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ORIGINAL RESEARCH

Beliefs and Barriers to COVID-19 Vaccine Acceptance in Three Countries with Different Human Development Index (HDI) Scores: A Comparative Study

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Background: As vaccination is a cornerstone strategy to prevent the spread of COVID-19, this study assessed and compared beliefs about and barriers to COVID-19 vaccination among the population of three countries with different Human Development Index (HDI) scores: Saudi Arabia (very high), India (medium), and Sudan (low).

Methods: A web-based, self-administered structured questionnaire was employed to collect data from the three countries. The questionnaire contained three sections that measured sociodemographic characteristics, participants' beliefs about and attitudes toward COVID-19 vaccines, barriers to receiving COVID-19 vaccines, and scenarios in which there is a possibility to take a COVID-19 vaccine. Multinomial logistic regression was used to determine whether there was an association between the country of the participant and their beliefs about COVID-19 vaccines.

Results: 972 responses were collected. The study participants from India were more likely to believe in the safety and efficacy of vaccines than those from Saudi Arabia or Sudan. Consequently, they reported more willingness to get vaccinated to avoid complications from COVID-19. Regarding barriers to COVID-19 vaccination, concerns about adverse effects and ineffectiveness of vaccines were more common among Saudi participants, while concerns about conspiracy were more common among Sudanese participants.

Conclusion: COVID-19 vaccine acceptance was higher in countries with a very high to medium Human Development Index, indicating greater belief in the safety and efficacy of COVID-19 vaccines.

Keywords: COVID-19 vaccination, human development index, beliefs, barriers

Introduction

Every aspect of life has been adversely affected by the current recession brought on by the coronavirus pandemic. In order to stop coronavirus infections and further devastation from the pandemic, vaccines have been developed. The World Health Organization (WHO) has already approved many vaccines, and vaccination campaigns have already begun in several countries. Although there is much evidence that vaccines are safe and help to improve health outcomes, there is still a lack of acceptance of vaccines among some people. The general public's reluctance to receive a COVID-19 vaccine is frequently attributed to apprehension about side effects, vaccine safety, and vaccine efficacy.[1,2]

Low acceptance rates for COVID-19 vaccines are also related to inadequate information, vaccine distrust, and uncertain or fleeting immunity. Another factor cited by Lin et al is the accelerated development of vaccines, which contributed to mistrust and doubt about the vaccine development process, clinical trials, and authorization, as well as

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increased vaccine safety concerns.[3] Additional factors contributing to increased distrust and opposition to vaccination include conspiracy theories and a lack of faith in authorities and healthcare professionals.

There have been numerous studies on vaccine acceptance and hesitation. In most international studies, the general public's acceptance rate was lower than that of healthcare professionals. The main justifications for lack of acceptance of vaccines were concern about potential side effects and the fast development of COVID-19 vaccines.[4] A cross-sectional online survey[5] was conducted in Greece and found that the probability of receiving a COVID-19 vaccine was associated with knowledge of Greek public health authorities and an absence of vaccine safety concerns. In contrast, some surveys[6–9] on acceptance of and hesitation about the COVID-19 vaccines in Japan have found that between 50% and 70% of the population support the vaccines.

Vaccine acceptance is also affected by a country's development index. A country's average performance in three fundamental areas of human development (health, knowledge, and standard of living) is summarized and combined in the Human Development Index (HDI). The HDI compares and ranks nations based on expected educational attainment and average annual income.[10,11] According to recent research, which was published on July 16, 2021, in *Nature Medicine*, respondents' willingness to receive a COVID-19 vaccine was significantly greater in developing nations (80% of respondents) than in the US (65%) and Russia (30%). In low- and middle-income countries, respondents cited personal protection against COVID-19 as the primary reason for vaccine acceptance (91%), while worry about side effects was cited as the main deterrent to vaccination (44%).[11] There is evidence that delays in vaccine rollout exacerbate inequality both within and between countries, with estimates stating that an additional 150 million people have already been pushed into extreme poverty as a result of COVID-19.[12] In addition to income and information sources, the availability of knowledge also affects vaccine acceptance. The most reliable sources of information about COVID-19 vaccines are thought to be medical professionals. The researchers, who conducted the surveys in 2020–21, found that vaccine acceptance may vary over time according to what information the general public is exposed to at a particular moment.[13,14] Many studies have investigated COVID-19 vaccine acceptance in individual countries, but to our knowledge no study has compared vaccine acceptance among the general population of countries based on their HDI score. Therefore, this study aimed to compare beliefs about and barriers to COVID-19 vaccine acceptance in countries with varied HDI scores.

Methodology

Study Design, Study Population, and Study Setting

We conducted a cross-sectional study on the general public of India, Sudan, and Saudi Arabia over 4 months (March-June 2021) using an online questionnaire.

Sample Size and Sampling Criteria

The HDI ranks Saudi Arabia as high, India as medium, and Sudan as low. These countries were chosen to explore how development index could affect vaccine acceptance. Data was collected from 324 participants from each country. Eligible study participants were recruited using the non-probability convenience sampling method. The inclusion criteria were age > 18 years and from India, Saudi Arabia, or Sudan. The exclusion criterion was severe cognitive impairment.

Research Instrument and Data Collection

The research instrument was a web-based, self-administered structured questionnaire. A draft questionnaire was created after a literature search,[15–17] using previous studies as a guide, and focus group discussions were held to understand people's concerns regarding COVID-19 vaccines. This draft questionnaire then underwent face and content validation, and a final questionnaire was prepared to fulfill the objective of this study. To protect the respondents' anonymity and elicit unbiased comments that more accurately represent their ideas, no identification details were requested from the respondents. The questionnaire was converted into a web-based format (Google Forms) and delivered to the participants in English and Arabic through social networking websites (Facebook, Twitter and WhatsApp). The questionnaire had

three sections. The first section of the survey asked seven questions about the participants' sociodemographic characteristics. The second section contained four questions about participants' attitudes toward and beliefs about COVID-19 vaccines; these questions were answered with yes, no, or maybe. The third section had two subsections containing seven questions on barriers to getting a COVID-19 vaccine and eight questions on scenarios in which there is a possibility to take a COVID-19 vaccine. For both subsections, the questions were answered with yes or no.

Statistical Analysis

After data collection, responses were downloaded as a Microsoft Excel file and blindly assessed. We used Statistical Package for Social Sciences Version 20 (SPSS Inc, Chicago, IL, USA) to conduct statistical analysis. Descriptive statistics were calculated to express the results as proportions, and the Mann Whitney test was used to determine whether there was a statistically significant relationship between each of the respondents' sociodemographic characteristics and acceptance of vaccines. A p value of < 0.05 was considered significant.

Ethical Considerations

The research ethics committee at King Khalid University approved this study, approval number ECM#2021-3703. Participants' consent was obtained through a question on the survey's first page indicating their voluntary participation.

Result

Baseline Characteristics

We obtained 972 responses from three countries: India, Saudi Arabia (SA), and Sudan. As shown in Table 1, participants aged 18–29 years had the highest response rates in India and SA (73% and 42%, respectively), whereas those aged 30–39 years had a relatively higher response rate than other age groups in Sudan (35%). In all three countries, more females than males participated in the study. Most participants from all three countries had a graduate or postgraduate degree (51% and 40%, respectively). Respondents from Sudan were more likely than those from SA and India to live in urban areas. Most of the respondents in all three countries reported good to excellent overall health.

Participant's Beliefs About and Attitudes Toward COVID-19 Vaccines

A Chi-square test was used to determine whether there was an association between the country of the participant and their beliefs about COVID-19 vaccines. We found statistically significant differences among participants from the three countries in all aspects of their beliefs about vaccines ($p < 0.005$). Participants from India were more likely to believe in the safety and efficacy of vaccines than those from SA or Sudan. Consequently, they reported more willingness to get vaccinated to avoid complications from COVID-19 (Table 2).

Barriers to COVID-19 Vaccination

In this part of the study, we investigated factors that were potential barriers to vaccination and possible motivations for vaccination among participants from each of the three countries. Of note, we received responses to this section from only 57 participants from India, 72 participants from SA, and 90 participants from Sudan. Factors with statistically significant differences across the three countries were: concern about adverse effects of the vaccines ($p < 0.005$), concern about the inability of vaccines to stop the spread of COVID-19 ($p = 0.038$), and concern that vaccines were a conspiracy ($p = 0.029$). Concerns about adverse effects and ineffectiveness of vaccines were most common among Saudi participants, whereas concerns about conspiracy were most common among Sudanese participants (Table 3).

Factors that encouraged vaccination and had statistically significant differences across the three countries included vaccines being available free of charge, physician recommendation to receive a vaccine, employers or the government mandating vaccination, vaccination of family members or friends, availability of non-injectable vaccines ($p < 0.005$), and the emergence of studies that that confirm the safety and efficacy of vaccines ($p = 0.001$; Table 4).

Table 1 Baseline Characteristics

		The Country You Live in							
		India		Saudi Arabia		Sudan		Total	
		N (324)	%	N (324)	%	N (324)	%	N (972)	%
Age	18–29 years	236	73%	136	42%	85	26%	457	47%
	30–39 years	67	21%	101	31%	112	35%	280	29%
	40–59 years	15	5%	79	24%	93	29%	187	19%
	>60 years	6	2%	8	2%	34	10%	48	5%
Gender	Female	178	55%	237	73%	210	65%	625	64%
	Male	146	45%	87	27%	114	35%	347	36%
Education level	Primary	5	2%	2	1%	5	2%	12	1%
	Secondary	34	10%	17	5%	20	6%	71	7%
	Graduate	167	52%	174	54%	157	48%	498	51%
	Post-graduate	118	36%	131	40%	142	44%	391	40%
Occupation	Educator	143	44%	73	23%	50	15%	266	27%
	Healthcare worker	33	10%	117	36%	91	28%	241	25%
	Not employed	66	20%	78	24%	69	21%	213	22%
	Other	82	25%	56	17%	114	35%	252	26%
Location	Rural	123	38%	35	11%	19	6%	177	18%
	Urban	201	62%	289	89%	305	94%	795	82%
Self-rated overall health	Fair/poor	4	1%	9	3%	13	4%	26	3%
	Good	144	44%	100	31%	125	39%	369	38%
	Excellent/very good	176	54%	215	66%	186	57%	577	59%

Abbreviations: N, number of participants; %, percentage.

Factors Associated with COVID-19 Vaccine Rejection

We used a multinomial logistic regression to determine the baseline characteristics associated with accepting or rejecting COVID-19 vaccination. Most baseline characteristics did not show a statistically significant relationship with vaccination status. However, participants from Sudan were more likely to reject or be reluctant about vaccines than Saudi participants (OR for "No" = 1.519, p = 0.035; OR for "Maybe" = 1.684, p = 0.018; Table 5).

Discussion

Of the 972 respondents obtained during the vaccination era, a majority from India and SA (69% and 62%, respectively) were willing to take a COVID-19 vaccine if it were available. This result is similar to data from the United States of America (US), where 59–75% of US adults indicated a willingness to get vaccinated.[18,19] Another study in SA found that 64.7% were willing to get vaccinated.[20] While only half of the respondents (50%) from Sudan were willing to take a COVID-19 vaccine if it became available, this finding is close to that of the SA study, which found that 44.7% of respondents were willing to be vaccinated.[21] Sudanese respondents' low willingness to get vaccinated might be because

Table 2 Participant`s Belief/Attitude Towards the COVID-19 Vaccine

		Country You Live in								p value
		India		Saudi Arabia		Sudan		Total		
		N (324)	%	N (324)	%	N (324)	%	N (972)	%	
Do you think that the COVID-19 vaccine would be safe?	Maybe	92	28%	134	41%	167	52%	393	40%	<0.005
	No	13	4%	42	13%	61	19%	116	12%	
	Yes	219	68%	148	46%	96	30%	463	48%	
Do you think that the COVID-19 vaccine would be effective?	Maybe	101	31%	136	42%	184	57%	421	43%	<0.005
	No	27	8%	39	12%	40	12%	106	11%	
	Yes	196	60%	149	46%	100	31%	445	46%	
Do you think that the best way to avoid the complications of COVID-19 is by being vaccinated?	Maybe	74	23%	81	25%	87	27%	242	25%	<0.005
	No	50	15%	71	22%	92	28%	213	22%	
	Yes	200	62%	172	53%	145	45%	517	53%	
If the COVID-19 vaccine is available, will you or did you take it?	Maybe	43	13%	51	16%	72	22%	166	17%	<0.005
	No	57	18%	72	22%	90	28%	219	23%	
	Yes	224	69%	201	62%	162	50%	587	60%	

Abbreviations: N, number of participants; %, percentage.

Table 3 Barriers Associated with the COVID-19 Vaccine (Reason for Not Taking the Vaccine)

	Country You Live in								p value
	India		Saudi Arabia		Sudan		Total		
	N (57)	%	N (72)	%	N (90)	%	N (219)	%	
Are you concerned about the side effect of the COVID-19 vaccine?	44	77%	70	97%	84	93%	198	90%	<0.005
Do you think the vaccine is too costly?	20	35%	29	40%	42	47%	91	42%	0.368
Do you believe that the vaccine will not stop the infection?	36	63%	59	82%	70	78%	165	75%	0.038
Do you think you do not need the vaccine because you follow all the precautionary measures?	39	68%	44	61%	57	63%	140	64%	0.684
Are you afraid of needles?	16	28%	12	17%	23	26%	51	23%	0.252
Do you think the COVID-19 vaccine is a conspiracy?	24	42%	40	56%	58	64%	122	56%	0.029
Do you think you do not need the vaccine because you are young and healthy?	32	56%	28	39%	46	51%	106	48%	0.120

Abbreviations: N, number of participants; %, percentage.

Table 4 Scenarios Under Which There is a Possibility to Take the COVID-19 Vaccine

	Country You Live in								p value
	India		Saudi Arabia		Sudan		Total		
	N (57)	%	N (72)	%	N (90)	%	N (219)	%	
Will you take the vaccine if it provided free of cost?	20	35%	1	1%	2	2%	23	11%	<0.005
Will you take the vaccine if your physician recommends it to you?	36	63%	15	21%	26	29%	77	35%	<0.005
Will you take the vaccine if it is mandatory by your job?	43	75%	39	54%	32	36%	114	52%	<0.005
Will you take the vaccine if it was compulsory by the government (MOH)?	40	70%	48	67%	35	39%	123	56%	<0.005
Will you take the vaccine if your friends or family members get vaccinated?	31	54%	9	13%	14	16%	54	25%	<0.005
Will you take the vaccine if you know more studies that prove that the vaccine is safe and effective?	51	89%	49	68%	54	60%	154	70%	0.001
Will you take the vaccine if there is a way other than injection?	24	42%	10	14%	15	17%	49	22%	<0.005
Will you deny taking the vaccine in any situation?	28	49%	43	60%	52	58%	123	56%	0.446

Abbreviations: N, number of participants; %, percentage.

they have the lowest belief in the safety and efficacy of COVID-19 vaccines compared to respondents from India and SA, as evidence showed that beliefs are the most important factor in determining acceptance of the vaccines.[22]

In contrast to the previously mentioned studies, we found three significant barriers to COVID-19 vaccination. These three barriers were concern about the vaccines' adverse effects, concern about vaccines' inability to stop the spread of COVID-19, and concern that vaccines were a conspiracy. Concerns about conspiracy were most common among Sudanese participants. COVID-19 conspiracy theories spread widely and readily over the world through social media. This might be due to the rapid development of COVID-19 vaccines, as the same scenario was observed and reported during the H1N1 pandemic.[23–25] Conspiracy theories also emerged as a reason for low vaccine acceptance, as was the case with the H1N1 pandemic.[26] A similar report also noted this phenomenon with the influenza vaccine in SA.[27] The rapid development of COVID-19 vaccines might also be a reason for the growth of concerns about adverse effects and the vaccines' inability to stop the spread of COVID-19, which were the most common reasons for vaccine hesitation among Saudi respondents.

Our results showed that vaccines being available free of charge, physicians recommending vaccines, employers or the government mandating vaccination, vaccination of family members or friends, availability of non-injectable vaccines, and the emergence of studies that confirm the safety and efficacy of vaccines were all factors that could encourage COVID-19 vaccination among participants in these three countries. Evidence showed that physician recommendations boost vaccine acceptance.[28]

Table 5 If the COVID-19 Vaccine is Available, Will You or Did You Take It

			Odds Ratio (OR)	95% Confidence Interval for OR		p value
				Lower Bound	Upper Bound	
Maybe		Intercept				0.001
	Age	18–29 years	1.714	0.689	4.263	0.247
		30–39 years	2.070	0.843	5.084	0.113
		40–59 years	1.639	0.649	4.139	0.295
		>60 years (Reference category)				
	Education Level	Primary	7.826	1.773	34.536	0.007
		Secondary	0.896	0.421	1.909	0.776
		Graduate	0.755	0.503	1.133	0.175
		Post-graduate (Reference category)				
	Occupation	Educator	0.923	0.566	1.506	0.750
		Health care worker	0.647	0.39	1.072	0.091
		Not employed	0.696	0.408	1.188	0.184
		Other (Reference category)				
	Residence	Rural	1.163	0.705	1.919	0.554
		Urban (Reference category)				
	Country	India	0.633	0.379	1.057	0.080
		Sudan	1.684	1.095	2.589	0.018
		Saudi Arabia (Reference category)				
No		Intercept				0.001
	Age	18–29 years	1.136	0.51	2.527	0.755
		30–39 years	2.004	0.917	4.382	0.082
		40–59 years	1.533	0.683	3.443	0.300
		>60 years (Reference category)				
	Education Level	Primary	2.573	0.486	13.635	0.267
		Secondary	1.271	0.665	2.43	0.469
		Graduate	1	0.693	1.445	0.999
		Post-graduate (Reference category)				
	Occupation	Educator	1.077	0.677	1.712	0.754
		Health care worker	0.819	0.509	1.318	0.411
		Not employed	1.404	0.891	2.213	0.143
		Other (Reference category)				
	Residence	Rural	1.004	0.631	1.596	0.988
		Urban (Reference category)				
	Country	India	0.745	0.475	1.166	0.198
		Sudan	1.519	1.03	2.239	0.035
		Saudi Arabia (Reference category)				

Future research should address the following limitations of this study. First, the sample may not be representative of the entire population because the participants were recruited using a convenience sampling technique. Second, in contrast to longitudinal studies, a cross-sectional study design makes it impossible to draw conclusions about causes and effects. It is important to note that, due to social isolation, lockdowns, and the fact that study participants were located in different countries, a longitudinal study design was not a practical option. Thirdly, the study did not include the participants` comorbidities, but this would affect the vaccine acceptance as per the reports of the WHO,[29] so a future study emphasizing comorbidities would be worth it. In addition, this study initially intended to collect data from four countries to cover all levels of the HDI: Saudi Arabia (very high), Egypt (high), India (medium), and Sudan (low). However, due to a low number of responses (N = 7) from Egypt, those responses could not be included in the data analysis.

Conclusion

In conclusion, this study confirms that vaccine acceptance was higher in countries ranked very high to medium on the HDI because the people of these countries had greater belief in the safety and efficacy of COVID-19 vaccines. However, if vaccines were provided free of charge or if more data were available to support the safety and effectiveness of these vaccines, vaccine acceptance could be encouraged and promoted in low-development countries.

Data Sharing Statement

The data and relevant materials will be provided upon request from the corresponding author.

Ethics Approval and Consent to Participate

The research ethics committee has approved this study at King Khalid University, approval number ECM#2021-3703. The study complies with the Declaration of Helsinki. Participants` consent was obtained through a question on the survey's first page indicating their voluntary participation.

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Disclosure

The authors declare no conflicts of interest in this work.

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