



# The negative impact of misinformation and vaccine conspiracy on COVID-19 vaccine uptake and attitudes among the general public in Iraq

Malik Sallam<sup>a,b,\*</sup>, Nariman Kareem<sup>a</sup>, Mohammed Alkurtas<sup>c</sup>

<sup>a</sup> Department of Pathology, Microbiology and Forensic Medicine, School of Medicine, The University of Jordan, Amman, Jordan

<sup>b</sup> Department of Clinical Laboratories and Forensic Medicine, Jordan University Hospital, Amman, Jordan

<sup>c</sup> Department of Pathology, Al-Kindy College of Medicine, University of Baghdad, Baghdad, Iraq

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## ABSTRACT

**Background:** Vaccine hesitancy is a major barrier to infectious disease control. Previous studies showed high rates of COVID-19 vaccine hesitancy in the Middle East. The current study aimed to investigate the attitudes towards COVID-19 vaccination and COVID-19 vaccine uptake among adult population in Iraq.

**Methods:** This self-administered survey-based study was conducted in August–September 2022. The survey instrument assessed participants' demographics, attitudes to COVID-19 vaccination, beliefs in COVID-19 misinformation, vaccine conspiracy beliefs, and sources of information regarding the vaccine.

**Results:** The study sample comprised a total of 2544 individuals, with the majority reporting the uptake of at least one dose of COVID-19 vaccination (n = 2226, 87.5 %). Positive attitudes towards COVID-19 vaccination were expressed by the majority of participants (n = 1966, 77.3 %), while neutral and negative attitudes were expressed by 345 (13.6 %) and 233 (9.2 %) participants, respectively. Factors associated with positive attitudes towards COVID-19 vaccination in multivariate analysis included disbelief in COVID-19 misinformation and disagreement with vaccine conspiracies. Higher COVID-19 vaccine uptake was significantly associated with previous history of COVID-19 infection, higher income, residence outside the Capital, disbelief in COVID-19 misinformation, disagreement with vaccine conspiracies, and reliance on reputable information sources.

**Conclusion:** COVID-19 vaccine coverage was high among the participants, with a majority having positive attitudes towards COVID-19 vaccination. Disbelief in COVID-19 misinformation and disagreement with vaccine conspiracies were correlated with positive vaccine attitudes and higher vaccine uptake. These insights can inform targeted interventions to enhance vaccination campaigns.

## 1. Introduction

Vaccination represents a great achievement of modern science, with remarkable success in controlling the infectious diseases' morbidity and mortality (Greenwood, 2014; Rodrigues and Plotkin, 2020; Toor et al., 2021). The success that accompanied the advent of several effective and safe vaccines is manifested in eradication of smallpox, and control of measles and poliomyelitis (Kayser and Ramzan, 2021).

Despite the role of vaccination as a central measure in infectious disease prevention, vaccine hesitancy emerged as a threatening challenge undermining the success of vaccination (Larson et al., 2022). Vaccine hesitancy, defined as the reluctance or rejection of vaccines despite their availability, has become a top threatening global health concern (MacDonald, 2015; Peretti-Watel et al., 2015; Galagali et al.,

2022). The issue of vaccine hesitancy emerged long before the emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the subsequent coronavirus disease 2019 (COVID-19) pandemic (World Health Organization (WHO), 2001; Ramsay and White, 1998).

Previous studies indicated the wide range of factors linked with vaccination hesitancy, which is a place-, time-, and context-specific phenomenon (MacDonald, 2015; Larson et al., 2014; Schmid et al., 2017; Dubé et al., 2014). Nevertheless, the emergence of the COVID-19 pandemic exacerbated the issue of vaccine hesitancy (Wiysonge et al., 2022; Sallam, 2021). Unsubstantiated conspiracy theories, myths, and mis-/dis-information surrounding the virus, preventive measures, and COVID-19 vaccines fueled the phenomenon of COVID-19 vaccine hesitancy, which was reported in various regions worldwide (Sallam, 2021; Sallam et al., 2022; Ullah et al., 2021). Thus, effective control of COVID-

\* Corresponding author.

E-mail address: [malik.sallam@ju.edu.jo](mailto:malik.sallam@ju.edu.jo) (M. Sallam).

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19 relies not only on the availability of effective and safe vaccines, but extends to involve positive attitudes and behaviors towards vaccination (Greyling and Rossouw, 2022).

The development and distribution of vaccines emerged as the promising measure to mitigate the negative impact of this unprecedented pandemic (Kashte et al., 2021; Clemente-Suárez et al., 2021). However, the success of COVID-19 vaccination campaigns extended beyond the issues of COVID-19 vaccine efficacy and safety, since the attitudes towards COVID-19 vaccination played a major role in its uptake (Motta et al., 2021).

The infiltration of conspiracy beliefs and misinformation regarding various infectious diseases and vaccines—including COVID-19—has recently been notable in Arab countries (Sallam et al., 2022; Abdaljaleel et al., 2023; Al-Rawi et al., 2022). This included unsubstantiated claims which lacked credible scientific evidence. Examples include the idea that SARS-CoV-2 is a man-made virus, the claim that COVID-19 vaccination aimed to implant microchips for surveillance, and the misconception of vaccine-associated infertility (Sallam et al., 2022; Sallam et al., 2020; Sallam et al., 2021). The association between misinformation and adverse health behaviors has been documented in various settings including the recurring pattern of association between vaccine hesitancy and endorsement of conspiracy beliefs (Sallam et al., 2021; Oliver and Wood, 2014; Regazzi et al., 2023).

Iraq, a Middle Eastern country, has a diverse population of over 41 million in 2021, and the country serves as a distinctive case study with a versatile society (Commons, 2022). As of 18 October 2023, Iraq reported 2,465,545 cumulative COVID-19 cases and 25,375 cumulative deaths (WHO Health Emergency Dashboard, 2024). COVID-19 vaccination in Iraq started on 2 March 2021, with 19,600,00 vaccine doses administered, benefiting 11,332,925 individuals with at least one dose and 7,944,775 individuals with a complete primary vaccination series as of 26 November 2023 (WHO Health Emergency Dashboard, 2024). Four vaccine types—Pfizer/BioNTech, Oxford/AstraZeneca, Sinopharm, and Sputnik V—received approval for use in Iraq (VIPER Group COVID19 Vaccine Tracker Team, 2023). Several early studies from Iraq showed varying attitudes towards COVID-19 vaccination and its associated determinants; nevertheless, the majority of these studies did not address the role of misinformation and conspiracies on COVID-19 vaccine uptake (Ghazi et al., 2021; Abdulah, 2021; Alatrany et al., 2023; Tahir et al., 2022; Shareef et al., 2022; Al-Qerem et al., 2022; Darweesh et al., 2022; Luma et al., 2022).

Therefore, the objectives of the current study included investigating possible factors associated with higher COVID-19 vaccine uptake and positive attitudes towards vaccination among adult Iraqi population. Specifically, we aimed to assess the role of vaccine conspiracies and COVID-19 misinformation in shaping vaccination attitudes and behaviors.

## 2. Methods

### 2.1. Study design

This cross-sectional design study utilized a self-administered online questionnaire to collect data. Inclusion criteria included: being an Iraqi citizen, possessing proficiency in Arabic language, and age of 18-year or older.

Survey distribution took place during 5 August 2022–14 September 2022. The questionnaire was hosted in Google Forms in Arabic. Chain-referral sampling was used for survey distribution starting with the contacts of the authors from Iraq (N.K. and M.A.) using e-mails, the direct messaging application WhatsApp, and social media platforms (Facebook and Twitter). Additionally, the participants were asked to share the survey with their contacts. The survey was anonymous, and no incentives were offered for participation. For those who consented to participate, response to all items was mandatory to eliminate item non-response bias.

The minimum sample size was estimated at 2401 participants. Calculation of the minimum sample size was done using Epitools—Epidemiological Calculators, using the following assumptions: an estimated prevalence of 50 %, the desired precision of estimate at 2 %, and the Iraqi population size of about 41,179,351 people in 2021 (Commons, 2022; Epitools, 2022).

### 2.2. Survey instrument

The survey instrument comprised seven sections with details presented in (Supplementary file S1). Briefly, the survey began with an introductory section including the mandatory electronic consent item.

Second, the socio-demographics section assessed age, sex, occupational category, governorate, educational level, monthly income of household in Iraqi dinar (IQD, 500,000 IQD  $\cong$  342.55529 US Dollars); (Iraq Ministry of Finance, 2022; Xe Currency Converter, 2022), and history of chronic disease.

Third, a section on COVID-19 history of infection and COVID-19 vaccine uptake. Fourth, a section on the attitude of the participants towards COVID-19 vaccination, comprising the following question: “In your personal opinion, how would you rate the importance of getting the vaccine to protect against COVID-19?”. The item was measured on a 5-point Likert scale: very important, important, neutral/no opinion, not important, and not important at all. Fifth, assessment of COVID-19 misinformation, with three items based on previous studies addressing COVID-19 vaccine hesitancy in the Middle East (Sallam et al., 2021; Sallam et al., 2021). Sixth, assessment of the sources of COVID-19 vaccine information. Finally, the seventh section on assessment of COVID-19 vaccine conspiracy beliefs using seven items based on the original vaccine conspiracy beliefs scale (VCBS) adopted from Shapiro et al. that was used previously in the assessment of COVID-19 vaccine hesitancy and influenza vaccine uptake (Sallam et al., 2021; Shapiro et al., 2016; Sallam et al., 2022). Content validity was assessed by the first and senior authors through reviewing the survey items with minor refinements to improve relevance and comprehensiveness. Subsequently, we conducted a pilot test involving six adult Iraqi individuals excluding these responses from final analysis. Additionally, construct validity was established by earlier work in the context of COVID-19 vaccination (Sallam et al., 2021; Sallam et al., 2021). The Cronbach  $\alpha$  value for the VCBS was 0.893 indicating excellent internal consistency of the scale.

### 2.3. Ethical approval

The study was approved by the Scientific and Ethical Unit at Al-Kindy College of Medicine, University of Baghdad (approved by the Council of Al-Kindy College of Medicine in session No. 20, date: 6 July 2022) and complied to the guidelines for protection of participants' safety and privacy. An electronic informed consent was required for successful completion of the survey.

### 2.4. Statistical analysis

Data and statistical analyses were conducted using BM SPSS v26.0 for Windows. Univariate analyses were conducted employing the chi-squared ( $\chi^2$ ) test. Associations with a significance level of  $p < 0.100$  in univariate analyses were considered for inclusion in subsequent multivariate analysis. Multivariate analysis was conducted using multinomial logistic regression. The Nagelkerke  $R^2$  statistic was employed to assess the variance explained by the model. A significance threshold of  $p < 0.050$  was applied to determine statistical significance.

### 3. Results

#### 3.1. Study sample characteristics, attitude towards COVID-19 vaccination, COVID-19 vaccine uptake and its associated variables

The study sample comprised a total of 2544 individuals.

**Table 1**

Descriptive statistics of the study participants who were adult Iraqi citizens with data collected during August–September 2022 ( $N = 2544$ ).

Variable	Category	N <sup>4</sup> (%)
Sex	Male	1230 (48.3)
	Female	1314 (51.7)
Age	≤ 27 years	1218 (47.9)
	> 27 years	1326 (52.1)
Occupation	HCW <sup>2</sup>	262 (10.3)
	Employed (non-HCW)	1093 (43.0)
	Unemployed	202 (7.9)
	Student	987 (38.8)
Place of residence	Baghdad	1494 (58.7)
	Outside Baghdad	1050 (41.3)
Education	High school or less	180 (7.1)
	Undergraduate	1534 (60.3)
	Postgraduate	830 (32.6)
Income	≤ 500 K IQD <sup>3</sup>	668 (26.3)
	> 500 K IQD	1876 (73.7)
History of chronic disease	Yes	381 (15.0)
	No	2163 (85.0)
History of COVID-19 <sup>1</sup>	Confirmed infection	1526 (60.0)
	No history of confirmed infection	1018 (40.0)
How many times the participant got COVID-19?	0	1018 (40.0)
	1	876 (34.4)
	2	490 (19.3)
	3	135 (5.3)
	4	25 (1.0)
COVID-19 vaccine uptake	Yes	2226 (87.5)
	No	318 (12.5)
Vaccine type received	Pfizer-BioNTech vaccine	1651 (74.2)
	Oxford/AstraZeneca vaccine	172 (7.7)
	Sinopharm BBIBP vaccine	343 (15.4)
	Others	9 (0.4)
	Mixed	51 (2.3)
Number of doses received	0	318 (12.5)
	1	255 (10.0)
	2	1800 (70.8)
	3	166 (6.5)
	4	5 (0.2)

<sup>1</sup> COVID-19: Coronavirus disease 2019; <sup>2</sup> HCW: Healthcare worker; <sup>3</sup> K IQD: 1000 Iraqi dinars; <sup>4</sup>N: Number.

Characteristics of the study sample is shown in (Table 1).

The overall attitude of the participants towards COVID-19 vaccination was mostly positive ( $n = 1966$ , 77.3 %), while neutral attitude was expressed by 345 participants (13.6 %), and negative attitude was expressed by 233 participants (9.2 %).

Using univariate analysis, the following factors were associated with a positive attitude towards COVID-19 vaccination: male sex, age > 27 years, being a healthcare worker (HCW), postgraduate education, and a monthly income > 500 K IQD (Table 2).

The majority of participants reported uptake of at least a single dose of COVID-19 vaccination ( $n = 2226$ , 87.5 %) while 318 participants had no self-reported history of COVID-19 vaccine uptake (12.5 %). Using univariate analysis, the following factors were associated with COVID-19 vaccine uptake: being an HCW, residence outside the Capital, income > 500 K IQD, and a history of confirmed COVID-19 infection (Table 2).

#### 3.2. The belief in COVID-19 misinformation and the embrace of COVID-19 vaccine conspiracy beliefs

Regarding the belief in COVID-19 misinformation, the complete absence of such beliefs was reported among 731 participants (28.7 %), while a slight belief in misinformation was reported among 922 participants (36.2 %). Moderate belief in misinformation was reported among 576 participants (22.6 %), and the strong belief in COVID-19 misinformation was observed among 315 participants (12.4 %). For the attitude towards COVID-19 vaccine conspiracies, the majority of participants exhibited a neutral attitude ( $n = 1464$ , 57.5 %), with 607 participants showing the embrace of COVID-19 vaccine conspiracies (23.9 %), and 473 showing disagreement with such beliefs (18.6 %).

In univariate analysis, the strong belief in COVID-19 misinformation and the agreement with COVID-19 vaccine conspiracies were associated with both negative attitude to COVID-19 vaccination and less COVID-19 vaccine uptake (Table 3).

#### 3.3. Source of information about COVID-19 vaccines

The main sources of information regarding COVID-19 vaccination included physicians, scientists, and scientific journals ( $n = 1090$ , 42.8 %), followed closely by social media platforms ( $n = 1040$ , 40.9 %), and finally TV programs and newspapers ( $n = 414$ , 16.3 %). The dependence on social media platforms was associated with both negative attitude to COVID-19 vaccination and less COVID-19 vaccine uptake (Fig. 1).

#### 3.4. Multivariate analysis for the factors associated with positive attitude towards COVID-19 vaccination

The Nagelkerke  $R^2$  value of 0.245 indicated that the regression model explained 24.5 % of the variability observed in the data. For demographic variables, only males were significantly less likely to have a neutral attitude compared to females, with an adjusted odds ratio (aOR) of 0.64 (95 %CI: 0.44–0.92,  $p = 0.016$ ).

Statistically significant associations were observed between belief in misinformation and COVID-19 vaccine attitude. Participants with no belief in misinformation displayed a significantly higher likelihood of a positive attitude, with an aOR of 7.82 (95 %CI: 4.16–14.68), while those with slight belief exhibited an aOR of 3.75 (95 %CI: 2.46–5.71), and those with moderate belief an aOR of 1.58 (95 %CI: 1.07–2.31), all compared to strong belief ( $p < 0.001$ , Table 4). Similarly, those who disagreed with COVID-19 vaccine conspiracy beliefs (VCBS: 7–20) showed a higher likelihood of a positive attitude towards COVID-19 vaccination, with an aOR of 10.42 (95 %CI: 4.62–23.54), while those with a neutral attitude (VCBS: 21–35) displayed an aOR of 4.57 (95 %CI: 3.30–6.33), both compared to those who endorsed vaccine conspiracies ( $p < 0.001$ , Table 4). Additionally, the participants with a neutral vaccine conspiracy attitude (VCBS: 21–35) displayed a higher likelihood of

**Table 2**

Associations between study variables with attitude to COVID-19 vaccination and COVID-19 vaccine uptake in univariate analysis among study participants who were adult Iraqi citizens with data collected during August–September 2022 (N = 2544).

Variable	Category	Attitude towards COVID-19 vaccination			p-value, $\chi^2$	Self-reported history of COVID-19 vaccine uptake		p-value, $\chi^2$
		Positive N <sup>4</sup> (%)	Neutral N (%)	Negative N (%)		Yes N (%)	No N (%)	
Sex	Male	991 (80.6)	124 (10.1)	115 (9.3)	<0.001, 24.695	1092 (88.8)	138 (11.2)	0.059, 3.570
	Female	975 (74.2)	221 (16.8)	118 (9.0)		1134 (86.3)	180 (13.7)	
Age	≤ 27 years	898 (73.7)	206 (16.9)	114 (9.4)	<0.001, 23.276	1069 (87.8)	149 (12.2)	0.697, 0.152
	> 27 years	1068 (80.5)	139 (10.5)	119 (9.0)		1157 (87.3)	169 (12.7)	
Occupation	HCW <sup>2</sup>	222 (84.7)	27 (10.3)	13 (5.0)	<0.001, 24.264	248 (94.7)	14 (5.3)	0.002, 14.561
	Employed (non-HCW)	869 (79.5)	123 (11.3)	101 (9.2)		940 (86.0)	153 (14.0)	
	Unemployed Student	151 (74.8) 724 (73.4)	32 (15.8) 163 (16.5)	19 (9.4) 100 (10.1)		176 (87.1) 862 (87.3)	26 (12.9) 125 (12.7)	
Place of residence	Baghdad	1141 (76.4)	214 (14.3)	139 (9.3)	0.364, 2.022	1274 (85.3)	220 (14.7)	<0.001, 16.392
	Outside Baghdad	825 (78.6)	131 (12.5)	94 (9.0)		952 (90.7)	98 (9.3)	
Education	High school or less	133 (73.9)	30 (16.7)	17 (9.4)	<0.001, 25.358	149 (82.8)	31 (17.2)	0.135, 4.002
	Undergraduate	1145 (74.6)	240 (15.6)	149 (9.7)		1346 (87.7)	188 (12.3)	
Income	Postgraduate	688 (82.9)	75 (9.0)	67 (8.1)	0.001, 14.561	731 (88.1)	99 (11.9)	<0.001, 14.036
	≤500 K IQD <sup>3</sup>	481 (72.0)	114 (17.1)	73 (10.9)		557 (83.4)	111 (16.6)	
History of chronic disease	Yes	292 (76.6)	54 (14.2)	35 (9.2)	0.929, 0.148	340 (89.2)	41 (10.8)	0.266, 1.239
	No	1674 (77.4)	291 (13.5)	198 (9.2)		1886 (87.2)	277 (12.8)	
History of COVID-19 <sup>1</sup>	Confirmed infection	1171 (76.7)	218 (14.3)	137 (9.0)	0.415, 1.758	1362 (89.3)	164 (10.7)	0.001, 10.714
	No history of confirmed infection	795 (78.1)	127 (12.5)	96 (9.4)		864 (84.9)	154 (15.1)	

<sup>1</sup> COVID-19: Coronavirus disease 2019; <sup>2</sup> HCW: Healthcare worker; <sup>3</sup> K IQD: 1000 Iraqi dinars; <sup>4</sup>N: Number.

**Table 3**

Association between attitude to vaccine conspiracies, COVID-19 misinformation and attitude to COVID-19 vaccination/COVID-19 vaccine uptake in univariate analysis among study participants who were adult Iraqi citizens with data collected during August–September 2022 (N = 2544).

Variable	Category	Attitude towards COVID-19 vaccination			p-value, $\chi^2$	COVID-19 vaccine uptake		p-value, $\chi^2$
		Positive N <sup>4</sup> (%)	Neutral N (%)	Negative N (%)		Yes N (%)	No N (%)	
Misinformation score <sup>1</sup>	No belief in misinformation	665 (91.0)	51 (7.0)	15 (2.1)	<0.001, 303.899	688 (94.1)	43 (5.9)	<0.001, 75.253
	Slight belief in misinformation	767 (83.2)	102 (11.1)	53 (5.7)		820 (88.9)	102 (11.1)	
	Moderate belief in misinformation	381 (66.1)	110 (19.1)	85 (14.8)		475 (82.5)	101 (17.5)	
	Strong belief in misinformation	153 (48.6)	82 (26.0)	80 (25.4)		243 (77.1)	72 (22.9)	
Attitude towards COVID-19 <sup>2</sup> vaccine conspiracy	Disagreement (VCBS <sup>3</sup> : 7–20)	455 (96.2)	11 (2.3)	7 (1.5)	<0.001, 346.968	452 (95.6)	21 (4.4)	<0.001, 96.532
	Neutral (VCBS: 21–35)	1168 (79.8)	224 (15.3)	72 (4.9)		1308 (89.3)	156 (10.7)	
	Agreement (VCBS: 36–49)	343 (56.5)	110 (18.1)	154 (25.4)		466 (76.8)	141 (23.2)	

<sup>1</sup> Misinformation score: Using three items to assess the belief in COVID-19 misinformation

<sup>2</sup> COVID-19: Coronavirus disease 2019.

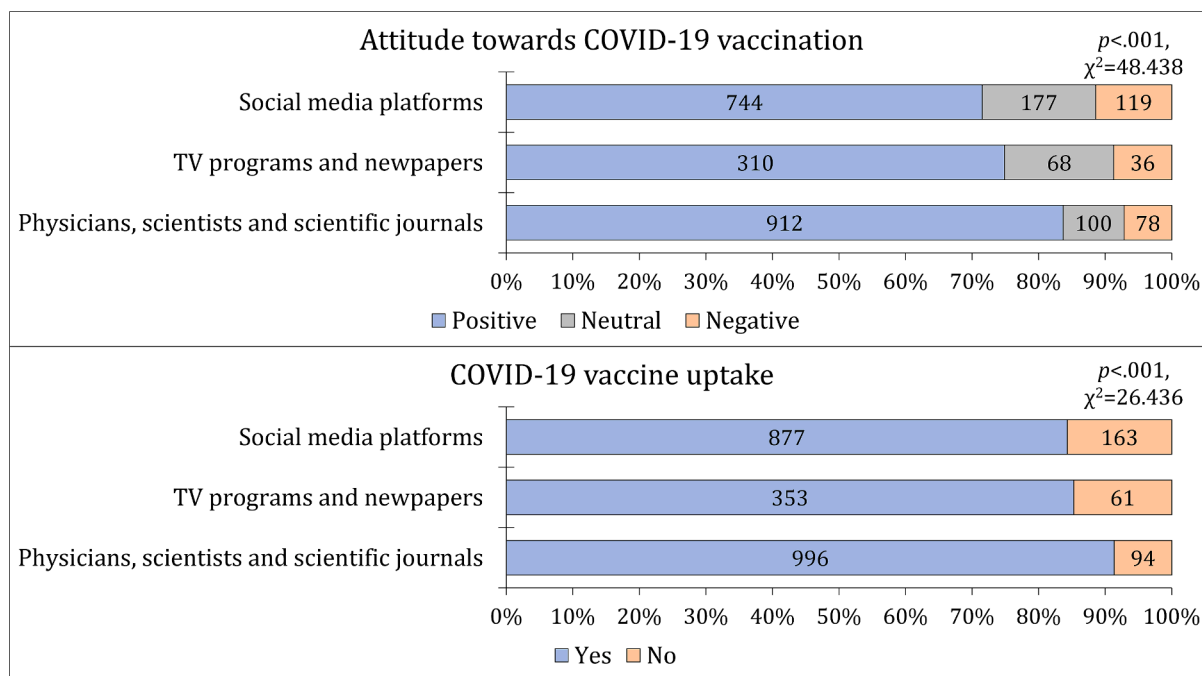
<sup>3</sup> VCBS: Vaccine conspiracy beliefs scale.

<sup>4</sup> N: Number.

a neutral attitude towards COVID-19 vaccination, with an aOR of 4.02 (95 %CI: 2.73–5.92), compared to those who endorsed vaccine conspiracies ( $p < 0.001$ , Table 4).

### 3.5. Multivariate analysis for the factors associated with COVID-19 vaccine uptake

The Nagelkerke R<sup>2</sup> of 0.128 showed that the regression model



**Fig. 1.** The association between attitude towards COVID-19 vaccination, COVID-19 vaccine uptake and the main source of information regarding the vaccine among the study participants who were adult Iraqi citizens with data collected during August–September 2022 ( $N = 2544$ ). COVID-19: Coronavirus disease 2019.

explained 12.8 % of the variability observed in the data. Participants residing in Baghdad were less likely to have received the COVID-19 vaccine, as indicated by an aOR of 0.56 (95 %CI: 0.43–0.73,  $p < 0.001$ , Table 5), compared to those residing outside Baghdad. Employed individuals in non-healthcare roles were significantly less likely to have received the COVID-19 vaccine, with an aOR of 0.70 (95 %CI: 0.52–0.93,  $p = 0.015$ , Table 5) compared to university/college students. Individuals with a history of COVID-19 infection showed higher rates of COVID-19 vaccine uptake, with an aOR of 1.53 (95 %CI: 1.19–1.97,  $p = 0.001$ , Table 5). Additionally, participants with an income of  $\leq 500$  K IQD showed less likelihood of COVID-19 vaccine uptake, with an aOR of 0.66 (95 %CI: 0.50–0.88), compared to those with incomes exceeding 500 K IQD ( $p = 0.004$ , Table 5).

Moreover, participants who reported no belief in COVID-19 misinformation exhibited a significantly higher likelihood of COVID-19 vaccine uptake, reflected in an aOR of 2.29 (95 %CI: 1.45–3.61) compared to those with strong beliefs in misinformation ( $p < 0.001$ ). Also, participants with a slight belief in misinformation demonstrated a higher likelihood of COVID-19 vaccine uptake, with an aOR of 1.49 (95 %CI: 1.04–2.15,  $p = 0.031$ , Table 5). A higher likelihood of COVID-19 vaccine uptake was observed among the participants who disagreed with COVID-19 vaccine conspiracy beliefs (VCBS: 7–20) reflected by an aOR of 3.65 (95 %CI: 2.16–6.18), and among participants with neutral attitude towards vaccine conspiracies (VCBS: 21–35) with an aOR of 2.06 (95 %CI: 1.56–2.71) compared to those who endorsed vaccine conspiracies ( $p < 0.001$  for both comparisons, Table 5). Finally, participants who relied on physicians, scientists, and scientific journals as their source of information regarding COVID-19 vaccination exhibited a significantly increased likelihood of COVID-19 vaccine uptake, as indicated by an aOR of 1.46 (95 %CI: 1.10–1.94,  $p = 0.009$ , Table 5) compared to those who relied on social media platforms.

#### 4. Discussion

The current study revealed a clear distinct pattern in the possible factors influencing COVID-19 vaccination attitudes and uptake. Notably, lower vaccine uptake and negative attitudes towards the vaccine were

significantly associated with endorsement of vaccine conspiracies and COVID-19 misinformation.

In comparison to previous studies in Iraq, the participants in the current study demonstrated a favorable attitude towards COVID-19 vaccination. For example, an earlier study indicated that 77.6% of respondents were willing to take the vaccine when available, a rate almost exactly the same of the current study findings which indicated that 77.3% displayed a positive attitude to COVID-19 vaccination (Ghazi et al., 2021). Another Iraqi study in 2021 reported a lower acceptance rate of 56.2% (Shareef et al., 2022). On the other hand, another survey study in July 2021 found that 88.6 % of respondents were willing to be vaccinated against COVID-19, with concerns about vaccine safety and the need for more information being the primary reasons for vaccine refusal (Al-Qerem et al., 2022).

From a global perspective, the acceptance rate observed in this study is slightly higher than the global average of 65–75% (Norhayati et al., 2021; Fajar et al., 2022). Despite the observed variability in the rates of COVID-19 vaccine acceptance which can be attributed to survey timing, phrasing the of the items assessing vaccination hesitancy, and possible sampling bias, the common pattern in line with our findings is the generally positive attitude towards COVID-19 vaccination in Iraq (Sallam, 2021; Shareef et al., 2022; Al-Qerem et al., 2022; Darweesh et al., 2022).

A notable aspect of this study was the discernible correlation between COVID-19 vaccine conspiracies, COVID-19 misinformation, and negative attitudes and behaviors towards COVID-19 vaccination. This manifested in significantly lower vaccine uptake and less favorable attitudes towards the vaccine. The government in Iraq has taken measures to combat COVID-19 misinformation, emphasizing the importance of vaccination and warning against spreading false information (Iraqi News Agency, 2023; Iraqi News Agency, 2023).

The Iraqi government adopted a non-mandatory approach regarding COVID-19 vaccination, refraining from imposing vaccine mandates due to the lack of legal support of this measure (Iraqi News Agency, 2023). Instead, the Iraqi Ministry of Health and Environment advocated for alternative public health strategies. In Iraq, the employees were encouraged to voluntarily provide either a weekly COVID-19 testing



**Table 4**

Associations between study variables with attitude to COVID-19 vaccination in multinomial logistic regression analyses, among study participants who were adult Iraqi citizens with data collected during August–September 2022 (N = 2544).

Model	Nagelkerke R <sup>2</sup> = 0.245	aOR <sup>6</sup> (95 % CI <sup>7</sup> )	p value
<b>Positive attitude vs. negative attitude towards COVID-19 vaccination</b>			
Sex	Male	0.99 (0.73–1.35)	0.951
	Female	Ref.	.
Age	≤ 27 years	0.93 (0.60–1.45)	0.763
	> 27 years	Ref.	.
Occupation	HCW <sup>3</sup>	1.52 (0.77–2.98)	0.229
	Employed (non-HCW)	1.04 (0.67–1.63)	0.857
	Unemployed	1.03 (0.58–1.83)	0.922
	Student	Ref.	.
Education	High school or less	0.80 (0.42–1.54)	0.506
	Undergraduate	0.74 (0.50–1.10)	0.139
	Postgraduate	Ref.	.
Income	≤500 K IQD <sup>4</sup>	1.03 (0.73–1.46)	0.873
	>500 K IQD	Ref.	.
Misinformation score <sup>1</sup>	No belief in misinformation	7.82 (4.16–14.68)	<0.001
	Slight belief in misinformation	3.75 (2.46–5.71)	<0.001
	Moderate belief in misinformation	1.58 (1.07–2.31)	0.020
	Strong belief in misinformation	Ref.	.
Attitude towards COVID-19 <sup>2</sup> vaccine conspiracy	Disagreement (VCBS <sup>5</sup> : 7–20)	10.42 (4.62–23.54)	<0.001
	Neutral (VCBS: 21–35)	4.57 (3.30–6.33)	<0.001
	Agreement (VCBS: 36–49)	Ref.	.
Source of information regarding COVID-19 vaccination	Physicians, scientists and scientific journals	1.26 (0.90–1.75)	0.179
	TV programs and newspapers	1.43 (0.93–2.19)	0.105
	Social media platforms	Ref.	.
<b>Neutral attitude vs. negative attitude towards COVID-19 vaccination</b>			
Sex	Male	0.64 (0.44–0.92)	0.016
	Female	Ref.	.
Age	≤ 27 years	1.38 (0.83–2.31)	0.217
	> 27 years	Ref.	.
Occupation	HCW	1.49 (0.69–3.21)	0.314
	Employed (non-HCW)	1.17 (0.69–1.96)	0.562
	Unemployed	1.10 (0.57–2.11)	0.774
	Student	Ref.	.
Education	High school or less	1.31 (0.61–2.78)	0.488
	Undergraduate	1.17 (0.73–1.87)	0.512
	Postgraduate	Ref.	.
Income	≤500 K IQD <sup>3</sup>	1.00 (0.68–1.49)	0.987
	>500 K IQD	Ref.	.
Misinformation score	No belief in misinformation	1.74 (0.85–3.54)	0.128
	Slight belief in misinformation	1.09 (0.67–1.78)	0.730
	Moderate belief in misinformation	0.89 (0.57–1.39)	0.613

**Table 4 (continued)**

Model	Nagelkerke R <sup>2</sup> = 0.245	aOR <sup>6</sup> (95 % CI <sup>7</sup> )	p value
	Strong belief in misinformation	Ref.	.
Attitude towards COVID-19 vaccine conspiracy	Disagreement (VCBS <sup>3</sup> : 7–20)	1.71 (0.61–4.79)	0.306
	Neutral (VCBS: 21–35)	4.02 (2.73–5.92)	<0.001
	Agreement (VCBS: 36–49)	Ref.	.
Source of information regarding COVID-19 vaccination	Physicians, scientists and scientific journals	0.85 (0.57–1.26)	0.415
	TV programs and newspapers	1.38 (0.85–2.25)	0.191
	Social media platforms	Ref.	.

<sup>1</sup> Misinformation score: Using three items to assess the belief in COVID-19 misinformation.

<sup>2</sup> COVID-19: Coronavirus disease 2019.

<sup>3</sup> HCW: Healthcare worker.

<sup>4</sup> K IQD: 1000 Iraqi dinars.

<sup>5</sup> VCBS: Vaccine conspiracy beliefs scale.

<sup>6</sup> aOR: Adjusted odds ratio.

<sup>7</sup> CI: Confidence interval. Statistically significant p values are highlighted in bold style.

card or a vaccination card as a prerequisite for work attendance without punishing measures against unvaccinated employees (Iraqi News Agency, 2023). The Iraqi government also initiated vaccination campaigns to enhance COVID-19 vaccine coverage, with comprehensive plans to increase vaccine supply and to expand vaccination facilities, with a particular focus on vaccinating HCWs to counter vaccine-related misinformation effectively (Iraqi News Agency, 2023; WHO Regional Office for the Eastern Mediterranean, 2023).

The findings of the current study highlighted the significant association between conspiracy beliefs and negative health behavior manifested in lower COVID-19 vaccine uptake. Extensive evidence has consistently highlighted the widespread presence of medical conspiracy theories and their impact on various aspects of health-related behaviors, including the willingness to get vaccinated and actual vaccine uptake (Sallam et al., 2021; Sallam et al., 2022; Ripp and Röer, 2022; van Mulukom et al., 2022; van Prooijen et al., 2023; Alsanafi et al., 2023; Kowalska-Duplaga and Duplaga, 2023). The adoption of conspiracy theories can exert a direct influence on individual engagement behaviors, including health-related practices (van Prooijen and Douglas, 2018; Douglas et al., 2017; Bierwaczonczek et al., 2022). For example, the detrimental impact of embracing COVID-19 conspiracy beliefs on compliance with government-imposed restrictions, adherence to preventive measures, and willingness to receive COVID-19 vaccination was shown in a study from the U.S. (Romer and Jamieson, 2020). Similarly, research conducted in Finland demonstrated that the endorsement of COVID-19 conspiracy beliefs was associated with lower support for pandemic-related governmental restrictions (Pivetti et al., 2021). In the Arab countries of the Middle East, the COVID-19 vaccine conspiracies were shown to be associated with higher rates of vaccine hesitancy/rejection (Sallam et al., 2021; Sallam et al., 2021).

In the current study, an interesting observation was the striking contrast in the determinants of participants' attitudes towards COVID-19 vaccination compared to their actual vaccine uptake. Notably, the demographic variables appeared to play a minimal role in shaping attitudes, whereas several demographic variables were significantly correlated with actual vaccine uptake. This divergence between attitudes and behavior can be attributed to the inherent distinction between what people think or feel representing attitudes, and what they actually do manifested in behavior (Yuan et al., 2023). Attitudes often reflect abstract viewpoints and personal beliefs, while behavior could be influenced by a range of external factors, including governmental policies and societal expectations (Ajzen and Fishbein, 2005; Ajzen, 2020).

**Table 5**

Associations between study variables with COVID-19 vaccine uptake in multinomial logistic regression analyses, among study participants who were adult Iraqi citizens with data collected during August–September 2022 ( $N = 2544$ ).

Model	Nagelkerke $R^2 = 0.128$	aOR <sup>6</sup> (95 % CI <sup>7</sup> )	$p$ value
<b>COVID-19 vaccine uptake vs. no history of COVID-19 vaccination</b>			
Sex	Male	1.27 (0.97–1.64)	0.079
	Female	Ref.	.
Place of residence	Baghdad	0.56 (0.43–0.73)	<0.001
	Outside Baghdad	Ref.	.
Occupation	HCW <sup>3</sup>	1.69 (0.93–3.07)	0.083
	Employed (non-HCW)	0.70 (0.52–0.93)	0.015
	Unemployed	1.00 (0.62–1.60)	0.985
History of COVID-19	Student	Ref.	.
	Yes	1.53 (1.19–1.97)	0.001
	No	Ref.	.
Income	≤500 K IQD <sup>4</sup>	0.66 (0.50–0.88)	0.004
	>500 K IQD	Ref.	.
Misinformation score <sup>1</sup>	No belief in misinformation	2.29 (1.45–3.61)	<0.001
	Slight belief in misinformation	1.49 (1.04–2.15)	0.031
	Moderate belief in misinformation	1.08 (0.75–1.54)	0.687
	Strong belief in misinformation	Ref.	.
Attitude towards COVID-19 <sup>2</sup> vaccine conspiracy	Disagreement (VCBS <sup>5</sup> : 7–20)	3.65 (2.16–6.18)	<0.001
	Neutral (VCBS: 21–35)	2.06 (1.56–2.71)	<0.001
	Agreement (VCBS: 36–49)	Ref.	.
Source of information regarding COVID-19 vaccination	Physicians, scientists and scientific journals	1.46 (1.10–1.94)	0.009
	TV programs and newspapers	1.13 (0.81–1.58)	0.469
	Social media platforms	Ref.	.

<sup>1</sup> Misinformation score: Using three items to assess the belief in COVID-19 misinformation

<sup>2</sup> COVID-19: Coronavirus disease 2019

<sup>3</sup> HCW: Healthcare worker

<sup>4</sup> K IQD: 1000 Iraqi dinars

<sup>5</sup> VCBS: Vaccine conspiracy beliefs scale

<sup>6</sup> aOR: Adjusted odds ratio

<sup>7</sup> CI: Confidence interval. Statistically significant  $p$  values are highlighted in bold style.

Thus, it is conceivable that individuals may hold certain attitudes about vaccination but, when faced with practical circumstances, their behavior may align differently.

The major finding in this study was demonstrating the association between vaccine conspiracy beliefs, misinformation, and negative attitudes towards COVID-19 vaccination, as well as a reduced likelihood of vaccine uptake. Plausible explanations of this association could be based on the previous and recent evidence highlighting the impact of conspiracies and misinformation on vaccination behavior (van Mulukom et al., 2022; Bertin et al., 2020; Altman et al., 2023; Loomba et al., 2021). Conspiracy theories and misinformation have the potential to deter individuals from getting vaccinated through reducing vaccine confidence (Ullah et al., 2021; Jolley and Douglas, 2014). Endorsing conspiracy beliefs can undermine trust in healthcare systems, governmental agencies, and pharmaceutical companies (Milosević Đorđević et al., 2021; Bonetto and Arciszewski, 2021). Trust is an essential aspect in decision-making process to get vaccinated (Larson et al., 2018; Sapienza and Falcone, 2022). Hence, compromised trust could result in

negative attitude towards vaccination due to fear of not being provided with accurate and safe preventive measures (Seddig et al., 2022).

Additionally, the current study showed that the source of information could play an important role in COVID-19 vaccine uptake. Health misinformation often spreads through channels that may lack credibility, such as social media platforms (Muhammed and Mathew, 2022; Pennycook and Rand, 2021; Suarez-Lledo and Alvarez-Galvez, 2021). When individuals rely on social media for health information, they may inadvertently expose themselves to distorted views on vaccine safety and efficacy (Ngai et al., 2022). The current study results were consistent with this point of view by revealing that COVID-19 vaccine uptake was lower among participants who relied on social media platforms compared to individuals who sought vaccine information from scientifically credible sources (e.g., physicians, scientists, etc.).

Besides the important roles of vaccine conspiracy beliefs and misinformation, it is worth mentioning the other factors were linked with actual COVID-19 vaccine uptake in this study. These factors could offer useful insights into the complexity of the vaccine uptake as a health behavior. First, participants living outside the Capital, Baghdad exhibited higher COVID-19 vaccine uptake. This suggests that targeted efforts should be made to prioritize vaccination campaigns in the Capital city. Additionally, lower income was associated with lower COVID-19 vaccine uptake, which emphasizes the importance of addressing socioeconomic disparities to ensure equitable access to COVID-19 vaccination. Furthermore, the history of COVID-19 infection appeared to influence vaccination behavior, though the exact nature of this relationship is not discernible. It is possible that individuals who had experienced the disease may have been less complacent about vaccination due to their disease experience. However, establishing a direct cause-and-effect relationship in this regard can be challenging and requires further investigation. Finally, in this study, university/college students, as a group, exhibited higher COVID-19 vaccination rates. This aligns with previous research and can be attributed to the view that students are generally more informed and engaged in health-related matters (Sallam et al., 2021; Patrinely et al., 2020).

Lastly, it is essential to acknowledge the limitations of this study, which should be considered carefully in any attempt to generalize the results as follows. The possibility of response bias should be considered with participants who chose to respond to the survey being not representative of the entire adult population in Iraq. Additionally, individuals with stronger opinions, whether positive or negative, about COVID-19 vaccination might have been more motivated to participate in the study resulting in response bias, with subsequent over- or under-estimation of COVID-19 vaccine hesitancy/resistance and misinformation levels. The study employed a cross-sectional design, which is helpful for elucidating associations but cannot establish causality. Additionally, the cross-sectional design precluded drawing definitive conclusions about the temporal trends in vaccination attitudes and behaviors. It is recommended to conduct longitudinal studies to establish causal relationships and to analyze the temporal trends. The current study utilized the chain-referral sampling method to recruit participants, which is a non-random sampling method possibly introducing selection bias; therefore, the sample may not be fully representative of the broader adult Iraqi population. In addition, the study inevitably excluded certain groups, such as individuals without internet access, further deepening the issue of possible selection bias. The findings of this study may not be easily generalizable to other regions or countries with different cultural, social, or healthcare contexts, based on the attributes of vaccine hesitancy as a phenomenon. Subsequently, this could compromise the generalizability of the study results on the global level. Social desirability bias should be considered since the participants might have provided what they believed as socially acceptable responses. This could have led to over-reporting positive attitudes towards vaccination and under-reporting negative vaccination attitudes endorsing conspiracy beliefs.

## 5. Conclusions

This study provided valuable insights into the interplay between COVID-19 vaccine conspiracies, COVID-19 misinformation, and negative health attitudes and behaviors, which were manifested in lower COVID-19 vaccine uptake and unfavorable attitudes towards the vaccine.

These results emphasized the critical need for targeted interventions aiming to address misinformation and to enhance COVID-19 vaccine literacy. Engaging HCWs as advocates for vaccination can play key role in improving vaccine acceptance and uptake among, highlighted by their significant role as a source of information among participants who had higher rates of COVID-19 vaccine uptake. Furthermore, tailoring communication strategies to specific demographics can be an important measure for effectively countering COVID-19 vaccine-related uptake challenges. Ultimately, these strategies can help to increase vaccine acceptance resulting in a positive impact on the global health.

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## CRediT authorship contribution statement

**Malik Sallam:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nariman Kareem:** Writing – review & editing, Validation, Methodology, Investigation, Data curation. **Mohammed Alkurtas:** Writing – review & editing, Validation, Methodology, Investigation, Data curation.

## 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 (Malik Sallam).

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2024.102791>.

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