-19 vaccine acceptance and risk perception mean scores across sociodemographic characteristics.

Characteristic		n (%)	Risk perception of COVID 19 pandemic score Mean (SD)	P value	COVID-19 vaccine acceptance n (%)
Gender	Female	2304 (73.8%)	4.9 (1.87)	.001	1650 (71.6%)
	Male	817 (26.2%)	4.6 (1.91)		618 (75.6%)
Age group	18–24 years	1521 (48.7%)	4.7 (1.87)	<.001	1188 (78.1%)
	25–34 years	572 (18.3%)	4.7 (1.95)		406 (71%)
	35–44 years	419 (13.4%)	4.6 (1.89)		277 (66.1%)
	45–54 years	376 (12%)	4.3 (1.99)		242 (64.4%)
	55 years and more	233 (7.5%)	4.4 (1.81)		155 (66.5%)
Region	North	1106 (35.4%)	4.7 (1.88)	.218	825 (74.6%)
	Central	1845 (59.2%)	4.6 (1.91)		1317 (71.4%)
	South	170 (5.4%)	4.7 (1.91)		126 (74.1%)
Income	Low income	348 (11.2%)	4.8 (1.89)	.093	250 (71.8%)
	Lower middle and upper middle income	2061 (66%)	4.6 (1.91)		1498 (72.7%)
	High income	712 (22.8%)	4.6 (1.87)		520 (73%)
Marital status	Single/never married	1966 (63%)	4.7 (1.90)	.062	1486 (75.6%)
	Married/previously married	1155 (37%)	4.6 (1.91)		782 (67.7%)
Number of family members living together	1–3	498 (16%)	4.7 (1.92)	.064	358 (71.9%)
	4–6	1551 (49.7%)	4.6 (1.94)		1131 (72.9%)
	7 and more	1072 (34.3%)	4.7 (1.84)		779 (72.7%)
Living with children (less than 18 years old)	Yes	2167 (69.4%)	4.7 (1.90)	.751	1601 (73.9%)
	No	954 (30.6%)	4.6 (1.92)		667 (69.9%)
Living with elderly (over 65 years old)	Yes	858 (27.5%)	4.7 (1.96)	.872	617 (71.9%)
	No	2263 (72.5%)	4.6 (1.88)		1651 (73%)
Level of education	Up to secondary school	717 (23%)	4.6 (1.89)	.194	536 (74.8%)
	Undergraduate degree	2076 (66.5%)	4.7 (1.91)		1501 (72.3%)
	Graduate Degree	328 (10.5)	4.6 (1.88)		231 (70.4%)
Healthcare practitioner	Yes	933 (29.9%)	4.7 (1.86)	.751	696 (74.6%)
	No	2188 (70.1%)	4.6 (1.92)		1572 (71.8%)
Presence of chronic conditions	Yes	886 (28.4%)	4.7 (1.92)	.918	322 (71.6%)
	No	2235 (71.6%)	4.7 (1.90)		1946 (72.9%)
Smoker	Yes	886 (28.4%)	4.8 (1.92)	.005	663 (74.8%)
	No	2235 (71.6%)	4.6 (1.89)		1605 (71.8%)
Employment status	Employed	1083 (34.7%)	4.6 (1.89)	.194	755 (69.7%)
	Unemployed	1846 (59.1%)	4.7 (1.91)		1383 (74.9%)
	Retired	192 (6.2%)	4.6 (1.88)		130 (67.7%)
Have you been sick with novel coronavirus/ COVID-19?	Yes	458 (14.7%)	4.6 (1.91)	.217	335 (73.1%)
	No	2100 (67.3%)	4.6 (1.92)		1515 (72.1%)
	Not sure	560 (18%)	4.8 (1.84)		415 (74.1%)
Do you know in your immediate social network anyone sick with novel coronavirus/COVID-19?	Yes	2143 (68.7%)	4.6 (1.89)	.641	1564 (73%)
	No	733 (23.4%)	4.7 (1.93)		521 (71.1%)
	Not sure	245 (7.9%)	4.7 (1.96)		183 (74.7%)
Do you know in your immediate social network anyone who passed away because of novel coronavirus/COVID-19	Yes	741 (23.7%)	4.6 (1.94)	.464	543 (73.3%)
	No	2380 (76.3%)	4.7 (1.89)		1725 (72.5%)

Table 2. Participants' views on COVID-19 administration and enforcement.

Item		n (%)
Who should be authorized to administer COVID-19 vaccine	Physicians	2,658 (85.2%)
	Nurses	1,429 (45.8%)
	Pharmacists	945 (30.3%)
From whom would you take recommendations to take COVID-19 vaccine	Physician	2,134 (68.4%)
	Nurses	320 (10.3%)
	Pharmacists	639 (20.5%)
	Family and friends	304 (9.7%)
	Not willing to take the vaccine no matter who recommends it	853 (27.3%)
Government should enforce COVID-19 vaccine on citizens		916 (29.4%)
Employers should enforce COVID-19 vaccine on employees		1,012 (32.4%)

getting sick following vaccination (2.9 (0.91) vs. 2.3 (0.80)). Interestingly, participants who were willing to take the vaccine had higher mean scores for the item related to the possible death causality of the COVID-19 vaccines (2.9 (0.85) vs. 2.5 (0.99)). Moreover, participants who were willing to be vaccinated were more likely than participants who were unwilling to be vaccinated to believe that the vaccines would help in controlling the spread of COVID-19 infection, recovering the economy, and minimizing the burden on healthcare systems (mean scores 3.6 (0.81) vs. 2.8 (0.91), 3.7 (0.82) vs. 2.9 (0.97), and 3.1 (0.94) vs. 3.9 (0.76), respectively).

The binary logistic regression assessed the association between risk perception and vaccine acceptance adjusting for gender, age, and living with children (less than 18 years) (Table 4). Males a had

Table 3. Factors related to COVID-19 vaccine hesitancy.

Item	All participants Mean (SD)	Willing to take the vaccine group Mean (SD)	Not willing to take the vaccine group Mean (SD)	P value
It is possible that COVID19 vaccine will cause side effects	2.7 (0.84)	2.5 (0.78)	3.0 (0.92)	<.001
It is possible that COVID19 vaccine will make me sick	2.4 (0.88)	2.3 (0.80)	2.9 (0.91)	<.001
It is possible that COVID19 vaccine will cause death	3.1 (0.93)	2.9 (0.85)	2.5 (0.99)	<.001
I believe that COVID19 vaccine will be painful	2.1 (0.86)	2.0 (0.81)	2.3 (0.95)	<.001
I believe that COVID19 vaccine will be expensive	2.4 (0.91)	2.4 (0.92)	2.5 (0.88)	.784
I will not be able to take COVID 19 vaccine due to shortage	2.2 (0.90)	2.4 (0.86)	2.9 (0.95)	<.001
It will be hard to have access to COVID 19 vaccine	2.3 (0.92)	2.4 (0.87)	2.0 (0.96)	<.001
COVID 19 vaccine will minimize the spread of the virus	3.4 (0.92)	3.6 (0.81)	2.8 (0.91)	<.001
COVID 19 vaccine will help the economy to recover	3.5 (0.93)	3.7 (0.82)	2.9 (0.97)	<.001
COVID 19 vaccine will minimize the burden on the healthcare system	3.7 (0.89)	3.9 (0.76)	3.1 (0.94)	<.001

Table 4. Binary logistic regression for COVID-19 vaccine acceptance by sociodemographic variables.

		OR	SE	95% CI	*P* value
Gender	Male	1.220	0.098	1.007–1.479	.043
	Female	REF	REF	REF	REF
Age group	18–24 years	1.635	0.162	1.189–2.246	.002
	25–34 years	1.104	0.175	0.783–1.556	.573
	35–44 years	0.873	0.185	0.608–1.254	.462
	45–54 years	0.901	0.187	0.625–1.299	.576
	55 years and more	REF	REF	REF	REF
Living with children (less than 18 years old)		1.210	0.092	1.010–1.450	.039
Perceived risk score toward COVID-19 pandemic		1.319	0.023	1.261–1.380	<.001

a greater odds ratio (OR) for vaccines acceptance than did females (95% CI = 1.007–1.479, p = .043). Besides, younger participants' (i.e., 18–24 years) also had 1.635 greater odds for vaccine acceptance in comparison to older age groups(≥55 years) (95% CI = 1.189–2.246, p = .002). In addition, participants who had children aged under 18 years were more likely than their counterparts to report vaccine acceptance (OR = 1.210, 95% CI = 1.010–1.450, p = .039). Moreover, COVID-19 risk perception was found to predict vaccine acceptance (OR = 1.319, 95%, CI = 1.261–1.380, p < .001) indpendent from other factos.

Reported influenza vaccine uptake was compared to reported COVID-19 vaccine acceptance in light of the sociodemographic characteristics of the participants in order to identify whether having received the seasonal influenza vaccine predicted COVID-19 vaccine acceptance (Figure 1). Firstly, although participants with higher income level were more willing than low-income participants to take the COVID-19 vaccine (73% vs 71.8%; Table 1), only a quarter of participants with high income had received the seasonal influenza vaccine (25.4%; Figure 1). Further, 78.1% of

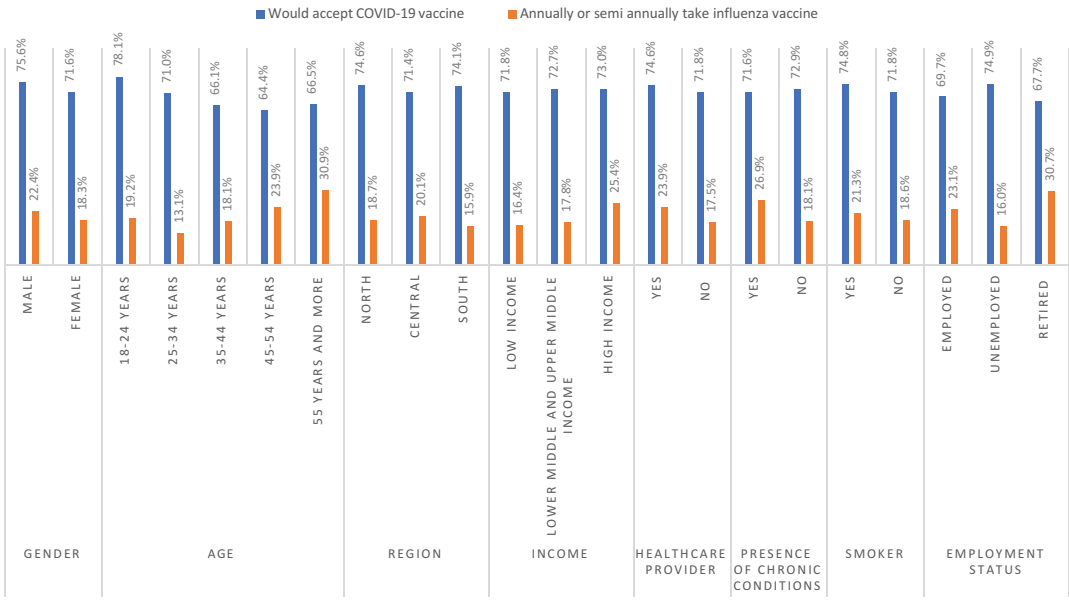

Figure 1. Comparison between the rates of influenza vaccine uptake (annual or semiannual) and COVID-19 vaccine acceptance among the participants based on the sociodemographic variables.

participants aged 18–24 years reported COVID-19 vaccine acceptance, though only 19.2% reported seasonal influenza vaccine uptake. Lastly, although two thirds of chronic disease sufferers reported high vaccine acceptance, the influenza vaccine uptake percentage among the same group was lower than expected (71.6% vs. 26.9%, respectively).

Discussion

In the present study, 72.3% of the participants demonstrated willingness to receive COVID-19 vaccination, and COVID-19 risk perception was significantly associated with vaccine acceptance. Moreover, male participants, participants aged 18–24 years, and participants who had children aged under 18 years were more willing than their counterparts to get vaccinated.

The majority of the participants (72.3%) reported willingness to be vaccinated against COVID-19 if this was recommended by a healthcare professional (e.g., physician or pharmacist) and proven to be safe and effective. Similar results have been reported in Germany (70%), the Netherlands (73%), Italy (74%), France (75%), and Portugal (75%).[18,19] On the other hand, lower acceptance rates have been reported by other studies in Jordan (28.4%-37.4%)[20,21] and other countries such as Kuwait (23.6%-53.1%), Poland (57%), and Russia (55%).[20,22,23] The present study findings suggest that willingness to take the COVID-19 vaccine should be sufficient for achieving COVID-19 herd immunity, based on the previous herd immunity threshold of 70%. However, a sharp increase in the herd immunity threshold to around 90% or more has been proposed in light of the development of the Delta variant of Coronavirus.[24] Moreover, the rate of acceptance toward taking COVID-19 vaccines was at least three times higher than the rate of influenza annual or semiannual vaccine uptake (n = 605, 19.4%). One logical explanation for this difference is that 66.2% of the participants believed COVID-19 to be more severe than influenza.

Our study results indicated that male participants had a significantly lower mean COVID-19 risk perception score (4.9, SD 1.91) than did females (4.6 SD 1.87), although vaccine acceptance among male participants (75.6%) was significantly higher than among female participants (71.6%). Similar findings have been reported by other studies around the world.[15,19,23] According to Sallam et al., females in Jordan rely on social media platforms as a source of information regarding the COVID-19 outbreak and vaccination, and therefore, they are more likely than males to believe vaccine-related conspiracies.[20,25,26] Moreover, in the present study, rates of COVID-19 vaccine acceptance were higher among participants who had children than among participants who did not have children (73.9% vs. 69.9%). At the time of data collection for this study, there were no data to suggest the safety of COVID-19 vaccination for children. However, there was no significant difference in the mean COVID-19 risk perception scores between the two groups. A previous study in Turkey reported that 63.7% of the participating parents were unwilling to have their children vaccinated against COVID-19, although 59.9% were willing to get vaccinated themselves.[27] Therefore, it is possible that participants who had children had higher acceptance toward getting vaccinated as an indirect measure to protect their children from becoming infected with COVID-19, since children were unable to receive the vaccine at the time this study was conducted.

In this study, nearly one third of the participants believed that pharmacists should be authorized to administer COVID-19 vaccines. This is an interesting finding considering the fact that pharmacists in Jordan were granted authorization to administer the influenza vaccine in August 2020 (i.e., only four months prior to data collection for this study). In a previous study in Jordan, pharmacists reported that administering COVID-19 vaccines in community pharmacies would expedite the vaccination process, encourage more people to get vaccinated, and increase vaccine accessibility.[14,28,29]

Moreover, in the present study, participants who were unwilling to get vaccinated against COVID-19 had greater concerns regarding vaccine safety and were more skeptical toward the effectiveness of the vaccines, as compared to their counterparts. This finding comes consistent with findings reported by previous studies.[13,19] Furthermore, nearly 30% of the participants believed that the government and employers should mandate getting vaccinated against COVID-19. A study conducted in the United States found that 40.9% of the participants accepted their state government mandating COVID-19 vaccination for adults, while 47.7% of the participants accepted employers mandating the vaccination of their employees.[30] However, mandatory vaccination can reduce public support by overriding personal autonomy, ultimately reducing vaccine uptake.[31]

The current study highlights the need to involve healthcare professionals (e.g., physicians and pharmacists) to positively influence the population's acceptance for COVID-19 vaccine.[15] In addition, policymakers are encouraged to grant trained pharmacists the authority to offer and administer COVID-19 vaccine in community pharmacies or as part of mass vaccination campaigns.[14] Moreover, authorities can employ social media to encourage anti-vaccine and undecided people to ensure global immunity, hence slowing the emergence of new variants of the virus.

Limitations

Although the large number of retrieved responses adds to the reliability and generalizability of the study findings, there are a few limitations to the present study. Firstly, the sample may not be representative for some demographic groups (i.e., insufficient representation of the south region, and the majority of respondents were female and from a young age group). Secondly, data were collected online through social media networks using a self-report tool, which may have led to selection bias. However, the use of a large study sample is expected to have counteracted potential selection bias. Furthermore, the present study explored vaccine acceptance among Jordanians prior to the development of currently identified variants of coronavirus (e.g., the Delta variant), which may have affected the way people envision the protective and harmful effects of available vaccines. Thus, it is highly recommended to conduct a series of follow-up studies with change detection analysis as we progress through the

COVID-19 pandemic in order to obtain an accurate and up-to-date reflection of vaccine acceptance among the Jordanian population.

Conclusion

In conclusion, the majority of our study participants demonstrated willingness to receive COVID-19 vaccination. COVID-19 risk perception and certain sociodemographic characteristics (i.e., being male, being young, and having children aged under 18 years) were found to be significantly associated with vaccine acceptance. The results of the present study underpin the importance of collaborative multidisciplinary campaigns to enhance public trust in COVID-19 vaccination. In this regard, healthcare providers (including physicians and pharmacists among others) can play an active role as leaders of mass public evidence-based campaigns to enhance people's trust in COVID-19 vaccination. Furthermore, attitudinal surveillance is encouraged to get better insights regarding stems of vaccination hesitancy among general population.

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