

Prevalence and Determinants of COVID-19 Vaccine Hesitancy Among the Ethiopian Population: A Systematic Review

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Introduction: Although vaccination is the most effective way to end the COVID-19 pandemic, there are growing concerns that vaccine hesitancy may undermine its effectiveness. In Ethiopia, vaccine hesitancy forms a major challenge to the uptake of COVID-19 vaccines. This systematic review examined the prevalence and determinants of the COVID-19 vaccine hesitancy among the Ethiopian population.

Methods: A systematic search of articles was conducted in PubMed, EBSCO, Google Scholar, and Semantic Scholar. Studies that evaluated the prevalence and determinants of COVID-19 vaccine hesitancy in Ethiopia were included. The identified determinants of COVID-19 vaccine hesitancy were analyzed based on the frequency of occurrence in the included studies.

Results: The overall COVID-19 vaccine hesitancy level in the Ethiopian population ranged from 14.1% to 68.7%. The high COVID-19 vaccine hesitancy rate observed in this study was due to contextual factors, individual factors, and vaccine-specific factors. Young age, female sex, living in rural areas, lack of adequate information, and lower education are the most common contextual determinants of the COVID-19 vaccine hesitancy. Lack of awareness about the COVID-19 vaccine, low risk of COVID-19, poor adherence to COVID-19 prevention strategies, and negative attitude towards the COVID-19 vaccine are the most frequently reported personal factors. Common vaccine-specific determinants of COVID-19 vaccine hesitation are the side effects of the vaccine and doubts about its effectiveness of the vaccine.

Conclusion: Our review showed that COVID-19 vaccine hesitancy remains highly prevalent and varied across regions of Ethiopia, with a wide variety of factors associated with it. Potential interventions on the benefits of vaccination and the adverse effects of vaccine rejection are crucial to enhance COVID-19 vaccine uptake among the Ethiopian population.

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

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the novel coronavirus (SARS-CoV-2) and was first identified in December 2019 in Wuhan, China.¹ The World Health Organization (WHO) declared COVID-19 as a global pandemic on 11 March 2020.² The virus infects millions of people and kills millions since its inception.³ Vaccines effectively reduce the risk of serious illness and death from COVID-19. The COVID-19 vaccine is also safe and has a low risk of serious adverse events.^{4–6}

Vaccines provide great protection in terms of public health, however, to be successful, the vaccine level must be high.⁷ Especially relevant in the context of the current COVID-19 epidemic, high vaccination coverage rates are needed to provide indirect protection to society as a whole, bring society back to a normal way of life, and to re-open the world economy to the general population.⁸ High vaccination rates are also important in achieving herd immunity to reduce the spread of COVID-19 and to create a lower risk of infection in the general population and those most susceptible to transmission.^{8–10}

The success of the COVID-19 vaccination program depends on the proportion of people who prefer to be vaccinated, and recent estimates suggest that up to 70% of the population may need to be vaccinated to end the current epidemic.¹¹ COVID-19 vaccines need to be released as quickly as possible to bring the public back to normal as soon as possible. However, vaccine hesitancy poses a major threat to the effectiveness of the vaccine in preventing disease and death from COVID-19.^{12,13} Studies conducted in 2021 show that between 40% and 50% of respondents worldwide are reluctant to receive the COVID-19 vaccine with wide variations across countries.^{14,15} In Ethiopia, a survey found that only 31% of the general population was willing to receive the COVID-19 vaccine.¹⁶

The WHO defines vaccine hesitancy as “delay in acceptance or rejection of safe vaccines despite the availability of vaccine services”.¹⁷ COVID-19 vaccine hesitancy is thought to be a multi-factor event influenced by a range of factors. It includes cognitive, psychological, socio-demographic, political, and cultural factors and varies among different populations.¹⁸ Numerous studies have shown that public concern about the safety and/or side effects of COVID-19 vaccines, widespread misinformation about COVID-19 vaccines, and distrust in governments are the factors contributing to the growing hesitancy toward COVID-19 vaccines.^{19–22} Overcoming vaccine hesitancy is complex, so no single intervention can be completely resolved, especially in the case of COVID-19 where the evidence for effective strategies to address it is currently limited.²³ Hence, a multi-component approach tailored to the local population is required to effectively address vaccine hesitancy.²³ Accordingly, it is essential to understand the proportion and determinants of the COVID-19 vaccine hesitancy to inform policymakers and formulate direct intervention measures that can successfully combat the COVID-19 pandemic.

Despite the growing literature, examining the prevalence and determinants of the COVID-19 vaccine in Ethiopia, limited comprehensive evidence has been presented to provide an in-depth and systematic summary of important factors driving vaccine hesitancy specific to the Ethiopian population. This systematic review aimed to examine the proportion of COVID-19 vaccine hesitancy and its associated factors among the Ethiopian population. This review provides valuable insights for policymakers to design and implement targeted and holistic interventions to combat the COVID-19 epidemic in Ethiopia. It helps and facilitates the planning of vaccination campaigns to improve the uptake of the COVID-19 vaccine. Furthermore, our result can not only increase COVID-19 vaccine coverage but also improve the readiness of the existing health system for routine and emergency vaccination.

Methods

A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.²⁴ By using these guidelines, we have developed a search strategy and eligibility criteria before review. Then, the search was conducted through a two-step selection process based on the pre-defined eligibility criteria and evaluated the returned articles. After identifying studies relevant to this review, relevant data were collected from each study. Details of the review process are provided below.

Research Questions

1. What is the proportion of COVID-19 vaccine hesitancy among the Ethiopian population?
2. What are the determinants of COVID-19 vaccine hesitancy among the Ethiopian population?

Information Sources and Search Strategy

PubMed, EBSCO, Google Scholar, and Semantic Scholar were searched by using the following search strategy: (“COVID-19” OR “SARS-CoV-2” OR “corona virus disease 2019” OR “nCOV” OR “2019-nCOV”) AND (“vaccine” OR “vaccination”) AND (“acceptance” OR “willingness” OR “intention” OR “hesitancy”) AND (“associated factors” OR “determinant factors”) AND (“Ethiopia”).

Eligibility Criteria

The inclusion criteria for this systematic review were peer-reviewed journal articles, survey studies done among the Ethiopian population (general population, health care workers, teachers, students, drivers, lactating mothers, adults, bankers, pregnant women, and patients), studies that investigated the prevalence and/or determinants of COVID-19

vaccine hesitancy/acceptance/willingness, and studies published in English until January 18, 2022. Unpublished manuscripts (preprints), non-empirical studies, articles studying vaccine hesitancy other than COVID-19 disease, studies conducted in other countries, and articles that did not report the outcome of interest were excluded from the present systematic review.

Screening and Selection

The identified articles were selected in two stages. The first step involves screening all article titles and abstracts based on eligibility criteria, followed by reviewing the full text of articles with similar criteria. Initially, two independent reviewers examined all titles and abstracts for eligible articles. Disputes regarding exclusions between the two reviewers were resolved through discussions. Finally, all the reviewers individually evaluated the full text of each article and made a final selection of articles to be included.

Outcome of Interest

In this systematic review, the primary outcome was the prevalence of the COVID-19 vaccine hesitancy, which was reported in the included studies. The secondary outcome was determinants of COVID-19 vaccine hesitancy, which has been reported in included studies.

Data Extraction and Analysis

Studies that met the inclusion criteria were further analyzed and the following items were extracted from each study: authors, year of publication, study period, data collection method, target population, study design, sample size, prevalence, and determinants of COVID-19 vaccine hesitancy. The Strategic Advisory Group of Experts (SAGE) determinants of vaccine hesitancy model²⁵ was used to categorize the determinants. Using this model, the determinants of COVID-19 vaccine hesitancy were categorized into three groups: contextual factors, individual/group factors, and vaccine/vaccination-related factors. Finally, the factors were analyzed according to the frequency of occurrences in the studies.

Quality Assessment

Quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Study.²⁶ There are nine criteria in the checklist to assess the quality of cross-sectional studies. Each item in the evaluation criterion is represented by “yes”, “no”, “unclear” or “not available”. The score is one (1) for yes and zero (0) for the rest. A quality score is calculated for each article by dividing the total score by the total possible score. Each article is classified as low quality (<50%), medium quality (50–69%), or high quality ($\geq 70\%$).

Results

Study Selection

The selection process and relevant eligibility criteria are presented in [Figure 1](#). A total of 1801 articles were identified for initial screening. Of this, 903 articles were excluded due to duplication. Following the removal of the duplicates, the titles and abstracts of 898 articles were evaluated for eligibility. Leaving 824 articles based on title and abstract screening, 74 articles were retained for full-text screening. Subsequently, 54 studies were excluded after the full-text screening. Finally, 20 articles have been included in the present systematic review.

Characteristics of Included Studies

A total of 20 cross-sectional studies published up to January 18, 2022, were analyzed in this review. Most studies have been conducted on health workers. The paper questionnaire is a commonly used data collection tool in the included studies. The largest sample size was 1184 and the smallest sample size was 323. More than half of the studies were conducted in the SNNPR ($n = 7$) and Amhara regions ($n = 6$) in Ethiopia. Further details of the included studies are shown in [Table 1](#).

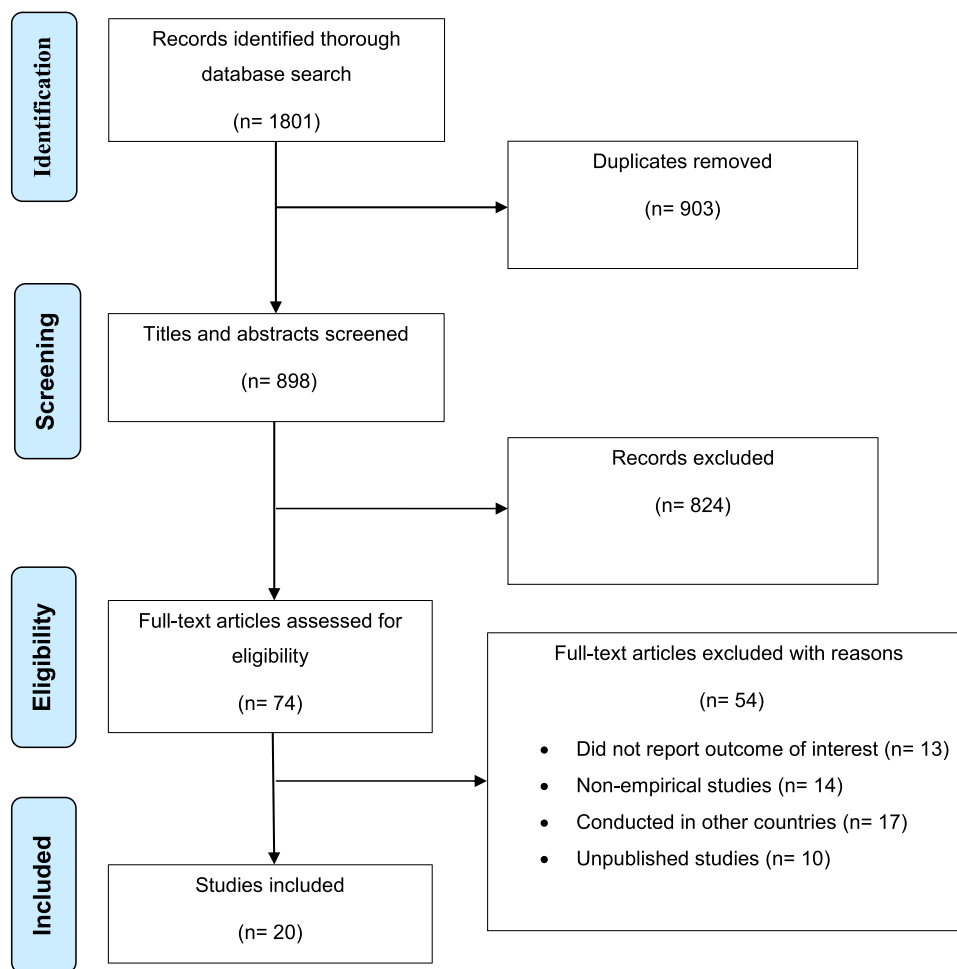


Figure 1 PRISMA flow chart of study selection process for systematic review of the prevalence and determinants of COVID-19 vaccine hesitancy among the Ethiopian population.

Notes: Adapted from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi:10.1136/bmj.n71.²⁴ Creative Commons Attribution (CC BY 4.0) license (<https://creativecommons.org/licenses/by/4.0/legalcode>).

COVID-19 Vaccine Hesitancy Rate in Ethiopia

The proportion of COVID-19 vaccine hesitancy from different parts of Ethiopia is presented in [Table 1](#). The highest level of COVID-19 vaccine hesitancy was reported among pregnant women in SNNPR (68.7%)²⁷ and the lowest level of COVID-19 vaccine hesitancy was recorded among cancer patients in Addis Ababa (14.1%).²⁸

Determinants of COVID-19 Vaccine Hesitancy in Ethiopia

Contextual Factors

A total of 12 factors were identified under contextual determinants of COVID-19 vaccine hesitancy ([Table 2](#)). Among the contextual factors being young appeared in seven of the 20 studies (35%).^{29–35} Lower educational status appeared in six of the 20 studies (30%).^{16,27,36–39} Lack of adequate information on COVID-19 vaccination appeared in four of the 20 studies (20%).^{28,32,39,40} Being females,^{16,39,41} living in rural areas,^{16,27,38} and religious beliefs,^{16,30,37} each appeared in three of the 20 studies (15%). Lack of trust in government^{33,40} and being only academic staff in university hospitals^{34,36} appeared in two of the 20 studies (10%). Four factors, namely: being married,¹⁶ not having health insurance,⁴² being a non-health science student,³⁵ and unclear information by public health authorities,²⁹ each appeared in one of the 20 articles (5%).

Table 1 Characteristics of Studies Included in the Systematic Review of Prevalence and Determinants of COVID-19 Vaccine Hesitancy in Ethiopia, 2022

Authors	Year	Study Period	Region	Data Collection Method	Participants	Sample Size	Hesitancy Rate
Mose et al ³⁸	2021	February to March 2021	SNNPR	Questionnaire	Lactating mothers	630	39%
Alle et al ³¹	2021	February to March 2021	Amhara	Questionnaire	HCWs	327	57.7%
Mohammed et al ³³	2021	March to July 2021	Addis Ababa	Questionnaire	HCWs	634	60.3%
Abebe et al ³⁶	2021	March 1 to 15, 2021	SNNPR	Questionnaire	Adults	501	37.4%
Zewude et al ⁴⁰	2021	Not provided	SNNPR	Questionnaire	HCWs, teachers, bankers and drivers	384	53.9%
Rikitu Tefera et al ³⁴	2021	June 1 to 30,2021	Ethiopia	Online questionnaire	HCWs	522	37.9%
Ahmed et al ³⁰	2021	January to March 2021	Oromia	Questionnaire	HCWs	423	46.9%
Zewude et al ⁴⁵	2021	Not provided	Harari	Questionnaire	HCWs	384	38.4%
Handebo et al ³⁷	2021	December 2020-January 2021	Amhara	Questionnaire	School teachers	323	45.2%
Angelo et al ⁴⁴	2021	March 15–28, 2021	SNNPR	Questionnaire	HCWs	423	51.6%
Taye et al ³⁵	2021	January 2–30, 2021	Amhara	Questionnaire	University students	423	30.7%
Mesele et al ³²	2021	April 1 to 30 2021	SNNPR	Questionnaire	General population	424	54.5%
Seboka et al ³⁹	2021	February to March 2021	Ethiopia	Online questionnaire	General population	1160	35.3%
Belsti et al ¹⁶	2021	February March 2021	Ethiopia	Online questionnaire	General population	1184	68.6%
Berihun et al ⁴²	2021	May 1 to 20, 2021	Amhara	Questionnaire	Chronic patients	422	40.6%
Aemro et al ²⁹	2021	May to June 2021	Amhara	Online questionnaire	HCWs	440	45.9%
Hailemariam et al ²⁷	2021	February to March 2021	SNNPR	Questionnaire	Pregnant women	423	68.7%
Mesfin et al ⁴¹	2021	March to April, 2021	SNNPR	Questionnaire	HIV patients	424	66.3%
Tadele et al ²⁸	2021	May to August 2021	Addis Ababa	Questionnaire	Cancer patients	422	14.1%
Adane et al ⁴³	2022	May 2021	Amhara	Questionnaire	HCWs	404	36.0%

Abbreviations: HCWs, health-care workers; SNNPR, south nation and nationalities people representative.

Individual Factors

Ten factors were identified for the individual determinants of COVID-19 vaccine hesitancy (Table 3). Among the ten factors under this category poor knowledge about the COVID-19 vaccine^{27,30,35,36,38,41,42} and low perceived risk of being infected with COVID-19^{28–30,32,37,43,44} appeared in seven of the 20 studies (35%). Poor compliance with COVID-19 prevention measures^{27,29,35,38,44} and negative attitude towards COVID-19 vaccine^{30,40,42–44} appeared in five of the 20 studies (25%). Not having a history of chronic illness appeared in three of the 20 studies (15%).^{36,41,44} Not having close relatives or friends diagnosed with COVID-19^{39,42} and not having COVID-19 infection experience^{28,34} appeared in two of the 20 studies (10%). Three factors, namely: believing that other non-vaccine preventive mechanisms are sufficient to prevent COVID-19 infection,⁴⁵ belief in having adequate natural immunity,⁴⁵ and lesser trust in science,³³ each appeared in one of the 20 articles (5%).

Table 2 Contextual Determinants of COVID-19 Vaccine Hesitancy in Ethiopia

S.No	Factors	Supporting Studies	Frequency (%)
1	Younger age	[29–35]	7 (35)
2	Lower education	[16,27,36–39]	6 (30)
3	Lack of information about the vaccine	[28,32,39,40]	4 (20)
4	Being female	[16,39,41]	3 (15)
5	Rural residence	[16,27,38]	3 (15)
6	Religious beliefs	[16,30,37]	3 (15)
7	Reduced trust in government	[33,40]	2 (10)
8	Being a non-clinical staff of teaching hospital	[34,36]	2 (10)
9	Being married	[16]	1 (5)
10	Not having health insurance	[42]	1 (5)
11	Being a non-health science student	[35]	1 (5.5)
12	Unclear information by health authorities	[29]	1 (5.5)

Table 3 Individual/Group Related Determinants of COVID-19 Vaccine Hesitancy in Ethiopia

S.No	Factors	Supporting Studies	Frequency (%)
1	Poor knowledge of the COVID-19 vaccine	[27,30,35,36,38,41,42]	7 (35)
2	Low perceived risk of being infected with COVID-19	[28–30,32,37,43,44]	7 (35)
3	Lesser compliance with COVID-19 prevention measures	[27,29,35,38,44]	5 (25)
4	Negative attitude towards COVID-19 vaccine	[30,40,42–44]	5 (25)
5	No history of chronic illness	[36,41,44]	3 (15)
6	Not having friends diagnosed with COVID-19	[39,42]	2 (10)
7	Not having COVID-19 infection experience	[28,34]	2 (10)
8	Believing that non-vaccine mechanisms are more important	[45]	1 (5)
9	The belief in having adequate natural immunity	[45]	1 (5)
10	Lesser trust in science	[33]	1 (5)

Vaccine Related Factors

A total of 3 factors were identified under vaccine-related determinants of COVID-19 vaccine hesitancy (Table 4). Among the three factors under this category concern about the safety and/or side effect of the vaccine appeared in six of the 20 studies (30%).^{29,33,37,39,40,45} Doubts about the effectiveness of the vaccine appeared in four of the 20 studies (20%).^{32,37,40,45} Lack of advocacy for COVID-19 vaccination from health professionals appeared in one of the 20 studies (5%).³⁸

Quality of Included Studies

The JBI critical appraisal checklist for analytical cross-sectional studies included the following eight criteria. (#1) Was the criteria for inclusion in the sample clearly defined? (#2) Were the study subjects and the setting described in detail? (#3) Was the exposure measured validly and reliably? (#4) Were objective, standard criteria used for measurement of the

Table 4 Vaccine/Vaccination-Related Determinants of COVID-19 Vaccine Hesitancy in Ethiopia

S.N	COVID-19 Vaccine Related Factors	Supporting Studies	Frequency (%)
1	Concern about safety and/or side effects	[29,33,37,39,40,45]	6 (30)
2	Doubts about the effectiveness of the vaccine	[32,37,40,45]	4 (20)
3	Lack of advocacy for COVID-19 vaccination from health professionals	[38]	1 (5)

condition? (#5) Were confounding factors identified? (#6) Were strategies to deal with confounding factors stated? (#7) Were the outcomes measured validly and reliably? (#8) Was appropriate statistical analysis used? Based on the above criteria, the quality score of included studies is given in (Table 5). Of the included studies, 15 were rated as high quality, five as moderate quality, and no studies were rated as poor quality.

Table 5 Quality Assessment Results of the Included Studies Using the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies

Authors	Criteria and Corresponding Scores										Quality
	#1	#2	#3	#4	#5	#6	#7	#8	Total	%	
Mose et al ³⁸	1	1	1	1	0	0		1	6/8	75	High
Alle et al ³¹	1	0	1	1	0	1	1	1	6/8	75	Moderate
Muhammed et al ³³	1	1	1	1	0	0	1	1	6/8	75	High
Abebe et al ³⁶	1	1	1	1	0	1	1	1	7/8	87.5	High
Zewude et al ⁴⁰	1	0	1	1	0	0	1	1	5/8	62.5	Moderate
Rikitu Tefera et al ³⁴	1	1	1	1	0	1	1	1	7/8	87.5	High
Ahmed et al ³⁰	1	1	1	1	0	0	1	1	6/8	75	High
Zewude et al ⁴⁵	1	0	1	1	0	0	1	1	5/8	62.5	Moderate
Handebo et al ³⁷	1	1	0	1	0	1	1	1	6/8	75	High
Angelo et al ⁴⁴	1	1	1	1	0	0	1	1	6/8	75	High
Taye et al ³⁵	1	1	1	1	0	1	1	1	7/8	87.5	High
Mesele et al ³²	1	1	1	1	0	1	1	1	7/8	87.5	High
Seboka et al ³⁹	1	1	1	1	0	1	1	1	7/8	87.5	High
Belsti et al ¹⁶	1	1	1	1	0	0	1	1	6/8	75	High
Berihun et al ⁴²	1	1	1	1	0	1	1	1	7/8	87.5	High
Aemro et al ²⁹	1	1	1	1	0	0	1	1	6/8	75	High
Hailemariam et al ²⁷	1	1	1	1	1	0	1	1	7/8	87.5	High
Mesfin et al ⁴¹	0	1	1	1	0	0	1	1	5/8	62.5	Moderate
Tadele et al ²⁸	0	1	1	1	0	0	1	1	5/8	62.5	Moderate
Adane et al ⁴³	1	1	1	1	0	0	1	1	6/8	75	High

Discussion

In this review, we examined the proportion and determinants of COVID-19 vaccine hesitancy in Ethiopia. The overall proportion of COVID-19 vaccine hesitancy ranged from 14.1% to 68.7%, as reported in Addis Ababa and SNNPR, respectively. This finding suggests that vaccine hesitancy poses a serious challenge to COVID-19 pandemic management and control. Many countries are developing vaccines to protect their populations from the current COVID-19 pandemic.⁴⁶ The widespread use of the COVID-19 vaccine is believed to boost herd immunity and protect the population from COVID-19.⁴⁷ However, with this high level of COVID-19 vaccine resistance, the current COVID-19 pandemic is becoming increasingly difficult to manage and control. Therefore, the establishment of educational resources should be implemented to improve the use of the COVID-19 vaccine to make the population aware of its safety, the importance of the vaccine, and the adverse effects of vaccine rejection.

In this study, the proportion of the COVID-19 vaccine hesitancy in the general population in Ethiopia ranged from 35% to 68%. Similarly, previous studies show that between 40% and 50% of the world's population are reluctant to receive the COVID-19 vaccine, with variations in different countries.^{14,15} In addition, our results were similar to another study conducted in Germany, with 42.5% of the participants reporting that they were hesitant to vaccinate against COVID-19.⁴⁸ On the contrary, the acceptance rate of the COVID-19 vaccine was observed to be high in the USA (81%)⁴⁹ and the Chinese population (91.3%).⁵⁰ This can be attributed to differences in the spread and burden of the COVID-19 pandemic between countries. In addition, the variation can be explained by differences in awareness of the severity of COVID-19 and access to healthcare. This discrepancy may also be due to differences in respondents' local traditions, cultures, and beliefs about the benefits and risks of the COVID-19 vaccine. For example, the Chinese population had strong beliefs about the effectiveness of the COVID-19 vaccine, as 89.5% thought the vaccine was an effective way to prevent and control COVID-19.⁵⁰ This positive attitude towards COVID-19 vaccination and the perceived major pandemic impact may explain the high acceptance of the COVID-19 vaccine among the Chinese population compared to the Ethiopian population.

Our review also indicated that the proportion of COVID-19 vaccine hesitancy among healthcare workers in Ethiopia ranged from 36% to 60.3%. The result of this study was in line with a previous systematic review which reported the proportion of COVID-19 vaccine hesitancy as 49%.⁵¹ This implies that a considerable proportion of healthcare workers were hesitant towards the COVID-19 vaccine, which hinder their recommendation of vaccination to their patients. Evidence shows that the attitude of the healthcare workers toward the COVID-19 vaccine was found to influence their intention to suggest the vaccine to their patients and the general population.⁵² This problem is alarming due to the position of health care workers at the forefront in combating the spread and impact of the COVID-19 epidemic, which puts them at risk of infection.^{53–55} Therefore, health workers need to be involved in future priority education so that they can influence the use of vaccines and be approved by the population.

The widespread prevalence of COVID-19 vaccine hesitancy observed in our study is due to the following factors: contextual factors, individual factors, and vaccine-specific factors. Younger age, being females, living in rural areas, lack of adequate information, and lower education were common contextual factors associated with COVID-19 vaccine hesitancy. Poor knowledge about the COVID-19 vaccine, lower self-perceived risk of infection with COVID-19, poor adherence to COVID-19 prevention rules, and negative attitude towards COVID-19 vaccine were most frequently mentioned individual and group related factors associated with increased COVID-19 vaccine hesitancy. Common vaccine/vaccination-specific determinants included concerns about the safety and/or side effects of the vaccine and worries about the effectiveness of the vaccine.

Being young was the most frequently mentioned determinant of COVID-19 vaccine hesitancy. This is in line with previous systematic reviews of COVID-19 vaccine hesitancy.^{56–60} This increase in the hesitancy of the COVID-19 vaccine among young people may be due to the WHO announcement about groups at high risk of COVID-19 infection and death. The WHO has declared that the COVID-19 pandemic is more prevalent and worse for older people than for younger ones. This leads to younger participants being more hesitant than older participants.⁶¹ This finding also means that older people may have more responsibility and accountability towards themselves and their families. Therefore, an in-depth understanding

of the potential factors influencing adolescents' hesitancy to take the COVID-19 vaccine and their vaccine intent will contribute to the development and implementation of effective methods to promote the COVID-19 vaccine in this group.

Our review also confirmed that females were more hesitant to the COVID-19 vaccine. This is consistent with the findings of various systematic reviews,^{56–60} which identified being females as one of the most frequently reported factors associated with increased COVID-19 vaccine hesitancy. Studies conducted in Bangladesh and Vietnam also reported higher COVID-19 vaccine hesitancy among female respondents.^{62,63} The main reasons may be the apparent low-risk perception of COVID-19, high beliefs of conspiracy-related theories about the pandemic in women than men,⁶⁴ and concerns about the safety of vaccination during pregnancy and lactation.⁶⁵

The current study also identified a low level of education as a major determinant of COVID-19 vaccine hesitancy. This is in line with the findings of some systematic reviews,^{57,58,66} which identified a low level of education among commonly cited determinants of COVID-19 vaccine hesitancy. In a US study, high levels of hesitancy against the COVID-19 vaccine were shown in people with limited education.⁶⁷ This may be because more educated people have better access to vaccine information and can understand information about the benefits and safety of the COVID-19 vaccine; on the contrary, the uneducated are more likely to be misinformed about the vaccine. Thus, individuals should be aware of herd immunity, vaccine safety, and how vaccines can help people return to their daily lives.

Consistent with the findings in many systematic reviews,^{57–59,66,68} living in rural areas was one of the most frequently reported determinants of COVID-19 vaccine hesitancy. Further, a study from Bangladesh reported that rural residents were more reluctant to vaccinate than those living in urban areas.⁶² The high prevalence of vaccination among urban dwellers can be explained as people living in urban areas have improved access to health care and are more exposed to different media than the rural population. In addition, compared with the urban community, rural communities may be reluctant to vaccinate because of certain cultural practices and religious beliefs that prevent vaccination.⁶⁹

Poor knowledge of the COVID-19 vaccine was also an important factor associated with the growing hesitancy against the COVID-19 vaccine. This result is consistent with previous studies conducted in Southeast Asia and England.^{70,71} These findings are explained by having good knowledge of the COVID-19 vaccine will help people to know the benefits of the COVID-19 vaccine. Hence, improving public awareness of the benefits, efficacy, and safety of the COVID-19 vaccine is one of the strategies to achieve targeted vaccine coverage. To increase public awareness about the COVID-19 vaccination, there need to be frequent social campaigns that highlight the vaccine's usefulness.

Poor adherence to COVID-19 prevention measures was one of the most frequently stated factors influencing COVID-19 vaccine hesitancy. Consistent with this, a high hesitancy of the COVID-19 vaccine was found among people who showed poor adherence to COVID-19 protection measures such as social isolation, face masking, and frequent hand washing.⁷² Our study found that low trust in the government and the actions they took, the health care response, and the information provided by health officials were associated with the rejection of the COVID-19 vaccine. Other studies have also reported a lack of trust in government/health officials as a factor in the COVID-19 vaccine reluctance.^{73,74} Evidence suggests that people who trust the government's message are more likely to adhere to disease prevention practices. Therefore, the Ethiopian government and health authorities should work to build public trust and explicitly state the effectiveness of the vaccine, adverse effects, and safety through traditional media and other means.

The perception of a low risk of being infected with COVID-19 was found to be associated with COVID-19 vaccine hesitancy. This is consistent with studies conducted in Vietnam and South Italy.^{75,76} This is because people who find themselves at low risk are less concerned about getting infected with COVID-19. As a result, they will not fully participate in COVID-19 prevention strategies, including vaccination.⁷⁷ Therefore, interventions with different communication methods should be implemented to explain the risk of COVID-19 to the population.

Concerns about the safety and side effects of the vaccines were recognized as a major determinant of COVID-19 vaccine hesitancy. This is in line with a study conducted among healthcare workers in Egypt.⁷⁸ Another systematic review found that the main reasons for vaccine rejection were concerns about vaccine safety and efficacy.²¹ This is because hesitancy is largely caused by concerns about the safety, efficiency, and side effects of the vaccine. People who are unsure whether the side effects of the COVID-19 vaccine are tolerable or not are very reluctant to take this vaccine.^{79,80} Therefore, the provision of clear and scientifically valid information about the safety of the COVID-19 vaccine and its adverse outcomes should be a priority task for public health authorities. Since willingness to take the COVID-19 vaccine and its perceived safety and

efficacy are strongly linked, it is important to build confidence in the vaccine. The high efficacy and safety of COVID-19 vaccines increase public confidence in the vaccines, thus reducing vaccine hesitancy. The government should continue to educate the public about the safety and side effects to boost confidence in vaccines. It is also important to understand how the implementation of public health measures affects vaccination hesitancy.

Overall, this review has briefly summarized the level of COVID-19 vaccine hesitancy among the Ethiopian population and associated factors. These findings will make a significant contribution to health policymakers, health authorities, researchers, health care providers, and the entire population. All relevant organs should be actively involved to overcome the COVID-19 vaccine hesitancy that can minimize the morbidity and mortality associated with this pandemic and halt this period of the pandemic. Identifying factors based on their frequency of occurrence in the literature can help policymakers prioritize effort levels for maximum effectiveness, and the results of this review should enable future studies to explore the significance and order of importance. In addition, public health authorities should encourage the uptake of the COVID-19 vaccine by providing reliable information about the COVID-19 vaccine. The population needs to be educated about the efficacy, benefits, and safety of the COVID-19 vaccine to increase acceptance rates of this vaccine. It is also imperative to disseminate better public health messages to raise awareness and change the negative attitudes of the population towards the COVID-19 vaccine. Furthermore, future studies may use our findings to explore strategies to address COVID-19 vaccine hesitancy in Ethiopia.

Strengths and Limitations

To our knowledge, our study is the first to bring together key factors of COVID-19 vaccine hesitancy across contextual, individual, and vaccine-specific effects among the Ethiopian population to shed light on the design of targeted intervention programs. Another strength of this review lies in the analysis of factors based on the frequency of occurrence in the literature, which facilitates the understanding of the most important factors causing COVID-19 vaccine hesitancy in Ethiopia. Despite its strength, our review has some limitations. Some of the studies included in this review were subject to selection bias because people required internet access to participate in the study and complete the survey. Moreover, the protocol for this review has not been prospectively registered in PROSPERO.

Conclusion

Overall, COVID-19 vaccine hesitancy is quite common and differs in different parts of Ethiopia. Younger age, being female, living in a rural area, lack of adequate information, and low education were the most common contextual determinants of COVID-19 vaccine hesitancy. Insufficient knowledge about the COVID-19 vaccine, low self-perceived risk of contracting COVID-19, poor adherence to COVID-19 prevention measures, and negative attitude toward the COVID-19 vaccine were the most frequently studied individual factors. Common vaccine-specific determinants included concerns about vaccine safety and side effects, and doubts about vaccine efficacy.

Healthcare managers should acknowledge the widespread prevalence of COVID-19 vaccine hesitancy in Ethiopian regions and be aware of the factors we identified when formulating policies regarding the COVID-19 vaccine. Although we present our identified factors as separate factors, each factor alone does not affect COVID-19 vaccine hesitancy. Therefore, understanding the relationships between our identified factors and knowing how our factors affect each population group is crucial to improving COVID-19 vaccine uptake and addressing vaccine hesitancy among the Ethiopian population.

Data Sharing Statement

The data used to support the findings of this study are included in the manuscript.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest in this work.

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