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Open Access Journal of Microbiology & Biotechnology
ISSN: 2576-7771

Knowledge, Attitudes and Practice towards COVID-19 Vaccinations: A Cross Sectional Community Survey in Sudan

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Research Article

Volume 7 Issue 1

Received Date: January 05, 2022

Published Date: January 21, 2022

DOI: 10.23880/oajmb-16000211

Abstract

Background: Several prophylactic vac¬cines against COVID-19 have already been developed in various countries. However, general community knowledge, attitudes and practice towards COVID-19 vaccinations are needed to investigate. Thus, the study aimed to investigate community knowledge, attitudes and perceptions towards COVID-19 vaccinations in Sudan.

Methodology: prospective, cross sectional, online survey study through a self-administered questionnaire was carried out during the period between March 2021 to August 2021 in Khartoum, Sudan among 3310 Sudanese participants. The questionnaire included informed consent along with five sections (i.e., socio-demographics, knowledge, attitudes, Behavior toward COVID-19 national prevention guidelines and vaccine acceptance) was utilized during data collection.

Results: The majority of the participants were female (64.35%). More than half (55.92%) of the participants were Adult (>25years). The majority of the respondents are knowledgeable about the approved COVID-19 vaccines (55.55%). The study also revealed that majority of respondents was believed that COVID-19 vaccination could not protect them from infection with COVID-19 (58.70%). The majority of the respondents are knowledgeable about the approved COVID-19 vaccines (55.55%).

Conclusions: The findings reflect Good knowledge but more negative attitudes towards COVID-19 vaccine among the general population Sudan. Before and during vaccine rollout, practical ways to eliminate vaccination barriers in Sudanese populations must be implemented, including effective communication and supervision.

Keywords: Knowledge; Attitudes; Perceptions; COVID-19; Vaccine

Abbreviations: COVID-19: Coronavirus Disease; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2; SD: Standard Deviation

Introduction

Coronavirus disease (COVID-19) caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has been reported as major public health problem worldwide since March 11, 2020 [1,2]. The clinical presentation of disease range from asymptomatic to severe acute pneumonia and other multi-organ complications and represents a real threat to population worldwide [3-6]. By December 2021 more than 281, 808,270 confirmed cases and nearly 5,411,759 COVID-19 deaths had been reported globally [3]. The incidence is higher in the Americas (102,287,397 cases and 2,404,354 deaths) and Europe (99,133,183 cases and 1,661,105 deaths) than in South East Asia (44,933,587

cases and 720,545 deaths), Africa (7,164,485 cases and 155,675 deaths) and the Western Pacific (11,165,866 cases and 154,667 deaths) [3]. The true scale of COVID-19 in most countries is much greater than these reported figures. The first coronavirus case in Sudan was reported on March 12, 2020. Since then, the numbers of new cases have been rising rapidly in the country [7,8]. As of 02 October 2021, the country has recorded 38,263 positive cases of COVID-19 and 2902 deaths domestically [7,8].

Protective measures are essential in pandemic management [9] and Vaccines are the most important public health measure and most effective strategy to protect the population from COVID-19 [10-12]. Several prophylactic vaccines against COVID-19 have already been developed in various countries, including vaccines produced by Astra Zeneca, Pfizer– BioNTech, Moderna, and Johnson & Johnson (Janssen). These vaccines have been distributed to various countries. With the distribution of vaccines underway, it is very important to examine community acceptance of COVID-19 vaccinations [13-20]. Vaccine hesitancy has been a concern since even before the current pandemic [21]. A recent global review found that 72% of people would take a vaccine against COVID-19 if it were proven safe and effective, but willingness varied widely between the included nations [14]. Differences in acceptance rates among the 19 countries included in this survey ranged from almost 90% (in China) to less than 55% (in Russia) [14]. In general, factors related to vaccine hesitancy, as reported in the literature, include religious reasons, personal beliefs, and safety concerns, including the association of vaccines with myocarditis, pericarditis, and brain damage, and other conditions [22]. Mistrust towards healthcare professionals and health authorities and governments in general were documented in the literature as major influencers in intentions to get vaccinated [23,24]. Additionally, vaccine hesitancy level differs across the different vaccines; the factors related to acceptance of the influenza vaccine, for example, may not apply to the new COVID-19 vaccines [25]. Therefore, investigating the factors related to the COVID-19 vaccine in specific contexts and cultures is necessary to identify factors influencing the decision to become vaccinated or not.

In Sudan, the government has already started the formal COVID-19 vaccination programme in the second week of March 2021 targeting healthcare workers primarily, then the elderly (over 50 years old) and patients with chronic disease. Although there are numerous vaccination services in Sudan, the complete newness of the COVID-19 vaccination roll-out poses questions about the distribution and acceptance of vaccines in this country. It also poses questions about the general population's knowledge, attitudes and perceptions towards the COVID-19 vaccine and vaccination rollout. The presents study conducted to assess the knowledge, attitudes and perceptions towards COVID- 19 vaccinations in Sudanese population Sudan.

Materials and Methods

Study Population

A prospective, cross sectional, online community survey study through a self-administered questionnaire was carried out during the period between March 2021 to August 2021 in Khartoum, Sudan. A semi-structured questionnaire was designed using Google form online questionnaire that was accessible by clicking on a link; it was disseminated by the investigators using social media such as Facebook and WhatsApp, etc. The link was also shared personally to the contact lists of the investigators and research assistants. The minimum sample size was calculated using the Open Epi-calculator (https://www.openepi.com/ Sample Size/ SSPropor.htm) to be 386, taking the margin of error as 5%, confidence interval at 95%, estimated population 40 million according to the 2008 census population projection. The inclusion criteria of participants were included being a Sudanese resident, being an adult (≥ 18 years old), and providing consent. The exclusion criteria included those under 18 year's old and incomplete surveys. By the end of the 2-week time limit to respond to the survey, 3,310 participants responded and were included in the study. This sample size is 8-fold larger than that required (386 participants).

Measures

The online questionnaire was designed based on previous studies which are assessing vaccine acceptance [13-20]. The contents of the questionnaire included informed consent along with five sections (i.e., socio-demographics, knowledge, attitudes, Behavior toward COVID-19 national prevention guidelines and vaccine acceptance) were utilized during data collection.

Socio-demographic Information

Some questions related to socio-demographics were asked during the survey including age, sex (male/female), marital status (single /married), educational status (Primary school, secondary school or university), and current residence (Khartoum /outside Khartoum). In addition, another question was asked as shown in Table 1.

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Variables		Frequency (%) (n = 3.310)
Age (years)	Young(18-25 years)	1459 (44.07%)
	Adult (>25years)	1851 (55.92%)
Gender	Male	1180 (35.64%)
	Female	2130 (64.35%)
Education	Primary school	469(14.17%)
	Secondary school	980(29.60%)
	University	1861 (56.22%)
Residence	Khartoum State	1778 (53.72%)
	Outside Khartoum State	1532 (46.28%)
Marital status	Single	2174 (65.68%)
	Married	1136 (34.32%)
Vaccination history : (Received all necessary vaccines in your life?)	Yes	2464 (74.44%)
	No	846 (25.55%)
Vaccine developed during an epidemic/pandemic could not be considered guaranteed	agree	2792 (84.35%)
	disagree	518 (15.64%)
How safe do you think COVID-19 vaccines are?	They are not safe with obvious side effects	1740 (52.56%)
	Not sure	1371 (41.42%)
	They are safe with no side effects	199 (6.01%)

Table 1: General characteristics of the study participants.

Knowledge, Attitudes, and Perceptions

To assess the level of knowledge, attitudes, and perceptions of the respondents, a total of 43 items that were structured questions (including 18-items for knowledge, 15-items for behavior toward COVID-19 national prevention guidelines, and 5 -items for attitudes and 5-items for vaccine acceptance. All questions were based on validated questions in previous literature [13-20]. The knowledge section comprised 18-items with three possible responses (i.e., "Yes", "No" and "Don't know") (Table 2). The 'yes' response was coded as 1, while the 'No/ don't know' responses were conducted as 0. The total score was obtained by summating the raw scores of 18 items and ranged from 0 to 18, with the higher score indicating the greater level of knowledge towards COVID-19 vaccinations. For behavior toward COVID-19 national prevention guidelines section it comprised from 15-items with three possible responses (i.e., "Always", "Sometimes" and "Never") (Table 3). The 'Always' response was coded as 1, while the 'Sometimes / Never' responses were conducted as 0. The total score was obtained by summating the raw scores of 15 items and ranged from 0 to 15 with the higher score indicating the greater level of behavior toward COVID-19 national prevention guidelines. The attitude section consisted of 5-items (Table 4), and the response of each item was indicated as 0 = Disagree, and 2 = Agree) (Table 4). The total score was calculated by summating the raw scores of the five items ranging from 0 to 10, with an overall greater score indicating more positive attitudes towards COVID-19 vaccine.

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No	Knowledge of COVID-19 vaccine	Yes (n %)	No (n %)	Don't Know (n %)	Mean ±SD
1	Do you think you follow the recommended guideline for COVID-19 adequately?	422(12.75%)	2810(84.89%)	78(2.35%)	4.50± 2.41
2	Do you worry about being infected with COVID-19?	1850(55.89%)	1105(33.38%)	355(10.72%)	4.26± 2.35
3	Are you at risk of getting COVID-19 infection?	736(22.23%)	1916(57.89%)	658(19.87%)	4.27± 2.14
4	Are you interested in knowing the methods of prevention of COVID-19?	2315(69.94%)	73(2.20%)	922(27.85%)	4.39± 2.38
5	Do you know about the COVID-19 vaccine?	1839(55.55%)	1182(35.71%)	289(8.73%)	4.25± 2.33
6	Do you know about the effectiveness of COVID-19 vaccine?	1038(31.36%)	1916(57.88%)	356(10.75%)	427 ±2.40
7	Do you think COVID-19 vaccines could protect you from COVID-19?	876(26.46%)	1943(58.70%)	491(14.83%)	4.29 ±2.57
8	Do you think it is dangerous to use overdose vaccines?	1969(59.49%)	1105(33.38%)	236(7.13%)	4.30 ±2.31
9	Do you think you need to test COVID-19 before vaccination	1880(56.80%)	1297(39.18%)	133(4,01%)	4.24 ±2.27
10	Does vaccination increase allergic reactions?	235(7.09%)	1157(34.95%)	1918(57.95%)	428 ±2.44
11	Does vaccination increase autoimmune diseases?	335(10.12%)	916(27.67%)	2059(62.20%)	4.43 ±2.34
12	I do not need to get vaccinated if I already had COVID-19	2504(75.64%)	664 (20.06%)	142 (4.29%)	4.47±2.52
13	After getting a COVID-19 vaccine, I can still test positive for COVID-19 on a viral test	256 (7.73%)	2504(75.64%)	550 (16.62%)	4.46 ±2.58
14	Do you think you the COVID-19 vaccine is necessary only for travelling purpose?	2325(70.24%)	676(20.42%)	309(9.33%)	4.42 ±2.56
15	Will you encourage your family and friends to receive a COVID-19 vaccine?	720(21.75%)	852(25.74%)	1738 (52.50%)	422 ±2.28
16	Should the history of travel to areas experiencing transmission of COVID-19 be considered to identify persons at risk of having COVID-19?	2442 (73.77%)	720 (21.75%)	148 (4.47%)	4.45 ±2.30
17	Could the novel COVID-19 disease be prevented by adopting the isolation measures?	2952(89.18%)	256(7.73%)	102 (3.08%)	4.55 ±2.46
18	Could the COVID-19 be reduced by awareness?	2729(82.44%)	410 (12.38%)	171 (5.17%)	4.49 ±2.45

Table 2: Knowledge of COVID-19 vaccination.

No	National prevention guidelines	Always	Sometimes	Never	Mean± SD
1.	I Avoid social gatherings, no matter its purpose	1088(32.87%)	1933(58.39%)	289(8.73%)	4.18 ±1.79
2.	Avoid eating or gathering at restaurants and food courts, pickup, or delivery options instead	1760(53.17%)	711(21.48%)	839(25.34%)	4.15 (1.74)
3.	Avoidun necessary travel, shopping trips and social visitations	1460(44.10%)	1765(53.32%)	85(2.57%)	4.16 ±1.89
4.	Put 6 ft of physical distance between myself and other people	170(5.13%)	1623(49.03%)	1517(45.83%)	4.12 ±1.70
5.	Avoid physical touch when greeting other people (i.e., handshakes, hugs)	1337(40.39%)	1924(58.12%)	49(1.48%)	4.17 ±1.77
6.	I Do not touch my eyes, nose and mouth with unwashed hands	2666(80.54%)	631(19.06%)	13(0.39%)	4.37 ±1.57
7.	Avoid close contact with people who are sick	2530(76.44%)	757(22.87%)	23(0.69%)	4.32 ±1.91
8.	I Cover my mouth and nose with a tissue or my elbow when coughing/sneezing	1983(59.90%)	1108(33.47%)	219(6.62%)	4.20 ±1.78
9.	I Clean and disinfect frequently touched surfaces daily	1529(46.19%)	1529(46.19%)	252(7.61%)	4.10 ±1.70

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10.	I Clean and disinfect my room	1412(42.65%)	1713(51.75%)	185(5.59%)	4.14 ±1.73
11.	Wash your hands often, with soap and water for at least 20 s	1516(45.80%)	1376(41.57%)	418(12.62%)	4.05 ±1.64
12.	I Use an alcohol-based hand sanitizer	2322(70.15%)	724(21.87%)	264(7.97%)	4.25±1.81
13.	I Wear a facemask whenever I have visitors	954(28.82%)	2164(65.38%)	192(5.80%)	4.22 ±1.69
14.	I Wear a facemask while using public transport	1577(47.64%)	1685(50.90%)	48(1.45%)	4.13 ±1.72
15.	Routinely check my body temperature?	1383(41.78%)	1017(30.72%)	910(27.49%)	4.06 ±1.66

Table 3: Behavior toward COVID-19 national prevention guidelines.

No	Attitude	Agree (n %)	Disagree (n%)	Mean± SD
1.	Do you know anyone who does not take a vaccine because of religious or cultural values?	1740 (22.35%)	2570(77.64%)	3.91 ± 0.938
2.	Do you trust pharmaceutical companies to provide credible data on COVID-19 vaccine safety and effectiveness vaccines?	1880(56.80%)	1430(43.20%)	3.80 ± 1.130
3.	Worries about unexpected effect	2922(88.27%)	388(11.72%)	3.98 ± 1.093
4.	Concern about commercial exploitation	1983(59.90%)	1327(40.09%)	3.84 ± 1.124
5.	Preference for natural immunity	2203 (66.55%)	1107 (33.44%)	3.88 ± 1.105

Table 4: Attitudes toward COVID-19 vaccine.

The acceptance section included 5-items regarding participant's acceptance towards the COVID-19 vaccine, including 5 items as "yes/no/ not sure" questions (Table 5). The 'yes' response was coded as 1, while the 'No/ Not sure' responses were conducted as 0 with an overall greater score indicating more positive acceptance towards COVID-19 vaccine. The total scores of these items were then converted to percentages (0–100%). The scores of 50% were classified as poor knowledge, negative attitude, or high-risk practices and high hesitated from vaccine acceptance; the scores of 50. 1–70% was moderate knowledge, moderate attitude, or moderate-risk practices and moderate hesitated from vaccine acceptance; and the scores of 70.1% were good knowledge, positive attitude, or low-risk practices well vaccine acceptance.

NO	Variable		Frequency (%)	Mean± SD
1.	Do you think that there are better ways to prevent COVID-19 than using vaccines (e.g., developing	Yes	1038(31.36%)	
	Immunity by getting sick and recovered)?	No	1916(57.88%)	4.41 ± 0.905
		Not sure	356(10.75%)	
2.	Do you feel you have enough information about COVID-19 vaccines and their safety?	Yes	1740 (52.56%)	4.33 ± 1.004
		No	1371 (41.42%)	
		Not sure	199 (6.01%)	
3.	Do you think that the benefits of COVID-19 vaccines outweigh their reported side effects/adverse reactions?	Yes	1412(42.65%)	4.31 ± 0.974
		No	1713(51.75%)	
		Not sure	185(5.59%)	
4.	In general, when a new vaccine is introduced, are you inclined to consent on your vaccination?	Yes	736(22.23%)	
		No	1916(57.89%)	4.42 ± 0.902
		Not sure	658(19.87%)	
5.	Do you feel confident that the health center or doctor's office will have the COVID-19 vaccine you need, when you need them?	Yes	1760(53.17%)	4.36 ± 1.004
		No	711(21.48%)	
		Not sure	839(25.34%)	

Table 5: COVID-19 vaccination acceptance.

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Ethical Approval, Informed Consent and Permissions

The present study was approved by the Ethics Committee of University of Khartoum, Khartoum, Sudan (1/2021). The Informed consent of the participants was questioned with the first question of the online survey form. The questionnaire was terminated for the participants who did not declare consent to participate in the study.

Statistical Analysis

All statistical analyses were performed using SPSS for Windows v25.0 statistical analysis software (Chicago, IL, USA). Descriptive statistics of the data were expressed as mean ± standard deviation for variables with normal distribution in continuous data and frequency for categorical variables as percentage (n (%)). Finally, logistic regression was used to investigate the factors associated with COVID-19 vaccine acceptance among participants categorized into low and high acceptance levels based on attitude scores. All statistical tests were considered significant at 95% confidence interval with a P-value of <0.05 was deemed statistically significant.

Results

A total of 3310 responses were collected and subsequently used in the analysis. As shown in Table 1, the majority of the participants were female (64.35%). More than half (55.92%) of the participants were Adult (>25years). The majority of participants (65.68%) were single and had university/ higher levels of education (56.22%) (Table 1). About 53.72% of the participants were residence in Khartoum state. The distribution of each knowledge item about the COVID-19 vaccine is presented in Table 2. The majority of the respondents are knowledgeable about the approved COVID-19 vaccines (55.55%). The study also revealed that majority of respondents were believed that COVID-19 vaccination could not protect them from infection with COVID-19 (58.70%), and after getting a COVID-19 vaccine, they can still test positive for COVID-19 on a viral test (75.64%). They think the COVID-19 vaccine is necessary only for travelling purpose (70.24%). Unfortunately the majority of respondents do not followed the recommended guideline for COVID-19 adequately (84.89%).Meanwhile, a smaller percentage of respondents they need to encourage their family and friends to receive a COVID-19 vaccine (21.75%).

Findings shown in Table 3 indicate that majority of the participants have a positive behavior toward the COVID-19 national prevention guideline. The majority of participants does not touch their eyes, nose and mouth with unwashed hands (80.54%); Avoid close contact with people who are sick (76.44%); Use an alcohol-based hand sanitizer (70.15%); cover their mouth and nose with a tissue or use their elbows when coughing/sneezing (59.90%); avoid eating or gathering at restaurants, and food courts(53.17%). Findings presented in Table 4 indicate that the attitudes of the majority of the respondents' toward COVID-19 vaccine include worries about the unforeseen effect (88.27%), preference for natural immunity (66.55%).This belief was even more emphasized when (51.75%) were did not believe in the benefits of COVID-19 vaccines outweigh their reported side effects (Table 5). In general, 52.56% they think have enough information about theCOVID-19 vaccines and their safety, and 57.89% were not inclined to consent when a new vaccine is introduced, in general. 57.88% of our participants did not hear about anyone who does not want to take the vaccine because of cultural or religious values (Table 5).

Discussion

Vaccination is an important measure to control COVID-19 global pandemic, Efforts were began in many African countries in early 2021 to build public trust in COVID-19 vaccination campaigns [6,9]. The most hopeful way of controlling COVID-19 could be universal vaccination to achieve herd immunity [26]. In Sudan, the government has already started the formal COVID-19 vaccination programme in the second week of March 2021 targeting healthcare workers primarily, then the elderly (over 45 years old) and patients with chronic disease. Sudan is a participant in the COVAX facility and requested 17million doses of Covid-19 vaccine to cover 8.5 million people, representing 20% of its population. With the distribution of vaccines underway, it is very important to examine community acceptance of COVID-19 vaccinations [13-20]. Vaccine hesitancy has been a concern since even before the current pandemic [21]. Our results showed that respondents' are knowledgeable about COVID-19 vaccines that have already been approved for use, but their knowledge on vaccines that are not meant for COVID-19 is inconsistent (Table 2). The findings also revealed that participants have a positive behavior toward COVID-19 national prevention guidelines, and that they complied with these guidelines (Table 3). The study revealed that 57.89% of respondents they did not feel they were at risk but only 22.23% believing that they were at personal risk of being infected (Table 2). Majority of the participants believed a COVID-19 vaccine was not needed because the immune system (Table 4) is more effective at tackling the virus, that the mortality rate of COVID-19 does not warrant a vaccine and that the pandemic has not been particularly severe in Africa [3].

Largesurvey by an Africa CDC from 13 out 15 counties, with total number of 13,699participants from Burkina Faso (n=1037); Côte D'Ivoire (n=1039); DRC (n=1007); Ethiopia

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(n=1001); Gabon (n=1112); Kenya (n=1000); Mali (n=1009); Nigeria (n=1172); Niger (n=1173); Senegal (n=1010); South Africa (n=1056); Sudan (n=1075); Uganda (n=1008) found the highest overall acceptance toward COVID-19 vaccination : 79% of respondents would agree to take a COVID-19 vaccine if it was deemed safe and effective. Ethiopia (94%) reporting the highest acceptance rate and the DRC (59%) the lowest [27]. In contrast, the present study reports low acceptance of COVID-19 vaccination among the respondents (84.35%) (Table 1). The low acceptance of COVID-19 vaccination was also reported from China which revealed only about 28.7% reported a definite intention [15]. In contrast a study showed a higher COVID-19 vaccine intention in Malaysia (94.3%) [28], France (74%) [29], United States (74.1%) [30] and Europe (73%) [31] Indonesia (67%) [32] and Japan (67.1%) [33]. Also, an online survey also found a higher vaccine intention in. According to a global survey of 19 nations, 71.5% of the participants said they would get the COVID-19 vaccine if available [33].

Vaccine acceptance may need to be improved further, as high vaccination coverage is needed to combat epidemics [33]. Attitudes towards vaccination were affected by popular understandings of the virus: its origins, perceived risk profile such as mortality and severe illness rates, ideas of natural immunity and the impact of variants on vaccine effectiveness. One of the principal factors behind these attitudes seems to be a concern that the new vaccines will not be safe and Vaccine developed during an epidemic/pandemic could not be considered guaranteed (Table 1) and (Table 6). Trust in the authorities, including medical institutions was seen in several studies as an indicator for vaccine acceptance and confidence in vaccine safety. Healthcare professionals and medical institutions including the WHO were seen to have an important role to play in vaccination communication and engagement [34].

Variables		High	Low	P-value	OR (95% CI)
Age (years)	Young(18-25 years)	950	509		
	Adult (>25years)	1544	307	0.83	1.78(0.48–1.18)
Gender	Male	710	470	0.95	
	Female	1880	250		1.74(0.52–1.20)
Education	Primary school	344	125		
	Secondary school	620	360		
	University	1654	207	0.26	1.04(0.67–1.64)
Residence	Khartoum State	1265	513		1.09(0.69–1.64)
	Outside Khartoum State	1115	417	0.78	
Marital status	Single	1151	1023	0.19	1.10(0.64–1.97)
	Married	978	158		
Vaccination history :	Yes	1289	1175		
(Received all necessary vaccines in your life?)					
	No	511	335	0.44	1.57(0.90–2.34)
Vaccine developed during an epidemic/ pandemic could not be considered guaranteed	agree	2510	282		
	disagree	378	140	0.01	0.97(0.47–1.96)
How safe do you think COVID-19 vaccines are?	They are not safe with obvious side effects	1548	192	< 0.001	1.70(1.08–2.67)
	Not sure	945	426		
	They are safe with no side effects	121	78		

Table 6: Logistic regression analysis with low and high acceptance toward COVID-19 vaccine.

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Conclusion

Before and during vaccine rollout, practical ways to eliminate vaccination barriers in Sudanese populations must be implemented, including effective communication and supervision. Cultural considerations, differing understanding and attitudes about disease causes, and essential information and concerns about vaccine safety and efficacy alleviating these concerns and enhancing public confidence in COVID-19 vaccines are crucial for future vaccination strategies and immunization programs against the COVID-19 pandemic.

Acknowledgements: The authors would like to express the most profound gratitude to all of the respondents who participated in this study.

Authors' contributions: NAM was provided conceptual framework for the project, participated in data collection, analysis and writing the manuscript.

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