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COVID-19 Vaccine Acceptance and Associated Factors Among Adult Health Care Attendants at Public Hospitals in Eastern Ethiopia Using the Health Belief Model: Multi-centered cross-sectional study

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Abstract

Objective: Immunization against COVID-19 is still one of the best ways to reduce viral-related mortality and morbidity. Therefore, the aim of this study was to assess COVID-19 vaccine acceptance and associated factors among adult clients at public hospitals in Eastern Ethiopia.

Method: A multi-centered facility based cross-sectional study design was utilized. The systematic random sampling technique was used to select 420 study participants. The characteristics of individuals were described using descriptive statistical analysis such as simple frequency, median and interquartile range. Mean was used for health belief model components. The association was assessed using bivariate and multivariate logistic regression and described by the odds ratio along with a 95% confidence interval. Finally, a P-value <0.05 in the adjusted analysis was used to declare a significant association.

Outcome Measure: Covid-19 vaccine acceptance and associated factors

Result: A total of 420 adult clients were interviewed, with a response rate of 98.1%. Of the total study participants, 225 (54.6%; 95% CI: 50.0–59.7%) were willing to accept the COVID-19 vaccine. Age >= 46 (AOR = 3.64, 95% CI: 1.35–9.86), college and above level of education (AOR = 2.50, 95% CI: 1.30–4.81), having health insurance (AOR = 1.79, 95% CI: 1.11-2.87), and experiencing chronic disease (AOR = 1.96, 95% CI: 1.02-3.77) were predictor variables. Also, components of the health belief model; were significantly associated with COVID-19 vaccine acceptance.

Conclusion: Only half of the adults were willing to accept Covid-19 vaccine. Older age, having a high educational status, having health insurance, being a chronic patient, and having a good view of susceptibility, severity, and benefit were all factors that influenced willingness to be

vaccinated. Thus, addressing these components and empowering community awareness will be needed to improve vaccination acceptability

Keywords: Vaccine, Covid-19, acceptance, willingness, hesitancy, adult client, health

Strengths and Weaknesses of the Study

- An adequate sample size was used, which allowed generalizability of the study's findings.
- The health belief model was used to assess factors that affect the outcome variable.
- A cross-sectional study design was used, which does not develop a cause-and-effect relationship.
- Better if supported by a qualitative study

Introduction

A new acute respiratory infectious disease called COVID-19 is caused by the corona virus [1]. Covid-19 creates public health crisis by affecting social, psychological, and economic dimensions [2]. Over 5.5 million deaths have been reported worldwide since the COVID-19 pandemic began, with an estimated 280 million confirmed cases [3].

The use of vaccines to prevent disease began in the 18th century [4]. The best strategy to avoid infectious diseases is by vaccination, and when enough people are immunized, herd immunity can be produced [5]. It is suggested that a minimum herd-immunity threshold of 67% among the general population is necessary to attain population immunity [6]. Vaccination is still one of the best approaches to lower viral-related mortality and morbidity [7].

The success of a vaccination program depends on population coverage, high levels of public acceptance, and unambiguous scientific safety facts [8]. The term "vaccine hesitancy" describes a delay in accepting or refusing a vaccination despite the availability of vaccination services [9]. Vaccine reluctance has coexisted and hampered immunization effectiveness since the

development of vaccines. Therefore, it is a significant concern globally and is designated by the World Health Organization (WHO) as one of the top ten health risks [10, 11].

Evidence suggests that myths and incorrect assertions about vaccines, as well as a lack of general understanding about the disease and the efficacy of vaccines, were among the causes of vaccine hesitation [12, 13]. Despite this, there are still concerns about the vaccine's efficiency and safety, as well as the longevity of COVID-19 immunity, as numerous instances of reinfection have been documented [14, 15]. This doubtfulness is evident in many countries [16].

Understanding the anticipated acceptability of COVID-19 vaccination and the barriers to uptake is important given the growing availability of COVID-19 vaccines. Until Jan 05, 2022, around 50.3% of the world's population were fully vaccinated, while only 1.4% of Ethiopia's population were fully vaccinated [17].

A study conducted in Zambia revealed lower levels of vaccination acceptance [18]. A study conducted in six selected kebeles of Sodo town, southern Ethiopia, found that 45.5% of participants accepted the COVID-19 vaccine [19]. There are individual, group, contextual, and vaccine-specific factors which determine vaccine acceptance [9]. A lack of confidence, inconvenience, and cost were identified as barriers to vaccine uptake [12].

Understanding the factors that influence people's decisions to get or refuse vaccinations is crucial for implementing the most successful immunization strategy in Ethiopia. It is important to provide additional evidence regarding COVID-19 vaccine acceptability among the adult population in Ethiopia because immunization is the most efficient way to reduce COVID-19-related mortality and morbidity and its effects. The goal of this research was to evaluate adult

client acceptance of COVID-19 immunization and related factors in public hospitals in eastern Ethiopia.

Methods

Study setting, design and period

The study was conducted in seven randomly selected public hospitals (Dilchora, Deder, Bisidimo, Chiro, Haramaya, Gelemso, and Gara Mulata) in eastern Ethiopia. There are five, four, and two public hospitals in eastern, western, and Dire Dawa cities, respectively. Dilchora Hospital is one of the public hospitals in Dire Dawa City that provides compressive services for about five million people in Dire Dawa and neighboring Oromia and Somali regions. The entire population of the East Hararghe zone is 3,587,042, while the total population of the West Hararghe zone is 2,467,364. A multi-centered facility-based cross-sectional study was conducted from June 1 and June 30, 2021.

Study population

All adult patients who attended public hospitals in eastern Ethiopia during the study period were source populations, while those randomly selected clients in selected public hospitals were study populations.

Eligibility Criteria.

All patients visiting selected public hospitals during the study period were included, but those who were severely ill and unable to respond to survey questions were excluded.

Sample size determination and Sampling procedure

The required sample size was determined using the single population proportion formula ($n = (Z/2)^2\ p\ (1-p)/d^2$) under the following assumptions: COVID-19 vaccine acceptance in Walaita Sodo, southern Ethiopia (p = 46.1%); confidence level at 95% (Z/2) = 1.96; margin of error (d) = 0.05; and non-response rate = 10%. So, the final sample size was 420. Seven randomly selected

public hospitals (Dilchora hospital, Bisidimo hospital, Haramaya hospital, Gara Muleta hospital, Deder hospital, Chiro hospital, and Gelemso hospital) currently providing service for all clients and found in the study area were included in the study. The required study samples from each public hospital were allocated proportionally according to client flow. The study subjects were selected using a systematic random sampling technique. Based on the average monthly client follow, the interval k was calculated (K = N/n = 2075/420 = 4.95≈ 5) and a study subject was chosen every 5 until the specified sample size was reached. The initial eligible study subject was chosen at random.

Data collection procedures

The data was gathered in-person using a questionnaire administered by an interviewer, which was adapted from previous literature [20-23]. The questionnaire was first prepared in English, then translated to local languages (Amharic and Afan Oromo) The questionnaire was developed to gather data on socio demographic variables, vaccination acceptance, and health belief measures based on the Health Belief Model. Ten skilled BSc Nursing and Midwifery graduates, under the supervision of three MSc nurses, collected the data. Data collectors briefed the study participants with a short overview to the study objective and the significance of their participation. Then participants, who were volunteers, were interviewed face-to-face using a structured and pre-tested questionnaire.

Measurements and Operational definition

Acceptance of the COVID-19 vaccine refers to the percentage of adult clients who are willing to receive the vaccine once it becomes available**.** [24]**.** Adult clients' acceptance of the COVID-19 vaccine was measured by asking, "Will you take the COVID-19 vaccine when it becomes

available?" with "Yes" and "No" response options. If the respondent answered "yes," he/she is considered to have the willingness to accept the COVID-19 vaccine; otherwise, no.

The Health Belief Model (HBM): The five components of the HBM were perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action. **Perceived susceptibility** was measured with five items. The chance of getting COVID-19 in the next few months is great; getting COVID-19 is currently possible for me; I'm worried about the chance of getting COVID-19; I'm afraid of getting COVID-19 unless I get the vaccine; and my family may get infected if they don't get the COVID-19. vaccine. **Perceived severity** was measured with three items (complications from COVID-19 are serious; I will be very sick if I get COVID-19; and recovering from COVID-19 would take a long time). **Perceived benefits** were measured with three items: vaccination is a good idea; the COVID-19 vaccine may reduce my fear of infection; the vaccine will be highly effective to reduce the spread of COVID-19. Five items were used to assess **perceived barriers** (concern about potential side effects of the COVID-19 vaccine; concern about the efficacy of the COVID-19 vaccine; concern about the COVID-19 vaccination interfering with daily activities; concern about my affordability of the COVID-19 vaccine; and concern about a faulty or fake COVID-19 vaccine. **The cue to action** is measured by four items. (I will only take the COVID-19 vaccine if I was given adequate information; I will only take the COVID-19 vaccine if it was taken by many in the public; I will only take the COVID-19 vaccine if it was recommended by doctors; and I will only take the COVID-19 vaccine if it was recommended by the ministry of health's published guidelines). All HBM questions were rated by respondents on a five-point scale that ranged from 1 to 5 (strongly disagree to strongly agree). The mean score for each domain was calculated, along with the overall score for each dimension. Scores higher than the mean indicate higher levels of a

particular dimension, with the exception of the perceived barrier dimension, which was reversely coded.

Data Quality Assurance

Prior to beginning the actual data collection on 21 of the study participants, the questionnaire was pre-tested at Jigol Hospital. Prior to collecting data, training was provided to data collectors and supervisors on the purpose of the study, information confidentiality, respondent rights, maintaining privacy, and interviewing techniques. The completed questionnaires were checked by the investigators for completeness, accuracy, and clarity of data, and required corrections were made immediately by the principal investigator and supervisors on a daily basis.

Data processing and analysis

Kobo Collect version 2021.3.4 software was used to collect the data, and SPSS 25 was used to analyze it. Participants' sociod emographic characteristics, awareness of COVID-19, and HBM components were described using descriptive statistical analyses like simple frequency, mean, and standard deviation. After that, tables and frequencies were used to show the information. The VIF and tolerance tests were used to identify colinearity, while the Hosmer-Lemeshow statistic and Omnibus tests were used to assess the goodness of fit. The associations between each independent variable and the outcome variables were assessed using bivariate and multivariate analysis. All variables with $P \leq 0.25$ in the bivariate analysis were included in the final model of multivariate analysis. An adjusted odds ratio and a 95% confidence interval (CI) were used to show the strength of statistical correlations. Finally, a p-value of less than or equal to 0.05 was used to declare statistical significance.

Patient and Public Involvement

There is no patient or other people involved in this study

Results

Socio-demographic characteristics

A total of 420 adult clients were interviewed, with a 98.1% (412) response rate. Nearly half of the study participants were in the 26–35 age group, with a median age of 28 and an interquartile range of 24-33 years. The majority of study participants (63.4%) lived with three or more family members. Most of the respondents were married individuals (**Table 1**).

Table 1: Socio-demographic characteristics of adult clients at public hospitals in Eastern Ethiopia in 2021 (n= 412)

Variable	Category	Frequency	Percent(%)
Age	18-25	130	31.6
	26-35	195	47.3
	36-45	56	13.6
	≥ 46	31	7.5
Sex	Male	196	47.6
	Female	216	52.4
Residence	Urban	221	53.6
	Rural	191	46.5
Level of Education	No formal education	103	25.0
	Primary education	85	20.6
	Secondary education	85	20.6
	college and above	139	33.7
Type of occupation	Housewife	102	24.8
	Governmental employee	130	31.6
	Private employee	134	32.5
	Farmer	46	11.1
Marital Status	Married	236	57.3
	Divorced	38	9.2
	Separated	31	7.5
	Widowed	22	5.3
	Single	85	20.6
Number of family	≤ 2	149	36.2
	3-4	133	32.3
	≥ 5	130	31.6
Have health Insurance	Yes	191	46.4
	No	221	53.6

Cov

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19 Vaccine awareness and acceptance among adult clients

Of the total study participants, 225 (54.6; 95% CI: 50.0, 59.7%) were willing to get the COVID-19 vaccine. Contrarily, the most frequent justifications for choosing not to receive the vaccine were concern over side effects (75, 44.6%), a lack of knowledge (66, 39.3%), and uncertainty regarding its efficacy (37, 22%). (Table 2).

Table 2: Awareness, health status, and willingness to take the COVID-19 vaccine among adult clients at public hospitals in Eastern Ethiopia in 2021 (n = 412)

Variables	Category	Frequency	Percentage(%)
Have you ever heard about COVID-19 vaccine?	Yes	282	68.4
	No	130	31.6
From whom you heard about COVID 19 Vaccine? (n=282)	Friends	60	14.6
	Mass media	184	44.7
	Health professional	38	9.2
Have you ever diagnosed with chronic disease?	Yes	68	16.5
	No	344	83.5
Have you ever experienced COVID-19 disease?	Yes	38	9.2
	No	374	90.8
What do you think about your general state of health?	Very good	189	45.9
	Good	121	29.4
	Fair	40	9.7
	Poor	29	7.0

	Very poor	33	8.0
Is there anybody diagnosed with chronic disease in your family?	Yes	53	12.9
	No	359	87.1
Is there anybody aged 64 and above in your family	Yes	118	28.6
	No	294	71.4
Will you accept the COVID-19 vaccination?	Yes	225	54.6
	No	187	45.4
Reason for Refusing COVID-19 vaccination	Fear of side effect	75	44.6%
	It is biological weapon	9	5.4%
	Doubt about vaccine	26	15.5%
	Unreliable due to short time for vaccine development	20	11.9%
	No enough information	66	39.3%
	Vaccine cause covid19	21	12.5%
	Vaccine is in effective	37	22.0%
	No vaccine needed (COVID-19 is over rated)	24	14.3%

Health believes model measures

The mean score and standard deviation of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action were 13.88 ± 3.03, 8.07 ± 2.28, 7.85 ± 2.41, 12.55

± 2.66, and 8.68 ± 2.89, respectively. Of the total study participants, 237 (57.5%) and 148 (43.2%) scored above the calculated mean for perceived susceptibility and perceived severity domains, respectively. Similarly, for the perceived benefit and perceived barrier domains, 207 (50.2%) and 217 (51.7%) scored above the calculated mean (**Table 3**).

Table 3: COVID-19 related health belief among clients at public hospital in Easter Ethiopia 2021

Variables	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree(%)	Strongly agree (%)
Perceived Susceptibility					
The possibility of getting COVID-19 in the near future is very strong.	51(12.4)	106(25.7)	95(23.1)	129(31.3)	31(7.5)
Getting COVID-19 is currently possible for me	55(13.3)	128(31.1)	77(18.7)	117(28.4)	35(8.5)
Worry about the possibility of contracting COVID-19	40(9.7)	149(36.2)	101(24.5)	109(26.5)	13 (3.2)
I'm afraid of getting COVID-19 unless I get vaccine	47(11.4)	178(43.2)	90(21.8)	89(21.6)	8(1.9)
My family may get infected if they don't get the COVID-19 vaccine.	47(11.4)	158(38.3)	95(23.1)	104(25.2)	8 (1.9)
Perceived Severity					
The complications from COVID-19 are serious.	48(11.7)	174(42.2)	108(26.2)	63(15.3)	19(4.6)
I will be very sick if get COVID-19	34(8.3)	139(33.7)	137(33.3)	78(18.9)	24(5.8)
Recovering from COVID-19 would take a long time.	52(12.6)	151(36.7)	119(28.9)	59(14.3)	31(7.5)
Perceived Benefit					
Vaccination is a good idea	17(4.1)	143(34.7)	137(33.3)	103(25)	12 (2.9)

The COVID-19 vaccine may reduce my fear of infection.	49(11.9)	144(35)	93(22.6)	102(24.6)	24(5.8)
The vaccine will be highly effective in reducing COVID-19 spread.	117(28.4)	167(40.5)	63(15.3)	59(14.3)	6 (1.5)
Perceived barrier					
Worry about possible side effects of the COVID-19 vaccine.	75(18.2)	140(34)	134(32.5)	54(13.1)	9 (2.2)
Concern about the efficacy of the COVID-19 vaccine	37(9)	145(35.2)	141(34.2)	81(19.7)	8 (1.9)
The COVID-19 vaccination may interfere with my daily activities.	30(7.3)	129(31.3)	192(46.6)	49(11.9)	12(2.9)
Concerning the cost of the COVID-19 vaccine	123(29.9)	178(43.2)	85(20.6)	26 (6.3)	
Concern over the possibility of substandard or fake COVID-19 vaccines being produced	54(13.1)	146(35.4)	121 (29.4)	83(20.1)	8 (1.9)
Cues to action					
I will only take the COVID-19 vaccine if I am given adequate information.	107(26)	197(47.8)	58(14.1)	45 (10.9)	5 (1.2)
I will only take the COVID-19 vaccine if it is taken by many people in the public.	102(24.8)	163(39.6)	103(25)	39(9.5)	5 (1.2)
I will only take the COVID-19 vaccine if it is recommended by Doctors.	106(25.7)	207(50.2)	60(14.6)	35(8.5)	4 (0.9)
If the Ministry of Health recommends the COVID-19 vaccine, I will only get it.	108(26.2)	159(38.6)	95(23.1)	44(10.7)	6 (1.5)

Factors associated with Covid-19 Vaccine acceptance

Age, gender, residence, level of education, having health insurance, having heard about the COVID-19 vaccine, experiencing chronic disease, experiencing COVID-19, rating health status positively, and, from the HBM component, susceptibility perception, severity perception, perception of benefit, perception of barrier, and cues to action were all associated with COVID-19 vaccine acceptance in bivariate regression (candidates for multivariable regression). However, in multivariable regression, only age, education level, having health insurance, having chronic disease, and four of the five components of HBM (susceptibility perception, severity perception, benefit perception, and perception) were significantly associated with the COVID-19 vaccine's acceptance.

Adults over the age of 46 were 3.64 times more likely than those between the ages of 18 and 25 to receive the COVID-19 vaccine. Attending education to the level of a diploma and above increased willingness to be vaccinated 2.50 (AOR = 2.5; 95% CI: 1.30–4.81) times. Those who have health insurance are 1.79 (AOR = 1.79, 95%CI: 1.11-2.87) times more likely to be vaccinated. The odds of having a willingness to be vaccinated are 1.96 (AOR = 1.96, 95%CI: 1.02-3.77) times more likely among adult clients diagnosed with chronic diseases. Severity perception predicts willingness to accept the COVID-19 vaccine by 4.11 (AOR = 4.11, 95% CI: 2.49–6.80). Similarly, those participants who considered themselves susceptible to COVID-19 were 2.90 (AOR = 2.90, 95 CI: 1.34, 3.60) times more likely to accept the COVID-19 vaccine when compared to their counterparts. Furthermore, the perception of benefit increases willingness to be vaccinated by 1.81 (95% CI: 1.14-2.87) times. whereas the perception of barriers affects willingness to be vaccinated negatively. In other words, not perceiving the barrier increased vaccination preference by 2.27 (AOR-2.27, 95%CI: 1.42-3.64) times (**Table 4**).

Table 4: Table 4: Factors associated with acceptance of the COVID-19 vaccine among adult patients at public hospitals in Dire Dawa city and the East and West Hararghe zones, Ethiopia, in 2022.

Variable	Covid19 Vaccine acceptance		COR 95% CI	AOR 95% CI	P- value
	Yes	No			
Age					
>=46	23	8	2.70 (1.13-6.48)	3.64(1.35-9.86)	0.01
36-45	28	28	0.94 (0.50-1.76)	1.39 (0.64-3.04)	0.40
26-35	107	88	1.14 (0.73-1.78)	1.65(0.96-2.84)	0.07
18-25	67	63	1	1	
Residence					
Urban	132	89	1.56 (1.05-2.31)	1.55 (0.95-2.50)	0.08
Rural	93	98	1	1	
Level of Education					
College and above	86	53	1.93 (1.15-3.24)	2.50(1.30-4.81)	0.01
Secondary	50	35	1.70 (0.95-3.04)	1.86(0.918-3.77)	0.08
Primary education	42	43	1.16 (0.65-2.06)	0.94 (0.47-1.89)	0.86
No formal education	47	56	1		
Do you have health Insurance					
Yes	113	78	1.41 (0.95-2.08)	1.79(1.11-2.87)	0.02
No	112	109	1	1	
Have you ever heard about Covd-19 vaccine?					
Yes	161	121	1.37(0.90-2.08)	1.50(0.90-2.49)	0.12
No	64	66	1		
Have you ever diagnosed with chronic disease?					

Yes	46	22	1.92 (1.11-3.34)	1.96(1.02-3.77)	0.04
No	179	165	1		
Have you ever have experienced with COVID-19?					
Yes	27	11	2.18 (1.05-4.52)	1.30(0.54-3.12)	0.55
No	198	196	1	1	
How do you rate overall your health status?					
very poor	22	11	1.93 (0.89-4.22)	1.89(0.75-4.80)	0.18
Poor	21	8	2.54 (1.07-6.03)	1.28(0.473.49)	0.62
Fair	22	18	1.18 (0.60-2.35)	0.86(0.39-1.90)	0.71
Good	64	57	1.09(0.68-1.72)	1.92 (0.531.58)	0.75
Very good	96	93	1	1	
Susceptibility perception					
Perceived susceptible	148	89	2.12 (1.42-3.15)	2.90(1.343.60)	0.002
Not perceived susceptible	77	98	1	1	
Severity perception					
Perceived sever at	128	50	3.62 (2.38-5.49)	4.11(2.49-6.80)	0.00
Not perceived sever	97	137	1	1	
Benefit Perception					
Perceived benefit	132	75	2.12 (1.43-3.15)	1.81(1.14-2.87)	0.01
Not perceived benefit	93	112	1	1	
Perception of barrier					
Not perceived barrier	126	73	1.99 (1.34-2.95)	2.27(1.42-3.64)	0.00
Perceived barrier	99	114	1	1	
Cues action					
Cue to act	107	72	1.45 (0.98-2.15)	1.03 (0.63-1.67)	0.90

Not cue to act	118	115	1

AOR: adjusted odd ratio, CI, confidence interval, COR: crude odd ratio, PV: p-value

Discussion

Vaccine hesitancy was a significant problem in tackling the spread of covid-19 infection. Furthermore, identifying the determinants of covid-19 vaccine acceptance among adult population has a paramount significance in setting policies and strategies in decreasing the burden of the infection. Therefore, the purpose of this study was to pinpoint the factors that influence adult residents' acceptance of the COVID-19 vaccine.

This study found that adult clients accepted the covid-19 vaccine at a rate of 54.6 percent. This is in line with study done in Dassie Hospital (59.4%) [23], nationwide survey conducted in Ghana (54.1%) [25], and study conducted in Kuwait (53.1%) [26]. This finding, however, was lower than that of studies conducted in the Gurage Zone (62.6%) [27], Addis Ababa (80.9%) [28], Ethiopia (88%) [22], Indonesia (93.3%) [29], Mozambique (64.8%) [30], South Africa (67%) [31], and sub-Saharan African countries (82.27%) [32]. This variance could be related to differences in data collection technique, sociodemographic characteristics of study participants, and scope of the study.

The finding of this study is higher than that of a study conducted in Ethiopia (31.4%) **[33]** and a study done in the Wolaita Zone, southern Ethiopia (45.5%) [19]. This might be because the study in Ethiopia only looked at a general population, whereas our study focused on a specific segment of the population. The study setting was the other explanation for this discrepancy. In our study, an institutional-based cross-sectional study was used, and the health seeking tendency was expected to be higher.

In this study, adults 46 years of age and older had an increased likelihood of accepting the COVID-19 vaccine. A research study among the adult population in the Gurage zone of Ethiopia provided evidence in support of this conclusion [27] , as did a study conducted in Bangladesh [21]. The relationship between age and vaccination acceptability may be explained by the fact that COVID-19 sickness worsens with age and that elderly unvaccinated individuals are more likely to require hospitalization or pass away from COVID-19 infection [34]. The elderly population becomes anxious and fearful as a result. They are therefore in need of the COVID-19 immunization as a coping mechanism.

Similarly, educational status has positive association with COVID-19 vaccine acceptance. Having a college or higher level of education was associated with an increased likelihood of COVID-19 vaccine acceptance. This finding was supported by a study conducted among the adult population in Gurage Zone, Ethiopia [27], a study conducted in Sodo Town, Ethiopia [19], and a national survey conducted in Ghana [25]. This may be appropriate because adults with higher educational levels can easily grasp the need to get vaccinated, including against COVID-19. Furthermore, people with higher educational status may have a better understanding of preventative strategies for health-related issues.

Those who have health insurance were more likely to be willing to accept the COVID-19 vaccine. This finding is supported by a study conducted at Dassie Compressive Specialized Hospital, Ethiopia [23]. This could be due to having health insurance, which may let them feel free of payment even if the vaccine was provided freely. This indicates that there is a segment of the community who views vaccines as a service provided for a fee. Therefore, health care

professionals were expected to create community awareness as the COVID-19 vaccine is given freely to all Ethiopians.

Those diagnosed with chronic diseases were more likely to be willing to take the COVID-19 vaccine. Similar findings were reported from a study conducted in Mozambique [30]. This could be owing to the fact that people with chronic diseases are more likely to acquire COVID-19, making recovery difficult. This could be owing to the fact that people with chronic diseases are more likely to acquire COVID-19, making recovery difficult. Thus, since populations with chronic diseases appear to be at a higher risk of developing complications and are at a higher risk of death, they are more likely to be interested in being vaccinated.

Four of the five components of HBM indicated a significant association with willingness to take the COVID-19 vaccine. Perceived susceptibility, perceived severity, and perceived benefit were found to increase the likelihood of COVID-19 vaccine acceptance. This finding is supported by a study conducted in Bangladesh [21], Saudi Arabia [35], Malaysia [36], and a population-based survey in Hong Kong [37]. The reason for this could be that when there is a perception of susceptibility and severity, stress is felt, and people are more willing to take the COVID-19 vaccine as a coping mechanism. The other possible justification could be that as more people learn about the value of COVID-19 vaccination, their willingness to get vaccinated will improve [38].

On the other hand, the other component of the health belief model perceived barrier affects the likelihood of COVID-19 vaccine acceptance negatively. In other words, those who did not perceive a barrier had a better chance of being willing to take the COVID-19 vaccination. This can be justified as participants who disagreed with HBM obstacles and constructs were more

inclined to take the COVID-19 vaccine. Another factor could be that misinformation has drastically affected vaccine acceptance [39].

Conclusion

Only about half of the adult population was willing to accept the COVID-19 vaccine. Age, educational status, having a chronic disease, having health insurance, and, from the components of HBM, perceived susceptibility, perceived severity, perceived benefit, and perceived barrier were factors associated with acceptability of COVID-19 vaccine. It was crucial to take these factors into account during the endeavor process in order to boost vaccination acceptability and eventually reduce this pandemic's effects.

Furthermore, health policymakers and professionals must encourage COVID-19 vaccine uptake and raise community awareness about the efficacy and safety of the COVID-19 vaccine by providing appropriate information, including to the elderly, those with chronic diseases, those with no formal education, rural residents, and those with a negative perception of COVID-19 vaccines.

Ethics approval and consent to participate

Ethical clearance was secured from Haramaya University, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC) (ref. no. IHRERC/069/2021). Each study participant provided informed, voluntary, written, and signed consent prior to the interview, and they had the right to withdraw their consent or end the interview at any moment.

Availability of data and materials: The manuscript includes pertinent data, and upon reasonable request, the corresponding author will provide additional data.

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Authors' Contributions

TG is the principal investigator and all authors contributed significantly to the work reported, whether that is in the conception(TG, AN, and MD), study design (TG, AE, MD, ML), execution (BB, AE, AN, AA, AD and ML), acquisition of data, analysis, (TG, AN, AE, AD, KG, KS, YD, AA, and BB) and interpretation, or in all these areas (AN, AE, KS, AS, KG, AO, AA, BB, and MD); all authors participated in drafting, revising, or critically reviewing the article and agreed to be accountable for all aspects of the work.

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COVID-19 Vaccine Acceptanceand Associated Factors among Adult Clients at Public Hospitals in Eastern Ethiopia Using the Health Belief Model: Multi-center Cross-sectional Study

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Abstract

Objective: Immunization against COVID-19 is still one of the best ways to reduce viral-related mortality and morbidity. Therefore, this study aimed to assess COVID-19 vaccine acceptance and associated factors among adult clients at public hospitals in Eastern Ethiopia.

Method: A multi-centeredfacility-based cross-sectional study design was utilized. The systematic random sampling technique was used to select 420 study participants. The characteristics of individuals were described using descriptive statistical analysis such as simple frequency, median and interquartile range. Mean was used for health belief model components. The association was assessed using bivariate and multivariable logistic regression and described by the odds ratio along with a 95% confidence interval. Finally, a P-value <0.05 in the adjusted analysis was used to declare a significant association.

Outcome Measure: COVID-19vaccine acceptance and associated factors

Result: A total of 420 adult clients were interviewed, with a response rate of 98.1%. Of the total study participants, 225 (54.6%; 95% CI: 50.0 – 59.7%) were willing to accept the COVID-19 vaccine. Age >= 46 (AOR = 3.64, 95% CI: 1.35 – 9.86), college and above the level of education (AOR = 2.50, 95% CI: 1.30 – 4.81), having health insurance (AOR = 1.79, 95% CI: 1.11 – 2.87), and experiencing chronic disease (AOR = 1.96, 95% CI: 1.02 – 3.77) were predictor variables.Also, components of the health belief model; were significantly associated with COVID-19 vaccine acceptance.

Conclusion: COVID-19 vaccine acceptance among the adult population was low in this study. Factors associated with COVID-19 vaccine acceptance were age, college and above educational level, having a chronic disease, having health insurance, perceived susceptibility, perceived severity, perceived benefit, and perceived barrier.

Improving awareness about COVID-19 among all sections of the population is crucial to improving vaccine acceptability.

Keywords: Vaccine, COVID-19, acceptance, willingness, hesitancy, adult client, health

Strengths and Weaknesses of the Study

- An adequate sample size was used, which allowed the generalizability of the study's findings.
- The health belief model was used to assess factors that affect the outcome variable.
- A cross-sectional study design was used, which does not develop a cause-and-effect relationship.
- Better if supported by a qualitative study

Introduction

A new acute respiratory infectious disease called COVID-19is caused by the coronavirus [1]. Covid-19 creates public health crisis by affecting social, psychological, and economic dimensions[2]. Over 5.5 million deaths have been reported worldwide since the COVID-19 pandemic began, with an estimated 280 million confirmed cases[3].

The use of vaccines to prevent disease began in the 18th century[4]. The best strategy to avoid infectious diseases is by vaccination, and when enough people are immunized, herd immunity can be produced[5].It is suggested that a minimum herd-immunity threshold of 67% among the general population is necessary to attain population immunity[6]. Vaccination is still one of the best approaches to lower viral-related mortality and morbidity[7].Immunization prevents about 4-5 million deaths every year [8].

Development of the COVID-19 vaccine alone doesn't end the pandemic, as vaccine hesitancy is another challenge[9]. The success of a vaccination program depends on population coverage, high levels of public acceptance, and unambiguous scientific safety facts[10].Vaccine hesitancy

has coexisted and hampered immunization effectiveness since the development of vaccines. Vaccine hesitancy is a significant concern globally and is designated by the World Health Organization (WHO) as one of the top ten health risks [11, 12].

Why vaccine hesitancy? is the question to be answered. Some witnesses indicated social environment, belief in herbal medicine[13], poor attitude toward avaccine, failure to accept the existence of disease [14],lack of trust for the vaccine, and need to wait for more [15] issues of vaccine safety, and fear of being infected with COVID-19 vaccine were some the barrier [16, 17]

Additionally, myths and incorrect assertions about vaccines, and a lack of general understanding of the disease were among the causes of vaccine hesitation [18, 19].Doubtfulness about the efficiency and safety of the COVID-19 vaccine as well as the longevity of its immunity is evident in many countries, which results in hesitancy[20-22].

Understanding the anticipated acceptability of COVID-19 vaccination and the barriers to uptake is important given the growing availability of COVID-19 vaccines. Until Jan 05, 2022, around 50.3% of the world's population was fully vaccinated, while only 1.4% of Ethiopia's population was fully vaccinated[23]. However, by the end of 2021, the Ministry of Health aims to vaccinate about 20% of the Ethiopian population[24].

A study conducted in Zambia revealed lower levels of vaccination acceptance [25]. A study conducted in Sodo town, southern Ethiopia, found that 45.5% of participants accepted the COVID-19 vaccine[26]. There are individual, group, contextual, and vaccine-specific factors that determine vaccine acceptance [27]. A lack of confidence, inconvenience, and cost was identified as barriers to vaccine uptake [18].

The Ethiopian government has taken different measures to tackle the spread of COVID-19, ranging from emergency response to a state of emergency (guidelines and protocol development lockdown)[28]. The other initiative is making the COVID-19 vaccine available and encouraging the community to take the vaccine through influencers like health experts and community leaders[29]. Additionally, the Ethiopian government gave priority to the elders for vaccines [30]

Understanding the factors that influence people's decisions to get or refuse vaccinations and having evidence regarding COVID-19 vaccine acceptability among the adult population in Ethiopia is crucial for implementing the most successful immunization strategy and tackling the COVID-19 pandemic in Ethiopia. The goal of this research was to evaluate adult client acceptance of the COVID-19 vaccineand related factors in public hospitals in eastern Ethiopia.

Methods

Study Setting, Design, and Period

The study was conducted in seven randomly selected public hospitals (Dilchora, Deder, Bisidimo, Chiro, Haramaya, Gelemso, and Gara Mulata) in eastern Ethiopia. There are five, four, and two public hospitals in eastern, western, and Dire Dawa cities, respectively. Dilchora Hospital is one of the public hospitals in Dire Dawa City that provides compressive services for about five million people in Dire Dawa and neighboring Oromia and Somali regions.The entire population of the East Hararghe zone is 3,587,042, while the total population of the West Hararghe zone is 2,467,364. A multi-centered facility-based cross-sectional study was conducted from June 1to 30, 2021.

Study Population

All adult patients who attended public hospitals in eastern Ethiopia during the study period were source populations, while those randomly selected clients in selected public hospitals were study populations.

Eligibility Criteria.

All adult patients visiting selected public hospitals during the study period were included, but those who were severely ill and unable to respond to survey questions were excluded.

Sample Size Determination and Sampling Procedure

The required sample size was determined using the single population proportion formula ($n = (Z/2)^2 p\ (1-p)/d^2$) under the following assumptions: COVID-19 vaccine acceptance in Walaita Sodo, southern Ethiopia (p = 46.1%); confidence level at 95% (Z/2) = 1.96; margin of error (d) = 0.05; and non-response rate = 10%. So, the final sample size was420. Seven public hospitals (Dilchora hospital, Bisidimo hospital, Haramaya hospital, Gara Muleta hospital, Deder hospital, Chiro hospital, and Gelemso hospital) providing service for all adult clientsat the time of the study were purposefully selected. The required study samples from each public hospital were allocated proportionally according to client flow. The study subjects were selected using a systematic random sampling techniquebased on hospital patient records. There were about 2075 monthly average adult patients in selected public hospitals. Based on the average monthly patient follow, the interval k was calculated (K = N/n = 2075/420 = 4.95≈ 5) and a study subject was chosen every 5 until the specified sample size was reached. The initial eligible study subject was chosen randomly by the lottery method.

Data Collection Procedures and Tools

Data collection will be undertaken using an interviewer-administered structured questionnaire using kobo collection software. The questionnaire was adapted by extensive searching of previous literature and considering the local context [31-34].Since the questionnaire was adapted from validated instruments, reliability, and validity tests were not performed. The questionnaire was first prepared in English, then translated into local languages (Amharic and Afan Oromo).

The questionnaire was developed to gather data on socio-demographic variables, vaccination acceptance, and health belief measures based on the Health Belief Model. Ten skilled BSc Nursing and Midwifery graduates, under the supervision of three MSc nurses, collected the data. Data collectors briefed the study participants with a short overview of the study objective and the significance of their participation. Then participants, who were volunteers, were interviewed face-to-face using a structured and pre-tested questionnaire.

Measurements and Operational Definition

Acceptance of the COVID-19 Vaccine refers to the percentage of adult clients who are willing to receive the vaccine once it becomes available**.** [35]**.**Adult clients' acceptance of the COVID-19 vaccine was measured by asking, "Will you take the COVID-19 vaccine when it becomes available?" with "Yes" and "No" response options. If the respondent answered "yes," he/she is considered to have the willingness to accept the COVID-19 vaccine; otherwise, no.

The Health Belief Model (HBM): The five components of the HBM were perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action. **Perceived susceptibility** was measured with five items. The chance of getting COVID-19 in the next few months is great; getting COVID-19 is currently possible for me; I'm worried about the chance of getting COVID-19; I'm afraid of getting COVID-19 unless I get the vaccine; and my family may get infected if they don't get the COVID-19. vaccine. **Perceived severity** was measured with three items (complications from COVID-19 are serious; I will be very sick if I get COVID-19; and recovering from COVID-19 would take a long time). **Perceived benefits** were measured with three items: vaccination is a good idea; the COVID-19 vaccine may reduce my fear of infection; the vaccine will be highly effective to reduce the spread of COVID-19. Five items were used to assess **perceived barriers** (concern about potential side effects of the

COVID-19 vaccine; concern about the efficacy of the COVID-19 vaccine; concern about the COVID-19 vaccination interfering with daily activities; concern about my affordability of the COVID-19 vaccine; and concern about a faulty or fake COVID-19 vaccine. **The cue to action** is measured by four items. (I will only take the COVID-19 vaccine if I was given adequate information; I will only take the COVID-19 vaccine if it was taken by many in the public; I will only take the COVID-19 vaccine if it was recommended by doctors; and I will only take the COVID-19 vaccine if it was recommended by the ministry of health's published guidelines). All HBM questions were rated by respondents on a five-point scale that ranged from 1 to 5 (strongly disagree to strongly agree). The mean score for each domain was calculated, along with the overall score for each dimension. Scores higher than the mean indicate higher levels of a particular dimension, except the perceived barrier dimension, which was reversely coded.

Data Quality Assurance

Before beginning the actual data collection on 21 of the study participants, the questionnaire was pre-tested at Jigol Hospital. Before collecting data, training was provided to data collectors and supervisors on the purpose of the study, information confidentiality, respondent rights, maintaining privacy, and interviewing techniques. The completed questionnaires were checked by the investigators for completeness, accuracy, and clarity of data, and required corrections were made immediately by the principal investigator and supervisors daily.

Data Processing and Analysis

Kobo Collect version 2021.3.4 software was used to collect the data, and SPSS 25 was used to analyze it. Participants' socio-demographic characteristics, awareness of COVID-19, and HBM components were described using descriptive statistical analyses like simple frequency, mean, and standard deviation. After that, tables and frequencies were used to show the information.The

VIF and tolerance tests were used to identify colinearity, while the Hosmer-Lemeshow statistic and Omnibus tests were used to assess the goodness of fit. The associations between each independent variable and the outcome variables were assessed using bivariate and multivariate analysis.All variables with P ≤ 0.25 in the bivariate analysis were included in the final model of multivariate analysis. An adjusted odds ratio and a 95% confidence interval (CI) were used to show the strength of statistical correlations. Finally, a p-value of less than or equal to 0.05 was used to declare statistical significance.

Patient and Public Involvement

There is no patient or other people involved in this study

Results

Socio-demographic Characteristics

A total of 420adult clients were interviewed, with a 98.1% (412) response rate.Nearly half of the study participants were in the 25─36 age group, with a median age of 28 and an interquartile range of 24─33 years.The majority of study participants (63.4%) lived with three or more family members.Most of the respondents were married individuals (**Table 1**).

Table 1: Socio-demographic characteristics of adult clients at public hospitals in Eastern Ethiopia in 2021 (n=412)

Variable	Category	Frequency	Percentage
Age	18─25	130	31.6
	26─35	195	47.3
	36─45	56	13.6
	≥46	31	7.5
Sex	Male	196	47.6
	Female	216	52.4
Residence	Urban	221	53.6
	Rural	191	46.5
Level of Education	No formal education	103	25.0
	Primary education	85	20.6

	Secondary education	85	20.6
	College and above	139	33.7
Type of occupation	Housewife	102	24.8
	Governmental employee	130	31.6
	Private employee	134	32.5
	Farmer	46	11.1
Marital Status	Married	236	57.3
	Divorced	38	9.2
	Separated	31	7.5
	Widowed	22	5.3
	Single	85	20.6
Number of family	≤ 2	149	36.2
	3–4	133	32.3
	≥ 5	130	31.6
Have health Insurance	Yes	191	46.4
	No	221	53.6

COVID-19 Vaccine Awareness and Acceptance among Adult Clients

Of the total study participants, 225 (54.6; 95% CI: 50.0, 59.7%) were willing to get the COVID-19 vaccine. Contrarily, the most frequent justifications for choosing not to receive the vaccine were concern over side effects (75, 44.6%), a lack of knowledge (66, 39.3%), and uncertainty regarding its efficacy (37, 22%). (Table 2).

Table 2: Awareness, health status, and willingness to take the COVID-19 vaccine among adult clients at public hospitals in Eastern Ethiopia in 2021 (n = 412)

Variables	**Category**	**Frequency**	**Percentage**
Have you ever heard about the COVID-19 vaccine?	Yes	282	68.4
	No	130	31.6
From whom have you heard about COVID-19 Vaccine? (n=282)	Friends	60	14.6
	Mass media	184	44.7
	Health professional	38	9.2

Have you ever been diagnosed with a chronic disease?	Yes	68	16.5
	No	344	83.5
Have you ever experienced COVID-19 disease?	Yes	38	9.2
	No	374	90.8
What do you think about your general state of health?	Very good	189	45.9
	Good	121	29.4
	Fair	40	9.7
	Poor	29	7.0
	Very poor	33	8.0
Is there anybody diagnosed with chronic disease in your family?	Yes	53	12.9
	No	359	87.1
Is there anybody aged 64 and above in your family	Yes	118	28.6
	No	294	71.4
Will you accept the COVID-19 vaccination?	Yes	225	54.6
	No	187	45.4
Reason for Refusing COVID-19 vaccination	Fear of side effect	75	44.6
	It is biological weapon	9	5.4
	Doubt about vaccine	26	15.5
	Unreliable due to short time for vaccine development	20	11.9
	No enough information	66	39.3
	Vaccine cause covid19	21	12.5
	Vaccine is in effective	37	22.0
	No vaccine needed (COVID-19 is over rated)	24	14.3

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Health Believes Model Measures

The mean score and standard deviation of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action were 13.88 ± 3.03, 8.07 ± 2.28, 7.85 ± 2.41, 12.55 ± 2.66, and 8.68 ± 2.89, respectively. Of the total study participants, 237 (57.5%) and 148 (43.2%) scored above the calculated mean for perceived susceptibility and perceived severity domains, respectively. Similarly, for the perceived benefit and perceived barrier domains, 207 (50.2%) and 217 (51.7%) scored above the calculated mean (**Table 3**).

Table 3: COVID-19-related health beliefs among clients at public hospitals in eastern Ethiopia, 2021.

Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Perceived Susceptibility					
The possibility of getting COVID-19 in near future is very strong.	51(12.4)	106(25.7)	95(23.1)	129(31.3)	31(7.5)
Getting COVID-19 is currently possible for me	55(13.3)	128(31.1)	77(18.7)	117(28.4)	35(8.5)
Worry about the possibility of contracting COVID-19	40(9.7)	149(36.2)	101 (24.5)	109(26.5)	13 (3.2)
I'm afraid of getting COVID-19 unless I get the vaccine	47(11.4)	178(43.2)	90(21.8)	89(21.6)	8(1.9)
My family may get infected if they don't get the COVID-19 vaccine.	47(11.4)	158(38.3)	95(23.1)	104(25.2)	8 (1.9)
Perceived Severity					
The complications from COVID-19 are serious.	48(11.7)	174(42.2)	108(26.2)	63(15.3)	19(4.6)
I will be very sick if get COVID-19	34(8.3)	139(33.7)	137(33.3)	78(18.9)	24(5.8)
Recovering from COVID-19 would take a long time.	52(12.6)	151(36.7)	119(28.9)	59(14.3)	31(7.5)
Perceived Benefit					
Vaccination is a good idea	17(4.1)	143(34.7)	137(33.3)	103(25)	12 (2.9)
The COVID-19 vaccine may reduce my fear of infection.	49(11.9)	144(35)	93(22.6)	102(24.6)	24(5.8)
The vaccine will be highly effective in reducing COVID-19 spread.	117(28.4)	167(40.5)	63(15.3)	59(14.3)	6 (1.5)
Perceived Barrier					
Worry about possible side effects of the COVID-19 vaccine.	75(18.2)	140(34)	134(32.5)	54(13.1)	9 (2.2)

Concern about the efficacy of the COVID-19 vaccine	37(9)	145(35.2)	141(34.2)	81(19.7)	8 (1.9)
The COVID-19 vaccination may interfere with my daily activities.	30(7.3)	129(31.3)	192(46.6)	49(11.9)	12(2.9)
Concerning the cost of the COVID-19 vaccine	123(29.9)	178(43.2)	85(20.6)	26 (6.3)	
Concern over the possibility of substandard or fake COVID-19 vaccines being produced	54(13.1)	146(35.4)	121 (29.4)	83(20.1)	8 (1.9)
Cues to Action					
I will only take the COVID-19 vaccine if I am given adequate information.	107(26)	197(47.8)	58(14.1)	45 (10.9)	5 (1.2)
I will only take the COVID-19 vaccine if it is taken by many people in the public.	102(24.8)	163(39.6)	103(25)	39(9.5)	5 (1.2)
I will only take the COVID-19 vaccine if it is recommended by Doctors.	106(25.7)	207(50.2)	60(14.6)	35(8.5)	4 (0.9)
If the Ministry of Health recommends the COVID-19 vaccine, I will only get it.	108(26.2)	159(38.6)	95(23.1)	44(10.7)	6(1.5)

Factors Associated with COVID-19Vaccine Acceptance

Age, gender, residence, level of education, having health insurance, having heard about the COVID-19 vaccine, experiencing chronic disease, experiencing COVID-19, rating health status positively, and, from the HBM component, susceptibility perception, severity perception, perception of benefit, perception of barrier, and cues to action were all associated with COVID-19 vaccine acceptance in bivariate regression (candidates for multivariable regression). However, in multivariable regression, only age, education level, health insurance, having a chronic disease, and four of the five components of HBM (susceptibility perception, severity perception, benefit perception, and perception) were significantly associated with the COVID-19 vaccine's acceptance.

Adults over the age of 46 were 3.64 times more likely than those between the ages of 18 and 25 to receive the COVID-19 vaccine. Attending education to the level of a diploma and above increased willingness to be vaccinated 2.50 (AOR = 2.5; 95% CI: 1.30, 4.81) timescompared to those having no formal education. Those who have health insurance are 1.79 (AOR = 1.79, 95%CI: 1.11, 2.87) times more likely to be vaccinated as compared to those who have no health insurance. The odds of having the willingness to be vaccinated are 1.96 (AOR = 1.96, 95%CI: 1.02, 3.77) times more likely among adult clients diagnosed with chronic diseases compared to those who were ever not diagnosed with chronic diseases. Severity perception predicts willingness to accept the COVID-19 vaccine by 4.11 (AOR = 4.11, 95% CI: 2.49, 6.80). Similarly, those participants who considered themselves susceptible to COVID-19 were 2.90 (AOR = 2.90, 95 CI: 1.34, 3.60) times more likely to accept the COVID-19 vaccine when compared to those who don't consider themselves susceptible to COVID-19. Furthermore, the perception of benefit increases willingness to be vaccinated by 1.81 (95% CI: 1.14, 2.87) times among those who perceive benefit when compared to their counterparts. whereas the perception of barriers affects willingness to be vaccinated negatively. In other words, those who donot perceive the barrier will accept the COVID-19 vaccine 2.27 (AOR-2.27, 95%CI: 1.42, 3.64) times more likely when compared to those who perceive the barrier (**Table 4**).

Table 4: Table 4: Factors associated with acceptance of the COVID-19 vaccine among adult patients at public hospitals in Dire Dawa city and the East and West Hararghe zones, Ethiopia, in 2022.

Variable	COVID-19Vaccine Acceptance		UOR 95% CI	AOR 95% CI	P- value
	Yes	No			
Age					
>=46	23	8	2.70 (1.13, 6.48)	3.64(1.35, 9.86)	0.01
36-45	28	28	0.94 (0.50, 1.76)	1.39 (0.64, 3.04)	0.40
26-35	107	88	1.14 (0.73, 1.78)	1.65(0.96, 2.84)	0.07
18-25	67	63	1	1	
Residence					
Urban	132	89	1.56 (1.05, 2.31)	1.55 (0.95, 2.50)	0.08
Rural	93	98	1	1	
Level of education					
College and above	86	53	1.93 (1.15, 3.24)	2.50(1.30, 4.81)	0.01
Secondary	50	35	1.70 (0.95, 3.04)	1.86(0.918, 3.77)	0.08
Primary education	42	43	1.16 (0.65, 2.06)	0.94 (0.47, 1.89)	0.86
No formal education	47	56	1		
Do you have health insurance					
Yes	113	78	1.41 (0.95, 2.08)	1.79(1.11, 2.87)	0.02
No	112	109	1	1	
Have you ever heard about the COVID-19 vaccine?					
Yes	161	121	1.37(0.90, 2.08)	1.50(0.90, 2.49)	0.12
No	64	66	1		
Have you ever been diagnosed with a chronic disease?					
Yes	46	22	1.92 (1.11, 3.34)	1.96(1.02, 3.77)	0.04
No	179	165	1		
Have you ever experienced COVID-19?					

Yes	27	11	2.18 (1.05, 4.52)	1.30(0.54, 3.12)	0.55
No	198	196	1	1	
How do you rate overall your health status?					
very poor	22	11	1.93 (0.89, 4.22)	1.89(0.75, 4.80)	0.18
Poor	21	8	2.54 (1.07, 6.03)	1.28(0.47, 3.49)	0.62
Fair	22	18	1.18 (0.60, 2.35)	0.86(0.39, 1.90)	0.71
Good	64	57	1.09(0.68, 1.72)	1.92 (0.53, 1.58)	0.75
Very good	96	93	1	1	
Susceptibility perception					
Perceived susceptible	148	89	2.12 (1.42, 3.15)	2.90(1.34, 3.60)	0.002
Not perceived susceptible	77	98	1	1	
Severity perception					
Perceived sever at	128	50	3.62 (2.38, 5.49)	4.11(2.49, 6.80)	0.00
Not perceived sever	97	137	1	1	
Benefit perception					
Perceived benefit	132	75	2.12 (1.43, 3.15)	1.81(1.14, 2.87)	0.01
Not perceived benefit	93	112	1	1	
Perception of barrier					
Not perceived barrier	126	73	1.99 (1.34, 2.95)	2.27(1.42, 3.64)	0.00
Perceived barrier	99	114	1	1	
Cues action					
Cue to act	107	72	1.45 (0.98, 2.15)	1.03 (0.63, 1.67)	0.90
Not cue to act	118	115	1		

AOR: adjusted odd ratio, CI, confidence interval, UOR: Unadjusted odd ratio, PV: p-value

Discussion

Vaccine hesitancy was a significant problem in tackling the spread of covid-19 infection. Furthermore, identifying the determinants of covid-19 vaccine acceptance among the adult population has a paramount significance in setting policies and strategies in decreasing the burden of the infection. Therefore, the purpose of this study was to pinpoint the factors that influence adult residents' acceptance of the COVID-19 vaccine.

This study found that adult clients accepted the covid-19 vaccine at a rate of 54.6 percent. This is in line with astudy done in Dassie Hospital (59.4%) [34], anationwide survey conducted in Ghana (54.1%)[36], and astudy conducted in Kuwait (53.1%)[37]. This finding, however, was lower than that of studies conducted in the Gurage Zone (62.6%)[38], Addis Ababa (80.9%)[39], Ethiopia (88%)[33], Indonesia (93.3%) [40], Mozambique (64.8%) [41], South Africa (67%) [42],and sub-Saharan African countries (82.27%)[43]. This variance could be related to differences in data collection technique, sociodemographic characteristics of study participants, and the scope of the study.

The finding of this study is higher than that of a study conducted in Ethiopia (31.4%) [44] and a study done in the Wolaita Zone, southern Ethiopia (45.5%) [26]. This might be because the study in Ethiopia only looked at a general population, whereas our study focused on a specific segment of the population. The study setting was the other explanation for this discrepancy. In our study, an institutional-based cross-sectional study was used, and the health-seeking tendency was expected to be higher.

In this study, adults 46 years of age and older had an increased likelihood of accepting the COVID-19 vaccine. A research study among the adult population in the Gurage zone of Ethiopia provided evidence in support of this conclusion [38], as did a study conducted in Bangladesh

[32].The relationship between age and vaccination acceptability may be explained by the fact that COVID-19 sickness worsens with age and that elderly unvaccinated individuals are more likely to require hospitalization or pass away from COVID-19 infection [45].The elderly population becomes anxious and fearful as a result. They are therefore in need of COVID-19 immunization as a coping mechanism.

Similarly, educational status had a positive association with COVID-19 vaccine acceptance. Having a college or higher level of education was associated with an increased likelihood of COVID-19 vaccine acceptance. This finding was supported by a study conducted among the adult population in Gurage Zone, Ethiopia[38], a study conducted in Sodo Town, Ethiopia[26],and a national survey conducted in Ghana[36]. This may be appropriate because adults with higher educational levels can easily grasp the need to get vaccinated, including against COVID-19. Furthermore, people with higher educational status may have a better understanding of preventative strategies for health-related issues.

Those who have health insurance were more likely to be willing to acceptthe COVID-19 vaccine. This finding is supported by a study conducted at Dassie Compressive Specialized Hospital, Ethiopia [34].This could be due to having health insurance,which may let them feel free of payment even ifthe vaccine was provided freely. This indicates that there is a segment of the community that views vaccines as a service provided for a fee. Therefore, healthcare professionals were expectedto create community awareness as theCOVID-19 vaccine is given freely to all Ethiopians.

Those diagnosed with chronic diseases were more likely to be willing to take the COVID-19 vaccine. Similar findings were reported from a study conducted in Mozambique[41]. This could

be because people with chronic diseases are more likely to acquire COVID-19, making recovery difficult.This could be because people with chronic diseases are more likely to acquire COVID-19, making recovery difficult. Thus, since populations with chronic diseases appear to be at a higher risk of developing complications and are at a higher risk of death, they are more likely to be interested in being vaccinated.

Four of the five components of HBM indicated a significant association with willingness to take the COVID-19 vaccine. Perceived susceptibility, perceivedseverity, and perceived benefit were found to increase the likelihood of COVID-19 vaccine acceptance. This finding is supported by a study conducted in Bangladesh [32],Saudi Arabia[46], Malaysia [47], and apopulation-based survey in Hong Kong [48]. The reason for this could be that when there is a perception of susceptibility and severity, stress is felt, and people are more willing to take the COVID-19 vaccine as a coping mechanism. The other possible justification could be that as more people learn about the value of COVID-19 vaccination, their willingness to get vaccinated will improve [49].

On the other hand, the other component of the health belief model perceived barrier affects thelikelihood of COVID-19 vaccine acceptance negatively. In other words, those who did not perceive a barrier had abetter chance of being willing to take the COVID-19 vaccination. This can be justified asparticipants who disagreed with HBM obstacles and constructs were more inclined to take the COVID-19 vaccine.Another factor could be that misinformation has drastically affected vaccine acceptance[50].

The study has several strengths. One of its strengths is that it is a multicenter study, which enables the generalizability of the study findings to the source population. Again, the study used a health belief model to assess perceptions toward vaccine acceptance, which was

adapted from a different validated tool with high internal consistency. However, the study is not without limitations, as it is cross-sectional, and does not indicate a causal relationship. Furthermore, acceptance of the COVID-19 vaccine was self-reported, which could lead to information bias. The study also does not indicate change over time as perceptions toward COVID-19 risk and awareness change over time and influence the acceptability of the vaccine.

Conclusions

COVID-19 vaccine acceptance among the adult population was low in this study. Factors associated with COVID-19 vaccine acceptance were age, college and above educational level, having a chronic disease, having health insurance, perceived susceptibility, perceived severity, perceived benefit, and perceived barrier.

Improving awareness about COVID-19 among all sections of the population is crucial to improving vaccine acceptability. A responsible body should work on community perception and clarify any myths about COVID-19 and its vaccine, which is recommended.

Ethics Approval and Consent to Participate

Ethical clearance was secured from Haramaya University, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC) (ref. no. IHRERC/069/2021). Each study participant provided informed, voluntary, written, and signed consent before the interview, and they had the right to withdraw their consent or end the interview at any moment.

Availability of data and materials: The manuscript includes pertinent data, and upon reasonable request, the corresponding author will provide additional data.

Funding: There was no explicit support for this study from public, corporate, or nonprofit organizations.

Competing of Interest: The authors have no competing interests to declare.

Authors' Contributions

TG is the principal investigator and all authors contributed significantly to the work reported, whether that is in the conception(TG, AN, and MD), study design (TG, AE, HB, MD, ML), execution (BB, AE, AN, AA, AD, and ML), acquisition of data, analysis, (TG, KN, AN, AE, AD, KG, KS, YD, AA, and BB) and interpretation, or in all these areas (AN, AE, HB, KS, AS, KG, AO, AA, BB, and MD); all authors participated in drafting, revising, or critically reviewing the article and agreed to be accountable for all aspects of the work.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 5, 6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential	

		bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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COVID-19 Vaccine Acceptance and Associated Factors among Adult Clients at Public Hospitals in eastern Ethiopia Using the Health Belief Model: Multi-center Cross-sectional Study

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	INFECTIOUS DISEASES

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COVID-19 Vaccine Acceptance and Associated Factors among Adult Clients at Public Hospitals in Eastern Ethiopia Using the Health Belief Model: Multi-center Cross-sectional Study

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Abstract

Objective: Immunization against COVID-19 is still one of the best ways to reduce viral-related mortality and morbidity. Therefore, this study aimed to assess COVID-19 vaccine acceptance and associated factors among adult clients at public hospitals in Eastern Ethiopia.

Method: A multi-centered facility-based cross-sectional study design was utilized. The systematic random sampling technique was used to select 420 study participants. The characteristics of individuals were described using descriptive statistical analysis such as frequency, median and interquartile range. Mean was used for health belief model components. The association was assessed using bivariate and multivariable logistic regression and described by the odds ratio along with a 95% confidence interval. Finally, a P-value <0.05 in the adjusted analysis was used to declare a significant association.

Outcome Measure: COVID-19 vaccine acceptance and associated factors

Result: A total of 420 adult clients were interviewed, with a response rate of 98.1%. Of the total study participants, 225 (54.6%; 95% CI: 50.0 – 59.7%) were willing to accept the COVID-19 vaccine. Age ≥ 46 (AOR = 3.64, 95% CI: 1.35 – 9.86), college and above level of education (AOR = 2.50, 95% CI: 1.30 – 4.81), having health insurance (AOR = 1.79, 95% CI: 1.11 – 2.87), and experiencing chronic disease (AOR = 1.96, 95% CI: 1.02 – 3.77) were predictor variables. Also, components of the health belief model; were significantly associated with COVID-19 vaccine acceptance.

Conclusion: COVID-19 vaccine acceptance among the adult population was low in this study. Factors associated with COVID-19 vaccine acceptance were age, college and above level of education, having a chronic disease, having health insurance, perceived susceptibility, perceived severity, perceived benefit, and perceived barrier.

Improving awareness about COVID-19 among all sections of the population is crucial to improving vaccine acceptability.

Keywords: Vaccine, COVID-19, acceptance, willingness, hesitancy, adult client, health

Strengths and Weaknesses of the Study

- An adequate sample size was used, which allowed the generalizability of the study's findings.
- The health belief model was used to assess factors that affect the outcome variable.
- A cross-sectional study design was used, which does not develop a cause-and-effect relationship.
- Better if supported by a qualitative study

Introduction

A new acute respiratory infectious disease called COVID-19 is caused by the coronavirus [1]. Covid-19 creates public health crisis by affecting social, psychological, and economic dimensions [2]. Over 5.5 million deaths have been reported worldwide since the COVID-19 pandemic began, with an estimated 280 million confirmed cases [3].

The use of vaccines to prevent disease began in the 18th century [4]. The best strategy to avoid infectious diseases is by vaccination, and when enough people are immunized, herd immunity can be produced [5]. It is suggested that a minimum herd-immunity threshold of 67% among the general population is necessary to attain population immunity [6]. Vaccination is still one of the best approaches to lower viral-related mortality and morbidity [7]. Immunization prevents about 4-5 million deaths every year [8].

Development of the COVID-19 vaccine alone doesn't end the pandemic, as vaccine hesitancy is another challenge [9]. The success of a vaccination program depends on population coverage, high levels of public acceptance, and unambiguous scientific safety facts [10]. Vaccine hesitancy

has coexisted and hampered immunization effectiveness since the development of vaccines. Vaccine hesitancy is a significant concern globally and is designated by the World Health Organization (WHO) as one of the top ten health risks [11, 12].

Why vaccine hesitancy is the question to be answered. Some witnesses indicated social environment, belief in herbal medicine [13], poor attitude toward a vaccine, failure to accept the existence of disease [14], lack of trust for the vaccine, and need to wait for more [15] issues of vaccine safety, and fear of being infected with COVID-19 vaccine were some the barrier [16, 17]

Additionally, myths and incorrect assertions about vaccines, and a lack of general understanding of the disease were among the causes of vaccine hesitation [18, 19]. Doubtfulness about the efficiency and safety of the COVID-19 vaccine as well as the longevity of its immunity is evident in many countries, which results in hesitancy [20-22].

Understanding the anticipated acceptability of COVID-19 vaccination and the barriers to uptake is important given the growing availability of COVID-19 vaccines. Until Jan 05, 2022, around 50.3% of the world's population was fully vaccinated, while only 1.4% of Ethiopia's population was fully vaccinated [23]. However, by the end of 2021, the Ministry of Health aims to vaccinate about 20% of the Ethiopian population [24].

A study conducted in Zambia revealed lower levels of vaccine acceptance [25]. A study conducted in Sodo town, southern Ethiopia, found that 45.5% of participants accepted the COVID-19 vaccine [26]. There are individual, group, contextual, and vaccine-specific factors that determine vaccine acceptance [27]. A lack of confidence, inconvenience, and cost was identified as barriers to vaccine uptake [18].

The Ethiopian government has taken different measures to tackle the spread of COVID-19, ranging from emergency response to a state of emergency (guidelines and protocol development to lockdown) [28]. The other initiative is making the COVID-19 vaccine available and encouraging the community to take the vaccine through influencers like health experts and community leaders [29]. Additionally, the Ethiopian government gave priority to the elders for vaccines [30]

Understanding the factors that influence people's decisions to get or refuse vaccinations and having evidence regarding COVID-19 vaccine acceptability among the adult population in Ethiopia is crucial for implementing the most successful immunization strategy and tackling the COVID-19 pandemic in Ethiopia. The goal of this research was to evaluate adult client acceptance of the COVID-19 vaccine and related factors in public hospitals in eastern Ethiopia.

Methods

Study Setting, Design, and Period

The study was conducted in seven randomly selected public hospitals (Dilchora, Deder, Bisidimo, Chiro, Haramaya, Gelemso, and Gara Mulata) in eastern Ethiopia. There are five, four, and two public hospitals in eastern, western, and Dire Dawa cities, respectively. Dilchora Hospital is one of the public hospitals in Dire Dawa City that provides compressive services for about five million people in Dire Dawa and neighboring Oromia and Somali regions. The entire population of the East Hararghe zone is 3,587,042, while the total population of the West Hararghe zone is 2,467,364. A multi-centered facility-based cross-sectional study was conducted from June 1 to 30, 2021.

Study Population

All adult patients who attended public hospitals in eastern Ethiopia during the study period were source populations, while those clients visiting a selected public hospitals during study periods were study populations.

Eligibility Criteria.

All adult patients visiting selected public hospitals during the study period were included, but those who were severely ill and unable to respond to survey questions were excluded.

Sample Size Determination and Sampling Procedure

The required sample size was determined using the single population proportion formula ($n = (Z/2)^2 p\ (1-p)/d^2$) under the following assumptions: COVID-19 vaccine acceptance in Walaita Sodo, southern Ethiopia (p = 46.1%); confidence level at 95% (Z/2) = 1.96; margin of error (d) = 0.05; and non-response rate = 10%. So, the final sample size was 420. Seven public hospitals (Dilchora hospital, Bisidimo hospital, Haramaya hospital, Gara Muleta hospital, Deder hospital, Chiro hospital, and Gelemso hospital) providing service for all adult clients at the time of the study were purposefully selected. The required study samples from each public hospital were allocated proportionally according to client flow. The study subjects were selected using a systematic random sampling technique based on hospital patient records. There were about 2075 monthly average adult patients in selected public hospitals. Based on the average monthly patient follow, the interval k was calculated ($K = N/n = 2075/420 = 4.95 \approx 5$) and a study subject was chosen every 5 until the specified sample size was reached. The initial eligible study subject was chosen randomly by the lottery method.

Data Collection Procedures and Tools

Data collection will be undertaken using an interviewer-administered structured questionnaire using kobo collection software. The questionnaire was adapted by extensive searching of

previous literature and considering the local context [31-34]. Since the questionnaire was adapted from validated instruments, reliability, and validity tests were not performed. The questionnaire was first prepared in English, then translated into local languages (Amharic and Afan Oromo). The questionnaire was developed to gather data on socio-demographic variables, vaccination acceptance, and health belief measures based on the Health Belief Model. Ten skilled BSc Nursing and Midwifery graduates, under the supervision of three MSc nurses, collected the data. Data collectors briefed the study participants with a short overview of the study objective and the significance of their participation. Then participants, who were volunteers, were interviewed face-to-face using a structured and pre-tested questionnaire.

Measurements and Operational Definition

Acceptance of the COVID-19 Vaccine refers to the percentage of adult clients who are willing to receive the vaccine once it becomes available [35]**.** Adult clients' acceptance of the COVID-19 vaccine was measured by asking, "Will you take the COVID-19 vaccine when it becomes available?" with "Yes" and "No" response options. If the respondent answered "yes," he/she is considered to have the willingness to accept the COVID-19 vaccine; otherwise, no.

The Health Belief Model (HBM): The five components of the HBM were perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action. **Perceived susceptibility** was measured with five items (The chance of getting COVID-19 in the next few months is great; getting COVID-19 is currently possible for me; I'm worried about the chance of getting COVID-19; I'm afraid of getting COVID-19 unless I get the vaccine; and my family may get infected if they don't get the COVID-19 vaccine). **Perceived severity** was measured with three items (complications from COVID-19 are serious; I will be very sick if I get COVID-19; and recovering from COVID-19 would take a long time). **Perceived benefits** were

measured with three items: vaccination is a good idea; the COVID-19 vaccine may reduce my fear of infection; the vaccine will be highly effective to reduce the spread of COVID-19. Five items were used to assess **perceived barriers** (Concern about potential side effects of the COVID-19 vaccine; concern about the efficacy of the COVID-19 vaccine; concern about the COVID-19 vaccination interfering with daily activities; concern about my affordability of the COVID-19 vaccine; and concern about a faulty or fake COVID-19 vaccine). **The cue to action** is measured by four items (I will only take the COVID-19 vaccine if I was given adequate information; I will only take the COVID-19 vaccine if it was taken by many in the public; I will only take the COVID-19 vaccine if it was recommended by doctors; and I will only take the COVID-19 vaccine if it was recommended by the ministry of health's published guidelines). All HBM questions were rated by respondents on a five-point scale that ranged from 1 to 5 (strongly disagree to strongly agree). The mean score for each domain was calculated, along with the overall score for each dimension. Scores higher than the mean indicate higher levels of a particular dimension, except the perceived barrier dimension, which was reversely coded.

Data Quality Assurance

Before beginning the actual data collection, the questionnaire was pre-tested on 21 of the study participants, at Jigol Hospital. Before collecting data, training was provided to data collectors and supervisors on the purpose of the study, information confidentiality, respondent rights, maintaining privacy, and interviewing techniques. The completed questionnaires were checked by the investigators for completeness, accuracy, and clarity of data, and required corrections were made immediately by the principal investigator and supervisors daily.

Data Processing and Analysis

Kobo Collect version 2021.3.4 software was used to collect the data, and SPSS 25 was used to analyze it. Participants' socio-demographic characteristics, awareness of the COVID-19 vaccine, and HBM components were described using descriptive statistical analyses like simple frequency, mean, and standard deviation. After that, tables and frequencies were used to show the information. The VIF and tolerance tests were used to identify colinearity, while the Hosmer-Lemeshow statistic and Omnibus tests were used to assess the goodness of fit. The associations between each independent variable and the outcome variables were assessed using bivariate and multivariate analysis. All variables with $P \leq 0.25$ in the bivariate analysis were included in the final model of multivariate analysis. An adjusted odds ratio and a 95% confidence interval (CI) were used to show the strength of statistical correlations. Finally, a p-value of less than or equal to 0.05 was used to declare statistical significance.

Patient and Public Involvement

There is no patient or other people involved in this study

Results

Socio-demographic Characteristics

A total of 420 adult clients were interviewed, with a 98.1% (412) response rate. Nearly half of the study participants were in the 25─36 age group, with a median age of 28 and an interquartile range of 24─33 years. The majority of study participants (63.4%) lived with three or more family members. Most of the respondents were married individuals (**Table 1**).

Table 1: Socio-demographic characteristics of adult clients at public hospitals in eastern Ethiopia in 2021 (n=412)

Variable	Category	Frequency	Percentage
Age	18─25	130	31.6
	26─35	195	47.3
	36─45	56	13.6

	≥46	31	7.5
Sex	Male	196	47.6
	Female	216	52.4
Residence	Urban	221	53.6
	Rural	191	46.5
Level of Education	No formal education	103	25.0
	Primary education	85	20.6
	Secondary education	85	20.6
	College and above	139	33.7
Type of occupation	Housewife	102	24.8
	Governmental employee	130	31.6
	Private employee	134	32.5
	Farmer	46	11.1
Marital Status	Married	236	57.3
	Divorced	38	9.2
	Separated	31	7.5
	Widowed	22	5.3
	Single	85	20.6
Number of family members	≤ 2	149	36.2
	3–4	133	32.3
	≥ 5	130	31.6
Have health Insurance	Yes	191	46.4
	No	221	53.6

CO

VID-19 Vaccine Awareness and Acceptance among Adult Clients

Of the total study participants, 225 (54.6; 95% CI: 50.0, 59.7%) were willing to get the COVID-19 vaccine. Contrarily, the most frequent justifications for choosing not to receive the vaccine were concern over side effects (75, 44.6%), a lack of knowledge (66, 39.3%), and uncertainty regarding its efficacy (37, 22%) (Table 2).

Table 2: Awareness, health status, and willingness to take the COVID-19 vaccine among adult clients at public hospitals in Eastern Ethiopia in 2021 (n = 412)

Variables	**Category**	**Frequency**	**Percentage**
Have you ever heard about the	Yes	282	68.4

COVID-19 vaccine?	No	130	31.6
From whom have you heard about COVID-19 Vaccine? (n=282)	Friends	60	14.6
	Mass media	184	44.7
	Health professional	38	9.2
Have you ever been diagnosed with a chronic disease?	Yes	68	16.5
	No	344	83.5
Have you ever experienced COVID-19 disease?	Yes	38	9.2
	No	374	90.8
What do you think about your general state of health?	Very good	189	45.9
	Good	121	29.4
	Fair	40	9.7
	Poor	29	7.0
	Very poor	33	8.0
Is there anybody diagnosed with chronic disease in your family?	Yes	53	12.9
	No	359	87.1
Is there anybody aged 64 and above in your family	Yes	118	28.6
	No	294	71.4
Will you accept the COVID-19 vaccination?	Yes	225	54.6
	No	187	45.4
Reason for Refusing COVID-19 vaccination	Fear of side effects	75	44.6
	It is a biological weapon	9	5.4
	Doubt about vaccine	26	15.5
	Unreliable due to the short time for vaccine development	20	11.9
	No enough information	66	39.3
	Vaccine cause covid19	21	12.5

	Vaccine is ineffective	37	22.0
	No vaccine is needed (COVID-19 is overrated)	24	14.3

Health Believes Model Measures

The mean score and standard deviation of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action were 13.88 ± 3.03, 8.07 ± 2.28, 7.85 ± 2.41, 12.55 ± 2.66, and 8.68 ± 2.89, respectively. Of the total study participants, 237 (57.5%) and 148 (43.2%) scored above the calculated mean for perceived susceptibility and perceived severity domains, respectively. Similarly, for the perceived benefit and perceived barrier domains, 207 (50.2%) and 217 (51.7%) scored above the calculated mean (**Table 3**).

Table 3: COVID-19 related health beliefs among clients at public hospitals in eastern Ethiopia, 2021.

Variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Perceived Susceptibility					
The possibility of getting COVID-19 in near future is very strong.	51 (12.4)	106 (25.7)	95 (23.1)	129 (31.3)	31 (7.5)
Getting COVID-19 is currently possible for me.	55 (13.3)	128 (31.1)	77 (18.7)	117 (28.4)	35 (8.5)
Worry about the possibility of contracting COVID-19.	40 (9.7)	149(36.2)	101 (24.5)	109 (26.5)	13 (3.2)
I'm afraid of getting COVID-19 unless I get the vaccine.	47 (11.4)	178 (43.2)	90 (21.8)	89 (21.6)	8 (1.9)
My family may get infected if they don't get the COVID-19 vaccine.	47 (11.4)	158 (38.3)	95 (23.1)	104 (25.2)	8 (1.9)
Perceived Severity					
The complications from COVID-19 are serious.	48 (11.7)	174 (42.2)	108 (26.2)	63 (15.3)	19 (4.6)
I will be very sick if get COVID-19	34 (8.3)	139 (33.7)	137 (33.3)	78 (18.9)	24 (5.8)
Recovering from COVID-19 would take a long time.	52 (12.6)	151 (36.7)	119 (28.9)	59 (14.3)	31 (7.5)

Perceived Benefit					
Vaccination is a good idea	17 (4.1)	143 (34.7)	137 (33.3)	103 (25)	12 (2.9)
The COVID-19 vaccine may reduce my fear of infection.	49 (11.9)	144 (35)	93 (22.6)	102 (24.6)	24 (5.8)
The vaccine will be highly effective in reducing COVID-19 spread.	117 (28.4)	167 (40.5)	63 (15.3)	59 (14.3)	6 (1.5)
Perceived Barrier					
Worry about possible side effects of the COVID-19 vaccine.	75 (18.2)	140 (34)	134 (32.5)	54 (13.1)	9 (2.2)
Concern about the efficacy of the COVID-19 vaccine	37 (9)	145 (35.2)	141 (34.2)	81 (19.7)	8 (1.9)
The COVID-19 vaccination may interfere with my daily activities.	30 (7.3)	129 (31.3)	192 (46.6)	49 (11.9)	12 (2.9)
Concerning the cost of the COVID-19 vaccine	123 (29.9)	178 (43.2)	85 (20.6)	26 (6.3)	
Concern over the possibility of substandard or fake COVID-19 vaccines being produced	54 (13.1)	146 (35.4)	121 (29.4)	83 (20.1)	8 (1.9)
Cues to Action					
I will only take the COVID-19 vaccine if I am given adequate information.	107 (26)	197 (47.8)	58 (14.1)	45 (10.9)	5 (1.2)
I will only take the COVID-19 vaccine if it is taken by many people in the public.	102 (24.8)	163 (39.6)	103 (25)	39 (9.5)	5 (1.2)
I will only take the COVID-19 vaccine if it is recommended by Doctors.	106 (25.7)	207 (50.2)	60 (14.6)	35 (8.5)	4 (0.9)
If the Ministry of Health recommends the COVID-19 vaccine, I will only get it.	108 (26.2)	159 (38.6)	95 (23.1)	44 (10.7)	6 (1.5)

Factors Associated with COVID-19 Vaccine Acceptance

Age, gender, residence, level of education, having health insurance, having heard about the COVID-19 vaccine, experiencing chronic disease, experiencing COVID-19, rating health status positively, and, from the HBM component, susceptibility perception, severity perception, perception of benefit, perception of barrier, and cues to action were all associated with COVID-19 vaccine acceptance in bivariate regression (candidates for multivariable regression). However,

in multivariable regression, only age, education level, health insurance, having a chronic disease, and four of the five components of HBM (susceptibility perception, severity perception, benefit perception, and perception of barrier) were significantly associated with the COVID-19 vaccine's acceptance.

Adults over the age of 46 were 3.64 times more likely than those between the ages of 18 and 25 to receive the COVID-19 vaccine. Attending education to the level of a diploma and above increased willingness to be vaccinated 2.50 (AOR = 2.5; 95% CI: 1.30, 4.81) times compared to those having no formal education. Those who have health insurance are 1.79 (AOR = 1.79, 95% CI: 1.11, 2.87) times more likely to be vaccinated as compared to those who have no health insurance. The odds of having the willingness to be vaccinated are 1.96 (AOR = 1.96, 95% CI: 1.02, 3.77) times more likely among adult clients diagnosed with chronic diseases compared to those who were ever not diagnosed with chronic diseases. The odd willingness to take the COVID-19 vaccine was 4.11 (AOR = 4.11, 95% CI: 2.49, 6.80) more likely among adult clients who perceive COVID-19 infection as severe than those who don't perceive it as severe. Similarly, those participants who considered themselves susceptible to COVID-19 were 2.90 (AOR = 2.90, 95% CI: 1.34, 3.60) times more likely to accept the COVID-19 vaccine when compared to those who don't consider themselves susceptible to COVID-19. Furthermore, the perception of benefit increases willingness to be vaccinated by 1.81 (95% CI: 1.14, 2.87) times among those who perceive benefit when compared to their counterparts. Whereas the perception of barriers affects willingness to be vaccinated negatively. In other words, those who do not perceive the barrier will accept the COVID-19 vaccine 2.27 (AOR-2.27, 95% CI: 1.42, 3.64) times more likely when compared to those who perceive the barrier (**Table 4**).

Table 4: Factors associated with acceptance of the COVID-19 vaccine among adult patients at public hospitals in Dire Dawa city and the East and West Hararghe zones, Ethiopia, in 2022.

Variable	COVID-19 Vaccine Acceptance		UOR 95% CI	AOR 95% CI	P- value
	Yes	No			
Age					
>=46	23	8	2.70 (1.13, 6.48)	3.64 (1.35, 9.86)	0.01
36-45	28	28	0.94 (0.50, 1.76)	1.39 (0.64, 3.04)	0.40
26-35	107	88	1.14 (0.73, 1.78)	1.65 (0.96, 2.84)	0.07
18-25	67	63	1	1	
Residence					
Urban	132	89	1.56 (1.05, 2.31)	1.55 (0.95, 2.50)	0.08
Rural	93	98	1	1	
Level of education					
College and above	86	53	1.93 (1.15, 3.24)	2.50 (1.30, 4.81)	0.01
Secondary	50	35	1.70 (0.95, 3.04)	1.86 (0.918, 3.77)	0.08
Primary education	42	43	1.16 (0.65, 2.06)	0.94 (0.47, 1.89)	0.86
No formal education	47	56	1		
Do you have health insurance					
Yes	113	78	1.41 (0.95, 2.08)	1.79 (1.11, 2.87)	0.02
No	112	109	1	1	
Have you ever heard about the COVID-19 vaccine?					
Yes	161	121	1.37 (0.90, 2.08)	1.50 (0.90, 2.49)	0.12
No	64	66	1	1	
Have you ever been diagnosed with a chronic disease?					
Yes	46	22	1.92 (1.11, 3.34)	1.96 (1.02, 3.77)	0.04
No	179	165	1	1	
Have you ever experienced COVID-19?					

Yes	27	11	2.18 (1.05, 4.52)	1.30 (0.54, 3.12)	0.55
No	198	196	1	1	
How do you rate overall your health status?					
very poor	22	11	1.93 (0.89, 4.22)	1.89 (0.75, 4.80)	0.18
Poor	21	8	2.54 (1.07, 6.03)	1.28 (0.47, 3.49)	0.62
Fair	22	18	1.18 (0.60, 2.35)	0.86 (0.39, 1.90)	0.71
Good	64	57	1.09 (0.68, 1.72)	1.92 (0.53, 1.58)	0.75
Very good	96	93	1	1	
Susceptibility perception					
Perceived susceptible	148	89	2.12 (1.42, 3.15)	2.90 (1.34, 3.60)	0.002
Not perceived susceptible	77	98	1	1	
Severity perception					
Perceived sever	128	50	3.62 (2.38, 5.49)	4.11 (2.49, 6.80)	0.00
Not perceived sever	97	137	1	1	
Benefit perception					
Perceived benefit	132	75	2.12 (1.43, 3.15)	1.81 (1.14, 2.87)	0.01
Not perceived benefit	93	112	1	1	
Perception of barrier					
Not perceived barrier	126	73	1.99 (1.34, 2.95)	2.27 (1.42, 3.64)	0.00
Perceived barrier	99	114	1	1	
Cues action					
Cue to act	107	72	1.45 (0.98, 2.15)	1.03 (0.63, 1.67)	0.90
Not cue to act	118	115	1	1	

AOR: adjusted odd ratio, CI, confidence interval, UOR: Unadjusted odd ratio, PV: p-value

Discussion

Vaccine hesitancy was a significant problem in tackling the spread of COVID-19 infection. Furthermore, identifying the determinants of COVID-19 vaccine acceptance among the adult population has a paramount significance in setting policies and strategies in decreasing the burden of infection. Therefore, the purpose of this study was to pinpoint the factors that influence adult residents' acceptance of the COVID-19 vaccine.

This study found that adult clients accepted the COVID-19 vaccine at a rate of 54.6 percent. This is in line with a study done in Dassie Hospital (59.4%) [34], a nationwide survey conducted in Ghana (54.1%)[36], and a study conducted in Kuwait (53.1%) [37]. This finding, however, was lower than that of studies conducted in the Gurage Zone (62.6%) [38], Addis Ababa (80.9%) [39], Ethiopia (88%) [33], Indonesia (93.3%) [40], Mozambique (64.8%) [41], South Africa (67%) [42], and sub-Saharan African countries (82.27%) [43]. This variance could be related to differences in data collection technique, socio-demographic characteristics of study participants, and the scope of the study.

The finding of this study is higher than that of a study conducted in Ethiopia (31.4%) [44] and a study done in the Wolaita Zone, southern Ethiopia (45.5%) [26]. This might be because the study in Ethiopia only looked at a general population, whereas our study focused on a specific segment of the population. The study setting was the other explanation for this discrepancy. In our study, an institutional-based cross-sectional study was used, and the health-seeking tendency was expected to be higher.

In this study, adults 46 years of age and older had an increased likelihood of accepting the COVID-19 vaccine. A research study among the adult population in the Gurage zone of Ethiopia provided evidence in support of this conclusion [38], as did a study conducted in Bangladesh

[32]. The relationship between age and vaccination acceptability may be explained by the fact that COVID-19 sickness worsens with age and that elderly unvaccinated individuals are more likely to require hospitalization or pass away from COVID-19 infection [45]. The elderly population becomes anxious and fearful as a result. They are therefore in need of COVID-19 immunization as a coping mechanism.

Similarly, educational status had a positive association with COVID-19 vaccine acceptance. Having a college or higher level of education was associated with an increased likelihood of COVID-19 vaccine acceptance. This finding was supported by a study conducted among the adult population in Gurage Zone, Ethiopia [38], a study conducted in Sodo Town, Ethiopia [26], and a national survey conducted in Ghana [36]. This may be appropriate because adults with higher educational levels can easily grasp the need to get vaccinated, including against COVID-19. Furthermore, people with higher educational status may have a better understanding of preventative strategies for health-related issues.

Those who have health insurance were more likely to be willing to accept the COVID-19 vaccine. This finding is supported by a study conducted at Dassie Compressive Specialized Hospital, Ethiopia [34]. This could be due to having health insurance, which may let them feel free of payment even if the vaccine was provided freely. This indicates that there is a segment of the community that views vaccines as a service provided for a fee. Therefore, healthcare professionals were expected to create community awareness as the COVID-19 vaccine is given freely to all Ethiopians.

Those diagnosed with chronic diseases were more likely to be willing to take the COVID-19 vaccine. Similar findings were reported from a study conducted in Mozambique [41]. This could

be because people with chronic diseases are more likely to acquire COVID-19, making recovery difficult. Thus, since populations with chronic diseases appear to be at a higher risk of developing complications and are at a higher risk of death, they are more likely to be interested in being vaccinated.

Four of the five components of HBM indicated a significant association with willingness to take the COVID-19 vaccine. Perceived susceptibility, perceived severity, and perceived benefit were found to increase the likelihood of COVID-19 vaccine acceptance. This finding is supported by a study conducted in Bangladesh [32], Saudi Arabia [46], Malaysia [47], and a population-based survey in Hong Kong [48]. The reason for this could be that when there is a perception of susceptibility and severity, stress is felt, and people are more willing to take the COVID-19 vaccine as a coping mechanism. The other possible justification could be that as more people learn about the value of COVID-19 vaccination, their willingness to get vaccinated will improve [49].

On the other hand, the other component of the health belief model perceived barrier affects the likelihood of COVID-19 vaccine acceptance negatively. In other words, those who did not perceive a barrier had a better chance of being willing to take the COVID-19 vaccination. This can be justified as participants who disagreed with HBM obstacles and constructs were more inclined to take the COVID-19 vaccine. Another factor could be that misinformation has drastically affected vaccine acceptance [50].

The study has several strengths. One of its strengths is that it is a multicenter study, which enables the generalizability of the study findings to the source population. Again, the study used a health belief model to assess perceptions toward vaccine acceptance, which was adapted from a different validated tool with high internal consistency. However, the study is not without

limitations, as it is cross-sectional, and does not indicate a causal relationship. Furthermore, acceptance of the COVID-19 vaccine was self-reported, which could lead to information bias. The study also does not indicate change over time as perceptions toward COVID-19 risk and awareness change over time and influence the acceptability of the vaccine.

Conclusions

COVID-19 vaccine acceptance among the adult population was low in this study. Factors associated with COVID-19 vaccine acceptance were age, college and above level of education, having a chronic disease, having health insurance, perceived susceptibility, perceived severity, perceived benefit, and perceived barrier.

Improving awareness about COVID-19 among all sections of the population is crucial to improving vaccine acceptability. A responsible body should work on community perception and clarify any myths about COVID-19 and its vaccine, which is recommended.

Ethics Approval and Consent to Participate

Ethical clearance was secured from Haramaya University, College of Health and Medical Sciences, Institutional Health Research Ethics Review Committee (IHRERC) (ref. no. IHRERC/069/2021). Each study participant provided informed, voluntary, written, and signed consent before the interview, and they had the right to withdraw their consent or end the interview at any moment.

Availability of data and materials: The manuscript includes pertinent data, and upon reasonable request, the corresponding author will provide additional data.

Funding: There was no explicit support for this study from public, corporate, or nonprofit organizations.

Competing of Interest: The authors have no competing interests to declare.

Authors' Contributions

TG is the principal investigator and all authors contributed significantly to the work reported, whether that is in the conception(TG, AN, and MD), study design (TG, AE, HB, MD, ML), execution (BB, AE, AN, AA, AD, and ML), acquisition of data, analysis, (TG, KN, AN, AE, AD, KG, KS, YD, AA, and BB) and interpretation, or in all these areas (AN, AE, HB, KS, AS, KG, AO, AA, BB, and MD); all authors participated in drafting, revising, or critically reviewing the article and agreed to be accountable for all aspects of the work.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 5, 6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential	

		bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.