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RESEARCH PAPER

Acceptance of COVID-19 vaccine and associated factors among health professionals working in Hospitals of South Gondar Zone, Northwest Ethiopia

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ABSTRACT

Background: Health-care professions are among the highly exposed group of population affected by COVID-19 pandemic and identified as the target population to get vaccination against the spread of the infection. However, vaccine reluctance is still high, which may negatively affect the efforts to prevent the spread of the infection. Hence, this study was aimed to assess acceptance of COVID-19 vaccine and associated factors among health professionals working in Hospitals of South Gondar Zone, Northwest Ethiopia.

Methods: Institutional-based cross-sectional study was performed among 422 health professionals working in Hospitals of South Gondar Zone, Northwest Ethiopia, from March 1 to 30, 2021. Study participants were selected through simple random sampling techniques. Data were collected through a self-administered questionnaire. Multivariable logistic regression analysis was performed to identified factors associated with acceptance of COVID-19 vaccine with a p-value < 0.05 at 95% CI considered as statistically significant.

Result: Overall, 45.3% of health professionals accepted COVID-19 vaccine. Age (AOR: 2.55; 95% CI: 1.32–4.92), being male (AOR: 1.729; 95% CI: 1.32–2.34), had higher risk of COVID-19 (AOR: 1.74, 95% CI: 1.00–3.02), and positive attitude (AOR: 3.26, 95% CI: 2.14–4.96) were found to be statistically significant with the acceptance of COVID-19 vaccine.

Conclusion: The acceptance of COVID-19 vaccine among health professionals was significantly low. Participant's age, sex, high risk of COVID-19, and attitude toward COVID-19 vaccine were significantly associated with vaccine acceptance. Therefore, the government with respective stakeholders should emphasize addressing the concern of the health professionals and increase attitudes regarding COVID-19 vaccine to scale up vaccine acceptance.

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Introduction

Vaccination is one of the most successful and cost-effective health interventions to prevent infectious diseases including the current pandemic. Vaccine development and deployment are one of the most promising health intervention strategies to mitigate the spread of COVID-19.[1,2] Thus, huge efforts were devoted by the scientific community and governments' support was directed toward development of efficacious and safe vaccines for COVID-19.[3]

Within 1 year of World Health Organization declaring the COVID-19 infection as a pandemic, the COVID-19 Vaccine Global Access (COVAX) was manufactured around 2 billion doses of vaccine and delivered to different countries in 2021. Around 1.3 billion doses of the vaccine were funded by the COVAX facility to the 92 low-income countries overall the world.[4]

Although COVID-19 vaccine was made after so many efforts, it encountered major challenges to get public acceptance including health professionals (HPs).[5–8] Vaccine hesitancy means delay in acceptance or refusal of vaccines despite its availability. According to WHO and SAGE reports, vaccine hesitancy was identified as one of the 10 global health threats.[9–11]

HPs are categorized among the highly exposed group of population affected by COVID-19 due to several risk factors including continuous exposure to patients, shortages of personal protective equipment (PPE), lack of commitment in using the available PPEs, and lack of sufficient infection control training.[12,13] However, vaccine reluctance is highly manifested by the majority of HPs, which needs urgent intervention.[14–16] Low acceptance of vaccine against COVID-19 mostly happened due to vaccine safety concern, misconception circulating concerning the vaccine through mass media, knowledge of vaccines, vaccine conspiracies, and negative attitude toward the vaccine.[17–19]

Globally the overall acceptance of COVID-19 vaccine was very low with 14.8% of participants unable to accept the COVID-19 vaccination.[17] A study done in America reported that only 60% of the population accepted the COVID-19 vaccination.[20] Another study conducted in the USA among health-care workers showed that only 36% of participants were willing to get vaccinated as soon as it is available.[21] In Ethiopia, studies also showed that only 31.4% of the general population and 53.1% of HPs were willing to accept the COVID-19 vaccines.[22,23]

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Protecting HPs from COVID-19 infection would be beneficial for themselves, their household contacts, and their patients, and it is crucial in the preservation and protection of health-care systems.[24]

Ethiopia has received 2.184 million doses of the Astra Zeneca COVID-19 vaccine via the COVAX initiative on March 7, 2021, and the Ministry of Health launched the vaccine on March 13, 2021, at Yeka Kotebe COVID-19 Hospital, where frontline HPs were vaccinated to announce the beginning of the vaccination campaign.[25,26] Around 5.4 million doses of COVID-19 vaccine were expected to be distributed to Ethiopia by May 2021, and the Ministry of Health of Ethiopia plans to vaccinate only 20% of the population due to vaccine constraints by the end of 2021 where HPs were among the priority segment of the population, and to achieve this goal the second campaign of COVID-19 vaccine has already started.[27]

HPs are the frontline and expected to be models for the rest in advocating and accepting the vaccine to mitigate the spread of COVID-19. To do so, different study findings suggested that misunderstanding related to COVID-19 vaccine willingness must be resolved to scale up the acceptance of COVID-19 vaccination.[18,28,29] However, in our context COVID-19 vaccine still experienced many challenges and its acceptance is very low. Therefore, this study was aimed to assess the acceptance of COVID-19 vaccine and identified factors that hinder its acceptance among HPs working in Hospitals of South Gondar Zone, Northwest Ethiopia.

Methods

Study design and study setting

An institution-based cross-sectional study design was conducted in Hospitals of South Gondar Zone, Northwest Ethiopia, from March 1–30, 2021. South Gondar is one of the 11 zonal districts of the Amhara regional state, Northwest Ethiopia. The zone is divided into 15 woredas and Debre Tabor is its capital city. The zone has eight public hospitals (one comprehensive specialized and seven primary hospitals). These are Debre Tabor Comprehensive Specialized Hospital (DTCSH) in Debre Tabor Town, Addis Zemen Primary Hospital (AZPH) in Libo Kemkem Woreda, Nefas Mewucha Primary Hospital (NMPH) in Lay Gaynt Woreda, Ebinat Primary Hospital (WPH) in Ebinat Woreda, Dr. Ambachew Memorial Primary Hospital (Dr. AMPH) in Tach Gaynt Woreda, Andabet Primary Hospital (APH) in Andabet Woreda, Mekane Eyesus Primary Hospital (MEPH) in Estey Woreda, and Wogeda Primary Hospital (WPH) in Simada Woreda.

Source population

The source populations were all HPs who were working in South Gondar Zone public hospitals. Based on the zonal department health official's report, an overall 1376 HPs are working in all eight hospitals.

Study population

The study populations were all HPs who were working in selected public hospitals of South Gondar Zone during the study period. Among the total 1376 HPs working in eight public hospitals, 1095 HPs were working in the selected hospitals.

Inclusion and exclusion criteria

All HPs who were working in the selected hospitals were included while HPs who were on annual leave, maternal leave, and sick leave were excluded.

Sample size determination

The sample size was determined by using single population proportion formula with the assumption 50% of COVID-19 vaccine acceptance rate due to lack of a related study done previously in Ethiopia, 5% margin of error (d), and considering 10% none response rate; and the final sample size was 422.

Sampling procedure

A simple random sampling technique was employed to select 422 HPs working in the selected public hospitals of the South Gondar zone. Out of eight hospitals, five of them were selected randomly using lottery methods (DTCSH, NMPH, AZPH, Dr. AMPH, and MEPH). Samples were selected and proportionally allocated to each selected hospital based on their total number of HPs (DTCSH = 498, NMPH = 111, AZPH = 208, Dr. AMPH = 105, and MEPH = 173). Therefore, the calculated samples for each hospital were DTCSH = 192, NMPH = 43, AZPH = 80, Dr. AMPH = 40, and MEPH = 67.

Data collection tools and procedure

The data were collected through self-administered techniques using a structured questionnaire, which was prepared in English after reviewing pertinent study literatures and frameworks to assess COVID-19 vaccine acceptance.[30–34] The questionnaires had four items (socio-demographic characteristics, health-related characters, attitude-related, and acceptance-related characteristics). The data were collected by four diploma HPs who had previous experience in data collection and were supervised by two BSc HPs.

Study variables

Dependent variable

Acceptance of COVID-19 vaccine (yes/no).

Independent variables

Socio-demographic

Age, sex, ethnicity, educational status, marital status, and working room.

Health status-related characteristics

History of COVID-19 infection, family history of COVID-19 infection (family member who lives in the same household and who has a history of COVID-19 infection irrespective of their relationship), chronic diseases (hypertension, DM, asthma, HIV/AIDS, etc.), and high risk for infection (older age, chronic disease, working area).

Attitude

Positive or negative attitude regarding COVID-19 vaccine.

Data quality control

To maintain the quality of the data, the questionnaire was prepared after a rigorous intensive appraisal of pertinent literature. Pretesting of the questionnaire was done on 5% of the sample size (21 HPs) in WPH, which was found in the zone and not part of the actual study. Based on the pretest, modifications, and corrections like wording, logical sequence, and skip patterns were made immediately. Data collectors and supervisors were trained for 1 day about the contents of the questionnaire, confidentiality, and informed consent before the actual data collection. Supervisors and principal investigators had cross-checked, cleaned, and documented the completeness and accuracy of the collected data regularly.

Operational definition

Acceptance of COVID-19 vaccine

In this study, acceptance was defined as the intention to accept to take COVID-19 vaccine. "Do you want to vaccinate against COVID-19 infection when the vaccine become available?" and the responses were "Yes" and "No."[32,35]

Attitude toward COVID-19 vaccine

The attitude of the participant was determined based on 10 attitude assessing questions and labeled as good and poor attitude based on mean score.[36]

HPs who scored greater than or equal to the mean score of attitude questions of COVID-19 vaccine were considered as having a positive attitude, while those who scored less than the mean score was considered as having a negative attitude.

Data analysis

The collected data were coded and entered into Epi-Data version 4.2 and then exported to SPSS version 23 for analysis. Descriptive analysis was carried out, and frequency tables and percentages were used to present the descriptive results. Bivariable logistic regression analysis was done to examine the crude association of dependent and independent variables and variables having p-value≤0.2 were entered into the multivariable logistic regression model for further analysis by controlling confounding factors and finally significant association was declared based on $p < .05$ and adjusted odds ratio (AOR) with 95% CI.

Results

Socio-demographic characteristics

A total of 422 HPs participated in this study with a response rate of 100%. Of the total participants, nearly half of them (192, 45.5%) belonged to the age group of 30–39 years ranging from 24 to 50 years old. The mean age of the participant was 32.28 (SD± 6.61) years. Nearly three-fourth of the study participants (305, 72.3%) were male and predominantly Amhara (402, 95.3%) and Orthodox Christian followers (403, 95.5%). Of the total respondents, 148 (35.1%) were nurses followed by midwives 83 (19.7%) (Table 1).

Health status-related characteristics of participants

The majority of the respondents 384 (90.8%) and 376 (89.1%) had no self and family history of COVID-19 infection, respectively. About 335 (79.4%) of the HPs had a higher risk of acquiring COVID-19 infection in their future life (Table 2).

Table 1. Socio-demographic characteristics study participants working in Hospitals of South Gondar Zone, Northwest Ethiopia, 2021 (N = 422).

Characteristics	Frequency	Percent
Age in years		
20–29	154	36.5
30–39	194	46.0
≥ 40	74	17.5
Sex		
Male	305	72.3
Female	117	27.7
Ethnicity		
Amhara	402	95.3
Others*	20	4.7
Religion		
Orthodox	403	95.5
Others**	19	4.5
Educational status		
Diploma	104	24.6
First degree (BSc)	212	50.2
Second degree (MSc)	96	22.7
Third degree (specialty)	10	2.5
Profession		
Nurse	148	35.1
Midwife	83	19.7
Physician	60	14.2
Laboratory	46	10.9
Anesthetist	33	7.8
Health officer	27	6.4
Pharmacist	25	5.9
Working areas/ward		
Emergency	70	16.6
Outpatient	64	15.2
Operation room	65	15.4
Inpatient	59	14.0
Laboratory	46	10.9
Intensive care unit	45	10.7
Labor/delivery	41	9.7
Pharmacy	25	5.9
Isolation	7	1.7
Working experience in years		
≤ 5	227	53.8
> 5	195	46.2
Monthly salary in Ethiopian birr		
≤ 6000 (≤136 US$)	136	32.2
> 6000 (>136 US$)	286	67.8
Marital status		
Single	152	36.0
Married	252	59.7
Others****	18	4.3

*Oromo, Tigray, Gurage. ** Muslim, Protestant, Catholic. *** Divorced, widowed.

Table 2. Health status-related characteristics of study participants working in Hospitals of South Gondar Zone, Northwest Ethiopia, 2021 (*N* = 422).

Characteristics	Frequency	Percent
History of COVID-19 infection		
Yes	39	9.2
No	383	90.8
Family history of COVID-19 infection		
Yes	46	10.9
No	376	89.1
History of chronic disease		
Yes	92	21.8
No	330	78.2
Increased risk of getting COVID-19 in future		
Yes	335	79.4
No	87	20.6
Tested for COVID-19		
Yes	134	31.8
No	288	68.2
If tested your result (N = 134)		
Yes	15	11.2
No	119	88.8
Advice to friend and family to get vaccination		
Yes	259	61.4
No	163	38.6

The attitude of participants toward COVID-19 vaccine

Most of the respondents' answered "I am not sure" for various elements of attitude measuring questions. According to this study, the major proportion of participants 219 (51.9%) had a negative attitude while 203 (48.1%) had a positive attitude toward COVID-19 vaccines (Table 3).

Acceptance of COVID-19 vaccine and reasons not to accept COVID-19 vaccine

All the participants (422, 100%) reported that they had ever heard about the COVID-19 vaccine. International health organizations (WHO, CDC) (206, 48.8%), television/radio (188, 44.5%), and social media (188, 44.3%) were their main sources of information. Of the total 422 participants, 217 (51.4%) believed that COVID-19 vaccination is an effective way to prevent and control the spread of the COVID-19 pandemic. Overall, this study identified that 45.3% with 95% CI (40.5–50.5) of participants had accepted COVID-19 vaccination as soon as it became available (Table 4).

However, 54.7% of the participants had not accepted COVID-19 vaccine due to various reasons. Among these, concern about unknown side effects (37.4%) was the major reason followed by insufficient trust in the source (producer 31.3%) (Table 4).

Factors associated with COVID-19 vaccine acceptance

The result of binary logistic regression analysis showed that age, sex, marital statuses, profession, higher risk for COVID-19 infection, test for COVID-19, and attitude toward COVID-19 vaccine were significantly associated with acceptance of COVID-19 vaccine. But in multivariable binary logistic regression analysis, only age, being male, higher risk for COVID-19 infection, and positive attitude toward COVID-19 vaccine had remained statistically significant with acceptance of COVID-19 vaccine.

HPs whose ages ranged from 30 to 39 years were 2.34 times higher the odds of accepting the COVID-19 vaccine (AOR: 2.34; 95% CI: 1.21–4.53) than respondents whose ages ranged from 20 to 29 years. Similarly, participants whose age lay greater than or equal to 40 years were 2.55 times more likely to accept COVID-19 vaccine (AOR: 2.55; 95% CI: 1.32–4.92) as compared with participants whose age was found between 20 and 29 years old. Compared to female HPs, male professionals were nearly two times more likely to accept COVID-19 vaccination (AOR: 1.729; 95% CI: 1.32–2.34).

Moreover, participants who had a higher risk of COVID-19 infection were nearly two times more likely to accept the COVID-19 vaccine (AOR: 1.74, 95% CI: 1.00–3.02) as compared to those who had a low risk for acquiring the COVID-19 infection. Lastly, HPs who had a positive attitude toward the COVID-19 vaccine were 3.26 times more likely to accept the vaccine (AOR: 3.26, 95% CI: 2.14–4.96) as compared to their counterparts (Table 5).

Discussion

Since the announcement of efforts to develop a COVID-19 vaccine, several studies have been carried out to measure the perception and acceptance of the vaccine among the general population.[37–43] However, the rollout of the vaccine is tiered to various subgroups of the population based on limited availability, and HPs are among the first subgroups of the

Table 3. Attitude of study participants toward COVID-19 vaccine working in Hospitals of South Gondar Zone, Northwest Ethiopia, 2021 (*N* = 422).

Attitude questions	Agree *N* (%)	I am not sure *N* (%)	Disagree *N* (%)
Do you think COVID-19 can be prevented by vaccination?	197 (46.6)	145 (34.4)	80 (19.0)
Do you think that the currently available vaccine will stop the COVID-19 infection?	109 (25.8)	226 (53.6)	87 (20.6)
Do you believe that COVID-19 vaccine approved for license has been fully evaluated in clinical trials?	106 (25.1)	187 (44.3)	129 (30.6)
Do you think that COVID-19 vaccination should be mandatory for health professionals?	248 (58.8)	60 (14.2)	114 (27.0)
Do you think the current COVID-19 vaccine is effective?	76 (18.0)	225 (53.3)	121 (28.7)
Do you think the current COVID-19 vaccine is safe?	59 (14.0)	241 (57.1)	122 (28.9)
Do you trust professional staff' advices?	229 (54.3)	104 (24.6)	89 (21.1)
Do you trust the information propagated by the official media regarding the vaccine?	175 (41.5)	118 (28.0)	129 (30.6)
Do you think that the information provided on vaccination against COVID-19 from the Ethiopian Public Health authorities is reliable?	162 (38.4)	130 (30.8)	130 (30.8)
Do you think the COVID-19 vaccine will be affordable and accessible for all population?	59 (14.0)	220 (52.1)	143 (33.9)

Table 4. Acceptance of COVID-19 vaccine among study participants working in Hospitals of South Gondar Zone, Northwest Ethiopia, 2021 (*N* = 422).

Acceptability questions	Frequency	Percent
Have you ever heard about COVID-19 vaccine?		
Yes	422	100
No	0	0.0
Source of information on COVID-19 vaccines? (multiple responses)		
International health organizations (WHO, CDC)	206	48.8
Television/radio	188	44.5
Social media	187	44.3
Website of Ethiopia Ministry of Health	158	37.4
Biomedical scientific publication	34	8.1
Do you want to vaccinate against COVID-19 infection when the vaccine becomes available?		
Yes	191	45.3
No	231	54.7
If you want which kind of immunization schedules you prefer (N = 191)?		
Routine immunization	115	60.2
Emergency immunization	20	10.5
Both	56	29.3
Reasons for refusing (not accepting) COVID-19 vaccination (multiple responses) (N = 231)		
Concerns about unknown side effect	158	68.4
Concerns about vaccine efficacy/effectiveness	132	57.1
Insufficient trust in the source (producer)	105	45.5
Don't have enough information	87	37.7
Unreliable, due to short time for vaccine development	73	31.6
Prior adverse reaction to any vaccine	45	19.5
Concern of extra acquiring of infection after vaccination	59	25.5
Biological weapon	64	27.7
Prefer to use other ways of protection	53	22.9
Health worker recommendation is an important factor in vaccination decision-making		
Yes	308	73.0
No	114	27.0
Vaccine convenience (vaccination method, frequency, distance, vaccination sites, etc.) is an important factor in vaccination decision-making		
Yes	336	79.6
No	86	20.4
Vaccine price is an important factor in vaccination decision-making		
Yes	271	64.2
No	151	35.8
Time elapsed to develop the vaccines against COVID-19 affects the acceptability of vaccine?		
Yes	306	72.5
No	116	27.5
Have you directly or indirectly taken care of the COVID-19 patients?		
Yes	312	73.9
No	110	26.1
Are you a frontline healthcare worker?		
Yes	301	71.3
No	121	28.7

population to have access to the vaccine. As such, it is crucial to assess predictors of vaccine acceptance among HPs, which will help policymakers target resources to maximize the uptake of COVID-19 vaccine.

To the best of our knowledge, this is one of the first studies in Ethiopia especially in the study area investigating HPs about COVID-19 vaccination. In our study, almost all of the HPs had heard about the COVID-19 vaccine. International health organizations (WHO, CDC) were the commonest source of information at 48.8% followed by television/radio 44.5% and social media 44.3%.

To battle the devastating effect of COVID-19, vaccination offers the most reliable hope for a permanent solution by developing herd immunity. To do so, a vaccine must be accepted and used by a large majority of the population.[43] However, the finding of our study showed that only 45.3% of participants accepted COVID-19 vaccination. This was consistent with a study conducted in Malta (44.2%),[44] Hong Kong (40.0%),[45] and Saudi Arabia (49.71%).[35]

But this finding was higher than a study conducted in Ghana (39.3%),[18] Democratic Republic of Congo (27.7%),[36] Jordan (28.4%),[46] Kuwait (23.6%),[46] and Ethiopia.[22] The possible reason might be the time gap, which affects the dissemination of information about the vaccine through various media including the Internet, Facebook, Telegram, Television, and radio. The high commitment of the Ethiopian government to minimize the effect of the pandemic by all possible preventing strategies including vaccination might be another probable reason. Study population difference might also be another reason, for example, a study done in Ethiopia was of the general population but our study focused specifically on HPs who were among the vulnerable group and may had higher knowledge related to the vaccine.

However, our study's findings were significantly lower than various studies conducted in Pakistan (70.25%),[47] Israel (78%),[48] France (76.9%),[28] Italy (75%),[31] Turkey (68.6%),[49] Greek (75.8%),[32] and Southern Ethiopia.[23] The discrepancies might be due to socio-demographic differences and differences in communities' insight of the seriousness of the pandemic. Besides, variation in access to a wide variety of conspiracy theories and debuts through social media might be another reason. Furthermore, this low acceptance might be explained by the harm of social networks and the spread of misinformation about the quality of the vaccine. Due to this mass media

Table 5. Factors associated with acceptance of COVID-19 vaccine among study participants working in Hospitals of South Gondar Zone, Northwest Ethiopia, March 1–21, 2021 ($N = 422$).

Variables	Accept vaccine		COR (95% CI)	AOR (95% CI)	*P*-value
	Yes (%)	**No (%)**			
Age in years					
20–29	67 (43.5)	87 (56.5)	1	1	
30-39	79 (40.7)	115 (59.3)	0.891 (0.73–1.721)	2.344 (1.211–4.538)	.011*
≥40	45 (60.8)	29 (39.2)	2.014 (1.983–3.087)	2.553 (1.324–4.922)	.005*
Sex					
Male	149 (48.9)	156 (51.1)	1.705 (0.378–0.910)	1.729 (1.321–2.345)	.003*
Female	42 (35.9)	75 (64.1)	1	1	
Profession					
Nurse	52 (31.5)	96 (64.9)	1	1	
Midwife	21 (25.3)	62 (74.7)	0.625 (0.879–2.911)	1.03 (0.645–5.980)	.045
Laboratory	34 (73.9)	12 (26.1)	5.230 (0.091–0.401)	2.345 (0.453–3.201)	.764
Anesthesia	19 (57.6)	14 (42.4)	2.505 (0.1850–2.861)	0.563 (9.086–2.023)	.124
Health officer	20 (74.1)	7 (25.9)	5.274 (0.975–3.478)	1.989 (0.234–4.903)	.087
Pharmacist	6 (24.0)	19 (76.0)	0.586 (0.645–4.561)	2.123 (3.097–8.954)	.324
Physician	39 (65.0)	21 (35.0)	3.428 (0.156–0.547)	1.012 (0.945–4.214)	.076
Marital status					
Single	73 (48.0)	79 (52.0)	1	1	
Married	112 (44.4)	140 (55.6)	0.865 (0.771–1.730)	0.437 (0.128–1.489)	.186
Others	6 (33.3)	12 (66.7)	0.541 (0.660–5.178)	0.761 (0.232–2.496)	.653
History of COVID-19 infection					.077
Yes	15 (38.5)	24 (61.5)	0.735 (0.692–2.674)	1.962 (0.929–4.148)	
No	176 (46)	207 (54)	1	1	
Family history of COVID-19 infection					.954
Yes	20 (43.5)	25 (56.5)	0.959 (0.585–2.010)	0.79 (0.894–3.094)	
No	171 (45.5)	205 (54.5)	1	1	
Presence of chronic disease					.415
Yes	53 (57.6)	39 (42.4)	1.890 (0.331–0.844)	0.795 (0.457–1.381)	
No	138 (41.8)	192 (58.2)	1	1	
Perceive a higher risk of infection in future					.047*
Yes	150 (44.8)	185 (55.2)	0.909 (0.567–1.460)	1.744 (1.006–3.021)	
No	41 (47.1)	46 (52.9)	1	1	
Test for COVID-19					.474
Yes	116 (40.3)	172 (59.7)	0.530 (0.351–0.803)	0.433 (0.271–1.239	
No	75 (56.0)	59 (44.0)	1	1	
Attitude					.001*
Positive	65 (32.0)	138 (68.0)	0.347 (1.931–4.284)	3.266 (2.149–4.962)	
Negative	126 (57.5)	93 (42.5)	1	1	

* *P* -value < 0.05 considered as statistically significant.

propagation of misinformation about poor vaccine quality and rumors, the HPs may have developed vaccine hesitancy, which can affect their decisions to accept vaccination and to promote the vaccine to their clients and the whole community.

This study found that COVID-19 vaccine acceptance increased with increasing age. This mirrors the trends seen with a study performed in the USA,[33] Pakistan,[47] France,[28] and the Democratic Republic Congo.[36] Higher vaccine acceptance with increasing age might be due to higher perceived susceptibility of the infectious pandemic.[42,50]

As mentioned elsewhere, vaccine acceptance was more likely among males as compared to females.[28,30,35,36,46,51] This might be due to the lesser tendency observed among males to believe in vaccine and virus origin conspiracies.[52,53] Since they mostly relied on medical doctors, scientists, and scientific journals as opposed to females, who relied more on social media platforms. Besides, females were less likely to perceive the disease, which may result in lower vaccine acceptance due to complacency as evidenced by Sallam M. et al.[52] Once more, males had an increased risk perception of disease compared to females. Perceptions of risk are an inherent part of the decision-making process. Data collected from Chinese death rates found that a gender gap is evident in the causality rate; 64 per 100 males (4.7% mortality rate) compared to 36 per 100 females (2.8% mortality rate).[54,55]

In line with other findings,[35,56,57] vaccine acceptance was higher in HPs who have perceived a higher risk of COVID-19 infection. This might be explained by individuals who are at risk of COVID-19 and were in a need to build immunity by taking the vaccination.

Moreover, HPs who had a positive attitude toward COVID-19 vaccine also had an increased need to be vaccinated. Likewise, a study done in the Democratic Republic of Congo stated that attitude is a positive predictor for acceptance of the vaccine.[36] The possible reason might be a positive attitude toward the vaccine may avoid misconception and misinformation regarding the vaccine and outweigh its importance and then encouraging to acceptance the vaccine.

Fear of unknown side effects (68.4%) was the main reason for the non-acceptance of COVID-19 vaccination, which was in line with many studies.[32,48,58] Concerns about vaccine effectiveness were also another major reason for non-acceptance of the

COVID-19 vaccine, which accounts for 57.1%, and this was supported by a study done by Corey L. et al.[59] and Dean NE et al.[60] This emphasized that the government needs to give tangible and reliable information regarding the general characteristics of the vaccine including the possible side effects to rule out misconceptions and rumors concerning the vaccine.

Conclusion

We found that the acceptance of COVID-19 vaccine among HPs was significantly low. Participants' age, sex, higher risk of infection, and attitude toward the vaccine were found to be significantly associated with COVID-19 vaccine acceptance. Despite the HPs are both the frontline and high-risk subgroup and strong advocates for eliminating vaccine hesitancy, their willingness to be vaccinated is an alarming sign for rushing effective intervention to increase the acceptance of the vaccine.

Therefore, the government in collaboration with other stakeholders should emphasize addressing the concern of the HPs regarding the side effect and safety of the vaccine. Besides trying to increase willingness especially in the younger community by providing reliable information to avert the misconception and rumors that negatively affect their attitude toward the vaccine and to protect others by getting oneself vaccinated may be the key to promote vaccine acceptance.

Strengths and limitations of the study

Despite the study trying to address the main tackles to combat the global pandemic COVID-19, it has its own limitation. First, accepting the vaccine at the time being may not be certain as vaccine may substantially change over time. Second, the design may limit inference on the rotating connection of the association detected.

Abbreviations

AOR	Adjusted odds ratio
CI	Confidence interval
HP	Health professional
SPSS	Statistical Package for Social Science
WHO	World Health Organization

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contribution

ADA, NTA, LAT, and BGK inception designed the study, conduct data analysis, result interpretation, manuscript drafting, wrote the paper, and revised the manuscript. EDY, EWA, GNM, and HGB participate in the data collection, editorial, data entry, and analysis. All authors read and approved the final paper.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics approval and consent to participate

Ethical clearance was obtained from Debre Tabor University College of Health Sciences institutional ethics review committee. A formal letter was given to the selected health institutions from the College of Health Sciences. Moreover, informed written consent was obtained from each respondent and they informed their right to withdraw from the study at any time. Confidentiality and privacy of participants were secured by omitting any identifier.

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References

1. Lurie N, Saville M, Hatchett R, Halton J. Developing covid-19 vaccines at pandemic speed. N Engl J Med. 2020;382:1969–73. doi:10.1056/NEJMp2005630.
2. Yang Y, Peng F, Wang R, Guan K, Jiang T, Xu G, Sun J, Chang C. The deadly coronaviruses: the 2003 SARS pandemic and the 2020 novel coronavirus epidemic in China. J Autoimmun. 2020;109:102434. doi:10.1016/j.jaut.2020.102434.
3. Conte C, Sogni F, Affanni P, Veronesi L, Argentiero A, Esposito S. Vaccines against coronaviruses: the state of the art. Vaccines (Basel). 2020 8. doi:10.3390/vaccines8020309.
4. Glanville D. COVID-19 vaccines: development, evaluation, approval and monitoring [Internet]. European Medicines Agency; 2020 [Accessed 2021 May 19; cited 2021 Mar 23]. https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/covid-19-vaccines-development-evaluation-approval-monitoring .
5. Recommendations on the use of COVID-19 vaccines. Government of Canada; 12 Jan 2021. https:/www.canada.ca/en/public-health/services/immunization/national-advisory-committee-on-immunization-naci/recommendations-use-covid-19-vaccines.html#b1 .
6. European Centre for Disease Prevention and Control (ECDC). First COVID-19 vaccine authorised for use in the European Union. Stockholm: ECDC; 21 Dec 2020. https://www.ecdc.europa.eu/en/news-events/first-covid-19-vaccineauthorised-use-european-union .
7. European Medicines Agency (EMA). EMA recommends COVID-19 Vaccine Moderna for authorisation in the EU. Amsterdam: EMA; 06 Jan 2021. https://www.ema.europa.eu/en/news/ema-recommends-covid-19-vaccine-moderna-authorisation-eu.
8. Harrison EA, Wu JW. Vaccine confidence in the time of COVID-19. Eur J Epidemiol. 2020;35:325–30. doi:10.1007/s10654-020-00634-3.

9. Gagneux-Brunon A, Pelissier C, Gagnaire J, Pillet S, Pozzetto B, Botelho-Nevers E, Berthelot P. SARS-CoV-2 infection: advocacy for training and social distancing in healthcare settings. J Hosp Infect. 2020;106:610e2. doi:10.1016/j.jhin.2020.08.001.
10. SAGE group vaccine hesitancy e Recherche Google n. d. [last accessed October 2018]. https://www.google.com/search?client¼safari&rls¼en&q¼SAGEþgroupþvaccineþhesitancy&ie¼UTF-8&oe¼UTF-8
11. MacDonald NE, Sage Working Group on Vaccine Hesitancy. Vaccine hesitancy: definition, scope and determinants. Vaccine. 2015;33:4161–64. doi:10.1016/j.vaccine.2015.04.036.
12. Kwok KO, Leung GM, Lam WY, Riley S. Using models to identify routes of nosocomial infection: a large hospital outbreak of SARS in Hong Kong. Proc Biol Sci. 2007;274(1610):611–17. doi:10.1098/rspb.2006.0026.
13. Lau JT, Fung KS, Wong TW, Kim JH, Wong E, Chung S, Ho D, Chan LY, Lui SF, Cheng A. SARS transmission among hospital workers in Hong Kong. Emerg Infect Dis. 2004;10(2):280–86. doi:10.3201/eid1002.030534.
14. Killian M, Detoc M, Berthelot P, Charles R, Gagneux-Brunon A, Lucht F, Pulcini C, Barbois S, Botelho-Nevers E. Vaccine hesitancy among general practitioners: evaluation and comparison of their immunisation practice for themselves, their patients and their children. Eur J Clin MicrobiolInfect Dis. 2016;35:1837e43.
15. Agrinier N, Le Mare´chal M, Fressard L, Verger P, Pulcini C. Discrepancies between general practitioners' vaccination recommendations for their patients and practices for their children. Clin Microbiol Infect. 2017;23:311e7. doi:10.1016/j.cmi.2016.08.019.
16. Wilson R, Zaytseva A, Bocquier A, Nokri A, Fressard L, Chamboredon P, Carbonaro C, Bernardi S, Dubé E, Verger P, et al. Vaccine hesitancy and self-vaccination behaviors among nurses in southeastern France. Vaccine. 2020;38:1144e51. doi:10.1016/j.vaccine.2019.11.018.
17. Ruiz JB, Bell RA. Predictors of intention to vaccinate against COVID-19: results of a nationwide survey.Vaccine. Vaccine. 2021;39(7):1080–86. PMID: 33461833. doi:10.1016/j.vaccine.2021.01.010.
18. Verger P, Scronias D, Dauby N, Adedzi KA, Gobert C, Bergeat M. Attitudes of healthcare workers towards COVID-19 vaccination: a survey in France and French-speaking parts of Belgium and Canada,2020. Eurosurveillance. 2021;26(3):1–8. doi:10.2807/1560-7917.ES.2021.26.3.2002047.
19. Singh L, Bansal S, Bode L, Budak C, Chi G, Kawintiranon K, Padden C, Vanarsdall R, Vraga E, Wang Y. A first look at COVID-19 information and misinformation sharing on Twitter. ArXiv Prepr ArXiv. 2003;2020:13907.8.
20. Funk C, Tyson A. Intent to get a COVID-19 vaccine rises to 60 % as confidence in research and development process increases. 2020 Dec.
21. Shekhar R, Sheikh AB, Upadhyay S, Singh M, Kottewar S. COVID-19 vaccine acceptance among health care workers in the United States. 2021;1–15.
22. Belsti Y, Gela YY, Akalu Y, Dagnew B, Getnet M, Seid MA, Diress M, Yeshaw Y, Fekadu SA. Willingness of Ethiopian population to receive COVID-19 vaccine. J Multidiscip Healthc. 2021:14 1233–1243.
23. Ahmed MH, Kanfe SG, Jarso MH. Intention to receive against COVID-19 and associated factors among health professionals working at public hospitals in resource limited settings. PLoS ONE. 2021;16(7):20254391. doi:10.1371/journal.pone.0254391.
24. NITAG Resource Center. WHO SAGE values framework for the allocation and prioritization of COVID-19 vaccination. n.d. [accessed 2020 Oct]. https://www.nitag-resource.org/media-center/whosage-values-framework-allocation-and-prioritization-covid-19vaccination
25. Zikargae MH. COVID-19 in Ethiopia: assessment of how the Ethiopian government has executed administrative actions and managed risk communications and community engagement. Risk management and healthcare policy. 2020;13:2803. doi:10.2147/RMHP.S278234.
26. Ethiopia introduces COVID-19 vaccine in a national launching ceremony. 2021 Mar 13. https://www.afro.who.int/news/ethiopia-introduces-covid-19-vaccinenational-launching-ceremony?
27. Ethiopia launches Covid vaccination in Addis Ababa. Africanews [Internet]; [accessed 2021 May 19; cited March 22, 2021]. Available from: https://www.africanews.com/2021/03/14/ethiopia-launches-covid-vaccinations-in-addis-ababa//. 6.
28. Gagneux-brunon A, Detoc M, Bruel S, Tardy B, Rozaire O. Intention to get vaccinations against COVID-19 in French healthcare workers during the first pandemic wave: a cross-sectional survey. J Hosp Infect. 2021;108:168–73. PMID: 33259883. doi:10.1016/j.jhin.2020.11.020.
29. Report T. COVID-19 vaccination and prioritisation strategies in the EU/EEA. 2020;(December):1–20.
30. Wang J, Jing R, Lai X, Zhang H, Lyu Y, Knoll MD, Fang H. Acceptance of COVID-19 vaccination during the COVID-19 pandemic in China. Vaccines. 2020 Sep;8(3):482. doi:10.3390/vaccines8030482.
31. Ledda C, Costantino C, Cuccia M, Maltezou HC, Rapisarda V. Attitudes of healthcare personnel towards vaccinations before and during the COVID-19 pandemic. Int J Environ Res Public Health. 2021 Jan;18(5):2703. doi:10.3390/ijerph18052703.
32. Papagiannis D, Rachiotis G, Malli F, Papathanasiou IV, Kotsiou O, Fradelos EC, Giannakopoulos K, Gourgoulianis KI. Acceptability of COVID-19 vaccination among Greek health professionals. Vaccines. 2021;9:200. doi:10.3390/vaccines9030200.
33. Shekhar R, Sheikh AB, Upadhyay S, Singh M, Kottewar S, Mir H, Barrett E, Pal S. COVID-19 vaccine acceptance among health care workers in the United States. Vaccines. 2021 Feb;9(2):119. doi:10.3390/vaccines9020119.
34. Agyekum MW, Afrifa-Anane GF, Kyei-Arthur F, Addo B. Acceptability of COVID-19 vaccination among health care workers in Ghana. medRxiv. 2021 Jan 1.
35. Qattan A, Alshareef N, Alsharqi O, Al Rahahleh N, Chirwa GC, Al-Hanawi MK. Acceptability of a COVID-19 vaccine among healthcare workers in the Kingdom of Saudi Arabia. Frontiers in Medicine. 2021 Mar 1;8:83. doi:10.3389/fmed.2021.644300.
36. Nzaji MK, Ngombe LK, Mwamba GN, Ndala DB, Miema JM, Lungoyo CL, Mwimba BL, Bene AC, Musenga EM. Acceptability of vaccination against COVID-19 among healthcare workers in the democratic Republic of the Congo. Pragmatic and Observational Research. 2020;11:103. doi:10.2147/POR.S271096.
37. Fisher KA, Bloomstone SJ, Walder J, Crawford S, Fouayzi H, Mazor KM. Attitudes toward a potential SARS-CoV-2 vaccine: a survey of US adults. Ann Intern Med. 2020 Dec 15;173(12):964–73. doi:10.7326/M20-3569.
38. Neumann-Böhme S, Varghese NE, Sabat I, Barros PP, Brouwer W, van Exel J, Schreyögg J, Stargardt T. Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. doi:10.1007/s10198-020-01208-6.
39. Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, Kimball S, El-Mohandes A. A global survey of potential acceptance of a COVID-19 vaccine. Nat Med. 2021 Feb;27(2):225–28. doi:10.1038/s41591-020-1124-9.
40. Lin Y, Hu Z, Zhao Q, Alias H, Danaee M, Wong LP. Understanding COVID-19 vaccine demand and hesitancy: a nationwide online survey in China. PLoS Negl Trop Dis. 2020 Dec 17;14(12):e0008961. doi:10.1371/journal.pntd.0008961.
41. Taylor S, Landry CA, Paluszek MM, Groenewoud R, Rachor GS, Asmundson GJ. A proactive approach for managing COVID-19: the importance of understanding the motivational roots of vaccination hesitancy for SARS-CoV2. Front Psychol. 2020 Oct 19;11:2890. doi:10.3389/fpsyg.2020.575950.
42. Detoc M, Bruel S, Frappe P, Tardy B, Botelho-Nevers E, Gagneux-Brunon A. Intention to participate in a COVID-19 vaccine clinical trial and to get vaccinated against COVID-19 in France during the pandemic. Vaccine. 2020 Oct 21;38(45):7002–06. doi:10.1016/j.vaccine.2020.09.041.

43. Pogue K, Jensen JL, Stancil CK, Ferguson DG, Hughes SJ, Mello EJ, Burgess R, Berges BK, Quaye A, Poole BD. Influences on attitudes regarding potential COVID-19 vaccination in the United States. Vaccines. 2020 Dec;8(4):582. doi:10.3390/vaccines8040582.
44. Grech V, Gauci C. Vaccine hesitancy in the University of Malta Faculties of Health Sciences, Dentistry and Medicine vis-a-vis influenza and novel COVID-19 vaccination. Early Hum Dev. 2020 Nov;12:105258. doi:10.1016/j.earlhumdev.2020.105258.
45. Wang K, Wong EL, Ho KF, Cheung AW, Chan EY, Yeoh EK, Wong SY. Intention of nurses to accept coronavirus disease 2019 vaccination and change of intention to accept seasonal influenza vaccination during the coronavirus disease 2019 pandemic: a cross-sectional survey. Vaccine. 2020 Oct 21;38(45):7049–56. doi:10.1016/j.vaccine.2020.09.021.
46. Sallam M, Dababseh D, Eid H, Al-Mahzoum K, Al-Haidar A, Taim D, Yaseen A, Ababneh NA, Bakri FG, Mahafzah A. High rates of COVID-19 vaccine hesitancy and its association with conspiracy beliefs: a study in Jordan and Kuwait among Other Arab Countries. Vaccines. 2021 Jan;9(1):42. doi:10.3390/vaccines9010042.
47. Malik A, Malik J, Ishaq U. Acceptance of COVID-19 vaccine in Pakistan among health care workers. medRxiv. 2021 Jan 1.
48. Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, Zigron A, Srouji S, Sela E. Vaccine hesitancy: the next challenge in the fight against COVID-19. Eur J Epidemiol. 2020 Aug;35(8):775–79. doi:10.1007/s10654-020-00671-y.
49. Kose S, Mandiracioglu A, Sahin S, Kaynar T, Karbus O, Ozbel Y. Vaccine hesitancy of the COVID-19 by health care personnel. Int J Clin Pract. 2020 Dec 19:e13917.
50. Niu S, Tian S, Lou J, Kang X, Zhang L, Lian H, Zhang J. Clinical characteristics of older patients infected with COVID-19: a descriptive study. Arch Gerontol Geriatr. 2020;89:104058. doi:10.1016/j.archger.2020.104058.
51. Sallam M. COVID-19 vaccine hesitancy worldwide: a concise systematic review of vaccine acceptance rates. Vaccines. 2021 Feb;9(2):160. doi:10.3390/vaccines9020160.
52. Sallam M, Dababseh D, Yaseen A, Al-Haidar A, Taim D, Eid H, Ababneh NA, Bakri FG, Mahafzah A. COVID-19 misinformation: mere harmless delusions or much more? A knowledge and attitude cross-sectional study among the general public residing in Jordan. PloS One. 2020 Dec 3;15(12):e0243264. doi:10.1371/journal.pone.0243264.
53. Sallam M, Dababseh D, Yaseen A, Al-Haidar A, Ababneh NA, Bakri FG, Mahafzah A. Conspiracy beliefs are associated with lower knowledge and higher anxiety levels regarding COVID-19 among students at the University of Jordan. Int J Environ Res Public Health. 2020;17:4915. doi:10.3390/ijerph17144915.
54. Zlxbxz Z. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. Chin J Epidemiol. 2020;41(2):145–51. doi:10.3760/cma.j.0254-6450.2020.02.003.
55. Denis M, Vandeweerd V, Verbeke R, Laudisoit A, Wynants L. COVIPENDIUM: information available to support the development of medical countermeasures and interventions against COVID-19. 2020. doi:10.11116/TDI2020.4.10.SI.Covipendium.
56. Bish A, Yardley L, Nicoll A, Michie S. Factors associated with uptake of vaccination against pandemic influenza: a systematic review. Vaccine. 2011;29:6472–84. doi:10.1016/j.vaccine.2011.06.107.
57. Brewer NT, Chapman GB, Gibbons FX, Gerrard M, McCaul KD, Weinstein, Weinstein ND. Meta-analysis of the relationship between risk perception and health behavior: the example of vaccination. Health Psychol. 2007;26:136. doi:10.1037/0278-6133.26.2.136.
58. Lin C, Tu P, Beitsch LM. Confidence and receptivity for COVID-19 vaccines: a rapid systematic review. Vaccines. 2021;9:16. doi:10.3390/vaccines9010016.
59. Corey L, Mascola JR, Fauci AS, Collins FS. A strategic approach to COVID-19 vaccine R&D. Science. 2020 May 29;368(6494):948–50. doi:10.1126/science.abc5312.
60. Dean NE, Gsell PS, Brookmeyer R, De Gruttola V, Donnelly CA, Halloran ME, Jasseh M, Nason M, Riveros X, Watson CH, et al. Design of vaccine efficacy trials during public health emergencies. Sci Transl Med. 2019 Jul 3;11(499). doi:10.1126/scitranslmed.aat0360.