Original Article

Vaccine Hesitancy: Beliefs and Barriers Associated with COVID-19 Vaccination among the General Population in Khartoum Locality, Sudan 2021

Abstract

Background: Vaccine hesitancy is a complex public health issue concerning the efficacy, safety, or need for vaccination. There needs to be more information about vaccine hesitancy, barriers, and beliefs associated with COVID-19 vaccination among the population in Sudan. Therefore, this study aimed to investigate the perception and awareness of Sudanese toward the intake of the COVID-19 vaccine and determine the underpinning beliefs. **Materials and Methods:** An online, cross-sectional, and self-administered questionnaire was used to survey adult participants from Khartoum locality, Khartoum state, Sudan, on the acceptability of the COVID-19 vaccine using stratified sampling technique method during August and October 2021. **Results:** The total number of participants was 369 (133 were males and 236 were females). The public acceptability of COVID-19 vaccines was (64.4%) in Sudan. Vaccination ("Accept" and "Not accept") to COVID-19 vaccine was predicted through a logistic regression model ($Y = 2.963 + 0.641 \times$ age groups $+ 0.147 \times$ gender $+ 0.484 \times$ educational level $+ 0.070 \times$ area $+0.449 \times$ chronic illness $- 0.071 \times$ Belief score [%]). The model revealed that accepting the vaccine, in any case, was statistically significant, with a *P*-value of 0.0000001. Age, gender, education level, and area of living, despite their contribution to the model, were not statistically significant, with a *P*-value of respectively 0.336, 0.374, 0.253, and 0.268. **Conclusions:** A high prevalence of refusal and hesitancy about COVID-19 vaccination in the Sudanese population was observed in the study. The safety concern was the main reason for the unwillingness to accept vaccines.

Keywords: *Beliefs, hesitancy, vaccine*

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Introduction

COVID-19 outbreak is a worldwide disaster, considered by the WHO a Public Health Emergency of International Concern.[1] Discovered firstly in Wuhan City, China[2,3] and then spread as a global pandemic.[4,5] The first reported COVID-19-positive case in Sudan was on March 11, 2020. The novel coronavirus can live on hands, mucus membranes, surfaces, objects, body fluids, and respiratory secretions and spread from person to person through direct contact,[6,7] so the most effective preventive measures are avoiding close contact with people, hand hygiene, clean and disinfect surfaces,[8] as there is no specific efficacious treatment available for this virus until the writing of this paper.[9,10]

The international collaborative efforts are more focused on effective and safe COVID-19 vaccines since there is currently no effective medical treatment for COVID-19.[11] Several influential and safe vaccines prevent people from getting seriously ill or dying from COVID-19.[12]

As of January 12, 2022, WHO has evaluated that the following vaccines against COVID-19 have met the necessary criteria for safety and efficacy: Johnson and Johnson, AstraZeneca/Oxford vaccine, Pfizer/BionTech, Moderna, Sinopharm, Sinovac, COVAXIN, Covovax, and Nuvaxovid.

COVID-19 vaccine provides protection from getting ill and dying from COVID-19 despite no 100% protective vaccine.[12] Sudan received the AstraZeneca vaccine through the COVAX alliance on March 3, 2021.[13]

Vaccine hesitancy is a delay in refusal or acceptance of vaccination while the

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availability of vaccine is defined by SAGE (the WHO Strategic Advisory Group of Experts).[14] Confidence, convenience, and complacency were the factors for vaccine acceptability.[15]

Vaccine hesitancy is considered by WHO a significant threat to global health. The acceptance rate of the COVID-19 vaccine illustrated that nearly 30% of the investigated participants would refuse or hesitate to take a COVID-19 vaccine when it is available. Globally the Middle East is among the regions with the lowest rates of vaccine acceptance.[16,18]

The study aims to understand the factors that affect the decision to vaccinate, as these factors may change individuals who accept to take the vaccine from those who do not and to develop effective COVID-19 vaccination strategies.

Materials and Methods

A web-based, cross-sectional study was conducted using a stratified sampling method from August to October 2021 in Khartoum County, Khartoum state. The structured questionnaire was divided into three sections. The first section consists of demographic data, the second section is beliefs toward the COVID-19 vaccine, and the third section consists of Represent Reasons for accepting the vaccination after refusing it.

The questionnaire was prepared using Google Forms, and the link was shared through social media; Facebook, e-mail, and Whatsapp groups. The study's purpose was explained to participants before attending the survey. Study participation was voluntary, and only those who willingly participated in the survey.

The questions started with consent for voluntary participation and a declaration affirming the age of more than equal 18 years and having not been vaccinated for COVID-19.

Statistical Package for Social Sciences software, version 21.0 (IBM SPSSInc., Chicago, IL) and STATA 11 was used to analyze data. Initially, all information was gathered via a questionnaire and then coded into variables. The normality of data was tested using the Kolmogorov–Smirnov test and Shapiro–Wilk test. Both descriptive and inferential statistics involving Pearson Chi-Square, Fisher's exact test, Pearson correlation, and way ANOVA (analysis of variances). Tests were used to present results. Less than 0.05 *P*-value is considered statistically significant. Score: to have a better assessment of overall knowledge, each correct answer in the knowledge domain carried one mark while the wrong answer carried 0 mark, also question consisted of more than one right answer one spot was distributed according to the number of solutions; this gave a total score range of 0–10 then converted to percentages. Ethical considerations survey questions do not include name or contact information, and participation in the study was voluntary.

Results

Three hundred ninety-six participated in the study, 64% female. About two-thirds (68.3%) obtained a university degree. The most numbers of participants were derived from urban regions (92.4%). Only (13%) declared a history of chronic disease [Table 1].

Beliefs toward COVID-19 vaccination

Table 2 illustrates the total score for beliefs toward the COVID-19 vaccine, where reasonable beliefs were (59.3%), and poor beliefs were (40.7%). Table 3 illustrates that the participants showed reasonable beliefs toward COVID-19 vaccination regarding safety (81.8%) and effectiveness (84.6%).

Table 4 illustrates there was an association between belief score with age group and educational level, and there was no association between belief score with gender, area, and chronic disease.

Table 5 illustrates the general public's belief toward the COVID-19 vaccine was predicted through a multiple

Table 1: Demographic characteristics of participants: (*n* = 369)

Demographic variables	Frequency	Percent
Age groups		
18–29 years	244	66.1
30–39 years	87	23.6
40–59 years	36	9.8
60 years and more	2	0.5
Gender		
Male	133	36
Female	236	64
Education level		
Primary	4	1.1
Secondary	36	9.8
University	252	68.3
Postgraduate	77	20.9
Area		
Urban	341	92.4
Rural	28	7.6
Presence of chronic disease		
Yes	48	13
No	321	87

Table 2: The beliefs score toward COVID-19 vaccine: (*n* = 369)

Belief score	Frequency	Percent
Poor	150	40.7
Good	219	59.3
Total	369	100

Table 3: Beliefs toward COVID-19 vaccine: (n = 369)

Belief score	Agree	Disagree
COVID-19 vaccine would be safe	302 (81.8%)	67 (18.2%)
COVID-19 vaccine would be effective	312 (84.6%)	57 (15.4%)
Vaccination is the best way to avoid COVID-19 complications	271 (73.4%)	98 (26.6%)
COVID-19 vaccine, if available	263 (71.3%)	106 (28.7%)
Concerned about the side effect of the COVID-19 vaccine	270 (73.2%)	99 (26.8%)
The vaccine is too costly	98 (26.6%)	271 (73.4%)
Vaccines will not stop the infection	231 (62.6%)	138 (37.4%)
Don't need the vaccine because following precautionary measures	106 (28.7%)	263 (71.3%)
The COVID-19 vaccine is a conspiracy	116 (31.4%)	253 (68.6%)
I don't need the vaccine because I am young and healthy	94 (25.5%)	275 (74.5%)

Table 4: Association between variables and belief score

Variables		Belief score		Pearson Chi-square test *P*-vale	Fisher's exact test *P*-vale
		Poor	Good		
Age groups	18–29 years	109 (44.7%)	135 (55.3%)	0.021**	0.015**
	30–39 years	25 (28.70%)	62 (71.30%)		
	40–59 years	14 (38.9%)	22 (61.1%)		
	More than 60 years	2 (100%)	0 (0%)		
Gender	Male	51 (38.3%)	82 (61.7%)	0.499*	0.286*
	Female	99 (41.9%)	137 (58.1%)		
Education level	Primary	2 (50%)	2 (50%)	0.053*	0.043**
	Secondary	21 (58.3%)	15 (41.7%)		
	University	103 (40.9%)	149 (59.1%)		
	Postgraduate	24 (31.2%)	53 (68.8%)		
Area	Urban	135 (39.6%)	206 (60.4%)	0.148*	0.107*
	Rural	15 (53.6%)	13 (46.4%)		
Chronic disease	Yes	22 (45.80%)	26 (54.2%)	0.433*	0.264*
	No	128 (39.9%)	193 (60.1%)		

By using Pearson Chi-square test *P*-vale and Fisher's exact test *P*-value
* *P* value >0.05 that's considered statistically insignificant
** *P* value <0.05 that's regarded as statistically significant

Table 5: Represent the belief of the general public toward the COVID-19 vaccine by using multiple linear regression models

Multiple linear regression for prediction belief score (%)							
Variables in equation	Unstandardized coefficients		Standardized coefficients	*t*	Sig.	95.0% Confidence interval for *B*	
	B	Std. error	Beta			Lower bound	Upper bound
(Constant)	98.558	10.781		9.142	0.0000001	77.357	119.76
Age groups	3.28	1.541	0.097	2.128	0.034	0.249	6.31
Gender	-0.992	2.082	-0.02	-0.476	0.634	-5.086	3.103
Education level	1.623	1.708	0.041	0.95	0.343	-1.736	4.983
Area	-3.743	3.747	-0.042	-0.999	0.319	-11.112	3.627
Chronic disease	1.391	3.13	0.02	0.445	0.657	-4.763	7.546
Accept taking the vaccine in any situation	-28.805	2.093	-0.588	-13.761	0.000001	-32.921	-24.688

[a]Dependent variable: belief score

linear regression model based on six predictors. The regression (belief of the general public toward COVID-19 vaccine = 98.558 + 3.28 × age + [-0.992] × gender + 1.623 × educational level + [-3.743] × area of living + 1.391 × chronic illness + [-28.80] accept taking the vaccine in any situation) model was statistically valid to predict the Belief of the general public toward COVID-19 vaccine with F test (6, 362) = 33.946 and a P-value = 0.000. The combination of the six predictors accounts for r = 0.600 to predict the belief of the general public toward the COVID-19 vaccine.

Table 6: Represent binary logistic regression for prediction belief toward COVID-19 vaccination

Binary logistic regression for prediction belief toward COVID-19 vaccination								
Variables in the equation	***B***	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(*B*)**	**95% CI for EXP(*B*)**	
							Lower	**Upper**
Age groups	0.435	0.452	0.926	1	0.336	1.544	0.637	3.744
Gender	0.233	0.262	0.791	1	0.374	1.262	0.756	2.109
Education level	0.465	0.407	1.306	1	0.253	1.592	0.717	3.531
Area	0.512	0.462	1.226	1	0.268	1.668	0.674	4.127
Chronic disease	0.091	0.394	0.054	1	0.817	1.096	0.506	2.373
Accept taking the vaccine in any situation	2.291	0.26	77.792	1	0.0000001	9.886	5.942	16.449
Constant	-5.077	1.092	21.609	1	0.000003	0.006		

Table 7: Represent total score for acceptance of taking the vaccine in any situation (n = 369)

Accept taking the vaccine in any situation	Frequency	Percent
Yes	239	64.8
No	130	35.2

All the six predictors contribute, but accepting taking the vaccine in any situation was a statistically significant *P* value of 0.000001. The five other predictors contributing to the model were not statistically significant ($P > 0.05$).

Participants contributed to being poor in Belief about the COVID-19 vaccine

The model revealed that accepting the vaccine, in any case, was statistically significant, with a *P*-value of 0.0000001. Age, gender, education level, and area of living, despite their contribution to the model, were not statistically significant, with a *P*-value of respectively 0.336, 0.374, 0.253, and 0.268. The chronic illness was not statistically significant ($P = 0.817$), and the contribution to the model was minimum at 0.091 [Table 6].

COVID-19 vaccine acceptance

COVID-19 vaccine acceptance in any situation was (64.4%) and refusal (was 35.2%) as shown in Table 7. Still, some people changed their minds or opinion and accepted vaccination after were refused it for the following reasons: (as shown in Table 8), if family or friends got vaccinated (9.2%), if it was compulsory by the government (MOH) (22.3%) if physician recommended it (22.3%) if it was mandatory by job (23.8%) if there is a way that injection (27.7%) and if more studies showed that the vaccine is safe and effective (59.2%).

Table 9 shows there was an association between accepting taking the vaccine in any situation with educational level, participants without chronic disease, and belief score, but there was no association between carrying taking the vaccine in any case with age group, gender, and area.

Participants contributed to refusing the vaccination

Participants had a lower belief score (%) more contributed to refuse the vaccination AOR: 0.931 (CI 95%: 0.917-0.946) times statistically significant with *P* value 0.000001<0.05. [Table 10].

Barriers associated with COVID-19 vaccination

Table 11 shows the barriers associated with the acceptance of COVID-19 vaccination.

Discussion

Although several studies are being conducted all around the world, this study observed that vaccine acceptance is 64.8%, which is lesser than the results obtained from similar studies conducted in the USA.[14] Thunstrom *et al.* (2020) reported that 80% of the general population accepted to get vaccinated,[17] and another study conducted by[19] (Fu *et al.*, 2021) in China, found that 72.5% of the healthcare workers accepted to get vaccinated. This study reported that vaccine acceptance among the participants was lower, but it is in alignment with the studies of South Africa (64%), Russia (54%), and France (59%)[19] IPSOS, 2020. Similarly, in Saudi Arabia, COVID-19 vaccine acceptance was 67%.[20]

The findings showed that COVID-19 vaccine acceptability has a statistically insignificant correlation with sociodemographic characteristics such as age, gender, and area and is statistically significant with educational level, and these findings are consistent with other studies conducted in recent times in different countries.

In the United Kingdom, France, Australia, the United States, and Japan, the significant factor for vaccine acceptability was socio-demographic factors.[15,23-26] Also, in Saudi Arabia, only age and marital status were significant factors in determining the willingness to accept the COVID-19 vaccines.[21]

Also, account for our finding that people with chronic conditions contributed more to refusing the vaccination, unlike a study conducted in Hong Kong found that people with chronic conditions were significantly more likely to express vaccine acceptance.[22]

The most significant reasons for acceptance of COVID-19 vaccination were beliefs. Previous studies on the vaccine belief model were conducted and had the same results, including the risk perception of vaccine safety and efficacy.[23,24]

In our study, a lack of confidence in the safety and effectiveness of vaccination was the main barrier preventing

Table 8: Represent Reasons for accepting the vaccination after refusing it (n = 130)

Reasons for accepting the vaccination after refusing it	Frequency	Percent
If my family or friends got vaccinated	12	9.2
If it was compulsory by the government (MOH)	29	22.3
If my physician recommended it to me	29	22.3
If it was mandatory for my job	31	23.8
If there is a way, then injection	36	27.7
If I know that more studies showed that the vaccine is safe and effective	77	59.2

Table 9: Represent the association between variables and accept taking the vaccine in any situation: by using Pearson Chi-square test *P*-value and Fisher's exact test *P*-value

Variables		Accept taking the vaccine in any situation		Pearson Chi-square test P-vale	Fisher's exact test *P*-value
		Yes	No		
Age groups	18–29 years	161 (66%)	83 (34%)	0.091*	0.095*
	30–39 years	59 (67.8%)	28 (32.2%)		
	40–59 years	19 (52.8%)	17 (47.2%)		
	60 years and more	0 (0%)	2 (100%)		
Gender	Male	84 (63.20%)	49 (36.80%)	0.627*	0.354*
	Female	155 (65.70%)	81 (34.30%)		
Education level	Primary	2 (50%)	2 (50%)	0.036**	0.031**
	Secondary	16 (44.40%)	20 (55.6%)		
	University	166 (65.90%)	86 (34.10%)		
	Postgraduate	55 (71.40%)	22 (28.6%)		
Area	Urban	223 (65.4%)	118 (34.6%)	0.379*	0.248*
	Rural	16 (57.1%)	12 (42.9%)		
Chronic disease	Yes	24 (50%)	24 (50%)	0.022**	0.018**
	No	215 (67%)	106 (33.00%)		
Belief score	Poor	54 (36%)	96 (64%)	0.0000001**	0.0000001**
	Good	185 (84.50%)	34 (15.5%)		

* *P* value >0.05 that's considered statistically insignificant.
** *P* value <0.05 that's regarded as statistically significant.

Table 10: Represent participants more contributed to refuse the vaccination: by using binary logistic regression for prediction to accept taking the vaccine in any situation

Binary logistic regression for prediction accept taking the vaccine in any situation								
Variables in the equation	*B*	S.E.	Wald	df	Sig.	Exp(*B*)	95% CI for EXP(*B*)	
							Lower	Upper
Age groups	0.641	0.511	1.575	1	0.210	1.898	0.698	5.164
Gender	0.147	0.293	0.25	1	0.617	1.158	0.652	2.057
Education level	0.484	0.474	1.045	1	0.307	1.623	0.641	4.106
Area	0.070	0.485	0.021	1	0.885	1.073	0.415	2.774
Chronic disease	0.449	0.429	1.096	1	0.295	1.567	0.676	3.633
Belief score (%)	-0.071	0.008	84.365	1	0.000001	0.931	0.917	0.946
Constant	2.963	0.81	13.368	1	0.0003	19.356		

Table 11: Represent reasons for refusing the vaccination

Reasons for refusing the vaccination	Frequency	Percent
I don't need the vaccine because I'm young and healthy	24	18.5
I don't need the vaccine because I do all the right things. I wash my hands and wear a mask and gloves	30	23.1
COVID-19 vaccination is a conspiracy	38	29.2
I don't like needles	61	46.9
I don't believe that the vaccine will stop the infection	73	56.2
I am concerned about the vaccine side effects	91	70
n = 130		

the acceptance of COVID-19 vaccination among the population. As stated by MacDonald,[15] confidence, complacency, and/or convenience were influencing vaccine hesitancy.

Vaccine acceptance may be affected by vaccine efficacy and side effects. The reported common side effects are generally mild to moderate and last a few days. These include injection site pain, fatigue, rigors, and fever, muscle and joint pains. Less commonly, a vaccine recipient may develop allergic reactions, anaphylaxis, and neurological side effects; however, they are rarely reported.[15] There is a rising concern mainly related to reported thrombo-embolic events, particularly after the administration of the AstraZeneca vaccine in Europe, but the European Medicines.[27]

The agency concluded that the vaccine's benefits outweigh the potential risk of this rare side effect.[26] In this context, Kaplan *et al.*[28] underlined that vaccine acceptance improved when vaccine efficacy exceeded 70%. Moreover, they addressed that minor side effects, such as a sore arm or fever lasting for a day, did not affect vaccine acceptance. In contrast, significant side effects in 1/100,000 greatly affected vaccine acceptance. These side effects may vary according to the type of vaccine used in each country. Emerging evidence suggests that both exposures to misinformation about COVID-19 and public concerns over the safety of vaccines may be contributing to the observed decline in intentions to be vaccinated, and this highlights the need for measures to address public acceptability, trust, and concern over the safety and benefit of approved vaccines.[28,29]

Moreover, another barrier to COVID-19 vaccination was the conspiracy behind vaccination, which has spread very rapidly around the world via social media platforms.[30-33]

Finally, the vaccine for COVID-19 availability is critical in facing the COVID-19 PandemicPandemic. But vaccine hesitancy represents a significant threat to global health during this PandemicPandemic and limits the power of health systems to control the COVID-19 PandemicPandemic. Hence, estimating the COVID-19 vaccine hesitancy represents a tool for designing an Action Plan to improve vaccine acceptance.

Conclusions

COVID-19 vaccination refusal and hesitancy among the Sudanese population were high, and high worries regarding the safety and efficacy of vaccines.

Limitations of the study

The online platform may limit the sample's representativeness due to limited access to online participation.

Recommendations

The government must implement appropriate, culturally accepted interventional vaccination educational campaigns to remove the beliefs and worries regarding the safety, efficacy, and vaccine side effects of COVID-19 vaccines, which will help to increase vaccine acceptance rates.

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