Werabe Journal of Science and Technology
WJST, Year 2026, Volume 1, Issue 1
Pages 15-19

Original Research

Magnitude and determinants of COVID-19 vaccine acceptance among adult residents of the Silte zone, Central Ethiopia: 2024

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Abstract

It's extensively known that the effectiveness of a COVID- 19 vaccine depends on acceptable uptake of the population. Based on currently available evidence, SARS- CoV- 2 is a largely transmittable contagion, and in order to halt transmission, about 82 of the population needs to be vaccinated to achieve herd immunity. However, low vaccination coverage is reported particularly in developing countries. During the study time, about 9.5% of people in low-income countries have received at least one dose. Therefore, this study was aimed at assessing the magnitude and determinants of COVID-19 vaccine acceptance among adult residents of the study area. A community-based cross-sectional study was employed. A multistage sampling method was employed to select 629 study participants. To collect the data, an interviewer-administered questionnaire was used, which was prepared in Kobo Toolbox, cleaned, and analyzed using SPSS version 20. Multiple logistic regression analysis was employed to identify determinants of COVID-19 vaccine acceptance. This study found a 76.4% acceptance rate of the COVID-19 vaccine. Rural residence (AOR=0.629; 95% CI: 0.331-0.897), having education above 12th grade (AOR=1.699; 95% CI: 1.077-6.358), presence of child at home (AOR=1.764; 95% CI: 1.039-2.996), attitude toward vaccine (AOR=1.276; 95% CI: 1.115-1.46), and knowledge of COVID-19 (AOR=2.527; 95% CI: 1.919-3.540) were significantly determines COVID-19 vaccine acceptance. This study revealed that the majority of the study subjects accepted the COVID-19 vaccine. Residence, having education above 12th grade, presence of a child at home, attitude toward the vaccine, and knowledge of COVID-19 were significantly associated with COVID-19 vaccine acceptance. Targeted awareness and educational intervention with particular focus on rural areas are recommended.

Keywords: COVID-19 vaccine, vaccine acceptance, hesitancy, Ethiopia

Highlights

- COVID-19 vaccine acceptance was 76.4% among adult residents.
- Rural residence was negatively associated with vaccine acceptance.
- Individuals with education above 12th grade were more likely to accept the vaccine.
- Presence of a child at home significantly increased vaccine acceptance.
- A favorable attitude toward the vaccine was positively associated with acceptance.
- Good knowledge about COVID-19 strongly increased the likelihood of vaccine acceptance.

1. Introduction

The novel coronavirus disease 2019 (COVID-19) has become a significant challenge for public health globally. The main strategy used around the world to deal with COVID-19 has been to manage the symptoms of patients. Many different treatments are being explored globally to address infections caused by the SARS-CoV-2 virus (Gao, Tian, & Yang, 2020). Despite these efforts, there are instances where individuals who were previously considered to have recovered from COVID-19 experience a second infection (Xing et al., 2020). These limitations in current methods underline the importance of creating vaccines against SARS-CoV-2, with numerous strategies being tested worldwide (Yuan et al., 2020).

Vaccines are one of the best interventions, saving millions of lives annually (Petousis-Harris, 2020). The COVID-19 vaccine not only saves the lives of people but also prevents the loss of the economy. The vaccines prevent the cost of billions to the global economy. Global equitable access to a vaccine is a key way to control the impact of the pandemic (World Health Organization, 2022).

The effectiveness of a COVID-19 vaccine in controlling the impact depends on adequate uptake by the population (Neumann-Böhme et al., 2020). Based on the currently available research findings, the virus is highly transmissible, and to break the chain of transmission, the recommended level of the population needs to be vaccinated to achieve herd immunity (Thorneloe, Wilcockson, Lamb, Jordan, & Arden, 2020). Vaccine hesitancy is one of the major barriers to the uptake of the vaccine (Organization, 2017). If a vaccine is less readily accepted by the population, there is the potential for the vaccine to exacerbate the COVID-19 incidence and mortality rate (Organization, 2017).

Despite growing data on COVID-19 vaccine acceptance in Ethiopia, existing studies are largely focused on specific groups such as pregnant women, healthcare workers, and urban populations (Mesele, 2021; Mose & Yeshaneh, 2021). Furthermore, existing studies found various determinants and comprehensive behavioral factors such as knowledge and attitudes, but their association varies across settings, suggesting a clear need for context-specific evidence at the community level (Youssef, Abou-Abbas, Berry, Youssef, & Hassan, 2022). To the best of our knowledge, there were no studies conducted about the magnitude and determinants of COVID-19 vaccine acceptance in the study area. Hence, this study aimed to assess the magnitude and determinants of COVID-19 vaccine acceptance among adult residents of the Silte zone, southern Ethiopia.

2. Methods and materials

2.1. Study design and location

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Recommended citation: Mohammed Muze, Hassen Mossa, and Abdulbasit Sherefa (2026). Magnitude and determinants of COVID-19 vaccine acceptance among adult residents of the Silte zone, Central Ethiopia: 2024. *Werabe Journal of Science and Technology*, 1(1), 15-19

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A community-based cross-sectional study was conducted in 2024 in the Silte Zone, Central Ethiopia. The Silte Zone is one of the zones of central Ethiopia and is located 175 km away from Addis Ababa, the capital city of Ethiopia. The administrative center of the zone is Werabe town. This zone consists of 12 rural Wereda, 4 administration towns, and 212 kebeles. Based on the last census conducted by the Central Statistical Agency (CSA), in 2018, this zone had an estimated population of 2 million, of whom 156915 are children under five. About 13% of the total population is urban inhabitants. A total of 221,208 households were counted in this zone.

2.2. Study population

All adults in the study area were the source population of this study. Household heads who were ≥18 years old and who lived in the zone for at least 6 months were included in the study. Seriously ill adults who have mental problems and are unable to speak were excluded from the study.

2.3. Sample size estimation

The sample size required for the study was calculated using a single population proportion formula. We used an estimated proportion of vaccine acceptance from a study done in Wolyta Sodo, where 45.5% of the adult population accepts the COVID-19 vaccine (Mesele, 2021). A 95% confidence interval and 5% marginal error were used to obtain the maximum sample size. The formula yields 381 study participants as an initial sample size (n). Considering design effect 1.5 and a non-response rate of 10%, the calculated sample size was increased from 381 to 629 study subjects.

2.4. Sampling technique

A three-stage sampling method was used to select 629 study participants. In the first stage, Dalocha administrative town, Silti Wereda, Hulbarag Wereda, and Alicho Wereda districts were selected randomly from 10 Weredas and 4 administrative towns. In the second stage, 30% of kebeles were selected randomly from each selected Wereda and administrative town. In the third stage, In the third stage, using a systematic random sampling technique, 629 households were selected by using a systematic random sampling technique. Sample size was proportionally allocated to each selected Wereda and administrative town. “The center of each kebele was used to determine a starting location. A random direction was selected, and data collection commenced from a randomly chosen starting point along that direction. Household heads were approached to collect the data. Trained health professionals collected and supervised the data.

2.5. Operational definitions of terms

COVID-19 vaccine acceptance: Vaccine acceptance refers to the degree to which an individual’s accept vaccination. COVID-19 vaccine acceptance will be measured using 10 items. They are three-point Likert-scaled items ranging from disagree to neutral to agree; respondents will be asked to select the option. 80% of points will be used to classify the respondent as accepting or hesitating about the vaccine (Ugochukwu A. Eze et al., 2021; Sirikalyanpaiboon et al., 2021).

The perceived susceptibility: Perceived susceptibility was measured by four questions; 1 is the lowest and 3 the highest perceived susceptibility (Coe, Gatewood, Moczygemba, Goode, & Beckner, 2012).

The perceived severity: Perceived severity refers to the individual’s subjective evaluation of the severity of COVID-19, including potential consequences. Perceived severity was measured using five questions that relate to the patient’s concerns about the seriousness of COVID-19; severity 1 is the lowest, and 3 is the highest perceived severity (Youssef, Abou-Abbas, Berry, Youssef, & Hassan, 2022).

The perceived benefits: It is about the value or efficacy of the COVID-19 vaccination. Perceived benefits were measured by seven questions linked to the perceived positive outcomes of vaccination in terms of reducing their susceptibility to getting the illness from COVID-19, with 1 being the lowest and 3 the highest perceived benefits (Guidry et al., 2021).

The perceived barriers: It is an individual's evaluation of the obstacles to taking COVID-19 vaccines. Perceived barriers were assessed by 13 questions that linked to the patient’s concerns or negative beliefs about COVID-19 vaccines; 1 is the lowest and 3 the highest perceived barriers (Youssef et al., 2022).

The cues to action: The cues to action were measured by seven questions addressing different clues for action that promote the willingness of respondents to take COVID-19 vaccines (Myers & Goodwin, 2011; Youssef et al., 2022)

Knowledge about COVID-19: It was measured by 12 items. The mean of item points was used to categorize knowledge as Poor or Good (Ugochukwu A. Eze et al., 2021; Youssef et al., 2022).

2.6. Data collection instrument and procedures

A structured interview-based questionnaire was used to gather the study data, which was adopted from previous studies (International, 2016; Mekonnen & Mengistu, 2022; Wubshet *et al*., 2023). The initial section of the questionnaire was sociodemographic characteristics, including level of education, age, marital status, occupation, place of residence, religious beliefs, and monthly income derived from the Ethiopian Demographic and Health Survey instruments (International, 2016). Other sections of the questionnaire were adapted from existing academic literature (Ugochukwu A Eze et al., 2021; Mohamed, Solehan, Mohd Rani, Ithnin, & Che Isahak, 2021) to evaluate individual health-related factors, beliefs about health, interpersonal influences, and knowledge. The questionnaire was translated into the local language.

2.7. Data quality control

Trained data collectors collected the study data, and the questionnaire was pretested with 5% of the participants, related to actual study participants but not part of the main study. This pre-test helped identify any problems with the data collection process. Supervisors, who had been selected and trained, were assigned to monitor the data collectors during the survey. In addition, the data underwent a thorough cleaning process to ensure its correctness and consistency.

2.8. Data processing and analysis

The collected data were transferred from KoboToolbox to SPSS for further processing. The data were analyzed using SPSS version 20. Bivariate logistic regression was used. to evaluate the relationship between the dependent and independent variables. All variables with a p-value less than 0.25 in the bivariate analysis were entered into the multiple logistic regression models. The $p < 0.25$ was taken because some variables may not be associated with outcome variables as a result of confounding. On multivariable analysis, variables with a p-value below 0.05 and 95% CI excluding 1 were considered statistically significant in the final output. The model's fitness was assessed using the Hosmer–Lemeshow test, and the Omnibus (Likelihood Ratio) test was used to check the overall model significance.

3. Result

2.1. Sociodemographic factors

A total of 614 responses were analyzed with a response rate of 97.6%. The mean age was 40.17 ± 8.4 years, and the majority, 57.7%, of the participants were between 21 and 30 years old; 55.7% of participants were male, 92.7% were married, 52% of participants had no formal education, and about half of the participants were farmers. The majority, 80%, of participants were rural residents [Table 1].

Table 1. Sociodemographic characteristics of respondents in Siltie zone, 2024, (n = 614).

Variables		Frequency (n)	Percent (%)
Age (years)	18-30	55	9.0
	31-40	354	57.7
	41-50	141	23.0
	> 50	64	10.4
	Total	614	100.0
Gender	Male	342	55.7
	Female	272	44.3
	Total	614	100.0
Education	No formal education	319	52.0
	Primary level (1-8 grade)	237	38.6
	Secondary level (9-12 grade)	48	7.8
	Above 12 grade	10	1.6
	Total	614	100.0
Religion	Islam	598	97.4
	Orthodox	16	2.6
	Total	614	100.0
Marital status	Married	569	92.7
	Unmarried	15	2.4
	.Divorced	7	1.1
	Widowed	23	3.7
	Total	614	100.0
Occupation	Farmer	333	54.2
	Employed	13	2.1
	Student	20	3.3
	Housewife/Retired/Unemployed/	248	40.4
	Total	614	100.0
Redidance	Urban	123	20
	Rural	491	80

2.2. Health belief, individual health, and interpersonal related factors

The majority (86%) of the respondents had health insurance; there was a child in the home of 60% of the respondents; 9% of respondents had a Covid-19 infection history. Of the total respondents, 36% of them reported that there were elderly people in their home. Overall, the mean ± SD scores for perceived susceptibility, perceived benefits, perceived barriers, perceived severity, and cues of action were 12.5 ± 2, 18.9 ± 2.1, 27 ±, 13 ± 1.5, and 14.9 ± 2.6, respectively.

2.3. Knowledge, attitude, and vaccine acceptance

Regarding Knowledge, attitude, and vaccine acceptance of participants, the majority (71%) of the respondents had adequate knowledge about COVID-19, and 98% of participants had a positive attitude about the COVID-19 vaccine. The majority (76.4%) of participants were willing to accept the COVID-19 vaccine.

2.4. Factors association

A binary logistic regression analysis was applied to identify the determinants of COVID-19 vaccine acceptance. The analyses rest on two outcomes of vaccine acceptance: whether they are accepted or not. On univariate analysis, gender, educational status, occupation, presence of child at home, perceived barriers, perceived severity, cues of action, knowledge, and attitude were significantly linked with vaccine acceptance. In multivariable analysis (multiple logistic regression analysis), rural residence (AOR=0.629; 95% CI: 0.331-0.897), having education above 12th grade (AOR=1.699; 95% CI: 1.077-6.358), presence of a child at home (AOR=1.764; 95% CI: 1.039-2.996), attitude toward the vaccine (AOR=1.276; 95% CI: 1.115-1.46), and knowledge toward COVID-19 (AOR=2.527; 95% CI: 1.919-3.540) were significantly associated with COVID-19 vaccine acceptance [Table 2].

Table 2: Regression analysis results about factors associated with COVID-19 vaccine acceptance among respondents in Silte Zone, Central Ethiopia, 2024, (n = 614)

Variables				95% C.I.for AOR		
		COR	AOR	Lower	Upper	Sig.
Residence	Urban					
	Rural	1.308	0.629	0.331	0.897	0.002
Gender	Male					
	Female	3.527	1.667	0.866	3.209	0.126
Education	None formal education					
	Primary level (1-8 grade)	0.765	0.911	0.547	1.516	0.720
	Secondary level (9-12 grade)	1.174	1.747	0.600	5.088	0.307
	Above 12 grades	0.181	1.699	1.077	6.358	0.040
Marital status	Married					
	Unmarried	1.269	0.054	0.003	1.092	0.057
	Divorced	0.793	0.586	0.083	4.138	0.592
	Widowed	2.114	0.332	0.081	1.368	0.127
Occupational	Farmer					
	Employed	0.400	0.736	0.100	5.391	0.763
	Student	2.646	13.027	0.663	256.113	0.091
	Housewife/Retired/Unemployed/	3.526	1.849	1.891	3.839	0.079

Presence of child at home (1)	No					
	Yes	2.286	1.764	1.039	2.996	0.036
Health insurance	No					
	Yes	0.633	0.566	0.297	1.080	0.084
Personal history of COVID-19 diagnosis (1)	No					
	Yes	1.761	1.175	0.544	2.538	0.682
Family member/friend ever diagnosis with COVID-19(1)	No					
	Yes	1.438	0.951	0.508	1.780	0.875
Attitude		1.210	1.276	1.115	1.460	0.000
Perceived susceptibility		1.229	1.109	0.975	1.263	0.116
Perceived severity		1.213	1.126	0.974	1.302	0.108
Perceived barriers		1.146	1.123	1.075	1.174	0.76
Cues		1.256	1.039	0.934	1.156	0.481
Knowledge	Inadequate					
	Adequate	2.185	2.527	1.919	3.540	0.003

4. Discussion

This study aimed to assess the magnitude and determinants of COVID-19 vaccine acceptance in the Silte zone. This study found 76.4% COVID-19 vaccine acceptance. Our finding is nearly comparable with those of a review done on LMICs, where 80% COVID-19 vaccine acceptance was reported (Solís Arce & Warren, 2021). This finding is also strongly supported by findings of a study done in South Sudan and a systematic review in Africa that reported 18.9% and 23.5%, respectively. On the other hand, our finding is higher than the findings of the studies done in other parts of Ethiopia, which reported 52.9% in Debre Birhan (Wubshet, Dagnaw, Gebrelibanos, & Tefera, 2023), 39.7% in Addis Ababa; 42.3% in Debre Tabor; and 45.5% in the Wolaita Zone (Mekonnen & Mengistu, 2022; Mose & Yeshaneh, 2021; Tefera & Assefaw, 2022). These differences might be explained by the differences in the study period and the cutoff values applied for the classification of the outcome variable.

The present study finding was lower compared to the findings reported in a previous study, such as COVID-19 vaccine acceptance, which was seen in Indonesia (93%), China (91%), the United Kingdom (86%), Brazil (85%), South Africa (82%), and Denmark (80%) (Joshi et al., 2021).The current finding is also lower than a study conducted in Ghana, where COVID-19 vaccine acceptance is 81% (Forkuo, Osarfo, & Ampofo, 2022). This may reflect the difference in increased public awareness over time, improved risk perception, and expanded governmental and media efforts promoting vaccination among countries.

Regarding factors' association, our study founds residence, having education above 12th grade, presence of a child at home, attitude toward vaccines, and knowledge about COVID-19 were significantly associated with COVID-19 vaccine acceptance. In the current study, the residence of the respondents was found to be significantly associated with the COVID-19 vaccine acceptance.

In our study, respondents from rural areas were less likely to accept COVID-19 vaccines than those who were living in urban areas. A possible explanation for this result is that urban dwellers have more access to COVID-19-related health information, which leads to better knowledge about COVID-19 vaccine results, and better vaccination acceptance. The finding is supported by existing studies, which reported lower acceptance in rural populations (Mose et al., 2022).

In our study, educational status was positively associated with COVID-19 vaccine acceptance. Thus, respondents whose educational level is 12th grade and above were more likely to have accepted COVID-19 vaccines than respondents who have no formal education. This finding is similar to a previous study (Ngamchaliew et al., 2023). A possible explanation for the higher odds of respondents with higher education accepting the vaccine might be due to respondents with higher education tending to be employed and urban residents, leading to better awareness about the disease and its vaccine.

Our study also found that the presence of a child at home is significantly associated with vaccine acceptance. Meaning, respondents who had a child in their home were more likely to have accepted COVID-19 vaccines than respondents who had none. Similar findings have been reported that individuals with dependents demonstrate higher engagement in preventive health behaviors due to increased perceived responsibility and risk perception than those who do not have dependents (Wake, 2021). A possible reason for the higher odds of respondents who had a child in their home accepting the vaccine might be due to respondents having the intention to protect the child from COVID-19.

Another finding of our study is that knowledge about COVID-19 was significantly associated with COVID-19 vaccine acceptance; the odds of vaccine acceptance among respondents with adequate knowledge were higher than those of their counterparts (Forkuo et al., 2022). This may be explained by the fact that adequate knowledge enhances risk perception and promoting informed decision-making leads to vaccine acceptance.

In this study, a positive attitude toward the COVID-19 vaccine demonstrated a positive association with COVID-19 vaccine acceptance. A similar finding was reported in a previous study (Wubshet et al., 2023). Attitude reflects trust in vaccine safety and effectiveness, as well as confidence in the health system (Alemayehu, Demissie, Yusuf, Gemechu Lencha, & Oljira, 2022). Negative attitudes, often driven by misinformation, fear of side effects, or mistrust, have been identified as major barriers to vaccine uptake (Alemayehu et al., 2022).

Our study had strengths; it used a large sample size and valid data collection from students. Our study had some limitations as well. The cross-sectional study design was used; it is impossible to establish the causal factors for the COVID-19 vaccine, it simply indicates an association rather than causal factors, which should be considered when interpreting the results.

5. Conclusion

This study revealed that the majority of the study subjects were accepting of the COVID-19 vaccine in the study area. Residence, having education above 12th grade, presence of a child at home, attitude toward the vaccine, and knowledge of COVID-19 were significantly associated with COVID-19 vaccine acceptance. Strengthening targeted health education, with particular focus on rural areas and among less educated groups, is recommended. Enhancing community- and family-focused efforts is also important to increase vaccine uptake.

Acknowledgments

We would like to appreciate the Werabe University for supporting this research work. We wish to express our deep appreciation to all staff and data collectors for their contribution to the overall success of this study, and all respondents for their cooperation, time, and genuine response

Declaration

Competing Interests: The authors declare that there is no conflict of interest

Author Contributions: MM conceived the idea and proposal development, report writing, and manuscript writing. HM had a major role in the methodology part, data interpretation, and editing the manuscript. AS play's role in manuscript writing. All the authors provide final approval of the manuscript to be published.

Funding sources: The study was funded by Werabe University, and the funder was only involved in funding, not taking part in the process.

Data availability statement: Data sets used and analyzed during the current study are available from the manuscript and the corresponding author on reasonable request.

Declaration of Generative AI and AI-assisted technologies in the writing processes: none

Consent for publication: Not applicable

Ethical clearance**:** Ethical approval was obtained from Werabe University research ethics review committee before the start of data collection. Informed consent was gotten from all participants before their involvement in the study. Participants who did not wish to take part were allowed to decline without any pressure. The confidentiality of all responses was maintained throughout the research process.

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