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The impact of health status on attitudes toward COVID-19 vaccination

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Abstract

Background and Aims: The COVID-19 outbreak has had an overwhelming effect on societies' access to essential services. Human-to-human transmission facilitates the spread of the disease, as do other conditions, such as temperature. Individuals with underlying health conditions are at increased risk of acquiring and suffering the devastating effects of COVID-19. Consequently, vaccine manufacturing was envisaged as a milestone toward "normalizing" the world. While scholarly attention has focused on attitudes toward vaccination, the relationship between health status and attitudes toward vaccination is understudied. This study attempted to fill this knowledge gap by assessing the impact of health status on attitudes toward the COVID-19 vaccine.

Methods: We developed a 26-item questionnaire titled "Attitudes toward COVID-19 Vaccination Scale" for data collection. A total of 1047 school or university staff members from 22 countries completed the questionnaire. The data were initially validated using exploratory factor analysis to determine its structure and subsequently analyzed using SPSS version 28. Two-way factorial analysis of variance and multiple regression analysis were performed to understand the influence of health status on attitudes toward vaccination.

Results: The results showed a direct effect of health status on attitudes toward COVID-19 vaccination, (Step 1; $\beta = 0.11$, $p = 0.001$; Step 2: $\beta = 0.10$, $p = 0.001$). In Step 2 also, vaccination status ($\beta = 0.22$, $p = 0.001$) and place of residence ($\beta = -0.08$, $p = 0.04$) also influenced attitudes towards vaccination. Health status also moderated the relation between attitude and education level ($F[3, 1038] = 3.04$) of participants.

Conclusion: Results show possible fear and hesitancy toward COVID-19 vaccination among those with underlying health conditions. Therefore, expeditious sensitization programs may be needed to promote the importance of vaccination for developing resistance against COVID-19 and vaccine acceptance. However, such initiatives should target vulnerable groups in society. Policymakers could focus on improving

sensitization toward COVID-19 vaccination among those living with underlying health conditions.

KEYWORDS
attitudes, COVID-19, health status, vaccination

1 | INTRODUCTION

The novel coronavirus (COVID-19) disease is caused by the severe acute respiratory syndrome coronavirus 2,[1–3] and is believed to have been originally transmitted from bat–human; currently, it can be transmitted from human–human in respiratory droplets. The major symptoms include, but are not limited to, respiratory difficulties, fever, cough, and muscle pain.[4–8] The ravaging effects of COVID-19 are widespread, with a high incidence of infection and death in the Americas, Europe, and South-East Asia.[9–11] According to the World Health Organization (WHO), as of April 27, 2022, there had been 508,041, 253 confirmed cases of COVID-19 globally and 6,224,220 deaths[9]; Europe had 213,498,77 cases and 1,981,928 deaths, while America confirmed 152,596,113 cases and 2,719,827 deaths.[9] Lockdowns and international travel bans restricting population movement have been eased worldwide. However, the threat of a fourth wave lingers, and countries are encouraging citizens to adopt precautionary measures to avert an outbreak.[12] Concurrent interventions, such as social distancing, vaccination, regular hand washing, and masks, have been widely accepted as measures that curb disease spread.[11]

While human-to-human transmission has received enormous attention,[13] studies have identified other conditions which contribute to the spread of COVID-19 in some countries.[13–15] For example, in Bahrain,[16] Brazil,[17] China,[18] Germany,[19] and the United States,[20–23] climate conditions and environmental pollution have emerged as conditions which may facilitate the spread of the disease. For example, temperature, air quality, humidity, and wind speed correlate with an increase in COVID-19 infections; specifically, an exponential increase in the number of cases as temperatures decrease or humidity increases. This could suggest that while countries are establishing protective measures and policies, they must also address ancillary factors which may facilitate the spread of the disease.

The complexity, myths, misinformation, and euphoria surrounding the onset of COVID-19 and controversies over vaccine manufacturing cannot be overemphasized. The COVID-19 pandemic surprised the world, and health systems or interventions were developed after disease outbreak. Contemporary discourse is focused on keeping society safe and guarding against another wave of infection.[14,17,19,20] Governments are easing restrictions while setting sights on policies to safeguard societies. Indeed, empirical studies on attitudes toward vaccination, which is believed to boost the immune system to fight the disease,[24–26] are recommended to provide a snapshot of public opinion concerning vaccine acceptance readiness. As a psychological construct, attitudes refer to public perceptions which determine an individual's willingness to accept or participate in a given phenomenon. Studies on vaccine acceptance will provide ideas on the level of acceptance and policy direction.

Vaccines are essential in promoting lives and reducing the spread of the disease.[27,28] According to the WHO,[9] as of April 2022, over 11 billion vaccines had been administered globally, with 3.3 billion people estimated to be fully vaccinated. However, the challenge is that most countries and experts recommend COVID-19 vaccines every 6 months as part of the control measures.[29] While twice a year vaccination has been found effective in protecting against infection and creating immunity against the disease, there are still concerns regarding whether society will be open to continuing this vaccination schedule. Among other factors, this concern has provided the impetus for scholarly research to understand societal attitudes toward vaccination to direct advocacy and policy.

Studies have been conducted worldwide to understand the attitudes toward COVID-19 vaccination.[24–26] For instance, in a Chinese study, Wang et al.[26] used a cross-sectional design to explore the acceptance of the COVID-19 vaccine among adult Chinese. The majority of study participants were willing to accept the vaccine because they believed it would help prevent the spread of the disease. The results also showed that males and married couples were more likely to receive the vaccine, and individuals with a medically compromised individuals at risk of infection were more likely to accept vaccination. Furthermore, other factors, such as vaccine safety and price, could be a barrier to vaccination. Unfortunately, this study had some limitations in that it was conducted before developing a breakthrough vaccine, and the study population was limited to Chinese adults, which could affect the generalizability of the findings. In a more recent study, Quinaibi et al.[30] compared vaccine hesitancy between Arab-speaking health workers and others. While the rate of vaccine acceptance was lower among Arab health workers, most participants were concerned about the side effects and safety of the vaccine. However, this finding may be inaccurate because the authors compared the perspectives at item level. In contrast, it is more appropriate to aggregate attitude scores to identify factors that may influence the extent of vaccine acceptance.

Individuals with underlying health conditions could be at greater risk of acquiring COVID-19.[4–8,31–35] For example, the review by Al-Quteimat et al.[4] found that patients with cancer were susceptible to COVID-19, severe complications, and risk of dying from cancer. Ehmsen et al.[7] reported that patients with cancer were more prone to COVID and had worse prognoses. This was attributed to the underlying cancer condition that led to immunosuppression.

In addition, Sinha and Kundu[36] noted that acquisition of COVID-19 by patients with cancer could enhance the progression of the disease, while Farooque et al.[8] reported a higher mortality among patients with solid tumors compared to the general population. The psychological impact of COVID-19, in the form of anxiety, fear, stress, and distress, on the general population and affected individuals has been noted, with a call for increased attention to enhancing the population's well-being.[37–41] While these studies may provide a useful guide for policy development, they do not provide information concerning the influence of health status on COVID-19 vaccination uptake. Most importantly, the risk of disease for individuals with underlying health conditions supports the need to study the effects of health status on attitudes toward vaccination.

The outbreak of COVID-19 has had a devastating impact on education, with most schools closing down or adopting online learning. Indeed, empirical evidence has been at the heart of prevention and protective measures.[24–27] Unfortunately, such scholarly debate is yet to be extended to the influence of health status on attitude towards vaccination. To fill the scholarly gap, this study attempted to understand the impact of health status on attitudes towards vaccination. With the advent of COVID-19 vaccines, schools are slowly embracing the idea of a hybrid system of education. However, vaccines are recommended for school staff and adult students to protect lives and prevent disease spread. In view of this, the target population for this study was individuals working at all levels of education (primary, secondary, and university). The following questions guided the study reported here:

1. Do available vaccine types in a given context influence school and university staff attitudes toward COVID-19 vaccination?
2. Does the health status of school and university staff impact their attitudes toward acceptance of the COVID-19 vaccine?
3. Will health status and type of vaccine influence the school and university staff attitudes toward vaccination?

2 | METHODS

2.1 | Study participants

To develop a snapshot of the impact of health status on school and university staff attitudes toward vaccination, potential participants were recruited from different countries. The inclusion criteria for the study were as follows: (a) school or university staff; (b) internet access to complete the questionnaire; (c) older than 18 years of age; and (d) provided consent to participate in the study.

The online link to the questionnaire was shared on social media platforms such as Facebook, WhatsApp, and LinkedIn and sent directly to the personal email addresses of staff, who could forward it to colleagues. A total of 1067 participants completed the online questionnaire. We grouped the participants based on continent to improve understanding of the findings. However, only few data were collected from North and South America; therefore, we decided to delete those entries, leaving 1047 responses from 22 countries for consideration in this study.

2.2 | Instrument

This study was guided by a cross-sectional design, which is usually conducted to understand the perspective of a section of the population about a given phenomenon at a point in time. Amidst the current wave of COVID-19 and its impact on the education system, it was appropriate to focus on COVID-19 vaccine uptake among school staff. This would provide a snapshot of how school and university staff are embracing the COVID-19 vaccine.

To have a comprehensive understanding of the attitudes toward vaccination, a quantitative approach for this study was deemed appropriate to enable the collection of a large amount of data. Since there was a need for a comprehensive tool to capture the key issues concerning attitudes toward COVID-19 vaccination, we developed a new tool known as “Attitudes toward COVID-19 Vaccination Scale” (ACVS). The scale was validated by factor analysis.

The tool used for data collection consisted of two sections. The first section consisted of demographic variables, which included the following: gender, age, education level, place of residence, health status, vaccine type available, COVID-19 acquisition status, and vaccination status.

The second section consisted of the ACVS, which contained 27 items anchored on a 5-point Likert scale, ranging from 1 (*do not agree*) to 5 (*strongly agree*). The instrument was validated by exploratory factor analysis (SPSS version 28) to determine the factor structure (Table 1). The correlation matrix revealed many coefficients of at least 0.30. The Kaiser–Meyer–Olkin value was 0.94, and Bartlett's test of sphericity was significant ($p = 0.001$).

Principal component analysis revealed the presence of four components with eigenvalues exceeding 1, explaining 40%, 8%, 6%, and 4% of the variance. However, the scree plot showed a two-clear break, explaining the retention of two-factor components. The two-factor structure explained 48% of the cumulative variance in attitudes. This informed the decision to retain the two-factor structure of the ACVS. While six items loaded with a value of at least 0.30 on Factor I, which was referred to as Opinion toward Vaccination Scale (OVS), 20 items loaded on Factor II, which was referred to as Perceived Hesitancy Scale (PHS). Unfortunately, there was no loading on one item, and thus, that item was deleted.

Overall, the ACVS was deemed as having 26 items with two factors, namely, OVS ($n = 6$) and PHS ($n = 20$). While three items were positively worded (in the OVS), the remaining 23 were negatively worded (in the PHS). During analysis, the negatively worded statements were reverse coded.

The mean score, the sum mean divided by number of items, was computed for this study. On the OVS, a mean score of at least three was interpreted as a favorable opinion toward vaccination. Furthermore, on ACVS and PHS, a mean score of ≤3 was interpreted as more favorable and less hesitant to receive vaccination, respectively.

TABLE 1 Summary of loadings on Attitudes toward COVID Vaccination Scale

S. no.	Items	Factor I	Factor II
1	In my opinion, COVID-19 vaccine protects me against COVID-19 disease	0.58	
2	In my opinion, to return to physical face-to-face teaching, it is important for teachers and instructors to be vaccinated against COVID-19	0.83	
3	In my opinion, to return to physical face-to-face teaching, it is important for students to be vaccinated against COVID-19	0.73	
4	In my opinion, I am afraid of the unknown side effects		0.72
5	In my opinion, researchers did not have enough time to test vaccine safety		0.74
6	In my opinion, vaccine production was rushed		0.69
7	In my opinion, I do not trust the healthcare policies in my area		0.56
8	In my opinion, the studies did not involve enough participants		0.72
9	In my opinion, there is no value for the vaccine because of the new strains	0.42	
10	In my opinion, I do not trust company studies	0.33	
11	In my opinion, there are no published studies on vaccines		0.67
12	In my opinion, the COVID-19 pandemic is exaggerated to benefit pharma		.69
13	In my opinion, most infected people recover		0.43
14	In my opinion, vaccine immunity is short		0.74
15	In my opinion, vaccines irreversibly alter DNA		0.72
16	In my opinion, I am afraid/worried of the side effects mentioned in studies or media		0.62
17	In my opinion, the coronavirus, as well as the vaccine, are a conspiracy		0.61
18	In my opinion, the vaccine can cause COVID-19		0.39
19	In my opinion, the vaccine may cause death		0.60
20	In my opinion, the vaccines were not tested in my area (ethnicity)	0.37	
21	In my opinion, the infection rate is decreasing in my area		0.60
22	In my opinion, I do not believe in vaccines in general		0.60
23	In my opinion, most vaccinated people had side effects		0.54
24	In my opinion, most people already had COVID-19		0.60
25	In my opinion, vaccines contain aluminium		0.62
26	In my opinion, I may get COVID-19 after the vaccine		0.40
27	In my opinion, the vaccine is not available in my area		

Note: Factor I = Opinion toward Vaccination Scale; Factor II = Perceived Hesitancy Scale.

Computation of the reliability of the scale using Cronbach alpha yielded the following psychometric properties: ACVS (0.90), OVS (0.93), and PHS (0.76).

2.3 | Procedure

The Social Sciences Ethics Committee at United Arab Emirates University approved this study (approval number ERS_2021_7322). Due to the current wave of COVID-19, the online platform Google Forms was used for data collection. An information statement about the study and links to the questionnaire were emailed to institutional heads to forward to members of their staff. Weekly reminders were sent to institutional heads and other individuals to encourage participation. Social media platforms such as WhatsApp, Facebook, LinkedIn, Instagram, and Twitter were used to conduct a digital campaign targeting a convenience sample in several countries worldwide. Additionally, research team members shared the study information statement and link to Google Forms on their social media platforms. English and Arabic versions of the questionnaire were used for data collection between April and June 2021. Data were collected anonymously, and no personal information about

participants was collected. Informed consent was obtained from each participant before they took part in the study. Neither reimbursement nor financial rewards were given to study participants.

2.4 | Data analysis

After 3 months, the online platform was locked to avoid further completion of the questionnaire, and the data was transferred to Microsoft Excel for screening. Afterward, the data were transferred to Statistical Package for Social Science version 28 (SPSS) for further analysis. Since the data were normally distributed, the research team used parametric tests to answer the research questions.

To answer research questions 1 and 2, a two-way analysis of variance (ANOVA) was used to understand the moderation effect of available vaccine type and health status on other demographic variables and attitudes toward vaccination. Levene's test was used to assess the homogeneity of variance. Interaction effects were assumed on a two-tailed significance test levels ($p < 0.05$ or $p < 0.01$). Moreover, the weight of each result was assessed using the effect size, which was interpreted as follows: small (0.01–0.05), moderate (0.06–0.09), and large (≥0.1).[42]

To answer research question 3, hierarchical multiple regression was computed to assess whether vaccine type and health status would directly influence attitudes toward vaccination. Vaccine type and health status were entered, and other demographic variables were added to the model in Step 2. Predictions were assumed on two-tailed significance test levels ($p < 0.05$ or $p < 0.01$). The following checks were made to ensure that the data met the following assumptions: homogeneity of variance, homoscedasticity, and multicollinearity.[42]

3 | RESULTS

Table 2 summarizes the demographic characteristics of study participants. A total of 1047 participants from three continents working in schools and universities took part in this study, of which 68% were female and 32% were male. Participants were divided into four groups based on years of age as follows: 18–25 (15%); 26–35 (41%); 36–45 (32%); and ≥46 (12%) years old. Regarding educational qualification, 45% of participants had a high school qualification, 24% had a bachelor's degree, and 6% had a master's degree or above (see Table 1).

TABLE 2 Demographic characteristics of study participants

Demographics	Frequency	Percentage (%)
Sex		
Male	338	32
Female	709	68
Age		
18–25	159	15
26–35	426	41
36–45	337	32
46 years and above	125	12
Qualification		
High school	467	45
Certificate	262	25
Bachelor's degree	259	24
Master's degree or above	59	6
Place of residence		
Africa	209	20
Asia	688	66
Europe	150	14
Health status		
Very healthy	296	28
Minor/chronic health issues	851	72
COVID-19 acquisition status		
Yes	173	17
No	874	83
Vaccination status		
Already vaccinated	639	61
Not yet but intend to	278	26
Not yet and won't	130	13
Vaccine available in my area ($n = 1045$)		
Western vaccine	474	45
Non-western vaccine	382	37
Both	189	18

3.1 | Interaction effect of vaccine type on attitudes

A two-way between-groups ANOVA test was conducted to explore whether available vaccine type in a given context would moderate the relationship between other variables and attitudes (Table 3). First, there was an interaction effect between vaccine type and age on the opinion about vaccination only ($F[6, 1033] = 3.24$, $p = 0.004$, small effect size, partial $\eta^2 = 0.02$). Post-hoc comparison using Tukey's honestly significant difference (HSD) test found no difference between the participants.

Second, there were interaction effects of available vaccine and sex on perceived hesitancy ($F[2, 1039] = 5.83$, $p = 0.003$, partial $\eta^2 = 0.01$) and attitudes toward vaccination ($F[2, 103] = 4.84$, $p = 0.008$, partial $\eta^2 = 0.009$). The results of the mean score showed that females were less hesitant and more positive toward vaccination than males.

Third, available vaccine moderated the relationship between educational qualification of participants and opinion ($F[6, 1033] = 2.25$,

TABLE 3 Interaction effect of Available Vaccine Type on Attitudes

Variable	*df*	MS	*F*	*p*	η^2
Vaccine available × age					
OVS	6	46.01	3.24	0.004**	0.02
PHS	6	573.32	1.93	0.07	0.01
ACVS	6	647.59	1.88	0.08	0.01
Vaccine available × gender					
OVS	2	34.96	2.45	0.09	0.005
PHS	2	1757.26	5.83	0.003**	0.01
ACVS	2	1705.06	4.84	0.008**	0.009
Vaccine available × qualification					
OVS	6	32.01	2.25	0.04*	0.01
PHS	6	2681.37	9.33	0.001**	0.05
ACVS	6	2642.46	7.87	0.001**	0.04
Vaccine available × place of residence					
OVS	3	10.31	0.73	0.53	0.002
PHS	3	1433.67	5.22	0.001*	0.02
ACVS	3	1228.62	3.78	0.01*	0.01
Vaccine available × health status					
OVS	2	53.97	3.77	0.02*	0.007
PHS	2	713.63	2.37	0.09	0.005
ACVS	2	479.78	1.37	0.26	0.003
Vaccine available × COVID-19 acquisition status					
OVS	2	87.56	6.15	0.002**	0.01
PHS	2	201.65	0.661	0.52	0.001
ACVS	2	283.83	0.80	0.45	0.002
Vaccine available × vaccination status					
OVS	4	23.38	1.78	0.13	0.007
PHS	4	835.97	3.13	0.01**	0.01
ACVS	4	976.33	3.01	0.02*	0.01

Abbreviations: ACVS, Attitude toward COVID-19 Vaccination Scale; *df*, degree of freedom; MS, mean squares; OVS, Opinion toward Vaccination Scale; PHS, Perceived Hesitancy Scale.

*$p < 0.05$; **$p < 0.01$.

$p = 0.04$, partial $\eta^2 = 0.01$), perceived hesitancy ($F[6, 1033] = 9.33$, $p = 0.001$, with a moderate effect size, partial $\eta^2 = 0.05$), and attitudes toward vaccination ($F[6, 1033] = 7.87$, $p = 0.001$, partial $\eta^2 = 0.04$). Post-hoc comparison using Tukey's HSD test showed that participants with higher education levels were more likely to be less hesitant and positive toward receiving the vaccine than those with lower education levels.

Fourth, there was interaction effect between vaccine type and place of residence on perceived hesitancy ($F[3, 1037] = 5.22$, $p = 0.001$, partial $\eta^2 = 0.02$) and attitudes ($F[3, 1037] = 3.78$, $p = 0.01$, partial $\eta^2 = 0.01$). Post-hoc comparison using Tukey's HSD test showed a significant difference among participants, with those in Africa more hesitant and less positive toward vaccination than their counterparts in Asia and Europe.

There was also interaction effect of vaccine type available and health status on opinion toward vaccination only ($F[3, 1037] = 2.56$, $p = 0.05$, partial $\eta^2 = 0.007$). Similarly, there was interaction effect of vaccine type on COVID-19 acquisition status and opinion toward vaccination only ($F[2, 1039] = 6.15$, $p = 0.002$, partial $\eta^2 = 0.01$). In terms of health status, the mean score showed that those with minor/chronic health issues had a more positive opinion toward vaccination than those without health issues. Related to this, those who had been diagnosed with COVID-19 had a more positive opinion about vaccination than those who indicated otherwise.

Furthermore, there was interaction effect between vaccine type and vaccination status on perceived hesitancy ($F[4, 1036] = 3.13$, $p = 0.01$, partial $\eta^2 = 0.01$) and attitudes toward vaccination ($F[4, 1036] = 3.01$, $p = 0.02$, partial $\eta^2 = 0.01$). Post-hoc comparison using Tukey's HSD test showed that those who had been vaccinated and intended to be vaccinated were less hesitant and more positive on vaccination than those who indicated they did not intend to vaccinate.

3.2 | Impact of health status on attitudes

Table 4 summarizes the results of a two-way ANOVA test performed to ascertain the relationship between the interaction effect of health status and attitudes toward vaccination. First, there was interaction effect of health status on age and opinion toward vaccination only ($F[3, 1038] = 8.26$, $p = 0.001$, partial $\eta^2 = 0.02$). Post-hoc comparison using Tukey's HSD test showed no relationship between the participants.

Second, there was interaction effect of health status and education qualification on perceived hesitancy ($F[3, 1038] = 3.43$, $p = 0.02$, partial $\eta^2 = 0.01$) and overall attitudes toward vaccination ($F[3, 1038] = 3.04$, partial $\eta^2 = 0.009$). Post-hoc comparison using Tukey's HSD test showed that those with lower educational levels were more hesitant and appeared to have negative attitudes toward vaccination than those with higher education levels.

Third, there was interaction effect of health status on place of residence on opinion toward vaccination only ($F[3, 1042] = 5.44$, $p = 0.02$, partial $\eta^2 = 0.005$). Post-hoc comparison using Tukey's HSD test showed that those who indicated they were residing in Africa were less positive on opinion than those who indicated otherwise.

Fourth, there was interaction effect of health status on COVID-19 acquisition status and perceived hesitancy ($F[1, 1042] = 40.67$, $p = 0.001$, partial $\eta^2 = 0.04$) and attitudes ($F[1, 1042] = 36.28$, $p = 0.001$, partial $\eta^2 = 0.03$). The mean score showed that on perceived hesitancy, those who had been diagnosed with COVID-19 were less hesitant toward vaccination than those who had not been diagnosed. However, on

TABLE 4 Interaction effect of health status on attitudes

Variable	*df*	MS	*F*	*p*	η^2
Health status × age					
OVS	3	116.51	8.26	0.001*	0.02
PHS	3	123.64	0.42	0.74	0.001
ACVS	3	343.23	0.57	0.63	0.002
Health status × gender					
OVS	1	50.44	3.53	0.06	0.003
PHS	1	21.59	0.07	0.79	0.001
ACVS	1	6.03	0.02	0.90	0.001
Health status × qualification					
OVS	3	14.55	1.02	0.38	0.003
PHS	3	1014.06	3.43	0.02**	0.01
ACVS	3	1042.32	3.04	0.03**	0.009
Health status × place of residence					
OVS	1	78.07	5.44	0.02**	0.005
PHS	1	920.27	3.09	0.08	0.003
ACVS	1	462.27	1.33	0.25	0.001
Health status × COVID-19 acquisition status					
OVS	1	4.62	0.32	0.57	0.001
PHS	1	11857.51	40.67	0.001*	0.04
ACVS	1	12330.28	36.28	0.001*	0.03
Health status × vaccination status					
OVS	2	65.61	5.02	0.007*	0.01
PHS	2	740.96	2.78	0.06	0.005
ACVS	2	699.46	2.16	0.12	0.004

Abbreviations: ACVS, Attitude toward COVID-19 Vaccination Scale; *df*, degree of freedom; MS, mean squares; OVS, Opinion toward Vaccination Scale; PHS, Perceived Hesitancy Scale.
*$p < 0.01$; **$p < 0.05$.

overall attitudes, those who had acquired COVID-19 were less positive toward vaccination than those who indicated otherwise.

Last, there was interaction effect of health status on vaccination status and opinion only ($F[2, 1040] = 5.02$, $p = 0.007$, partial $\eta^2 = 0.01$). Post-hoc comparison showed a difference between vaccinated participants and participants who did not intend to be vaccinated, with the former having a more unfavorable opinion than the latter.

3.3 | Influence of health status and vaccine type on attitudes

A hierarchical multiple regression analysis was performed to assess the influence of health status and available vaccination type on attitudes toward overall vaccination while controlling for other demographics (Table 5). In Step 1, health status and vaccination type were entered in the model. The two variables made a significant contribution of only 2% in the variance in attitudes, ($F[2, 1041] = 7.05$, $p = 0.001$). However, only health status ($\beta = 0.11$, $p = 0.001$) made a significant contribution to the variance in attitudes.

In Step 2, the addition of six demographic variables contributed 9% to the variance in attitudes. The overall model contributed 11% to the variance in attitudes ($F[8, 1034] = 13.34$, $p = 0.001$). In the second model, the largest contribution of the variance was vaccination status ($\beta = 0.22$, $p = 0.001$). Once again, health status ($\beta = 0.10$, $p = 0.001$) made a significant contribution to the variance in attitudes. Also, place of residence made a significant contribution to the variance in attitudes.

TABLE 5 Summary of hierarchical multiple regression results

Category	*B*	*β*	*t*	*p*
Step 1				
Health status	4.45	0.11	3.43	0.001*
Vaccination available	0.96	0.04	1.23	0.22
Step 2				
Health status	4.07	0.10	3.26	0.001*
Vaccination available	0.25	0.01	0.32	0.75
Age	−0.83	−0.04	−1.25	0.21
Gender	−0.52	−0.01	−0.39	0.70
Place of residence	−2.67	−0.08	−2.10	0.04**
Qualification	−0.48	−0.02	−0.70	0.48
COVID-19 acquisition status	0.73	0.01	0.48	0.63
Vaccination status	5.98	0.22	6.53	0.001*

*$p < 0.01$; **$p < 0.05$.

4 | DISCUSSION

Global efforts are underway to encourage COVID-19 vaccination every 6 months in an attempt to boost the immune system. In this study, we aimed to understand the impact of individual health status on attitudes toward COVID-19 vaccination. Our results show that health status could possibly impact attitudes toward receiving or not receiving the vaccine, and that health status was a significant contributor to the variance in attitudes toward vaccination. These results appear to suggest that healthier individuals would be more inclined to accept the COVID-19 vaccine. Conversely, unfavorable attitudes toward receiving the vaccine could increase as individual health deteriorates. The intricate relationship between underlying health conditions and COVID-19 infection has been reported in many studies.[31–35] Furthermore, individuals with underlying conditions diagnosed with COVID-19 are more likely to die or suffer harsh

consequences.[8] Unfortunately, our findings show that individuals at higher risk of worse outcomes may have unfavorable attitudes toward vaccination. This pattern could be attributed to fears about the efficacy of the COVID-19 vaccine or its potential to weaken the immune system; thus, the result may be that only the healthiest population is more favorable toward receiving the vaccine. To control the spread of COVID-19, the world requires support for vaccine development from the healthy population. Vaccines have helped society return partly to normal, and such gains cannot be compromised. This potentially calls for more global education toward easing fears and encouraging individuals, especially those with underlying health conditions, to accept COVID-19 vaccination.

The moderation effects of health status and vaccine type on vaccination status present an interesting trend. For example, concerning health status, those who had received the vaccine were more likely to have an unfavorable opinion than those who had not been vaccinated. In addition, concerning vaccine type and vaccination status, those who had been vaccinated and those who intended to receive the vaccine were less hesitant and had more positive attitudes. It appears that individuals who had received the vaccine were not too concerned about where the vaccine was manufactured and were interested in taking them to boost their immune system. Likely, individuals who were vaccinated or planned to do so understood the usefulness of the vaccines and committed toward receiving them. Conversely, the identified trend between health status and vaccination status could be attributed to the experience of individuals who were vaccinated and probably had a health condition, since it is possible that those with health conditions were going through relapse, side effects, or worsening of the health condition after vaccination. It is evident that those with health condition are more likely to acquire COVID-19 as well as experience the devastating impact of the disease.[31–35] It is important for international organizations such as the WHO to take the lead in investigating some of the health effects of the vaccine, which could inform remediation strategies. This probably calls for more qualitative studies to gather in-depth information about the experiences of individuals with chronic health problems who received the vaccine.

Individual vaccination status had a direct effect on attitudes toward vaccination. Specifically, individuals who had received the vaccine appear to be more receptive toward vaccination. The effect of COVID-19 on many aspects of society cannot be overemphasized. The availability of the vaccine should serve as a relief to humanity; however, there has been much discourse on the efficacy of the vaccine and deliberations about its side effects.[43,44] In countries such as Australia, United Kingdom, and United States of America, conspiracy theories conjecture that the COVID-19 vaccine has been developed to annihilate the global population. The findings in this study show that vaccinated individual had positive attitudes toward the vaccine, as it may enhance their immune system and protect them from suffering the effects of COVID-19. There could be comparative studies to understand the accounts of individuals who acquired the disease after vaccination and those who acquired the disease without being vaccinated. This study shows that vaccinated individuals may have positive experiences. This could be at the frontline of public advocacy and sharing positive stories to the general populace to change the minds of those who might have bought into the conspiracy theories.

The continent of residence provided useful insight into participants' attitudes toward the vaccines. With respect to the interaction effect of vaccine type and health status, participants in Africa appeared to be more hesitant, have an unfavorable opinion, and generally held a negative attitude toward vaccination. This is probably not surprising because of the underlying poor health systems in Africa.[44] Potentially, African countries seemed not to have the financial muscle or technology to develop their own vaccines.[45,46] This appears to have led to a situation where less people have been vaccinated in Africa compared to Asia and Europe. WHO appears to be working toward ensuring equitable access to the vaccine for all[47]; however, the vaccine supply in Africa appears to be limited and, thus, not accessible to all persons. The unavailability of the vaccine in Africa appears to have contributed to limited public education about the importance of the vaccine to the larger populace. It appears that Africa is lagging when it comes to vaccine availability and public sensitization about mass vaccination. This finding may imply that even in advanced countries, some geographic areas, such as hard to reach communities or areas with a high population of people with low socioeconomic status, may struggle to make the vaccine available to its people. It is probably exigent for WHO to expedite efforts toward working with governments to make the vaccine available to the people in Africa and similar situations. The availability and expedition of public education on the vaccine could help change public perception and enhance public confidence toward receiving the COVID-19 vaccine.

The individual level of education appears to have an impact on attitudes toward vaccination. Regardless of health status or the vaccine type available in a given context, individuals' education level could play a fundamental role on whether or not they would accept the vaccine. The results of this study seem to show that the more educated the individual, the more likely they would have positive attitudes toward the vaccine. This is probably expected because educated persons may read about the disease and the vaccines available in their environment. Once they are convinced about the efficacy of the vaccines, they might be in a good position to accept the vaccine. However, the findings present a new challenge for governments and public health officials with respect to expediting public education. It may be fair to postulate that the lower the education level of individuals, the more they may hold erroneous perceptions and be more hesitant toward receiving the vaccine. This could be the result of limited understanding of the science and potency of the vaccine, as well as misinformation and acceptance of proposed theories. This group may also be susceptible to misinformation from antivaccination groups. In places such as Africa and similar situations where a significant number of the population is under-educated,[45] there is the need for the WHO and governments to demonstrate a commitment toward a more targeted education and intense advocacy to change public perception and encourage vaccine uptake.

4.1 | Study limitations

The findings of this study should be interpreted with caution because of a number of limitations. First, the trends reported here were based on self-reports from the participants. It was beyond the scope of the study to verify whether participants had been vaccinated, had health conditions, or had acquired COVID-19. Since the links were shared with individuals on social media platforms, it is possible that individuals who did not meet the inclusion criteria participated in the study. Second, although the study attempted to develop a global understanding of attitudes toward COVID-19 vaccination, there were very few participants from the Americas. The few who completed the survey from Canada and the United States of America were deleted, as they were insufficient for any useful comparison. Also, the views of participants who took part in this study do not reflect the views of all persons living in the respective countries. Indeed, the participants from over 22 countries have given useful baseline information with respect to the factors that might impact vaccine uptake among staff at schools and universities. Third, similar to quantitative studies, deep insights into the experiences of participants could not be reported here. Specifically, the experiences of participants with underlying health conditions after taking the vaccine need to be studied to provide first-hand information to policymakers. It is important for future qualitative studies to document or compare the experiences of persons who had received the vaccine and those who did not receive the vaccine and recovered from the disease. Overall, this study has used a standard survey tool to study the impact of health status on attitudes toward COVID-19 vaccines.

5 | CONCLUSION AND STUDY IMPLICATIONS

In the study reported here, an attempt was made to understand the effect of health status on attitudes toward COVID-19 vaccines. Drawing on participants from a school context, the results showed that the health status of individuals could play a pivotal role in efforts toward promoting COVID-19 vaccination. It appears healthier individuals would be more willing to accept the vaccine than those who have minor or chronic health conditions. Furthermore, vaccinated individuals appear to be more receptive toward the vaccine than those who were yet to receive the vaccine. Moreover, it emerged that vaccine acceptance was more likely in individuals with higher education levels. Further, the participants from Africa appeared to be less receptive, more hesitant, and held an unfavorable disposition toward the vaccines. The emergence of COVID-19 has negatively affected the way of life and communities. The human, economic and human cost of COVID-19 cannot be quantified. In view of this, governments and international organizations could partner or work together to promote uptake of the vaccine.

These findings appear to provide useful guidelines on ways through which countries and international bodies such as the WHO could expedite and support advocacy toward vaccination. First, government and international organizations need to adopt a more targeted vaccination campaign in countries and certain geographical areas. Public education toward vaccination could target individuals with underlying health conditions, such as cancer, and multiple disabilities, as they might have concerns about taking the vaccine. The education could center on the side effects and benefits of the vaccine for the individual. This could help vulnerable groups develop an understanding of the vaccine and possibly culminate in changing their attitudes and enable them to accept the vaccine. Second, there appears to be inequity and less public education toward the vaccination in Africa and similar locations. This probably underscores the need for the WHO to partner with governments as part of efforts toward promoting vaccination in communities. Third, public advocacy and education could target individuals living in deprived communities, who may be at risk of a low-level education. This is because education level appears to influence attitudes toward vaccination and thus, the need for more target education in deprived areas. The world is gradually easing back to normal; however, the threat of COVID still lingers. Deliberate efforts such as discussed above could help individuals globally to accept the COVID vaccine to protect themselves and others in society.

AUTHOR CONTRIBUTIONS

Ashraf Mustafa: conceptualization; data curation; formal analysis; investigation; methodology; project administration; writing – original draft; writing – review and editing. **Mohammed Safi**: conceptualization; data curation; formal analysis; methodology; project administration; software; writing – original draft; writing – review and editing. **Maxwell P. Opoku**: conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; writing – original draft; writing – review and editing. **Ahmed M. Hamdan**: conceptualization; data curation; formal analysis; methodology; writing – original draft; writing – review and editing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The present study received ethical approval from the Human Research Committee at United Arab Emirates University. All authors signed informed consent before taking part in this study. All authors have read and approved the final version of the manuscript (corresponding author) had full access to all of the data in this study

and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

TRANSPARENCY STATEMENT

The corresponding author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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