Original Research Article

Vaccine Hesitancy and Acceptability of COVID-19 Vaccines among Students in Medical Specialities. The University Aden, Yemen.

Abstract :
Background: The WHO considered the COVID-19 vaccine as a new critical tool against SARS-CoV-2 which has successfully reduced the global burden of illness and death. The aim of this study is to assess the acceptability of the COVID-19 vaccine among Students in Medical Specialties at the University of Aden, Yemen, and the factors affecting their intention to accept the vaccine.
Methods: A cross-sectional study design was used targeting medically related students in the University of Aden with a proportional sample stratified by specialty and educational level during the first semester of the academic year 2021-2022. A self-reported questionnaire consisted of five primary sections including sociodemographic characteristics, information on beliefs and attitudes about COVID-19, the attitudes and beliefs about a COVID-19 vaccination, level of willingness and support for COVID-19 vaccine, and finally about the sources of knowledge about the COVID-19 vaccine was used.
Results: The total number of students enrolled in this study was 422 from the different medical specialties at the University of Aden. The knowledge level was low among the participants (55.2%). However, the rest of the findings related to other domains were found to be poor and showed higher barriers to reduce the level of infection (70.9%), acceptability of the COVID-19 vaccine (47.4%), low level of attitude toward the COVID-19 vaccine (48.3%), and high negative perception on the vaccine (67.8%), respectively. Findings showed a significant statistical difference in gender between males and females (p=0.003), age group as younger compared to older age (p=0.048), and the area of residency by governorates (p=0.044).
Conclusion: Overall, medical students in the University of Aden demonstrated low knowledge, high false perceptions, and barriers to the COVID-19 vaccine. Male students showed a likely higher level of vaccine uptake willingness and demonstrated a more positive attitude to accept the vaccine than females. This strengthens the need to take measures and address the rumors and conspiracy theories to avoid distrust in the efficacy and safety of the vaccine.

Introduction

Preventative efforts on Coronavirus disease 2019 (COVID-19) and its variants as contagious diseases have been of supreme importance for the tremendous infections that result in global chaos in health, economic, and social fields.(Nicola, Alsafi et al. 2020) The global efforts to reduce the effects of the pandemic to the previous one before the pandemic era, and to depress its health and socio-economic

impact, crucially depend on the preventive efforts including the administration of vaccines by the people.(Viner, Russell et al. 2020)

Based on the Strategic Advisory Group of Experts on Immunization (SAGE), vaccine hesitancy is the term used to describe: “delay in acceptance or refusal of vaccination despite the availability of vaccination services”.(MacDonald 2015) Acceptance of new vaccines anywhere is considered as one of the main challenges for achieving immunization coverage.(Chen and Zhang 2021) Although immunization has successfully reduced the global burden of illness and death, public confidence in vaccines can be affected by various concerns. The World Health Organization (WHO) considered the COVID-19 vaccine as a new critical tool against SARS-CoV-2 that has successfully reduced the global burden of illness and death.(WHO 2021) Many people delay in accepting the covid-19 vaccine despite its availability and the free services provided to encourage people to accept it.(Almalki, Alotaibi et al. 2021) Therefore, vaccine acceptance described since the last decade as influenced by many factors including among others the low perception of the disease risk, hence, vaccination was deemed unnecessary complacency; the trust in vaccination safety, effectiveness, besides the competence of the healthcare systems; and the availability, affordability and delivery of vaccines in a comfortable context.(Larson, Jarrett et al. 2015, Domek, O'Leary et al. 2018, Bhopal and Nielsen 2021)

Public confidence in vaccine uptake can be affected by various concerns. As such, vaccine hesitancy can lead to delays, refusal and sometimes contribute to disease outbreaks in the target community.(Larson, Smith et al. 2013, Karafillakis, Dinca et al. 2016, Arce, Warren et al. 2021) However, investigating the attitude and vaccine literacy of the people may indicate the main factors affecting vaccine uptake. Moreover, in defining vaccine literacy is likely connected to the definition of

health literacy and could be applied in this context, as a “personal, cognitive and social skill that determines the capability of an individual to access, understand, and use information to improve and maintain personal health”.(Nutbeam 2000, Biasio 2019) The basic assumption of this definition is that people with a satisfactory level of health literacy manage their health more efficiently.(Gusar, Konjevoda et al. 2021) Therefore, it is assumed that level of vaccine literacy would be high among our university students.

Personal perception of the vaccine, beliefs, or attitudes toward vaccination, such as perceived efficacy or benefits of vaccines, safety concerns or side effects, and social/peer environment may also influence on vaccine-uptake.(WHO 2020) Many low-income countries, including Yemen, have low socio-economic status with low levels of education, income, and high unemployment as factors that may directly affect the vaccine distribution and acceptance among their people.(Arce, Warren et al. 2021, Moore, Purvis et al. 2021) Beside, people in communities under conflict or migrants has denied of being susceptible for COVID-19 infection and then show inaccessibility of the vaccine.(WHO 2021) This feeling was not exclusive to public but also demonstrated among health professionals and university students. For example, Mahdi (2021), has reported that vaccine hesitancy among Iraqi medical students was up to 65.21%.(Mahdi 2021) Similarly, other studies conducted among professional groups and university students showed high rate of hesitancy towards accepting the COVID-19 vaccine.(Al Kazzaz 2021, Bin-Ghouth and Al-Kaldy 2021, Sallam, Dababseh et al. 2021) In Yemen, no data were found regarding the beliefs and level of acceptance of COVID-19 vaccine among medically related university students. Therefore, this study aims to assess the acceptability of the COVID-19 vaccine among medically related university students in Aden, Yemen, and the factors associated with their intention to accept the vaccine.

Material and Method

Study design, Population and Sample

A cross-sectional study design was used targeting medically related students in the University of Aden**,** Yemen**,** and registered in one of the following medically related specialties: Medicine, Dentistry, Pharmacy, Medical laboratory Sciences, and Nursing during their first semester of the academic year 2021-2022. The ideal sample size was estimated based on the population size, a 50% response rate, a 5% margin of error, and a 95% confidence interval, which was calculated to be 384 participants. However, to strengthen the sample size, 10% of the sample was added to achieve a total of 422 students. A proportional sample stratified by specialty and educational level was used based on the total number of students registered in each of the five medically related specialties. A random selection of the students from each of the above-mentioned specialties was carried out.

Instrument and data collection

The self-reported questionnaire was designed and adapted by the authors based on similar studies on assessing the level of vaccine hesitancy and acceptance for COVID-19.(MacDonald 2015, Harapan, Wagner et al. 2020, Nzaji, Ngombe et al. 2020, Sherman 2020, Sherman, Smith et al. 2020, Zhong, Luo et al. 2020) The close-structured questionnaire was initially developed in English, translated into Arabic, and then back-translated into English to confirm the validity of the translation and the integrity of the content. The survey then used the Arabic text to administer the study. Similarly, the scientific credibility and validity of the tool was evaluated by three independent public health preventive medicine experts, who provided feedback on the accuracy, relevance, and simplicity of the included questions and statements. The questionnaire took about 5 minutes to be completed.

The questionnaire was pretested, and the final version was reviewed and approved by the research team. A calculated Cronbach alpha of more than 0.72, was obtained from the overall domains,

however, each domain was tested to assess the internal consistency of the questions. Items were grouped in the following sections: (A) demographic information included age, gender, marital status, the discipline of their study, education level, the governorate in which they were residing (administrative regions in Yemen), whether the participant had contracted COVID-19, whether any of the participant's relatives or friends had acquired COVID-19, whether any of the participant's relatives or friends died from COVID-19, (B) knowledge of novel coronavirus (COVID-19) with a total of 20 items of structured questions required possible responses of "Yes", "No" and "Don't know". (C) vaccine literacy (VL) to assess the knowledge on COVID-19 vaccine and vaccination intention which composed of 20 items of "Yes", "No" and "Don't know". (D) acceptance of COVID-19 vaccination: The survey's primary outcome was the acceptance of the COVID19 vaccination where participants were asked about their willingness to be vaccinated. Acceptability of COVID-19 vaccine consisted of five main questions on the factors influencing participants' trust toward COVID-19 vaccines that have been available in the country and factors for their acceptability or hesitancy toward the COVID-19 vaccine. All questions in part D used a five-point Likert scale ranging from strongly agree to strongly disagree and coded from 5 to 1, respectively. The last part was (E) related to the sources of knowledge about COVID-19 vaccine with some possible answers (e.g., mass media [radio/television], newspaper, internet, social media [Facebook, Twitter], family and relatives, friends, and neighbours.

Data Analysis

For the statistical analysis, coded data were entered and analysed using IBM SPSS statistics 25. Normality test was applied, and the examined scored data of most variables showed significant skewness and kurtosis. Therefore, the median score was used as determinant of the cut-off point for all the summative scores from each domain. A sum-up percentage of item' scores for each domain was

done, and then the median score was calculated to determine the level of goodness as good or not. Hence, higher value over the median for each domain was considered as positive value such as: adequate knowledge, perceived lees barrier in controlling COVID-19 infection, positive welling to receive the vaccine from those did not, positive attitude toward the vaccination, and finally perception toward COVID-19 vaccine.

The demographic data were evaluated and summarized using the descriptive presentation. Quantitative data were presented as mean, standard deviation (SD) and inter–quartile ranges. Chi-square testing was used in identifying associations between variables and outcomes.

A multivariable logistic regression analysis was performed using a backward stepwise approach to examine and identify factors associated with the vaccine demand group, intention to have the COVID-19 vaccine, acceptance, and hesitancy with Adjusted Odds Ratio (AOR), and a 95% confidence interval (CI) were calculated. The level of significance (α) was set at 0.05.

Ethical consideration

On the first page of the questionnaire, respondents were clearly informed about the background and objectives of the study, and they were free to withdraw at any time, without giving a reason, and that all information and opinions provided would be anonymous and confidential. Respondents shown an understanding of the content of the questionnaire and were agreed to participate in the study as marked in the corresponding box and signed before proceeding the answer of the questionnaire and clearly declaring that no personal identification is required. The study protocol was also approved by the Research Ethics Committee at the Faculty of Medicine and Health Sciences, University of Aden (REC-101 -2021).

Results

The total number of students enrolled in this study was 422 from the different medical colleges in the University of Aden as follow: 194 from Medicine, 68 from Pharmacy, 119 from Dentistry, 27 from Medical Laboratory Sciences, and finally 14 students from Nursing. The highest percentage of the participants were males (60%), in the age group of 20-23 years (46.0%), and a mean age of 22.7 (SD±2.0) years, from medical specialty (46.0%), and from Aden Governorate (64.7%). The findings showed that knowledge level was a low among the participants (55.2%). Also, few participants expressed a low level of barrier to reduce the COVID-19 infection (29.1%), that mean they feel that the capacity and ability to reduce and control the COVID-19 infection is low. Minor variations were noted among gender, age, specialty, and governorates. However, the level of knowledge and the level of barriers were analysis used the chi-square association test to test revealed that the difference between the demographic variables was statistically non-significant, as seen in table 1.

Table 1.

Findings in table 2 illustrated a general poor level of acceptability and willingness of COVID-19 vaccine (47.4%), high negative perceptions toward the vaccine (67.8%) and low levels of attitude toward vaccination against COVID-19 (48.3%), as seen in table 2.

Male participants (53.4%), younger age-groups (57.3%), and those residing in Al-Dhale'e governorate (55.6%) were found to be more accepting the COVID-19 vaccine than their counterparts with statistically significant differences (p=0.003, p=0.048, and p=0.044, respectively). However, no statistically significant difference was found between different medical specialties.

Likewise, on the analysis of the level of attitude toward COVID-19 vaccine and vaccination intention, a statistically significant differences were found between gender (p <0.001) where males showed more positive attitude in comparison to female (56.9%). The rest of the variables showed no statistically

significant differences between the level of attitude toward COVID-19 vaccine and other demographic variables such as age groups, specialty, and residency.

Regarding the association between the perception toward the vaccination process against COVID-19 and the different demographic variables including gender, age groups, specialty, and residency by governorates, no association was found ($p > 0.05$). However, the general level of perception was found positive.

Table 2.

Table 3. shows the results of logistic regression analysis. Reading the adjusted odds ratio (AOR), no one of the demographic covariant including gender, age, type of specialty, and the governorate that the student came from was predictor for the level of knowledge on COVID-10. Similar findings were found in relation to the level of perceived barrier to control the COVID-19 infection, except the younger age group were found less likely to show perceived barrier to control the COVID-19 infection than their counterpart (OR:0.556; 95% CI: 0.313-0.987; *p*:0.045).

Table 3.

The regression model in table 4 showed that, being a male was the only predictor attributed to having had 1.68 (95%CI: 1.06-2.67; *p*:0.028) times the odds of willingness to receive the COVID-19 vaccine and more likely 2.06 times of having positive attitude for receiving the COVID-19 vaccine (95%CI: 1.30-3.26; *p*: 0.002, respectively) in comparison to females' students. However, for the rest of the variables such as age groups, specialty, and governorate of residency, were found with no association with the dependent outcomes. In addition, the analysis of the positive perception to receive the COVID-19 vaccine showed no likelihood association with all independent variables in the study.

Table 4.

Figure 1 presents the difference in sources of information regarding the COVID-19 vaccine. When students asked about the trusted source of information related to COVID-19 vaccine, around 89% of the respondents have reported that doctors and professors at the colleges were the main source of information. Other sources were found such as social media (87.5%), and local and international satellite channels (82.0%). However, the role of doctors and teaching professors, governmental websites, and local radio programs as a source of information were found with statistically significant differences between those willing to receive the vaccines and those not willing (p value <0.001, 0.036, and 0.012, respectively).

Figure 1.

Discussion

The results of the survey provide information on knowledge, perceived barriers to control the COVID-19 diseases, willingness to receive the vaccine, attitude to receive vaccine, and the negative perception on the vaccine among university students at medically related colleges.

Several predictive factors and barriers, as well as the level of knowledge about the nature of the COVID-19 diseases and the used preventable vaccine could be linked strongly to the level of willingness to receive a vaccine.(Alqahtani, Althobaity et al. 2017, Kreps, Prasad et al. 2020, Neumann-Böhme, Varghese et al. 2020) Therefore, both low level of knowledge on the nature of COVID-19 infection (55.2%) was combined with the low level of willingness to accept the COVID-19 vaccine (47.4%) was found through the responses of the students in this study. Besides that, there was

not much variation between categories related to gender, age groups, medical specialty, and area of residency. Such findings were unexpected among university students who belonged to medically related colleges whereas almost half of them (46.0%) will be graduated soon as physician from the college of medicine and would be in close contact with their patients. Hence, they were prepared to play a role model in their community and as trusted health information source. Our finding of low COVID-19 vaccine acceptance was inconsistent with what was reported from other university students in other countries like Saudi Arabia,(Almalki, Alotaibi et al. 2021) Lebanon,(Hamdan, Singh et al. 2021) Italy,(Baccolini, Renzi et al. 2021) Japan,(Harada and Watanabe 2022), the United Kingdome,(Sherman, Sim et al. 2021) Australia,(Faasse and Newby 2020) and France,(Tavolacci, Dechelotte et al. 2021) (90.4%, 87%, 86.1%, 85.5%, 73.5%, 60.5%, and 58.0%, respectively). Moreover, some studies were in line with our findings showed low rate of COVID-19 vaccine acceptance like Turkey with 36.6% acceptance,(Soysal, Durukan et al. 2021) Egyptian students 35%,(Saied, Saied et al. 2021) Jordan with 34.9%,(Sallam, Dababseh et al. 2021) and 33 % of the Iraqi university students.(Tahir, Ramadhan et al. 2022) This variation in acceptancy rates could be explained as due to many factors including among others the differences in local culture, severity of the pandemic in each country, the role of the government in encouraging the people to receive the vaccine, and the availability and accessibility of the vaccine in the country.(SAGE 2020, Saied, Saied et al. 2021, Harada and Watanabe 2022) In Yemen, this is the first study conducted among university students, however, a study conducted in Mukalla city, Yemen among HCWs has reported a high percentage of COVID-19 vaccine hesitancy (74%),(Bin-Ghouth and Al-Kaldy 2021) which was much higher in comparison to our findings among students in the University of Aden (48.3%).

The main reported factors of low vaccine acceptance in our study could be explained by different reasons including among others: fear of potential side effects, lack of reliable data regarding the

vaccine, lack of trust for those creating and distributing the vaccine, misinformation in the covid context, disbelief of the vaccine effectiveness, and poor sources of information on the infection. In addition, poor role of the government in disseminating proper information on the SARS-2 CoV to all the population, limited accessibility, and affordability to all the people as the cost of the vaccine to the country is mainly donation-based, the weak role of the medical curricula in the university to intensify the relevant knowledge of the students as well as to encouraging them to use the preventive measures including the vaccine. Our findings were in line with findings from other studies elsewhere reported on COVID-19 vaccine hesitancy.(Harris, Maurer et al. 2010, Brown, Young et al. 2021, Lazarus, Ratzan et al. 2021) Moreover, perceived risk of becoming infected was considered in some studies as a predictor towards intention for accepting the vaccine.(Larson, Clarke et al. 2018, Fu, Wei et al. 2020) in our study, male students showed one and half more time higher of perceived risk for being infected than females, and two times more likely to have positive attitude for receiving the vaccine (OR: 2.06; 95%CI: 1.30-3.26; *p*: 0.002, and OR: 1.68; 95%CI: 1.06-2.67; *p*:0.028, respectively).

As the country is under protracted political conflict, such elements if not taken seriously, erode the level of trust and thus reduce the uptake of COVID-19 vaccine in our communities. Hence, vaccine hesitancy remains a major public health problem and is becoming a barrier to the prevention and containment of the COVID-19 pandemic. In the year 2019, the World Health Organization has listed the main reasons for vaccine hesitancy include complacency, inconvenient access to vaccines, and lack of confidence in vaccination; health workers remain the mainstay for overcoming these factors.(WHO 2019) Likewise, ensuring safe and effective vaccine against SARS-Cov-2 will influence positively on the containment of COVID-19 in the public as well as it will achieve high rate of vaccine uptake.(Lawes-Wickwar, Ghio et al. 2021)

In the meantime, some respondents in the present survey reported that they did not know where accurate/reliable information can be obtained from as the information provided by the health organizations was not sufficient. This part reflected in their high level of perceived barriers to control the COVID-19 infection. The most influential factors to accept or not accepting the COVID-19 vaccine in our study were different pieces of information from different social media platforms (87.5%). Repalust et al. stated that high vaccine hesitancy rates in younger ages might result from the possibility of higher acceptance of inaccurate information circulating among online or offline peer groups.(Repalust, Šević et al. 2017) Thus, the present study also found that the vaccine hesitancy/ refusal possibility increased when negative information was received. Many studies have referred that lack of effective information communication strategies could be damaging and could expose people to false and misleading information.(Puri, Coomes et al. 2020, Allington, Duffy et al. 2021, Muric, Wu et al. 2021) The spread of misinformation by the anti-vaccine movement through social media platforms intensified doubts about the vaccine among the public and, in turn, decreased vaccine acceptability as stated in some studies.(Almalki, Alotaibi et al. 2021)

Limitations

The present study a has few limitations that warrant consideration. Firstly, it is cross- sectional which depicts a picture of the community response at the point of the study. As participants were asked to report their intention to receive the COVID-19 vaccine if it is available in the future, answers in this regard could include “not sure” if they would take or not take in the future when the vaccine is abundant and easily accessible. It is interesting to study how the intention varies over time and the

context in the study population. Secondly, the current study did not explore the motivation behind the acceptance or barriers behind the hesitancy of the COVID-19 vaccine.

Despite the above limitations, the present study is the first of its kind with a representative sample size across the different medically related students at the University of Aden and demonstrated the student intention to uptake the COVID-19 vaccine.

Conclusion

COVID-19 vaccine hesitancy remains high among medically related students at the University of Aden, Yemen and mainly among females. Additional findings showed that students perceived low risk and trust in the health system were found to be significant predictors towards the low intention towards taking the COVID-19 vaccine in Yemen. Identifying the barriers to vaccination and related characteristics among those who expressed unwilling to take the vaccine is essential. Accordingly, interventions targeted towards increasing acceptance rates among university students are urgently needed. Future studies should use a composite measure based on a theoretical framework such as the theory of planned behaviour.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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list of abbreviations:

AOR	Adjusted Odds Ratio
CI	Confidence interval
R	Reference
SD	Standard deviation
WHO	World Health Organization

Ethics and Research Committee: The study protocol was also approved by the Ethics and Research Committee for ethical review at the Faculty of Medicine and Health Sciences, University of Aden (REC-101-2021).

Table 1. Demographic characteristics, level of knowledge on COVID-19 and barriers on controlling the infection among medically related students, University of Aden (n=422)

Variables	Categories	Total	Adequate knowledge		Less barrier	
		No. (%) *	No. (%) **	*p*-value	No. (%) **	*p*-value
Sex	Male	253 (60.0)	134 (53.0)	.256	72 (28.5)	.703
	Female	169 (40.0)	99 (58.6)		51 (30.2)	
Age (years)	18-21	110 (26.1)	54 (49.1)	.176	41 (37.3)	.090
	22-23	194 (46.0)	116 (59.8)		52 (26.8)	
	≥ 24	118 (28.0)	63 (53.4)		30 (25.4)	
Specialty	Medicine	194 (46.0)	109 (56.2)	.129	48 (24.7)	.476
	Pharmacy	68 (16.1)	29 (42.6)		23 (33.8)	
	Dentistry	119 (28.2)	68 (57.1)		38 (31.9)	
	Medical lab sciences	27 (6.4)	19 (70.4)		9 (33.3)	
	Nursing	14 (3.3)	8 (57.1)		5 (35.7)	
Governorates	Aden	273 (64.7)	154 (56.4)	.735	77 (28.2)	.853
	Lahej	49 (11.6)	25 (51.0)		15 (30.6)	
	Al-Dhale'e	63 (14.9)	32 (50.8)		21 (33.3)	
	All others	37 (8.8)	22 (59.5)		10 (27.0)	
Overall		-	**233 (55.2)**		**121(29.1)**	

* Percentages were taken from the total sample size (422)
****** Percentages were taken from the rows total

Table 2. Acceptability, positive attitude, and perception toward vaccination against COVID-19 among medically related students (n=422)

Variables	Categories	Willing to be vaccinated		Positive attitude		Positive perception	
		No. (%) **	***p*-value**	**No. (%) ****	***p*-value**	**No. (%) ****	***p*-value**
Sex	Male (253)	135 (53.4)	**0.003**	144 (56.9)	**<0.0001**	175 (69.2)	.452
	Female (169)	65 (38.5)		60 (35.5)		111 (65.7)	
Age (years)	18-21 (110)	63 (57.3)	**0.048**	59 (53.6)	.210	73 (66.4)	.256
	22-23 (194)	83 (42.8)		85 (43.8)		126 (64.9)	
	≥ 24 (118)	54 (45.8)		60 (50.8)		87 (73.7)	
Specialty	Medicine (194)	102 (52.6)	0.267	99 (51.0)	.088	125 (64.4)	.697
	Pharmacy (68)	31 (45.6)		39 (57.4)		49 (72.1)	
	Dentistry (119)	47 (39.5)		49 (41.2)		82 (68.9)	
	Medical Lab sciences (27)	13 (48.1)		9 (33.3)		20 (74.1)	
	Nursing (14)	7 (50.0)		8 (57.1)		10 (71.4)	
Governorates	Aden (273)	121 (44.3)	**0.044**	123 (45.1)	.088	179 (65.6)	.169
	Lahej (49)	20 (40.8)		22 (44.9)		31 (63.3)	
	Al-Dhale'e (63)	35 (55.6)		39 (61.9)		50 (79.4)	
	All others (37)	24 (64.9)		20 (54.1)		26 (70.3)	

***** Percentages were taken from the column total
****** Percentages were taken from the rows total

Table 3. Modelling regression analysis between level of knowledge on COVID-19 and the perceived barriers to control the diseases with the sociodemographic characteristics of the participants (n=422)

Variables	Categories	Knowledge			Perceived barriers		
		AOR	**95% CI**	***p* value**	**AOR**	**95% CI**	***p* value**
Sex	Male	0.962	0.610-1.516	.866	1.155	.699-1.908	.574
	Female	R	-	-	R	-	-
Age (years)	18-21	.783	.461-1.328	.363	.556	.313-.987	**.045**
	22-23	1.254	.782-2.011	.347	.962	.565-1.639	.888
	≥ 24	R	-	-	R	-	-
Specialty	Medicine	.844.	.272-2.613	.768-	1.408	.432-4.592-	.570-
	Pharmacy	472	.143-1.562	.219	.865	.250-2.995	.819
	Dentistry	.860	.269-2.744	.798	.964	.288-3.229	.952
	Medical Lab sciences	1.489	.368-6.026	.576	.953	.230-3.953	.947
	Nursing	R	-	-	R	-	-
Governorates	Aden	.768	.369-1.596	.479	1.028	.458-2.303	.947
	Lahej	.577	.237-1.405	.226	.858	.324-2.269	.757
	Al-Dhale'e	.691	.297-1.608	.391	.740	.295-1.854	.520
	All others	R	-	-	R	-	-

AOR: Adjusted Odds ratio
R: reference

Table 4. Modelling regression analysis between willingness to receive the COVID-19 vaccine, attitude to receive vaccine, and the negative perception on the vaccine with the sociodemographic characteristics of the participant (n=422)

Variables	Categories	Willingness			Positive Attitude			Positive perception		
		AOR	**95% CI**	***p* value**	**AOR**	**95% CI**	***p* value**	**AOR**	**95% CI**	***p* value**
Sex	Male	1.680	1.058-2.666	**.028**	2.059	1.300-3.262	**.002**	.943	.586-1.517	.810
	Female	R	-	-	R	-	-	R	-	-
Age (years)	18-21	1.589	.928-2.720	.091	1.170	.685-1.999	.566	1.408	.791-2.507	.245
	22-23	.934	.580-1.503	.778	.828	.515-1.333	.438	1.553	.928-2.601	.094
	≥ 24	R	-	-	R	-	-	R	-	-
Specialty	Medicine	1.123	.356-3.542	.843	.822	.257-2.623	.740	1.160	.331-4.064	.816
	Pharmacy	.775	.231-2.603	.680	.952	.279-3.240	.937	.920	.243-3.485	.903
	Dentistry	.749	.230-2.437	.631	.633	.192-2.081	.451	.887	.246-3.202	.855
	Medical Lab sciences	1.490	.376-5.903	.570	.670	.164-2.736	.577	.582	.129-2.637	.483
	Nursing	R	-	-	R	-	-	R	-	-
Governorates	Aden	.527	.249-1.114	.094	1.006	.488-2.075	.987	1.276	.587-2.774	.538
	Lahej	.409	.164-1.019	.055	.886	.364-2.157	.790	1.348	.530-3.429	.531
	Al-Dhale'e	.685	.289-1.624	.390	1.304	.560-3.038	.538	.612	.236-1.583	.311
	All others	R	-	-	R	-	-	R	-	-

R: reference

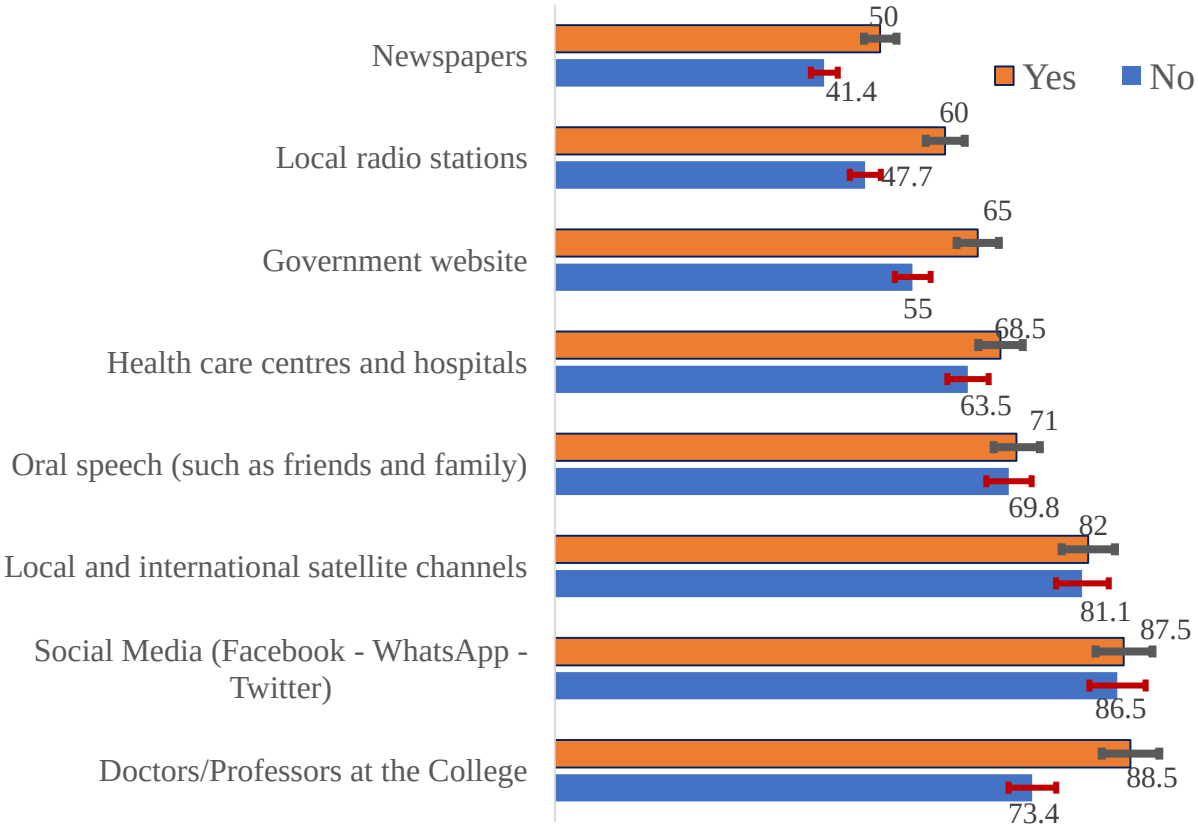

Figure 1. Source of information as factors related to vaccine-hesitancy