COVID-19 vaccine hesitancy in Africa: A scoping review

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Abstract

Background: Vaccination against the novel coronavirus is one of the most effective strategies for combating the global Coronavirus disease (COVID-19) pandemic. Vaccine hesitancy has however emerged as a major obstacle in several regions of the world, including Africa.

Objective: To rapidly summarize the literature on COVID-19 vaccine hesitancy in Africa.

Methods: We searched OVID Medline, Google Scholar, African Journals Online, and African Index Medicus for studies published from January 1, 2020, to July 5, 2021, examining acceptance or hesitancy towards the COVID-19 vaccine in Africa. Information on study characteristics study participants' attitudes towards COVID-19 vaccine were extracted from the included articles. Factors associated with vaccine hesitancy or uptake were grouped as themes and summarized.

Results: A total of 16 articles met the eligibility criteria and were included in the review. Majority of the studies were conducted in Nigeria and Democratic Republic of Congo. Studies conducted in Ghana, Somalia, Uganda, Benin, Cameroon, Malawi, Mali, Ethiopia, and South Africa were also included in the review. The vaccine acceptance rate ranged from 15.4 to 88.8 %. The major reasons for vaccine hesitancy were concerns with vaccine safety and side effects, lack of trust for pharmaceutical industries and vaccination trials, and misinformation or conflicting information from the media. Factors associated with positive attitudes towards the vaccine included being male, having a higher level of education, and fear of contracting the virus.

Conclusion: Our review provides important considerations for addressing the challenge of COVID-19 vaccine hesitancy and blunting the impact of the pandemic in Africa.

Introduction

Reports from several countries in Africa suggest a lower burden of the novel coronavirus disease 2019 (COVID-19) pandemic, relative to countries such as the United States, Italy, and Peru (1–3). However, factors influencing the pandemic's trajectory across Africa are not generalizable. These drivers are diverse, including a nation's experience dealing with communicable diseases, connectivity among communities, infection fatality ratios, low physical access to health facilities, as well as low testing rates (4,5). Considering the debilitating health, social, and economic consequences of COVID-19, a marked increase in infection and mortality rates may be particularly devastating for African countries with under-resourced healthcare systems. Governments have instituted measures to contain the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), including various forms of social distancing measures. The economic ramifications of these health restrictions disproportionately affect the populations in this region who are primarily informal workers. With their livelihoods predicated on in-person interactions, such workers do not readily adhere to lockdowns and similar measures (6–8).

Mass immunization has been demonstrated to be the most effective intervention for curtailing communicable disease pandemics and is therefore adopted and implemented by several countries (9,10).

Despite the innumerable deaths that have been prevented by vaccines, the emergence of vaccine hesitancy and its penetration into mainstream views threatens to undermine the future success of immunization campaigns. Specifically, the demonstrated efficacy of vaccines at curbing the spread of COVID-19 has not necessarily translated to a decrease in global vaccine-hesitancy (11,12).

According to the World Health Organization (WHO), vaccine hesitancy is the “delay in acceptance or refusal of vaccines despite availability of vaccination services” (13). This phenomenon has been highlighted by the WHO as one of the ten threats to global health. False rumours about vaccine effects often spread via social media, negative experiences with the healthcare system, and general distrust towards the government have established the perfect milieu for vaccine-hesitant attitudes across Africa. The accelerated development, approval, and roll-out of COVID-19 vaccines further fuel pre-existing distrust and suspicion. Thus, regions that historically struggle with adequate supplies and equitable access to healthcare also face a new hurdle- insufficient vaccine uptake.

The goal of this scoping review is to synthesize the current literature on vaccine-hesitant attitudes in Africa. This is necessary to establish an understanding of the multiplicity of perceptions and attitudes towards the COVID-19 vaccine, and to help frame strategies for addressing them.

Methods

This scoping review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (14). Literature that was examined included those indexed in OVID Medline, Google Scholar, African Journals Online, and African Index Medicus on the topic of attitudes or hesitancy towards the COVID-19 vaccine in Africa. Covidence (15) was used for deduplication of studies, as well as for screening, full text review, and data extraction.

The inclusion criteria were:

- (1) peer-reviewed, published articles indexed in one of African Index Medicus, African Journals Online, OVID Medline, and Google Scholar;
- (2) the primary aim of the article was to discuss or evaluate COVID-19 vaccine acceptance/hesitancy;
- (3) the article focused on Africa or included African countries
- (4) the publication language was English;
- (5) the article was published between January 1, 2020 to July 5, 2021.

Letters to the editor or protocols were also excluded from the review.

A search on Google Scholar was done on May 31, 5:00 PM PST. For this search, relevant search results from the first 10 pages were considered for eligibility. Relevant search terms included (Name of country in

Africa) AND (COVID-19) AND (Vaccine hesitancy). Likewise, a search was done on OVID Medline on May 31, 6:30 PM PST.

A search on African Index Medicus Online was done on July 5, 6:35 PM PST. Relevant search terms that were used included (COVID-19 or COVID19) AND (Vaccine Acceptance or Vaccine Hesitancy). A search on African Journals Online was done on July 5 8:10 PM PST following the same search strategy used for Google Scholar. No relevant search results were produced from either database.

Detailed search strategies and search results are presented in the additional file. Bibliographies of articles that were included for review were also scanned to capture any literature that was missed from the formal search.

Title, abstract screening, and full text reviews were conducted independently by two authors following the inclusion and exclusion criteria. The following information was extracted from articles that were included for data extraction: last name of the first author, year of publication, study design, country of focus, sample description, sample size, age of respondents, reported acceptance or hesitancy rate, reported factors and reasons associated with acceptance or hesitancy main themes, and conclusions.

Results

A combined total of 108 records from our initial search in the aforementioned databases were eligible for title and abstract screening. Duplicates (N = 48) were removed, and 60 studies were eligible for title and abstract screening. Twenty-two (22) articles were deemed irrelevant and were removed. We retrieved the full text of the remaining 38 studies. After full text screening, 22 studies were excluded because they were either non-peer reviewed (N=7), letters to the editor or protocols (N=8), not focused on vaccine hesitancy (N=3), not focused on Africa (N=3), or the full text was not available (N=1). The remaining 16 articles were included in the final analysis. The selection process is shown in the PRISMA flow diagram (Fig. 1).

Characteristics of the included studies

There was heterogeneity in the included articles in terms of country of focus and participant characteristics (Table 1).

Country of focus

Majority (N = 14) of the included studies were conducted in a single country while 2 studies (16,17) were conducted in multiple countries. The African countries of focus included Nigeria (N= 4 studies) (17–20), Democratic Republic of Congo (DRC) (N= 3 studies)(21–23), Ghana (N= 2 studies) (24,25), Somalia (N= 2 studies) (26,27), and Uganda (N= 2 studies) (16,28). Benin (16), Cameroon (29), Malawi(16), Mali(16), Ethiopia(30), and South Africa (16) were each reported in one study.

Study design and data collection

All of the included studies were cross-sectional in design. Participant data were collected online in 10 studies (16–18,20,21,24–26,28,31) while 4 studies reported paper-based data collection (19,22,23,30); both paper and online tools were used for data collection in the study by Dinga and colleagues (29), while the method of data collection was not specified in the work by Mohamud and colleagues (27).

Participant Characteristics

The study samples were mostly drawn from the general public or from healthcare settings, with adults aged ≥ 18 years, and sample sizes ranging from 234 to 10,183. The proportion of female participants ranged from 8.3-75.2%.

Themes from included studies

Three major themes were captured in the included studies: COVID-19 vaccine acceptance rate, factors associated with vaccine acceptability, and reasons for hesitancy.

COVID-19 Vaccine acceptance rate

The rate of acceptance of COVID-19 vaccine ranged from 24.60% to 88.8% (Table 2). Majority of the included studies (n=8, 50%) reported lower than 50% acceptance (19,22–24,27–29,31).

The lowest acceptance rate of 24.6% was reported in Nigeria (19) and the highest rate of 88.8% was reported by Bono and colleagues (16) which was not specific to a single country but corresponded to 9 low-and-middle-income countries which included five African countries (Democratic Republic of Congo, Benin, Uganda, Malawi, and Mali).

A study in Cameroon did not explicitly report acceptance rate but reported a very high hesitancy rate of 85.6% (29).

Factors associated with COVID-19 vaccine acceptability

Being male was the most common reported factor associated with increased acceptability of the COVID-19 vaccine (16,17,22–24,26,28). However, being female was also linked with higher vaccine acceptance in two studies (25,31). Other factors that were associated with COVID-19 vaccine acceptance included higher level of education (16,18,31), working in a health-related occupation (23,24) especially as a medical doctor (23), greater knowledge of COVID-19 or fear of contracting the virus (including having flu-like symptoms, being tested for COVID-19, or relatives who had contracted the virus) (16,18,21,23,24,26,28,31), being 16 to 30 years old (16,18,31), and possessing positive perceptions towards vaccine sources and the pharmaceutical industry (29). Higher income and effective media communication were also reported as facilitators of vaccine acceptance (16,21).

Reasons for COVID-19 vaccine hesitancy

The reasons for vaccine hesitancy varied considerably across studies (Table 2). Concern for safety was the most-mentioned factor (reported in 12 studies) (16–20,24–26,28–31). Some of these concerns appeared to

stem from mistrust towards the pharmaceutical industry, results from clinical trials, poor vaccine promotion with conflicting information, misinformation from social media, and the fear of getting ill or side effects from the vaccine (17–20,22,23,25,29). Some participants mentioned other measures such as hydroxychloroquine being a safer alternative to the vaccine (19).

Unwillingness to take the vaccine by health workers, including those in the DRC and Ghana, was a strong factor associated with vaccine hesitancy within the community (23,24,31). Similarly, discouragement from some religious leaders (19,20) was a factor that was repeatedly highlighted from studies conducted in Nigeria (17–19). Cultural myths including a lack of belief in the existence of COVID-19, and the belief in one's own immunity, were barriers to vaccine uptake (18,19,21). Although COVID-19 vaccines have mostly been delivered free-of-expense, vaccine affordability was mentioned in one study (19).

Lack of support from employers (20) and pre-existing chronic conditions (16) were also mentioned as factors inhibiting vaccine uptake among study participants.

Discussion

Since the start of the COVID-19 pandemic, mitigation strategies including rapid vaccine development and roll-out have been implemented to curb the spread of the virus. Governments are faced with an unprecedented need to acquire vaccines, distribute them, and immunize large populations at a pace and scale that has not been done before (32). However, vaccine hesitancy remains a major obstacle, even amongst cohorts that are not known to be particularly reluctant to accept vaccines or other health interventions.

This review presents a mapping of the relevant literature and findings on attitudes to COVID-19 vaccines in Africa. The included studies were cross-sectional studies that investigated diverse populations. A commonality across studies that reported statistics specific to African countries were the very low levels of vaccine acceptance (19,22–24,27,28,30,31). This sharply contrasts studies that were carried out in other regions like Europe and the Americas (33), China (34), Kuwait (35), and the United Kingdom (36). Bono and colleagues' study (16), which had global samples, reported that participants from Asian countries and Brazil demonstrated higher levels of acceptance towards vaccines compared to those from African countries. Some exceptions (18,20,21,25,26) found that between 53.5 and 74.5% of participants were willing to accept a COVID-19 vaccine. Notably, two studies from Nigeria that recruited participants from online platforms reported high acceptance rates (18,20), while Oriji et al.'s paper-based interviews with patients in health facilities found high hesitancy rates (19). Incongruence between these findings calls for in-depth exploration of data quality and comprehensiveness when the dynamics of vaccine hesitancy are examined through internet-based data collection techniques versus in-person interviews. Such variability could also be attributed to unique enabling socio-demographic factors of people who use the internet and those who do not.

Interestingly, vaccine hesitancy was persistent among students and workers in health fields (21–24,28,31). Health providers are role models for vaccine uptake, especially for populations expressing low levels of trust

towards vaccines. In many cases, they are gatekeepers for public health messaging, and their interactions could encourage health-seeking behaviours such as receiving vaccines (23,37). As such, vaccine hesitancy amongst health providers is especially concerning given their involvement at the forefront of immunization campaigns and other clinical interventions. In contrast, research on healthcare workers conducted in Italy, Saudi Arabia, France, and China (28,38–41) have shown greater acceptance of vaccines.

Kanyike and colleagues (28) underscored the fact that participants reported such high levels of hesitancy because of the relatively slower infection rates compared to other countries. Caserotti and colleagues (42) establish a link between risk perception and acceptance of COVID-19 vaccines. Thus, the reduced perception of risk and mortality in many African countries can be related to widespread vaccine hesitancy (33). For instance, the recovery rate in Cameroon at the time of Dinga et al.'s study (29) was 80%.

In general, more men than women were open to COVID-19 vaccinations (16,22–24,28). Ngoyi and colleagues (22) attributed this to a widespread impression that men were more at risk of poor outcomes from COVID-19 infections. These gendered patterns of vaccine acceptance match findings from other COVID-19 literature including a study mapping global trends with participants from eight countries (33,43). Faezi and colleagues' study (17) which also included participants from countries outside Africa had women showing a higher propensity for vaccines. Another similarity of the included studies was that people below the age of 40 were more hesitant, possibly because they perceived older people to have higher risks. The findings of Nzaji and colleagues (23) deviated from this, with participants younger than 25 years expressing more willingness to be vaccinated compared to those between 25-40 and above 40 years.

The studies listed a diversity of explanations for why participants refused to be vaccinated. A common reason was the concern for vaccine side effects (16,17,19–21,24,25,27,30,31). In many cases, female respondents were more concerned about negative side effects than male counterparts (17). Zewude and Zikarge (30) found that participants were particularly averse to the AstraZeneca vaccine. This sentiment was likely fueled by reports of serious side effects such as blood clots and other complications, as well as the decision by several European countries to halt AstraZeneca vaccinations for a period to investigate the adverse reactions.

With regards to the fear of side effects, an explanation that was cited in almost all research contexts was the role of misinformation of vaccine safety, especially on social media platforms. Social media holds substantial power at mediating the perpetuation of misinformation anti-vaccine campaigns (44–46). The major sources disseminating false information that were cited by some studies (17,21,22,28,29) were social media-based, and to a lesser extent traditional media. Some respondents also pointed to conversations with friends. A mere 3.6% of respondents in Ngoyi and colleagues (22) had accessed information on the disease and vaccines from official websites like the World Health Organization. They were more likely to accept vaccination. Similarly, participants in Bono and colleagues (16) who noted official websites as their information source also demonstrated a higher affinity to vaccination compared to those who did not. Added to this, even though they are medical students, respondents of Kanyike and colleagues' study (28) did not indicate discussions among health personnel as more legitimate than information from

social media contacts. Misinformation from social media fueled their vaccine hesitancy although they expressed a self-perception of an increased risk due to their participation in COVID-19 health interventions.

Other key commonalities from the included studies include mistrust of vaccine manufacturers (18,19,29) and the notion that COVID-19 vaccines would be used as targets to harm Africans (16,20–24,26–29). Respondents were mistrustful because the pharmaceutical companies are foreign, and scientists from their respective countries were not involved in developing the vaccines.

Several studies (16,20–24,26–29) surveyed respondents about a hypothetical occurrence, the studies were conducted before the countries received their first consignment of vaccinations. Further longitudinal studies will therefore be necessary to evaluate respondents' hesitation or willingness with the concrete reality of readily available vaccines.

The global need to attain high levels of vaccination rates will require more than one effective vaccine approach due to geographic diversity (32). Educational interventions that highlight vaccine safety and efficacy have been recognized in the literature as an urgent need to combat misinformation to increase compliance rates (47). These educational programs could be more impactful if targeted towards the individuals whom we have highlighted as especially concerned about getting vaccinated. The global health community needs to act as a united front while promoting the adaptation of local strategies to address the root causes of mistrust and skepticism for COVID-19 vaccines. This must be done in a respectful manner that acknowledges rather than dismisses the concerns of individuals who are genuinely wary about the safety and efficacy of the available vaccines. Lessons can be learned that will promote vaccine acceptance even for existing vaccines among historically non-compliant groups.

Strengths and limitations

The comprehensive nature of the search strategy is a strength of this paper. With regards to limitations, a critical appraisal of studies included in this review was not carried out as the objective of this review is to present available and relevant evidence in a time-sensitive manner to aid decision-making on strategies to urgently curb vaccine hesitancy during the COVID-19 pandemic in Africa. Moreover, studies were only included from the English language; this could have excluded other studies relevant to our research question, however written in a different language.

Conclusion

This scoping review illustrated the current state evidence regarding COVID-19 vaccine hesitancy in Africa. Our synthesis revealed that factors that drove vaccine hesitant sentiments across Africa varied from fear of adverse events following vaccination, distrust towards the pharmaceutical industry, as well as cultural myths surrounding immunization. Contrary to expectations, vaccine acceptance rates were particularly low amongst medical students in Nigeria at only 37.3%, and 39.3% amongst healthcare workers in Ghana. In contrast, a significantly higher acceptance rate of 66.9% were reported among junior doctors in Ghana, which may suggest the presence of healthcare worker-unique determinants influencing vaccine acceptance amongst healthcare personnel.

This evidence would be instrumental in addressing the sources and manifestations of skepticism towards vaccines to stop COVID-19 and its manifold impacts. This is integral as global efforts for equitable COVID-19 vaccine distribution are underway. The persistence of outbreaks and emergence of variants of concern make this endeavor even more pertinent for helping to frame educational and other approaches for reducing vaccine hesitancy in the continent. Further, identifying the determinants and facilitators of vaccine hesitancy is critical to improving both the current and future success of vaccine rollout.

Declarations

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Abbreviations

COVID-19: Coronavirus disease

DRC: Democratic Republic of Congo

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

WHO: World Health Organization

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Tables

Table 1. Studies included in the scoping review						
Author, year (citation)	Study design	Country of focus	Mode of data collection	Sample description	Sample size	Age of respondents (years)
Adebisi et al., 2020 (18)	Cross-sectional study	Nigeria	Online via social media	Social media users in Nigeria (≥15 years of age)	517	92.5% were 16-30
Agyekum et al., 2021(24)	Cross-sectional study	Ghana	Online	Healthcare workers	234	56% were 30-39
Ahmed et al., 2021(26)	Cross-sectional study	Somalia	Online via social media	Social media users	4543	Mean=23.5
Annan et al., 2021 (25)	Cross-sectional study	Ghana	Online via social media	Junior doctors who practiced for up to 5 years	305	83% were 25-30
Belsti et al., 2021(31)	Cross-sectional study	Ethiopia	Online via social media	Ethiopian resident, adults (≥18 years) using social media, good access to the internet	1,184	Mean=28.86
Bono et al., 2021 (16)	Cross-sectional study	9 LMICs (Including DRC, Benin, Uganda, Malawi, and Mali)	Online via social media	General public (adults ≥ 18 years)	10,183	Mean=45.1
Dinga et al., 2021 (29)	Cross-sectional study	Cameroon	Both online and in person	Adults (18 years and older), Cameroonian, speaking English/French, residents living in the country and abroad	2,512	≈50% were 18-25
Ditekemena et al., 2021(21)	Cross-sectional study	DR Congo	Online via social media	DRC residents, speakers of English and French	4131	Mean=35
Ekwebene et al., 2021(20)	Cross-sectional study	Nigeria (six geopolitical zones)	Online via social media	Adult (≥ 18 years), Nigerian resident, Healthcare workers	445	≥18

Faezi et al., 2021(17)	Cross-sectional study	African and Middle East countries (Iran, Turkey, Lebanon, South Africa, Nigeria etc.)	Online via social media	General public	1,880	62.07% were 20-40
Kanyike, 2021(28)	Cross-sectional study	Uganda	Online via social media	Medical students	600	61.2% were 8-24
Mohamud et al., 2021(27)	Cross-sectional study	Somalia	Did not specify	General public	500	43% were 21-30
Ngoyi et al., 2020 (22)	Cross-sectional study	Democratic Republic of Congo	Survey (did not specify if online or paper-based)	Students of post-secondary education	439	Mean=26.5
Nzaji, 2020 (23)	Cross-sectional study	Democratic Republic of Congo	Self-administered (paper-based)	Healthcare workers	613	Mean=40.31
Orijit et al., 2021(19)	Cross-sectional study	Nigeria	Paper-based	Patients attending any outpatient department at the Federal medical centre	1,000	34.6% were 26-35
Zewude and Habtegiorgis, 2021(30)	Cross-sectional study	Ethiopia	Self-administered questionnaire (paper-based)	High risk workers	319	Mean=32

Table 2. COVID-19 vaccine acceptance or hesitancy

Author, year (citation)	Acceptance rates	Factors associated with acceptability	Reasons for hesitancy
Adebisi et al. 2020 (18)	74.50%	From the Southern region of Nigeria as opposed to the Northern region, aged 16–30-year-olds. Factors associated with non-acceptance included: those with low education attainment, perceived high cost of vaccination, perceived unreliability of vaccine clinical trials, perception that immune system is sufficient at combating COVID-19	Perceived unreliability of the clinical trials, belief that their immune system is enough to combat the virus, and safety concerns
Agyekum et al., 2021(24)	39.30%	Male doctors compared to female doctors, medical doctors compared to nurses, having a relative who has been diagnosed with COVID-19, trust in accuracy of measures taken by the government in the fight against COVID-19	Concern about vaccine safety, concerns about adverse side effects
Ahmed et al., 2021(26)	76.80%	Those who experienced flu-like symptoms, those in the healthcare sector. Factors associated with non-acceptance included: being female, perception that immune system is sufficient at combating COVID-19, perception that COVID-19 pandemic had already ended in Somalia	Fear of side effects, concerns over vaccine effectiveness
Annan et al. 2021(25)	66.90%	Being female, living with the extended family and history of SARS-Cov-2 infection	Fear of adverse effects of the vaccine
Belsti et al., 2021(31)	32.20%	Sex (female), aged less than 25 years old, residing in urban areas, working in private sector, attained an education level of university or above, low cost of vaccine, presence of less side effects	Concern over safety (side-effects)
Bono et al., 2021(16)	76.4% & 88.8% (among all 9 low- and middle-income countries) Why are there 2 percentages here?	Being male, higher education, higher knowledge of COVID-19, worry/fear regarding COVID-19, higher income, younger age, having tested negative for COVID-19	Presence of chronic conditions, fear of side effects, lack of confidence in effectiveness
Dinga et al., 2021(29)	<i>Hesitancy</i> =84.6%	Communication and media environment, Perception of	Concerns regarding safety, efficacy and confidence of

pharmaceutical industry, reliability and/or source of vaccine and cost

vaccine, internet anti-vaccine campaigns surrounding anecdotal experiences, misconceptions that "Africans don't need the vaccine since there are herbal cures", distrust towards vaccines developed by foreign institutions

Ditekemena et al., 2021(21)	55.90%	Belonging to a middle/high-income bracket, those who already tested for COVID-19, belief that COVID-19 exists. Factors associated with non-acceptance included: being a healthcare worker	Perception that vaccine was made to kill people in Africa, perception that vaccine is used to sterilize people
Ekwebene et al., 202(20)	53.50%	Not reported	Poor knowledge about the vaccine, side effects, cultural disapproval, concerns over vaccine safety, lack of support from employers, discouragement from religious leaders
Faezi et al., 2021(17)	66.81%	Males and individuals who have not had COVID-19	Vaccine side effects, mistrust about the vaccine, fear of getting sick from the uptake of the vaccine, and the absence of accurate vaccine promotion news
Kanyike 2021(28)	37.30%	Being male, being single, individual's perceived high risk of getting COVID-19 in the future, having already received any vaccine in the past 5 years	Concerns over vaccine safety and side effects
Orij et al., 2021 (19)	24.60%	Not reported	Mistrust of pharmaceuticals, vaccine manufacturers and government, concern for vaccine safety and side effects
Mohamud et al., 2021(27)	36.80%	Not reported	Not reported
Ngoyi et al., 2020 (22)	25.30%	Male students, individuals who consult official sites (e.g., WHO) as their main source of information, students with poor knowledge of COVID-19	Misinformation through social and traditional media, suspicions of vaccines being used in a global conspiracy, rumours of vaccines being used "to exterminate the Black race"
Nzaji et al., 2020 (23)	27.70%	Male healthcare workers, doctors, positive attitude towards COVID-	Rumours of poor vaccine quality, false information

spread by mass media, rumours of vaccines being used "to exterminate the Black race"

Zewude and Habtegiorgis 2021 (30)	46.10%	Beliefs that COVID-19 is in the area, beliefs that reports from the government are real, having a chronic disease, having relatives/friends who are/have been infected	Concern over the safety and/or the side effects of the vaccine, doubt about the vaccine's effectiveness, lack of adequate information, belief of possessing natural immunity capable of protecting oneself against the disease, reasons related to religion, and being against all vaccines in general
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Figures

Figure 1

Flow diagram of study selection.

Supplementary Files

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