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Assessing the Predictors of COVID-19 Vaccine Hesitancy Among People Living with HIV/AIDS: A Scoping Literature Review

Charles Olomofe MBChB, MPH, FWACP, DrPH[1]; Billy Brooks MPH, DrPH[1]; Megan Quinn MSc, DrPH[1]; Funmike Olomofe LLB, BL, LLM[2]; Jonathan Moorman MD, PhD[3]

[1]East Tennessee State University – College of Public Health: Department of Biostatistics and Epidemiology
[2]East Tennessee State University – College of Clinical and Rehabilitative Health Sciences: Department of Social Work
[3]East Tennessee State University – Center of Excellence in Inflammation, Infectious Disease, and Immunity

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ABSTRACT

Background: The administration of the COVID-19 vaccine at some points in the COVID-19 pandemic resulted in a significant reduction in the spread, risk of complications, and death from coronavirus infection. However, in the face of hesitancy against COVID-19 vaccination springing from the novelty of the vaccines and safety concerns, vulnerable population to COVID-19 infection such as people living with HIV/AIDS (PLWHA) were showing higher hesitancy to COVID-19 vaccines than the general population. This scoping review aims to identify factors COVID-19 vaccine hesitancy among people living with HIV/AIDS.

Methods: A scoping review was conducted to identify and summarize studies from all over the world on COVID-19 vaccine uptake/hesitancy among people living with HIV/AIDS.

The Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) Extension for scoping reviews was used. Articles written in English, peer-reviewed, published within the years 2021-2023, and conducted in any part of the world with sample population being PLWHA, and with an outcome of uptake/hesitancy towards the COVID-19 vaccine were included.

Results: Fourteen articles met the inclusion criteria and were included in this review. The primary study settings were clinic and hospital-based and online self-reported. The prevalence of COVID-19 vaccine hesitancy was as high as 90.8% in an online survey done in the US and as low as 27.5% in a facility-based survey in China. The most common factors mentioned associated with COVID-19 vaccination were the fear of side effects of the COVID-19 vaccine, concerns about the safety of the vaccine, medical mistrust, vaccine novelty, disclosure of HIV status, and perceived interference with highly active antiretroviral therapy (HAART). Male gender, race, good knowledge of COVID-19 prevention practice, having a CD4 count > 200 cells ($p=0.032$) and lower or undetectable viral load ($p<0.001$) were identified as predictors of COVID-19 uptake.

Key findings: This wide margin in the prevalence of COVID-19 vaccine hesitancy between the US and China may be connected to the differences in the political climate, public perception and policies, and racial histories between the two countries. This review showed that those less willing to receive COVID-19 vaccination among people living with HIV/AIDS were those with high viral load and low CD4 count as they are more likely to have contact with healthcare system and more receptive of vaccination. Therefore, to limit the burden of COVID-19 vaccine hesitancy and the impact of COVID-19 disease among people living with HIV/AIDS, it is imperative for interventions to target people living with HIV/AIDS with suboptimal viral load and CD4 count (who are less likely to have contact with the healthcare system) as this predispose them to severe COVID-19 infection. A statistically significant association was found between COVID-19 vaccine hesitancy and black people living. So, it is important to address the root causes of negative perception and systemic racism experienced by the black race for steps to be made towards improving COVID-19 vaccine hesitancy and reducing the burden of disease among black people living with HIV/AIDS.

Introduction

Vaccination is among the most cost-effective public health interventions for preventing infectious diseases and their complications[1]. The administration of the COVID-19 vaccine at some points in the COVID-19 pandemic resulted in a significant reduction in the spread, risk of complications, and death from coronavirus infection[2,3]. However, in the face of hostility against COVID-19 vaccination[4] springing from the novelty of the vaccines, medical mistrust, safety concerns, fear of side effects, political inclination, religious beliefs, socioeconomic status, and ethno-racial background, there has been a reduction in the uptake of COVID-19 vaccines.

Vaccine hesitancy (VH) is defined as the delay in acceptance or refusal of vaccination despite the availability of vaccination services[5]. Given the monumental public health threat posed by vaccine hesitancy, WHO listed vaccine hesitancy as one of the top ten threats to global health in 2019[6]. In the US, poor uptake of routine vaccinations has made outbreaks of previously eliminated diseases such as measles, pertussis, and recently polio to reoccur[7]. The administration of COVID-19 vaccines has also been met with hesitancy from different sections of the population including people living with HIV/AIDS (PLWHA). What is more concerning is that though people living with HIV/AIDS are at risk of severe COVID-19 infections and complications, they seem to show a higher degree of hesitancy towards the vaccine than people living without the virus.

Some factors such as disclosure of HIV status possibly mediate the COVID-19 vaccine hesitancy behavior among PLWHA. This aligns with the Health Belief Model. In the Health Belief Model[8] in Figure 1, the perceived seriousness and susceptibility determine the perceived threat associated with a health problem, and this would ultimately inform the likelihood of engaging in health-promoting behavior such as vaccination. COVID-19 infection is generally perceived as a mild disease; therefore, the knowledge about the perceived threat of the disease may be considered low by PLWHA, and the need for receiving the COVID-19 vaccine maybe affected[9]. Moreover, given the relative capability of the human body to deal with the infection, the perceived benefit of taking COVID-19 vaccine may be downplayed by the media and the whole essence of vaccination may be subjected to populist scrutiny. Evidence also shows that preference for the development of natural immunity against the COVID-19 virus was one of the reasons why people were hesitant about taking the COVID-19 vaccine[9]. Similarly, concerns about the safety of the COVID-19 vaccines given the novelty and rapidity of its development, medical mistrust, and perceived interaction with HAART constitute perceived barriers to taking the vaccines by PLWHA[9–12]. Furthermore, increasing access to the COVID-19 vaccine is a cue to action to improve the uptake of the vaccine. However, when the vaccine first became available, it was only administered at few designated sites. At these sites, mandatory disclosure of HIV status was implemented which could limit PLWHA from receiving the vaccine for the fear of stigmatization[13]. But with the widespread access, multiple clinics giving the vaccine, and less emphasis on disclosure of HIV status, there is necessary cue to increase uptake of the COVID-19 vaccine among PLWHA. The modifying variables are race, gender, age, and religious affiliation. Some research has shown that females were more hesitant about COVID-19 vaccine than their male counterparts [14]. Similarly, the black race and Christianity were also linked with COVID-19 vaccine hesitancy[11,15]. These variables statistically modify COVID-19 vaccination uptake.

Given the combination of COVID-19 infection risk and the threat of COVID-19 vaccine hesitancy among the population of PLWHA, it becomes imperative to explore the literature to identify factors that predispose this population group to this choice of behavior and offer strategies to reverse the trend. The Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) Extension for Scoping Reviews was used to conduct a scoping review on COVID-19 vaccine uptake/hesitancy among people living with HIV/AIDS (PLWHA).

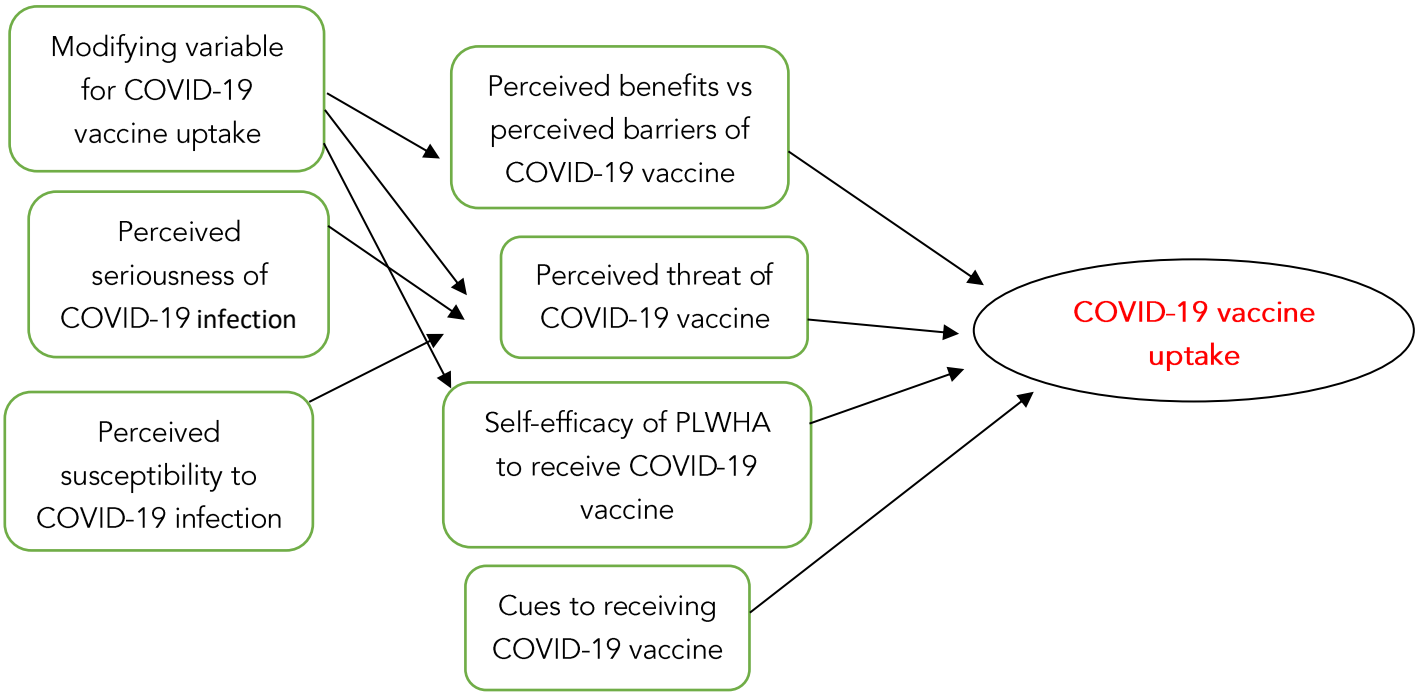

Figure 1 The Health Belief Model[8]

Methods

LITERATURE SEARCH STRATEGY

A scoping review was conducted to identify and summarize studies from all over the world. As described, the PRISMA Extension for scoping reviews[16] was conducted on COVID-19 vaccine uptake/hesitancy among PLWHA. The literature search was conducted between July-October 2023 using databases such as Pubmed, Scopus, Google Scholar, EBSCO, and Medline. Moreover, the websites of major organizations such as the World Health Organization (WHO), Center for Disease Control and Prevention (CDC), and the United Nation were also searched.

The keywords used in the search were changed and they included: COVID-19 vaccination and hesitancy, COVID-19 Immunization and PLWHA, COVID-19 Vaccination uptake and PLWHA, COVID-19 Vaccine Hesitancy and PLWHA, COVID-19 Hesitancy Factors, COVID-19 and PLWHA, *COVID-19 vaccines*, *HIV/AIDS population*, *COVID-19 vaccine hesitancy*, *COVID-19 vaccine uptake*, and Boolean operators (e.g., or, and) to link keywords together in the search. For example, '*COVID-19 vaccine AND HIV/AIDS population*,' *COVID-19 vaccine hesitancy OR PLWHA.*

Titles and abstracts were first screened for inclusion. Articles were selected for the review based on the quality and relevance of the articles having been written in English, peer-reviewed, published within the year 2021-2023, done in any part of the world with sample population being PLWHA, and with an outcome of uptake/hesitancy towards the COVID-19 vaccine. Articles were excluded if full manuscript could not be accessed.

DATA EXTRACTION AND CHARTING

Data was extracted and organized using Zotero library. Screening for duplicate articles was done in Zotero to keep track of the data. A descriptive table was used to summarize articles reviewed using these themes – first author and publishing year, objectives of the research, population location and study design, specific topics discussed, and major findings.

Twenty-five (25) articles were eligible for inclusion. After further restricting the inclusion criteria to only studies involving COVID-19 vaccine hesitancy and/or uptake only 14 articles were eligible and included (Figure 2). The principal investigator extracted data from each of the articles and this was ratified by the second author. The variables extracted included publishing year, objective(s) of the study, location, population, study design, specific topics, and major findings.

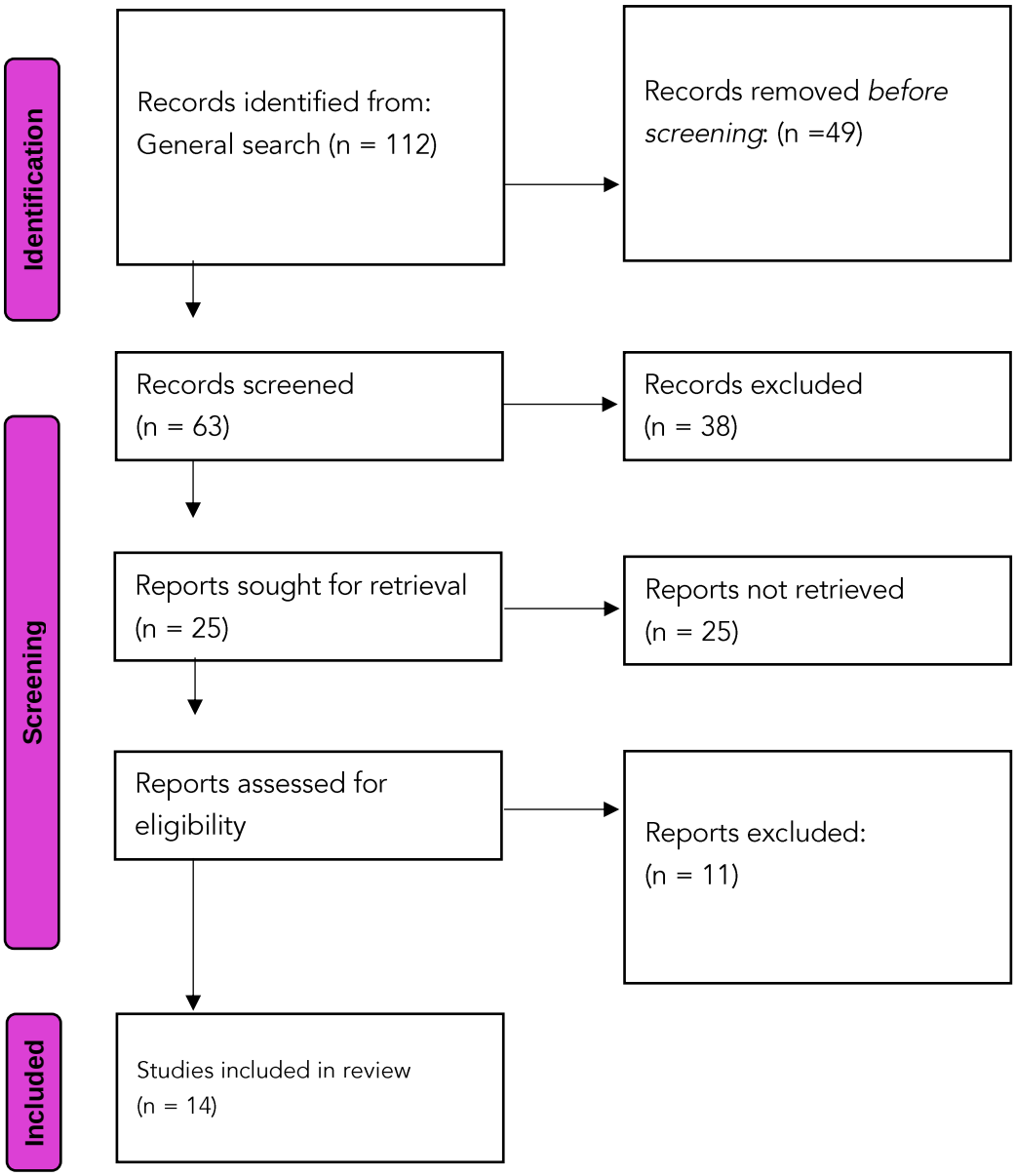

Figure 2 PRISMA Flowchart[17]

1st Author and Publishing Year	Objective(s)	Location, Population, and Study Design	Specific Topic(s)	Major Findings
Qi et al. (2021)	Explain the mediating factors of vaccine intention on COVID-19 vaccine behavior of PLWHA Determine the correlates of the influencing factors	China, cross-sectional web-based survey among 350 PLWHA	Perceive usefulness (PU) of the vaccine Perceive ease of use (PE) Perceive risk (PR) of the vaccine Behavior intention (BI) Behavior (B) Subjective norms (SNs) of vaccination Perceive behavior control (PBC)	The prevalence of COVID-19 vaccine uptake was 43.7%. There was no statistically significant association between vaccine behavior and age, gender, religious belief, marital status, income, educational level, and occupation with $p > 0.05$ in each case. PR had a significantly negative effect on BI ($p < 0.05$). SNs had a significantly positive effect on BI ($p < 0.05$). BI had a significantly positive effect on B ($p < 0.05$). PR fully mediated the effects of PU on BI, BI fully mediated the effects of PR on B, and BI fully mediated the effects of SNs on B ($p < 0.05$).
Liu et al. (2021)	Identify the factors associated with COVID-19 vaccine hesitancy among PLWHA Explore COVID-19 vaccine efficacy and safety among those vaccinated	China, cross-sectional clinic-based and online recruitment survey among 378 PLWHA	Vaccination hesitancy Willingness to be vaccinated Reasons for not vaccinating ART efficacy and COVID-19 vaccine Immunogenicity of COVID-19 vaccine Adverse reactions towards the vaccine	The prevalence of COVID-19 vaccine uptake was 57.5%. However, the prevalence of VH was 27.5% which was greater than 17.7% seen in general Chinese population. Concerns about the side effects and/or poor efficacy of the vaccine was the most common reason (56.0%), followed by waiting to be scheduled (19.5%), having contraindications for the vaccine (13.8%), no perceived need for vaccination (9.4%), and scheduling conflicts (1.9%). The bivariate analysis shows that age, marital status, educational background, occupation, duration of ART treatment, CD4+ T cell counts before 6 months, CD4+ T cell counts and VL prior to ART initiation, and SF-12 scores had no impact on vaccination willingness (all $p > 0.05$) No significant difference was found in the proportion of VL remaining to be "target not detected" (TND) between the vaccinated and unvaccinated group (91.9% vs. 94.3%, $p = 0.412$, Figure 2C), suggesting no negative impact of COVID-19 vaccine on ART efficacy After the whole-course vaccination, the S-RBD-IgG titers were similar in PLWH and HC (15.8 U/mL (IQR, 10.4–23.3) vs. 16 U/mL (IQR, 11.3–23.2), $p = 0.839$). Therefore, a similar immunogenicity of CoronaVac was noted in PLWH compared with HC. The results showed that the S-RBD-IgG titers of immunological responders (CD4+ T cell counts ≥ 350 cells/μL) was significantly higher than that of poor immunological responders (CD4+ T cell counts < 350 cells/μL) (22.4 U/mL (IQR, 17–24.4) vs. 11.2 U/mL (IQR, 4.6–21.2), $p = 0.023$, and two groups were well matched in age and time since whole-course vaccination ($p = 0.346$ and $p = 0.235$, respectively). Thus, the CoronaVac vaccine was more likely to elicit lower humoral immune responses in poor immunological responders.

Shrestha et al. (2022)	Explore VH among PLWHA in US Explore factors associated with VH	United States, Cross-sectional online survey, 1030 PLWHA in the US	COVID-19 VH COVID-19 vaccine attitudes COVID-19 VH factors	The prevalence of COVID-19 VH was 90.8%, and this worrisome because most of the participants were virally suppressed, which indicates their active engagement in health care. COVID-19 vaccine hesitancy was associated with being Black (b = 0.149, p = 0.005), single (b = 0.070, p = 0.018), politically conservative (b = 0.157, p = 0.010), "anti-vaxxer" (b = 1.791, p < 0.001), concern about side-effects (b = 0.226, p < 0.001), concern about safety (b = 0.260, p < 0.001), and being worried that the vaccine will not be effective (b = 0.169, p = 0.008) and they were being experimented on (b = 0.287, p < 0.001). Moreover, participants who had higher education levels (i.e., bachelor's degree or higher), reported lower levels of hesitancy. Conversely, individuals in our sample who had an undetectable viral load or a CD4 count of >200 cells/mm3 were less hesitant to get the vaccine.
Mesfin et al. (2021)	To assess the magnitude and determinant factors of intention to receive the COVID-19 vaccine among HIV-positive patients in southern Ethiopia.	Ethiopia, cross-sectional facility-based survey, among 398 PLWHA	COVID-19 vaccine intention COVID-19 vaccine intention factors	Only 33.7% (95% CI, 0.29–0.38) of the respondents have the intention to take the COVID-19 vaccine. The probability of PLWHA to take COVID-19 vaccine was two (AOR=2.0 (1.08–3.44)) times higher among those who have been diagnosed with chronic diseases (exclude HIV) than those who have not been diagnosed. PLWHA were male sex who had five (AOR= 5 (2.968.68)) time more likely to take COVID-19 vaccine compared with those who were female. The study also indicated that the odds of intention to take the COVID-19 vaccine were 4.1 times (AOR= 4.1 (2.33–7.31)) times higher among those participants who had good knowledge of COVID-19 practice compared with those who had poor knowledge.
Swendeman et al. (2022)	To assess general vaccination attitudes, SARS-CoV-2 vaccination intentions, and COVID-19 self-protective behaviors of people at risk of HIV and PLWHA	United States, cross-sectional study where 440 participants were recruited from community-based agencies, clinic sites, and social networking apps in Los Angeles and New Orleans	COVID-19 vaccination attitudes COVID-19 vaccine intentions COVID-19 protective behavior	Among the population, 29% were either resistant or hesitant about COVID-19 vaccines. Race/ethnicity, sexual orientation, and homelessness were significantly associated with vaccine acceptance. Whites and other race youth at risk or living with HIV/AIDS have higher odds of accepting COVID-19 vaccine than African American youth (p<0.05). Relative to gay youth, pansexual/asexual/other youth (OR 2.539 (1.018, 6.877) had significantly greater odds of vaccine acceptance. There were no significant differences in the odds of vaccine acceptance between bisexual and gay or heterosexual participants. Finally, the odds of vaccine acceptance were significantly lower among those who had experienced homelessness (OR 2.539 (1.018, 6.877)) relative to those who had not experienced homelessness. The odds of intending to receive a COVID-19 vaccine were lower among African Americans

				relative to White individuals. Relative to Cis-males, Cis-females exhibited lower odds of intending to receive a COVID-19 vaccine
Bogart et al. (2021)	To assess general COVID-19 mistrust related to COVID-19 and associations between general COVID-19 mistrust and COVID-19 treatment and future vaccine hesitancy	United States, cross-sectional study. 101 PLWHA were recruited though a community-based HIV service organization in Los Angeles County, CA	COVID-19 mistrust COVID-19 vaccine and treatment hesitancy COVID-19 information sources ART adherence	Nearly all (97%) endorsed at least one mistrust belief. The most prevalent general mistrust beliefs (endorsed by about half or more than half) concerned withholding information or a lack of honesty by the government. The sample showed greater trust in health care providers than the government. Three-quarters felt that health care providers have patients' best interests in mind. Pearson correlations indicated that participants with less than a high school education showed higher levels of general COVID-19 mistrust ($r = 0.27$, $P = 0.007$), vaccine hesitancy ($r = 0.20$, $P = 0.04$), and treatment hesitancy ($r = 0.23$, $P = 0.02$). Greater general COVID-19 mistrust was significantly associated with greater vaccine hesitancy [b (SE) = 0.85 (0.14), $P < 0.0001$] and treatment hesitancy [b (SE) = 0.88 (0.14), $P <.0001$] Greater general COVID-19 mistrust was associated with lower willingness to get a future vaccine [b (SE) = 0.81 (0.17), $P <0.0001$] or to get treatment [b (SE) = 0.97 (0.16), $P <0.0001$].
Valle et at. (2021)	To identify reasons for COVID-19 vaccine hesitancy among PLWHA	France, cross-sectional facility-based survey of 237 PLWHA attending the clinic.	COVID-19 vaccine hesitancy COVID-19 vaccine concerns COVID-19 vaccine acceptance	Sixty-eight (28.7%) participants among the 237 declared their hesitancy to be vaccinated against COVID-19. Some (37.1%) of the participants had concerns about COVID-19 vaccines. Concerns about health ($p < 0.001$), for mandatory COVID-19 vaccination ($p = 0.017$), and that vaccination was important for patients with chronic disease ($p = 0.026$) were significantly associated with the acceptance of vaccination. Conversely, general vaccine refusal ($p < 0.001$), concerns about the serious side effects of COVID-19 vaccines ($p < 0.001$), and with already thinking that an immune status to COVID-19 ($p = 0.008$) was significantly associated with COVID-19 vaccination hesitancy.
Huang et al. 2021	To assess the willingness to receive COVID-19 vaccines To assess the factors associated with COVID-19 vaccination among PLWHA	China, multi-center cross-sectional online survey among 2740 PLWHA in Chinese cities.	COVID-19 vaccine willingness COVID-19 vaccination attitude	Among the respondents, 57.2% were willing to receive COVID-19 vaccine. In the univariate logistic regression analysis, transgender persons, those with chronic conditions, and those with more severe AIDS-related symptoms showed lower willingness to receive CO VID-19 vaccination. Conversely, having commercial health insurance only and a history of other vaccinations in the past 3 years were associated with higher willingness to receive COVID-19 vaccination.

				Having more positive attitudes toward COVID-19 vaccination (aOR 1.11, 95% CI 1.09-1.12; P<.001), stronger perceived support from significant others (perceived subjective norm; aOR 1.53, 95% CI 1.46-1.61; P<.001), and higher perceived behavioral control (aOR 1.13, 95% CI 1.11-1.14; P<.001) to take up the vaccination were associated with higher willingness to receive COVID-19 vaccination. At the interpersonal level, receiving advice supportive of COVID-19 vaccination from doctors (aOR 1.99, 95% CI 1.65-2.40; P<.001), CBO staff (aOR 1.89, 95% CI 1.51-2.36; P<.001), friends and/or family members (aOR 3.22, 95% CI 1.93-5.35; P<.001), and other PLWHA (aOR 2.38, 95% CI 1.85-3.08; P<.001) were associated with higher willingness to receive COVID-19 vaccination.
Shallangwa et al. (2023)	To assess COVID-19 vaccine hesitancy among PLWHA in	Nigeria, hospital -based cross-sectional study among 344 PLWHA in Bornu State	COVID-19 vaccine hesitancy COVID-19 vaccine hesitancy factors	COVID-19 vaccine uptake rate is 25.6% while among yet to receive the vaccine 89.45% are hesitant. COVID-19 vaccine hesitancy factors include worries about the vaccine (43%), lack of vaccine confidence (19.2%), poor knowledge of the severity of COVID-19 infection (10%), and lack of information about the vaccine (14%). However, there is no any statistically significant association between COVID-19 vaccine hesitancy and the independent variables of the study; where P-value is greater than 0.05.
Menza et al. (2022)	To assessed COVID-19 vaccine uptake and correlates of vaccination among PLWH in Oregon.	United States, cross-sectional study using a HIV surveillance data of 8,122 PLWHA in Oregon.	COVID-19 vaccine uptake COVID-19 vaccine uptake correlates	Vaccine uptake rate (one dose) was 61.6% and 56.6% (two doses) among PLWHA. There is statistically significant difference between COVID-19 uptake rate between PLWHA and general population of Oregonians 65.6% (one dose) and 63.1% (two doses) (P < 0.001)). Vaccination was more likely among those aged 50 years old and older, white, MSM, urban zip codes, those with CD4 results, enrollment in ADAP, and history of taking influenza vaccination. Among the 6137 PLWH with a CD4 count in 2020, vaccination was more likely among those with CD4 counts ≥ 200 cells/mm3 (3939/5789; 68.0%) compared to those with CD4 counts < 200 cells/mm3 (203/348; 58.3%, P = 0.032). Among the 6441 PLWH with a viral load in 2020, vaccination was more likely among those with viral loads < 200 copies/mL (4286/6057; 70.8%) compared to those with viral loads ≥ 200 copies/mL (183/384; 47.7%, P < 0.001).
Kabir Sulaimon et al. (2023)	To assess the predictors of COVID-19 VH among PLWHA in low resource settings	Nigeria, cross-sectional facility-based survey among 790 PLWHA in Northern Nigeria	Prevalence of COVID-19 VH Predictors of COVID-19 VH Factors associated with COVID-19 VH	The prevalence of vaccine hesitancy was 57.75% Being 50 years and older (aOR: 0.43; 95% CI: 0.21–0.89), being unemployed (aOR: 0.57; 95% CI: 0.34–0.95), experiencing the adverse effects of ART (aOR: 0.36; 95% CI: 0.15–0.86), and perception of being at high risk of contracting COVID-19 (aOR: 0.22; 95% CI: 0.13–0.37) were associated with

				significantly lower odds of hesitancy. Conversely, being female (aOR: 1.64; 95% CI: 1.02–2.61) and attending ART clinics at state administrative capital cities (IIDH Kano [aOR: 2.40; 95% CI: 1.10–5.25], MMSH Kano [aOR: 5.59; 95% CI: 1.97–10.66], YSSH Damaturu [aOR: 9.88; 95% CI: 4.02–24.29] vs. GH Gashua) were associated with significantly higher odds of hesitancy. The most common reasons for hesitancy include fear of potential adverse effects, skepticism about vaccine efficacy, the rapid development of the COVID-19 vaccine, and the perceived lack of effort to develop a cure or vaccine for HIV/AIDS.
Wickersham et al. (2022)	To assess attitude towards COVID-19 vaccine among PLWHA To assess the willingness to receive COVID-19 vaccine among PLWHA	United States, cross-sectional online survey among 1030 PLWHA in the US	Attitude towards COVID-19 vaccines Willingness to receive COVID-19 vaccines COVID-19 vaccine-related concerns	Among the respondents 83.8% were willing to receive the COVID-19 vaccine. Black (aOR = 0.47, p = 0.008), politically conservative (aOR = 0.39, p = 0.002), or had an annual income of ≤$19,999 (aOR = 0.55, p = 0.005) were significantly less willing to receive a COVID-19 vaccine. However, participants who reported being vaccinated annually for influenza (aOR = 6.01, p < 0.001) or identified as politically liberal (aOR = 2.63, p < 0.001) were more willing to be vaccinated, after adjusting for socio-demographic characteristics, political orientation, HIV & health-related attributes, and COVID-19 history and experiences. Participants' primary vaccine-related concerns were side-effects (39.3%), safety (14.7%), and fair/equitable distribution of the vaccine to affected communities (13.6%). Side effects (48.0%), safety (19.8%), and fair/equitable distribution (17.9%) of the vaccine were also the primary concerns among low-income PWH. Participants reported that they would be more willing to get a COVID-19 vaccine if it were recommended by their doctor (61.5%), the Centers for Disease Control and Prevention (CDC; 56.8%), the World Health Organization (WHO; 47.8%), or if their doctor reported having been vaccinated (33.6%)
Yao et al. (2022)	To assess factors associated with VH among PLWHA in China	China, cross-sectional online survey among 1735 PLWHA	COVID-19 VH factors Perceived benefit of COVID-19 vaccine Perceived risk of COVID-19 vaccine	Among the respondents, 58.4% would accept COVID-19 vaccine while 41.6% was hesitant. Factors affecting willingness to receive the vaccine include: 66.8% demonstrated concerns about a possible influence on ART, 65% had concerns about a possible influence on HIV disease progression after vaccination, possibility of abnormal progression, including a rebound of viral load, or a decrease of absolute CD4+ T cell counts. Moreover, 57.6% had concerns about the possible side effects of the COVID-19 vaccine. Another 46% demonstrated fear of HIV disclosure, 42.7% had concerns that ART might affect the effectiveness of the vaccine,

				40.3% worried that their HIV status might affect the effectiveness of the vaccine, and 22.9% had concerns about the vaccine effectiveness alone. Compared with the group aged 18-29 years old, participants over 29 years old were more hesitant to get the COVID-19 vaccine (P=.009). Participants who had chronic diseases or a chronic disease history were more hesitant than those who did not have (PL WHA without chronic diseases: 2.62 vs PLWHA with chronic diseases or history: 2.42; P<.001). PLWHA who did not have other vaccinations in the past 3 years were more hesitant than the ones who did (eg, without other vaccinations: 2.35 vs with other vaccinations: 2.21; P=.01). The results of the multivariate linear regression analyses showed that, in general, older age (except for the group aged 40-49 years) was positively associated with COVID-19 vaccine hesitancy. Having received another vaccination in the past 3 years was negatively correlated with COVID-19 vaccine hesitancy (β=–0.07, P=.01). Having chronic diseases or a chronic disease history was positively correlated with COVID-19 vaccine hesitancy (β=2.77, P=.01). Perceived benefits, perceived risks, and subjective norms yielded significant direct effects on self-efficacy and COVID-19 vaccine hesitancy. The results showed a negative correlation between perceived benefits and vaccine hesitancy and a positive correlation between perceived risks and vaccine hesitancy (both P<.001). Self-efficacy and subjective norms were negatively correlated with vaccine hesitancy (both P<.001).
Krause et al. 2023	To identify factors associated with COVID-19 VH among PLWHA	Review of available literature (2021-2022) all over the world on VH and PLWHA	COVID-19 VH COVID-19 vaccine acceptance COVID-19 vaccine uptake	Older adults living with HIV, with preexisting conditions, and dying of the disease have been found more likely to accept COVID-19 vaccines. Conversely, female, single, black, conservative political ideology, unemployment and higher levels of COVID-19 VH. Across a multitude of studies, participants have indicated concerns related to safety, efficacy, fear of potential side effects, and the overall development of COVID-19 vaccines as reasons for delaying or not receiving vaccines. On the flip side, higher educational attainment, identification as males, whites, working in high-risk occupational settings, having COVID-19 prevention knowledge, prior engagement with other vaccinations and perceived effectiveness of the COVID-19 vaccine, trust in medical providers correlate with COVID-19 vaccine acceptance. Furthermore, factors directly related to living with HIV/AIDS also shown correlation with COVID-19

				vaccine hesitancy. HIV seropositivity is linked with possibility of developing complications with COVID-19 and high perceived severity and uptake of the vaccine. Having a CD4 cell count of at least 200 cells/ml, those who were more adherent to ART, and those with at least one other chronic condition were significantly more likely to be vaccinated for COVID-19 compared were significantly less likely to be hesitant to receive the COVID-19 vaccine

Key characteristics of each article (author, year, objective, population, study design, COVID-19 vaccine-specific topics, and major findings) were described in Microsoft Word tables; extracted data and study characteristics were then analyzed. The recurrent themes were prevalence of COVID-19 VH among PLWHA, factors associated with COVID-19 VH and predictors of COVID-19 VH or uptake. The prevalence of COVID-19 VH was determined from the articles that reported rate of hesitancy towards COVID-19 vaccine. The factors of COVID-19 VH and uptake were extracted from the articles that reported variables that were significantly associated with the uptake or willingness to receive, and COVID-19 VH.

Results

Fourteen articles met the inclusion criteria and were included in this review. The corresponding authors of the articles were from 5 countries, USA n= 6, China n=4, Nigeria n=2, Ethiopia n=1, and France n=1. The primary study settings were clinic and hospital-based and online self-reported – recruited via community-based organizations or social networking apps. The data were pulled from hospital/clinic data, online survey data, HIV surveillance data, and a literature review of available data in these countries. Articles included people diagnosed or living with HIV/AIDS from a few months to many years. Primary outcomes were COVID-19 vaccine hesitancy, defined by refusal or delay in receiving COVID-19 vaccine despite availability of the vaccination services; willingness to receive potential COVID-19 vaccine when it was not yet available; uptake of COVID-19 vaccines defined by people who did receive the vaccines when it became available for use.

THE PREVALENCE OF COVID-19 VACCINE HESITANCY AMONG PEOPLE LIVING WITH HIV/AIDS

Seven of the articles reported a prevalence of COVID-19 VH among the sampled PLWHA. Vaccine hesitancy was as high as 90.8% in an online survey done in the US[15] and as low as 27.5% in a facility-based survey in China[12]. In the surveys, COVID-19 vaccine hesitancy was assessed using different metrics. Some of the authors used an item scale (such as Vaccine Confidence Scale) with questions measured in a Likert-type scale, and a cumulative score of these responses was then used to determine vaccine hesitancy[15,18]. Others assessed COVID-19 vaccine hesitancy with a single question 'acceptance or refusal/ delay' in receiving the vaccine and the response 'yes' or 'no' from the respondents[19–22]. All the articles from the two countries (China and the US) where more than two-thirds of the reviewed articles draw their population of PLWHA, reported COVID-19 VH prevalence that was more than the prevalence seen in the general population[12,15,18,22]. Furthermore, two articles gave a very high COVID-19 VH prevalence among PLWHA, 90.8% in a US survey[15] and 89.5% in a survey in Nigeria[21].

Among articles that reported COVID-19 vaccine uptake, intent, or willingness among PLWHA, the majority gave vaccine uptake, intent, or willingness rate that was less than 60%[12,14,21–24]. Only two articles reported higher values 61.6% in a national online survey and 83.8% review of a state's HIV surveillance data in the US[25,26]. Some of these articles used the COVID-19 vaccine uptake, intent, or willingness rate to represent hesitancy towards the vaccines among those unwilling or with no intention to receive the vaccine.

FACTORS RELATED TO COVID-19 VACCINE HESITANCY

The majority of the articles identified many factors associated with COVID-19 vaccination. The most common factor mentioned by the respondents in the articles was the fear of side effects of the COVID-19 vaccine. This was closely followed by concerns about the safety of the vaccine. In one of the studies done in China, more than half of the respondents (56%) were worried about side effects from the vaccine[12]. Similarly, in an online survey among PLWHA in the US, 39.3% of the participants in upper-income and 48% of participants in low-income communities said the fear of side effects will be critical in their decision to be vaccinated with the COVID-19 vaccine[26]. In the same study, 14.7% were also concerned about the safety of the COVID-19 vaccine, and in another study done in Nigeria, 43% of the respondent expressed concerns about the safety of the COVID-19 vaccine and their hesitancy about receiving it. The concerns about safety and fear of side effects from the COVID-19 vaccines seem to be rooted in the novelty of the vaccine and the rapidity with which they were developed[27] as expressed by research participants in another facility-based cross-sectional in Nigeria[20]. In this scoping review, another important factor related to COVID-19 VH was medical mistrust. Medical mistrust is defined as "distrust of health care providers, the health care system, medical treatments, and the government as a steward of public health"[11]. In a survey among Black Americans living with HIV/AIDS in the US, more than half endorsed mistrust to be a potential impediment to COVID-19 vaccination[11]. These respondents believe that the government is withholding information and has shown a lack of honesty in handling COVID-19-related issues, and as such, could not be trusted with COVID-19 vaccination. Interestingly, participants in some of the surveys in this review reported that they would be more willing to receive the COVID-19 vaccines if recommended by their doctors[26,27]. Other factors associated with COVID-19 VH among the included articles in the review were concerns about vaccine effectiveness, disclosure of HIV status, perceived need for vaccination, poor knowledge of COVID-19 infection and the vaccine, and possible influence on highly active anti-retroviral drugs (HAART) and disease progression. However, variables such as age, marital status, income level, and type of occupation were reported by some of the studies not to be associated with either COVID-19 vaccine hesitancy or vaccine uptake[12,23]. It is noteworthy to mention that two studies did find an association between age and vaccine uptake[20,25] but this is fewer in number compared to articles that found no association between age and vaccine uptake or hesitancy[12,21,23].

THE HEALTH BELIEF MODEL CONSTRUCTS AND COVID-19 VACCINE HESITANCY

In this review, the constructs of the health belief model were found to predict COVID-19 vaccine hesitancy among PLWHA. Concerns about COVID-19 vaccine safety constitute a **perceived barrier** to the uptake of the vaccine. The issue about COVID-19 vaccine safety is rooted in the novelty of the vaccine. Previous research has linked the novelty of mRNA vaccine technology with hesitancy[28] and this is seen as a barrier to receiving the vaccine. Moreover, the fear of side effects and negative impact on HAART constitute a perceived barrier to uptake of the COVID-19 vaccine. In two studies, the concerns about the side effects of the COVID-19 vaccine and the possibility that the vaccine can negatively impact HAART were found to be significantly associated ($p < 0.001$) with VH[13,15,19]. Furthermore, disclosure of HIV status before COVID-19 vaccination that was required when the vaccines were first rolled formed a barrier for PLWHA. One of the reviewed article in China reported that disclosure of HIV status before COVID-19 vaccine was significantly associated with VH[13]. However, widespread access to the COVID-19 vaccine in Ryan White clinics constituted a **cue to action** for the uptake of the vaccine by PLWHA.

In addition to the variables associated with the constructs of health belief model above, five of the articles reported being Black as a predictor of COVID-19 VH. A statistically significant association

(p <0.05) was found between vaccine hesitancy and Black race[15,18,25–27]. Female gender was also found to predict COVID-19 VH among PLWHA in four surveys in this review[14,18,20,27]. A cross-sectional study to assess the predictors of COVID-19 VH among PLWHA in low resource settings – Nigeria reported that female PLWHA were 1.6 times more likely (aOR: 1.64; 95% CI: 1.02–2.61) to be hesitant than their male counterparts[20]. It is also noteworthy that two articles included in this review found no statistically significant association between gender and vaccine hesitancy[21,23].

Moreover, PLWHA who held a conservative political ideology were significantly more likely to be hesitant to COVID-19 vaccination (p <0.05)[15,26,27]. More so, PLWHA who have experienced homelessness have 2.5 times the odds (aOR: 2.539; 95% CI:1.02 - 6.88) of refusing COVID-19 vaccination than those who have not[18]. Other predictors of VH identified among PLWHA in the articles included in this review were presence of other chronic disease (p<0.001), history of other chronic diseases (p<0.001), and history of refusing other vaccinations.

PREDICTORS OF COVID-19 VACCINE UPTAKE

Some of the studies also explored predictors of COVID-19 vaccination uptake. Those who identified as males were more likely or willing to take the COVID-19 vaccine[14,18,27]. In one Ethiopian study, PLWHA who were male sex were five (AOR: 5; 95% CI: 2.96-8.68) times more likely to take the COVID-19 vaccine compared with those who were females[14]. White race was another predictor of COVID-19 vaccination across many of the studies[15,18,25–27]. Moreover, higher educational attainment and having good knowledge of COVID-19 prevention practice were also predictors of COVID-19 vaccine acceptance[14,15,27]. A study indicated that the odds of intention to take the COVID-19 vaccine were 4.1 times (AOR= 4.1 (2.33–7.31)) higher among those participants who had good knowledge of COVID-19 prevention practice compared with those who had poor knowledge [14]. Similarly, having received flu and some vaccinations in the last 3 years was significantly associated with COVID-19 vaccine acceptance[22,25–27].

Furthermore, some HIV/AIDS-specific indicators were also found to predict the uptake of COVID-19 vaccine. Having a CD4 count > 200 cells (p=0.032) and lower or undetectable viral load (p<0.001) were significantly associated with uptake COVID-19 vaccine[15,25,27]. In addition, constructs of the health belief model were found to significantly predict acceptance of COVID-19 vaccination[22–24]. Having more positive attitudes toward COVID-19 vaccination (aOR 1.11, 95% CI 1.09-1.12; P<.001), stronger perceived support from significant others (perceived subjective norm; aOR 1.53, 95% CI 1.46-1.61; P<.001), and higher perceived behavioral control (aOR 1.13, 95% CI 1.11-1.14; P<.001) to take up the vaccination were associated with higher willingness to receive COVID-19 vaccination [24]

Discussion

COVID-19 vaccine behavior is a delicate and evolving phenomenon, and given the impact of the COVID-19 pandemic in the world and the circumstances surrounding the development of vaccines against this infection – brevity and novelty[28], the topic seems to excite our society in multiple ways. Furthermore, exploring COVID-19 vaccine hesitancy among populations such as PLWHA who are prone to stigmatization and discrimination makes the subject matter very sensitive[10]. While the search yielded 14 studies examining vaccine behavior – hesitancy and acceptance by PLWHA, only five of these studies explored VH in this population when the vaccines were widely available for use. In the majority of the survey, COVID-19 vaccine hesitancy or uptake was framed within the context of intention or willingness to receive or not to receive a potential COVID-19 vaccine. Moreover, the vast majority of the studies were conducted either in the US or China.

In this scoping review, the prevalence of COVID-19 VH among PLWHA range was as low as 27.5% in China and as high as 90.8% in the US. This wide margin in the prevalence of COVID-19 VH between

the two countries may be connected to the differences in the political climate, public perception and policies, and racial histories between the two countries. In the US, the First Amendment prioritizes freedom of speech, religion, assembly and upholds principle of separation of powers[29]. This has implication for COVID-19 vaccine uptake. Religion is pivotal in VH uptake and freedom of speech makes it impossible to censor COVID-19 antivaxxer's propaganda[29]. Things are not exactly the same way in China. Separation of powers does not exist, people with contrary views to COVID-19 vaccination were somewhat repressed, and as such, resistance to the COVID-19 vaccination policies of the communist government was lesser compared to the US[30–32]. Nonetheless, these COVID-19 vaccine prevalence values (in the US and China) were found to be significantly higher than the prevalence of COVID-19 VH in the general population. This disparity in prevalence is quite concerning because research shows that people with chronic disease or co-morbidities including HIV/AIDS tend to have poorer prognosis from the COVID-19 infections[33]. This was also supported by a large cohort study in the United Kingdom that showed PLWHA had a higher risk of death from COVID-19 than the non-HIV population even after adjusting for sex and age[34]. Therefore, refusing or delaying acceptance of a potent preventive strategy such as a vaccine against a potentially dangerous and debilitating infection like COVID-19 is deleterious to the health and well-being of PLWHA. Although, studies have shown that PLWHA with undetectable viral load and CD4 count > 200 cells were less liable to severe morbidity and mortality from COVID-19 disease[35,36], this review showed that those less willing to receive COVID-19 vaccination among PLWHA were those with high VL and low CD4 count as they were less likely to have regular contact with the healthcare system and may not be regular on HAART. Therefore, to limit the burden of COVID-19 VH and the impact of COVID-19 disease among PLWHA, it is imperative for interventions to target PLWHA with suboptimal VL and CD4 count.

Several factors were identified as predictors of COVID-19 vaccine hesitancy among PLWHA. In this scoping review, the age-old dissent from vaccination among Black/African Americans also played out. A statistically significant association was found between COVID-19 vaccine hesitancy and black PLWHA [15,18,25–27]. This may be connected to the oral history of the slave trade and the United State Public Health Service Study in Tuskegee, Alabama. This history has created a notion of distrust and skepticism against white-led medical advancements such as vaccination among Black Americans[37–39]. Furthermore, vaccination is viewed by Black/African Americans as a ploy by 'whites' to decimate, enslave, and dominate the minority group [40]. This mental model and boundary restriction [41] have disproportionately held back many Black/African Americans from taking the vaccines. Unfortunately, research shows that Blacks/African Americans were more likely to be diagnosed, hospitalized, or die from infection with COVID-19 when compared with their white counterparts[11,34,42] and many researchers have linked this with the underlying inequality and inequity in access to health services experienced by black people[11,43,44]. This invariably constitutes a triple burden of mortality risk from COVID-19 among Blacks PLWHA – the tripod of being Black, living with HIV/AIDs, and refusing vaccination could potentially deal a devastating blow to the health and well-being of this segment of the population. Therefore, addressing the root causes of negative perception and systemic racism experienced by the Black race will be a critical step towards improving COVID-19 VH and the burden of disease among Black PLWHA.

Concerns about vaccine safety and fear of side effects were determinants of COVID-19 vaccine hesitancy among PLWHA found in this review[12,15,19–21]. The rapid development and introduction of novel mRNA COVID-19 vaccines heightened the concerns about safety and potential side effects of the vaccine and these constitute **perceived barrier** to the uptake of the COVID-19 vaccines respectively. More so, in the wake of the COVID-19 vaccine administration,

CDC reported ten anaphylactic reactions after administering over 4 million doses of the Moderna vaccine in the US[45] giving a negligible risk of <0.004%. However, the media sensationalize this outcome of the report and anti-vaxxers latched onto it to continue propagating messaging that vaccines are not safe. The impact of these messages generated fear (exacerbating **perceive barrier**) and hesitancy toward the vaccine among different population groups including PLWHA. It is noteworthy, that COVID-19 vaccines showed high safety and efficacy during phase three randomized controlled trials (RCTs) and this prompted its emergency approval for use against COVID-19 infection[36]. Similarly, the effectiveness of the vaccines against symptomatic infection has also been proven across different age brackets, population groups, nationalities, and occupations[2,3]. Among PLWHA, COVID-19 vaccines have demonstrated high efficacy, potency, and safety. The production of antibodies and cellular immune response following COVID-19 vaccination of PLWHA with high CD4 count and using HAART have been comparable with those without HIV infection[36]. Given the effectiveness of COVID-19 vaccines to protect against severe COVID-19 infection, it will be largely beneficial to the overall well-being of PLWHA to receive COVID-19 vaccines. Therefore, mitigating hesitancy towards the COVID-19 vaccines seen among PLWHA would require correcting the misinformation about the safety of the vaccine and allaying fears associated with its side effects through appropriate channels of communication suitable for this group of the population.

Medical mistrust is another phenomenon that has been intricately linked to COVID-19 and COVID-19 vaccines. Researchers and the lay public have accused political office holders, and governing health bodies including the CDC of spreading misinformation during the pandemic[46], and the outgoing CDC director described some of these falterings as 'early missteps with COVID' in her recent speech[47]. The backlash of this 'misinformation' and the concerns about the novel and rapidly developed COVID-19 vaccines soon evolved into conspiracy theories and mistrust beliefs worsening **perceived barrier** among the populace about public health interventions including vaccination. A survey among PLWHA in California shows that having COVID-19 mistrust belief was positively associated with COVID-19 vaccine hesitancy[11]. Similarly, the analysis of the European Social Survey (2020-2021) involving seventeen European countries shows that individuals who expressed conspiracy beliefs had lower COVID-19 vaccine uptake[48]. On the flip side, despite having mistrust beliefs about the public health actions from government and health organizations, there was evidence supporting PLWHA's trust and willingness to receive COVID-19 vaccines if recommended by their doctors and health care providers[11,26]. To their mind, health care providers have their best interest, unlike the government. Therefore, the critical partner in communicating and correcting mistrust beliefs about COVID-19 vaccines in the minds of PLWHA are their doctors and health care providers. The government, politicians, and health organizations must partner with healthcare providers to correct misinformation and improve the uptake of COVID-19 vaccines. Moreover, having support from significant others – family and friends on positive vaccine beliefs was also linked with a lower propensity for COVID-19 vaccine hesitancy[24]. So, other partners to be involved in communicating beliefs and benefits of COVID-19 vaccines to increase uptake of the vaccines among PLWHA are family members and friends.

Lastly, ensuring PLWHA attend scheduled clinics; comply with the intake of ART to reduce viral load and give optimal CD4 count, and get required vaccinations such as flu shots constitute **cues to action** which may indirectly help their compliance and uptake of COVID-19 vaccine. Evidence from this review showed that PLWHA with a CD4 cell count of at least 200 cells/ml, undetectable viral load, who were more adherent to ART and have taken flu vaccinations in the last three years were less likely to be hesitant about COVID-19 vaccination[12,25,27]. This could mean that the continuous interaction of PLWHA with the health system through clinic attendance for drug

refills, CD4 count and VL monitoring, and regular conversations with healthcare providers build trust and a healthy relationship between PLWHA and health service providers which can make communication on COVID-19 vaccine well received. Therefore, efforts should be geared towards keeping PLWHA on track with clinic attendance, ART compliance, CD4 count, and VL vigilance. One approach is through a cellphone reminder-recall system which has been shown to help healthcare appointments and management of patients[49].

The strengths of the current study include a strict application of the scoping review protocol and utilization of many database searches for articles on the topic. Moreover, the development and revision of the search strategy to include studies on both vaccine uptake and hesitancy gave a rounded understanding of the subject. More so, COVID-19 vaccine hesitancy among PLWHA is a new and developing phenomenon, and this review presents evidence that can guide interventions and policy direction in the coming years.

Nonetheless, there are limitations to this study. To begin with, over 70% of the included studies were from either the United States or China, as such, many of the outcomes may represent the opinion of the PLWHA from these two countries. The majority of the studies were cross-sectional studies making it difficult to access the temporality of association of the conclusions. Furthermore, the sample size of many of the surveys was relatively small and the participants of most of these surveys were selected via an online (web-based) convenience sampling technique. This potentially could give rise to response bias and would limit the representativeness of the outcomes of the scoping review.

Conclusion

This scoping review highlighted several factors and predictors of COVID-19 vaccine uptake and hesitancy among PLWHA. The connectedness of these factors with the constructs of the health belief model. Given the role of these predictors of the prevalence of COVID-19 hesitancy among PLWHA, efforts should be directed at correcting misconceptions about COVID-19 vaccines using various media. Governments and health organizations should also be transparent and continue to engage communities, and lay people about vaccine developments to reduce the impact of medical mistrust on COVID-19 vaccination. More so, addressing the inequality in access to healthcare and the bias of black people on health interventions would be critical going forward.

It is hoped that evidence from this scoping review will serve as a guide to direct intervention on COVID-19 VH and provide the framework upon which further research endeavors can be developed.

Conflict of Interest Statement:

None

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None

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