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COVID-19 Vaccination Uptake Among People Living with HIV in Chongwe District of Zambia from 2021 to 2023.

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Abstract

Background: *COVID-19 vaccination is especially important for people living with HIV because it significantly reduces their risk of severe illness and death due to their potentially weakened immune systems. Despite, PLWHIV being a priority population for the COVID-19 vaccination there has been low uptake of COVID 19 vaccines among PLWHIV in Zambia. Therefore, the aim of the research was to investigate determinants of COVID 19 vaccinations uptake among people living with HIV in Chongwe district of Zambia.*

Methods: *This was an analytical cross-sectional study conducted among 537 PLWHIV, aged 12 years and above in Chongwe district between 2021 and 2023. Data was collected through a data extraction form from SmartCare an electronic database used to manage HIV data and an interviewer administered questionnaire. Binary logistic regression models were used to investigate determinants of COVID-19 vaccine uptake among PLWHIV through bivariate and multivariate analysis.*

Results: *Results indicated that participants with a monthly income exceeding 1000 had significantly higher odds of influencing COVID-19 vaccination uptake among PLWHIV (aOR 4.061; 95% CI 1.751-9.421; p = 0.001). Additionally, variables such as not missing clinical visits (aOR 1.258; 95% CI 1.036-3.389; p = 0.006) and not missing pharmacy pick-ups (OR 2.752; 95% CI 1.527-3.660; p = 0.00), Clients without comorbidities (aOR 1.347; 95% CI 0.174-1.692; p = 0.003), participants who understood COVID-19 vaccination(aOR 1.125; 95% CI 1.052-2.299; p = 0.000), clients who were aware of COVID-19 vaccinations (aOR 2.021; 95% CI 1.001-3.652; p = 0.02), participants who reported receiving IEC (aOR 4.366; 95% CI 1.869-5.297; p = 0.006) and unsatisfied clients with services (aOR 2.444; 95% CI 1.390-4.298; p = 0.002) had higher odds of influencing COVID 19 vaccines uptake among PLWHIV in Chongwe.*

Conclusion and Recommendations: *The determinants of COVID-19 vaccination uptake are a combination of various factors. Therefore, there is need for tailored interventions to enhance eeducation and Awareness: enhance giving IEC, Improve Service delivery, Strengthen Support Systems, integration of vaccination into other ART services, Address financial barriers, target outreach awareness programs, tailor interventions for those with Comorbidities, Partnerships and Collaboration with key institutions.*

Keywords: COVID-19, HIV, Vaccination Uptake, Vaccines, ART, PLWHIV

List of Abbreviations

- **AIDS -** Acquired Immunodeficiency Syndrome
- **ART-** Antiretroviral therapy
- **ARVS -** Antiretroviral Drugs
- **BHIVA-** British HIV Association
- **CDC-** Centers for Disease Control and Prevention

- **CIDRZ-** Centre for Infectious Disease Research in Zambia
- **COVID 19-** Coronavirus disease
- **EACS-** European AIDS Clinical Society
- **HIV-** Human Immune-deficiency Virus
- **PLWHIV-** People Living with Human immune-deficiency Virus
- **TX-Curr-** Current on Treatment
- **USAID-** United States Agency for International Development
- **WHO-** World Health Organization
- **ZNPHI-** Zambia National Public Health Institute
- **IEC-** Information, Education, and Communication
- **SARs-** Severe acute respiratory syndrome
- **OR-** Odds ratio.

Introduction

Coronavirus disease (COVID-19) is a highly contagious illness caused by the SARS-CoV-2 virus. Since its emergence in Wuhan, China, in December 2019, it has led to over 510.2 million infections and 6.2 million deaths globally as of April 2022, exerting significant pressure on healthcare systems and economies [1]. In Zambia, by June 2022, there were 324,025 reported infections and 3,992 fatalities [2]. The disease manifested with symptoms such as fever, cough, and breathing difficulties, potentially progressing to severe complications like pneumonia [3].

People with underlying chronic diseases, such as persons living with HIV (PLWHIV) and those with diabetes, cancer, heart disease, and hypertension, are at an increased risk of persistent SARS-CoV-2 infections and severe COVID-19 comorbidities and death [4]. This may be due in part to a greater burden of predisposing risk factors associated with severe COVID-19 among PLWHIV and partly due to the immunocompromised state of some PLWHIV [5, 6]. Studies have also shown a 76–114% increased risk of COVID-19 mortality among PLWHIV, with an even higher risk for PLHIV who are not on treatment [7, 4, 8].

To mitigate the spread, public health measures such as social distancing, handwashing, mask-wearing, and isolation have been implemented [9]. To further mitigate the spread COVID-19 vaccines were developed for use in emergencies to contain COVID 19 and prevent its spread, and add to the arsenal in the fight against the pandemic, which represents a major step towards returning to normalcy [10, 11]. To control the COVID-19 pandemic, the World Health Organization (WHO) recommended coverage of COVID-19 vaccines to at least 70% of the population in all countries around the globe by mid-2022 [12].

Vaccination would play a critical role in combating COVID-19, with over 11.4 billion doses administered globally. In Zambia, at least 7,457,234 doses were given, covering approximately 20.9% of the population [13]. During the vaccination rollout, priority was given to vulnerable groups, such as those with underlying diseases such as HIV, hypertension, diabetes, and heart disease [14, 15]. However, Despite the availability of COVID-19 vaccines and being prioritised, vaccine uptake among PLWHIV remained low [16, 17]. Globally, only 55% of PLHIV are vaccinated against COVID-19, with misinformation, vaccine hesitancy, and lack of awareness cited as key barriers [18]. As of 2022, an estimated 1,336,056 people were living with HIV (PLHIV) in Zambia, according to Spectrum modeling data cited by UNAIDs [19]. By October 2022, about 850,000 PLWHIV in Zambia had been fully vaccinated against COVID-19 [20].

In Chongwe District, by November 2022 only 43% of the approximately 19,000 PLWHIV on antiretroviral therapy (ART) had received the COVID-19 vaccine significantly lower than in other districts in Lusaka Province, which reported vaccination rates of over 50% among PLWHIV at the same time of the year [21, 22].

Vaccine uptake was identified by the World Health Organization (WHO) as one of the top ten global health threats, hindering efforts to control vaccine-preventable diseases. Addressing this challenge required improving vaccine accessibility, providing accurate information, and fostering trust in healthcare systems [23]. COVID-19 vaccine hesitancy has been an important barrier to COVID-19 vaccination uptake among PLWHIV, with studies reporting vaccine hesitancy rates of 21–35% in participants in Africa and the Middle East [24, 25].

COVID-19 vaccine hesitancy has also been reported in developed countries such as the USA and France, with hesitancy rates of about 23–90% [8]. Reasons for COVID-19 vaccine hesitancy in these populations include concerns about vaccine safety, hesitancy towards vaccines in general, mistrust of vaccine information sources and scepticism regarding the accelerated development and approval of the vaccines [26-28].

In Zambia little research has been conducted on the specific determinants of COVID 19 vaccinations affecting PLWHIV. Given the heightened risk faced by PLWHIV and the fact that Little is known about determinants of COVID-19 vaccination uptake among PLWHIV in Zambia. The aim of the study was to investigate the determinants of COVID-19 vaccine uptake among PLWHIV in Chongwe district, Lusaka Province of Zambia. Understanding these factors would inform targeted interventions to improve vaccine coverage in this vulnerable population.

Methodology

Study Design and Population

A cross-sectional study was conducted in Chongwe district of Lusaka Province in Zambia. The study population were people living with HIV (ART clients) aged 12 years and above (12+ years) accessing ART services in Chongwe eight high volume health facilities (Chainda RHC, Chongwe RHC, Chalimbana RHC, Kanakantapa RHC, Lwimba RHC, Kasisi RHC, Chongwe Hospital and Ngwerere RHC) vaccinated or not vaccinated against COVID-19 between 2021 April and 2022 December in Chongwe district [26]. The people living with HIV on ART treatment (Tx-Curr) in Chongwe district stood at 19000 according to the health management information system [21, 4]. The study participants that were included in the study met a pre-defined eligibility criterion.

Eligibility Criteria

Inclusion Criteria- ART

- Clients aged 12 years and above who have been on ART for more than one month both vaccinated and un-vaccinated from the eight health facilities [26].

Exclusion Criteria

- ART clients aged 12 years and above who are lost to follow up (LTFU), stopped/discontinued ART and clients who have Died.
- ART clients aged 12 years and above with incomplete and missing information in SmartCare.

Sampling and Sample Size

The sample size for this study was 537 People living with HIV accessing ART services from the eight high volume health facilities in Chongwe district between April 2021 to December 2022 [26]. The appropriate sample size was calculated using the formula for cross-sectional studies. The prevalence sample size formula

= [Z2 (1 −)]/2

Where: the following parameters mean

P = proportion of the ART clients vaccinated was assumed at 43% (Prevalence calculated from proportion of ART clients vaccinated against COVID 19 in Chongwe district: source SmartCare).

= standard normal deviate set at 1.96 corresponding to 95% Confidence Interval value;

=5% margin of error (0.05)

n=desired total sample size

n =1.962×0.43(1-0.43)/0.052

=488

By considering 10% non-response, therefore the desired sample size was 537 study participants.

Sampling Technique

The SMARTCARE database was used as the sampling frame. A two staged Cluster sampling was used in this study. The eight 8 facilities were selected purposively based on high volume status in-terms of catchment population and number of people Accessing ART service. The eight facilities were then treated as clusters. The population sizes of Clients on ART in each health facility were different therefore Sampling Proportionate to size was applied to distribute the number of clients who are on ART based on the population size of each cluster.

Flowchart: Sampling Process for the Study

Obtaining ART client list from SmartCare (Total N=19000 clients in Chongwe district by 2022)

Total Facilities in Chongwe [29].

Stage 1: Purposive Selection of 8 High-Volume Health Facilities (Clusters)

Table 1: Distribution of Health Facilities purposively sampled

Facility	ART Clients
Chongwe District Hospital	1692
Chainda RHC	594
Chalimbana RHC	681
Chongwe RHC	4389
Lwimba RHC	703
Kasisi RHC	705
Kanakantapa RHC	778
Ngwerere RHC	1801
Total	11343

Stage 2: Sampling Within Each Facility Using Proportionate to Size (PPS)

Table 2: Sample Size Distribution by Health Facility

Facility	ART Clients	Total clients	Proportion	Total sample size	Sample Size per cluster
Chongwe District Hospital	1692	11343	0.149167	537	80
Chainda RHC	594	11343	0.052367	537	28
Chalimbana RHC	681	11343	0.060037	537	32
Chongwe RHC	4389	11343	0.386935	537	208
Lwimba RHC	703	11343	0.061977	537	33
Kasisi RHC	705	11343	0.062153	537	33
Kanakantapa RHC	778	11343	0.068589	537	37
Ngwerere RHC	1801	11343	0.158776	537	85
Total	11343	11343			537

Stage 3: Simple Random Sampling Applied to Select Participants

Stage 4: Final Sample Size = 537 ART Clients randomly selected

Variables and Data Collection

Data collection period was from august 2023 to December 2023. Data was collected using an data extraction form in excel and interviewer-administered questionnaire. Data extraction from SmartCare was conducted first through a SmartCare report called COVID 19 vaccinations report status across all the facilities of interest then the same clients that were extracted were also interviewed through a questionnaire and interviews were conducted physically as well as on phone, at the point of data extraction clients were contacted to get consent for a possible Physical or Phone interview.

Interviewer-administered questionnaire was designed to obtain relevant primary information on the determinants of the COVID 19 vaccinations in ART (such as awareness of vaccinations, knowledge of COVID 19 vaccinations, acknowledgement if IEC was given and if there were any available campaigns to educate the population to improve the coverage of the vaccination). The questionnaire only had closed-ended questions. Closed-ended questions helped to capture specific and guided responses from the participants.

The data extraction form was designed to obtain relevant secondary information on socio-demographic characteristics and the basic client information such as age, marital status, Religion, Level of education, type of profession, income, time spent on ART, Residence, Sex, work experience, Client clinical investigations (CD4 and Viral Load), Comorbidities (hypertension, Diabetes) from SmartCare data base. Data collection was done in the period of five months by the assigned research assistants.

Definition of the Outcome

The outcome variable for this study COVID-19 vaccination uptake was obtained from the national electronic health record system, SmartCare, which captures individual-level health information across health facilities in Zambia. Vaccination uptake was extracted based on documented COVID-19 vaccine administration records within SmartCare. Individuals were categorized as either vaccinated (coded as 1) or not vaccinated (coded as 0), depending on whether at least one dose of a COVID-19 vaccine was recorded in the system at the time of data extraction.

Data Analysis

The raw data collected from the questionnaires and data extraction form was entered into excel and cleaned then exported to STATA statistical software package version 14.0 (STATA™ Corporation, Texas, TX, USA) for analysis. Basic descriptive statistics of study participants was performed to describe the characteristics of the respondents. The main outcome variable, which was uptake of COVID 19 vaccinations among PLWHIV was expressed as a proportion of PLWHIV (ART clients) vaccinated or not vaccinated against COVID 19 and are registered in the SmartCare system.

A Bivariate analysis was performed to assess the possible association between the dependent variable (Uptake of COVID vaccines among ART clients) and the independent variables. Chi-square test was used to determine the associations between the dependent variable (Uptake of COVID vaccines among ART clients) and the various categorical variables after the assumptions of the Chi-square test are met. Statistical significance level was set at $p<0.05$ and 95% confidence interval.

Lastly, in order to determine the determinants of COVID 19 vaccinations among people living with HIV, Logistic regression was used. The outcome variable was uptake of COVID 19 vaccinations among PLWHIV, a binary categorical variable which was coded 1 vaccinated and 0 not vaccinated against COVID 19. Logistic regression was done at adjusted and unadjusted levels. Machine-lead stepwise and investigator-lead stepwise regression were used at adjusted analysis. Multivariable analytical model using multiple logistic regression was used to control for confounding at adjusted analysis and to come up with the final model of predictor variables.

Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) were used to choose the best fit model, of which an investigator-led stepwise regression approach was preferred over a machine-led stepwise method. Variables with the largest p-values above 1 (one) were removed one at a time until only significant variables were left in the final model. The odds ratios together with their 95% confidence interval were reported to explain how the independent variables influence uptake of COVID 19 vaccines among PLWHIV (ART clients). Logistic regression was appropriate for the analysis because the dependent variable was dichotomous. Distribution of data was presented using tables for a better interpretation.

Ethical Consideration

Ethical clearance was obtained from the University of Zambia Biomedical Research Ethics Committee (UNZABREC) (REF. NO. 4372-2023). In addition, approval to conduct the study at the various Health facilities was sought from Chongwe district health office administration. Authorization was also sought from the National Health Research Authority (NHRA) NHRAR-R-1433. Consent was also obtained from the participants before the interviews and Children.

Results

Description of the Study Population

A total of 537 People living with HIV in Chongwe were sample and enrolled in the study. Among the total sample of 537 People living with HIV in Chongwe district, 235 clients (43.76%) were vaccinated against COVID-19, while 302 clients (56.24%) were not vaccinated.

Socio-Demographic Characteristics of Participants

Among the 537 participants enrolled in the study 271(50%) were females and 266 (50%) were males. Moreover, the age distribution of respondents is displayed across nine age groups, with the percentage of respondents increasing from the lowest point in the 12 to 14-year age group (4%) to the highest in the 30-34-year age group (17%), followed by 16% in both the 35-39-year and 40-44-year age groups. Additionally, it is indicated that 53% of respondents are from rural areas of Chongwe, while 47% are from urban areas. In terms of religious affiliation, 89% of respondents identify as Christian, 9% as Muslim, and 2% adhere to other religions.

The majority (50%) of respondents are married, while 30% are single, 14% are divorced, and 6% are widowed. Furthermore, 55% of respondents are not formally employed, while 45% are formally employed. Regarding monthly income levels, 52% of respondents earn between 500 to 1000 kwacha per month, 25% earn above 1000 kwacha, and 24% earn below 500 kwachas. Finally, an insight into the education levels of respondents, reveals that majority (40%) of the PLWHIV had reached primary as the highest education level, 24% never went to school at all, 20% completed grade 12/secondary school and only 16% reached tertiary education (Table 3).

Table 3:Distribution for the Socio-demographic characteristics of the People Living with HIV

Varriable Name	Frequency(N)	Percentage (%)
Sex of the respondents		
Female	271	50.47
Male	266	49.53
Age of respondents		
12-14 years	22	4.1
15-19 years	24	4.47
20-24 years	27	5.03
25-29 Years	66	12.29
30-34 Years	93	17.32
35-39 Years	87	16.2
40-44 Years	88	16.39
45-49 Years	59	10.99
Above 50 Years	71	13.22
Residence		
Rural	284	52.89
Urban	253	47.11
Religion		
Christianity	476	88.64
Islam	50	9.31
Others	11	2.05
Marital Status		
Divorced	75	13.97
Married	270	50.28
Single/Never Married	161	29.98
Widowed	31	5.77
Employment		
Employed	244	45.44
Not Employed	293	54.56
Monthly Income		
Above 1000	133	24.77
Between K500 - K1000	277	51.58
Less than K500	127	23.65
Education Level		
Never gone to school	130	24.21
Primary	213	39.66
Secondary	109	20.3
Tertiary	85	15.83

***source: SmartCare data base Note: n means number, % represents percentage

Relationship Between the Socio-Demographic Characteristics and COVID 19 Vaccinations uptake Among People Living with HIV

This section reveals the relationship between socio-demographic characteristics and COVID-19 vaccination status. In this study it is revealed that the sex of the respondents exhibits a high significant statistical relationship with COVID-19 vaccination uptake, with a P-value of 0.000. Similarly, there is a statistically significant relationship between the age of the respondents and COVID-19 vaccination uptake among people living with HIV, with a P-value of 0.02. It is also demonstrated that there is a statistically significant relationship between the religious beliefs of the respondents and COVID-19 vaccination uptake among PLWHIV, with a P-value of 0.000. Additionally, the findings exhibit a highly statistically significant relationship between the employment status of the respondents and COVID-19 vaccination uptake (P-Value=0.000) (Table 4).

The monthly income of the respondents is shown to have a highly statistically significant relationship with COVID-19 vaccination uptake among PLWHIV (P-value=0.000). Furthermore, There was statistically significant relationship found between the education level of the respondents and COVID-19 vaccination uptake among PLWHIV (P-value=0.000). Lastly, the results shows that there is no statistically significant relationship between marital status of respondents (P-value = 0.149) and residence of respondents (P-value = 0.632) with COVID-19 vaccination uptake among people living with HIV (PLWHIV) (Table 4).

Table 4: Chi-square Analysis of Socio-Demographic Characteristics and COVID 19 Vaccinations Uptake Among PLWHIV.

Socio-demographic Characteristics	COVID 19 vaccination Uptake among PLWHIV		P-Value
	Vaccinated (%)	Not Vaccinated (%)	
SEX of Respondents			0.000*
Female	54.98	45.02	
Male	32.33	67.67	
Age of the Respondents			0.021*
12-14 years	18.18	81.82	
15-19 years	20.83	79.17	
20-24 years	44.44	55.56	
25-29 Years	56.06	43.94	
30-34 Years	50.54	49.46	
35-39 Years	37.93	62.07	
40-44 Years	45.45	54.55	
45-49 Years	44.07	55.03	
50 +Years	43.66	56.93	
Residence			0.149
Rural	40.85	59.15	
Urban	47.04	52.96	
Religion			0.000*
Christianity	47.27	52.793	
Islam	14	86	
Others	21.27	72.73	
Marital Status			0.632
Divorced	49.33	50.67	
Married	41.48	58.52	
Single/Never Married	45.34	54.66	
Widowed	41.94	58.06	
Employment			0.000*
Employed	29.1	70.9	
Not Employed	55.97	44.03	
Monthly Income			0.000*
Above 1000	21.05	78.95	
Between K500 - K1000	51.62	48.38	
Less than K500	50.39	49.61	
Education Level			
Never gone to school	61.54	38.46	0.000*
Primary	57.7	42.25	
Secondary	15.6	84.4	
Tertiary	17.65	82.35	

***** %= Percentage, C = Chi square test, * = statistically significant at *P<0.05,

Clinical Related Characteristics and COVID 19 Vaccinations Uptake Among PLWHIV

This results in this section depicts the relationship between clinical characteristics and COVID-19 vaccination uptake among PLWHIV. The results shows that the CD4 count of the respondents had a statistically significant relationship with COVID-19 vaccination uptake among PLWHIV (P-Value=0.000). Similarly, the viral load of the respondents exhibited a statistically

significant relationship with COVID vaccination uptake among PLWHIV (P-Value=0.000). Clinical visits also demonstrated a statistically significant relationship with COVID-19 vaccination uptake among PLWHIV (P-Value=0.000) (Table 5).

Additionally, the results reveals a statistically significant relationship between pharmacy pick up visits and COVID-19 vaccination uptake among PLWHIV (P-value=0.000). The duration on ART/years spent on ART had a statistically significant relationship with COVID-19 vaccinations uptake (P-value=0.000). Furthermore, it was highlighted that respondents who have had close relations who were once sick with COVID-19 before exhibited a statistically significant relationship with COVID-19 vaccination uptake among PLWHIV (P-value=0.000). Lastly, the relationship between the history of being sick with COVID-19 before and COVID-19 vaccination uptake was not statistically significant (P-value=0.840) (Table 5).

Table 5: Chi-Square Analysis of Clinical Related Characteristics Influencing COVID 19 Vaccinations Uptake Among PLWHIV

Clinical related Characteristics	COVID 19 vaccination Uptake among PLWHIV		P-Value
	Vaccinated (%)	Not Vaccinated (%)	
CD4 count for Respondents			0.000*
1. Above 500 cell/mm3	83.33	16.67	
2. 200-500 cell/mm3	19.94	80.06	
3. Below 200 cell/mm3	78.49	21.51	
Viral load for respondents			
0.000*			
Suppressed (below 1000)	47.17	52.83	
Unsuppressed (above 1000)	23.38	76.28	
Clinical Visit			0.000*
Missed clinical visit	32.46	67.54	
Did not miss clinical Visit	52.1	47.9	
Pharmacy Pick Up			0.000*
Missed Pharmacy pick up	32	68	
Did not miss Pharmacy pick up	52.24	47.76	
Duration on ART			0.000*
Less than 1 year	25.4	74.6	
1 to 2 years	38.87	61.73	
More than 2 years	50.32	49.68	
Sick of COVID 19 before			
Yes	44.15	55.85	0.840
No	43.28	56.72	
Close relation Sick with COVID 19 before			
Yes	61.46	38.54	0.000*
No	32.83	67.17	

***** %= Percentage, C = Chi square test, * = statistically significant at *P<0.05,

Comorbidities and COVID 19 Vaccinations Uptake Among PLWHIV

This section illustrates the relationship between respondent/client comorbidities and COVID-19 vaccination uptake among people living with HIV. The results indicate that having comorbidities is statistically significant with COVID-19 vaccination uptake among people living with HIV (P-value=0.03). Additionally, the results demonstrate that the types of comorbidities have a statistically significant relationship with COVID-19 vaccination uptake among people living with HIV (P-value=0.042) (Table 6).

Table 6: Chi-square Analysis of Comorbidities and COVID 19 Vaccinations Among PLWHIV

Comorbidities	COVID 19 vaccination uptake among PLWHIV		P-Value
	Vaccinated (%)	Not Vaccinated (%)	
Has comorbidities			
Yes	35.61	64.39	0.030*
No	46.42	53.58	

Comorbidity Type			
Diabetes	36.67	63.33	0.042*
Heart disease	57.14	42.86	
Hypertension	22.22	77.78	
Nothing	46.31	53.69	
Other	39.29	60.71	
Tuberculosis	52.38	47.62	

***** %= Percentage, C = Chi square test, * = statistically significant at *P<0.05,

Facility Related Characteristics and COVID 19 Vaccination Uptake Among People Living with HIV

This section displays the relationship between facility-related characteristics and vaccination uptake among people living with HIV. The results show that there was a statistically significant relationship between understanding of COVID-19 vaccinations and COVID-19 vaccination uptake among people living with HIV (P-value=0.000). Additionally, there was a statistically significant relationship between awareness campaigns conducted about COVID-19 vaccinations and the uptake among people living with HIV (P-value=0.000). Information, Education, and Communication (IEC) provided about COVID-19 vaccination at every point of contact with the client also demonstrated a statistically significant relationship with uptake among people living with HIV (PLWHIV) (P-value=0.000) (Table 7).

Furthermore, the waiting time before a service is offered at a facility was statistically significant with COVID-19 vaccination uptake among PLWHIV (P-value=0.000). Additionally, the quality of service provided exhibits a statistically significant relationship with COVID-19 vaccination uptake among people living with HIV (P-value=0.000). Recommendations about COVID-19 vaccinations given by health personnel was also found to be statistically significant with the uptake among people living with HIV. Lastly, variables such as the category of who provides the IEC (P-value=0.813), drug availability at health facilities (P-value=0.949), and staff attitude at health facilities (P-value=0.654) were found to have no statistically significant relationship with COVID-19 vaccination uptake (Table 7).

Table 7: Relationship Between Health Facility Related Characteristics and People Living with HIV

Comorbidities	COVID 19 vaccination uptake among PLWHIV		P-Value
	Vaccinated (%)	Not Vaccinated (%)	
Understanding of COVID 19 vaccinations			
Has knowledge of the vaccinations	60.22	39.78	0.000*
No knowledge on the vaccinations	6.67	93.33	
Awareness About COVID 19 vaccinations			
Yes	48.2	51.8	0.000*
No	12.12	87.8	
IEC Given			
Yes	48.09	51.91	0.000*
No	13.43	86.57	
Who gives the IEC			
Health professional S	44.35	55.65	0.813
Treatment supporter/c	43.34	56.68	
Waiting Time			
Below 20 minutes	88.60	11.4	0.000*
Between 20 to 40 minutes	28.57	71.43	
Between 40 to 60 minutes	30.74	69.26	
Above 1 hour	33.54	66.46	
Staff Attitude			
Good	44.44	55.56	0.949
Very good	46.48	53.52	
Neutral	45.79	54.21	
Bad	41.67	58.33	

Very bad	42.33	57.67	
Drug Availability			
Yes	42.35	57.65	0.654
No	44.41	55.59	
Quality of service provided			
Satisfied	19.66	80.34	0.000*
Un-satisfied	62.38	37.62	
Recommended by Health personnel			
Yes	61.46	38.54	0.000*
No	32.83	67.17	

***** %= Percentage, C = Chi square test, * = statistically significant at *P<0.05,

Factors Associated with COVID-19 Vaccine Uptake Among People living with HIV

Influence of Socio-Demographic Characteristics on COVID 19 Vaccination Uptake Among People Living with HIV

The results in the table below shows the odds ratios from logistics regression models at unadjusted and adjusted analysis. Taking COVID 19 vaccination uptake among people living with HIV as the outcome variable. Logistic regression results for determinants of COVID 19 vaccinations uptake among people living with HIV. At unadjusted level sex, age categories (except 15-19, 20-24 and 35-39 years), employment, monthly income, education level (except for primary education) had a statistically significant association with COVID 19 vaccination uptake (Table 8).

At adjusted level for socio-demographic characteristics, four variables made it to the final model. These were sex of the respondents, religion of the respondents, Monthly income and education level. People living with HIV who earn their monthly income between 500 to 1000 Kwacha had 2.666 times higher odds of influencing COVID 19 vaccination uptake among people living with HIV (OR 2.666; 95% CI 1.294-5.494) and this was statistically significant at P-value = 0.01. Similarly, people who had monthly income above 1000 kwacha had higher odds of influencing COVID 19 vaccination uptake among people living with HIV (PLWHIV) (OR 4.061; 95% CI 1.751-9.421) and the P-value=0.001. The Reported sex of the respondents, religion of the respondents, and educational level are the other three variables that were part of the best fit model for multiple regression, even though their effect on COVID 19 vaccinations among people living with HIV was not statistically significant (Table 8).

Table 8: Un-adjusted and Adjusted Logistic Regression of Socio-Demographic Characteristics and COVID 19 Vaccination Uptake Among PLWHIV

Variable name	Unadjusted Odds Ratio model 1			Adjusted Odds Ratio Model 2		
	OR	95% CI	P-value	OR	95% CI	P-Value
Sex of Respondents						
Female	1		0.000*	1		
Male	0.398	0.281-0.567		0.680	0.397-1.164	0.160
Age of the Respondents						
12-14 years	1					
15-19 years	1.184	0.274-5.121	0.821			
20-24 years	3.5999	0.959-13.515	0.058			
25-29 Years	5.741371	1.751-18.825	0.004*			
30-34 Years	4.597819	1.445-14.625	0.010*			
35-39 Years	2.749996	0.856-8.832	0.089			
40-44 Years	3.749995	1.173-11.984	0.026*			
45-49 Years	3.545449	1.069-11.761	0.039*			
50+ Years	3.487495	1.071-11.356	0.038*			
Residence						
Rural	1					
Urban	1.286155	0.914-1.811	0.149			
Religion						
Others	1			1		

Christianity	2.390	0.627-9.120	0.202	1.177	0.220-6.302	0.849
Islam	0.434	0.092-2.043	0.291	0.556	0.080-3.888	0.555
Marital Status						
Single/Never Married	1					
Married	0.854	0.577 -1.267	0.434			
Divorced	1.174	0.678-2.032	0.567			
Widowed	0.871	0.400-1.895	0.727			
Employment						
Employed	1					
Not Employed	3.098	2.161-4.440	0.000*			
Monthly Income						
Less than K500	1			1		
Between K500 - K1000	4.002	2.479-6.460	0.000*	2.666	1.294-5.494	0.008*
Above 1000	3.810	2.213-6.556	0.000*	4.061	1.751-9.421	0.001*
Education Level						
Never gone to school	1			1		
Primary	0.854	0.547-1.334	0.488	1.2106	0.631-2.324	0.566
Secondary	0.115	0.062-0.216	0.000*	0.577	0.237-1.406	0.226
Tertiary	0.134	0.069-0.259	0.000*	0.558	0.234-1.333	0.189

*****Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-1 Reference Category 50+=50 years and above

Influence of Clinical Related Characteristics on COVID 19 Vaccination Uptake Among PLWHIV

The results under this section present the impact of clinical characteristics on COVID-19 vaccination uptake among people living with HIV (PLWHIV), with vaccination uptake serving as the outcome variable. It outlines the logistic regression findings that identify the determinants of COVID-19 vaccination uptake in this population (Table 7).

At the unadjusted level, factors such as CD4 count, viral load, clinical visits, pharmacy pickups, duration on ART (more than 2 years), and having a close relation with a history of COVID-19 illness were significantly associated with COVID-19 vaccination uptake. Specifically, individuals with an unsuppressed viral load were less likely to influence vaccination uptake (OR 0.342; 95% CI 0.195-0.597, P-value=0.000). Those who missed clinical visits (OR 2.264; 95% CI 1.586-3.232, P-value=0.000) or pharmacy pickups (OR 2.235; 95% CI 1.626-3.324, P-value=0.000) had higher odds of influencing vaccination uptake. Additionally, clients on ART for more than 2 years (OR 2.975; 95% CI 1.618-5.471, P-value=0.000) and those with close relations who were previously sick with COVID-19 (OR 0.306; 95% CI 0.213-0.440, P-value=0.000) showed significant associations with vaccination uptake at the unadjusted stage (Table 9).

At the adjusted level, variables such as CD4 count, viral load, clinical visits, and pharmacy pickups were included in the final model. Clients with a CD4 count between 200-500 cells/mm^3 had significantly lower odds of COVID-19 vaccination uptake compared to those with a CD4 count above 500 cells/mm^3 (OR 0.156; 95% CI 0.042-0.582, P-value=0.006). Those with an unsuppressed viral load had 0.251 times lower odds of influencing COVID-19 vaccination uptake (OR 0.251; 95% CI 0.112-0.5657, P-value=0.001). Furthermore, clients who did not miss clinical visits (OR 1.258; 95% CI 1.036-3.389, P-value=0.006) and those who did not miss pharmacy pickups (OR 2.752; 95% CI 1.527-3.660, P-value=0.004) had higher odds of being vaccinated against COVID 19 and this was part of the best fit model for multiple logistic regression and their effects on COVID-19 vaccination uptake were -statistically significant (Table 9).

Table 9: Un-Adjusted and Adjusted Logistic Regression of Clinical Related Characteristics and COVID 19 Vaccination Uptake Among PLWHIV.

Variable name	Unadjusted Odds Ratio model 1			Adjusted Odds Ratio Model 2		
	OR	95% CI	P-value	OR	95% CI	P-Value
CD4 count for Respondents						
1. Above 500 cell/mm3	1			1		
2. 200-500 cell/mm3	0.050	0.018-0 .135	0.000*	0.156	0.042-0.582	0.006*
3. Below 200 cell/mm3	0.730	0.263-2.028	0.546	0.857	0.236-3.109	0.815
Viral load for respondents						
Suppressed (below 1000)	1			1		
Unsuppressed (above 1000)	0.342	0.195-0.597	0.000*	0.251	0.112-0.566	0.001*

Clinical Visit						
Missed clinical visit	1			1		
Did not miss clinical visit	2.2638	1.586-3.232	0.000*	1.258	0.113-1.389	0.006*
Pharmacy Pick Up						
Missed Pharmacy pick up	1			1		
Did not miss Pharmacy pick up	2.325	1.626-3.324	0.000*	2.752	1.527-3.660	0.004*
Duration on ART						
Less than 1 year	1					
1 to 2 years	1.821	0.951-3.488	0.071			
More than 2 years	2.975	1.618-5.471	0.000*			
Sick with Covid 19 Before						
Yes	1					
No	0.965	0 .685-1.360	0.840			
Close relation Sick with COVID 19 before						
Yes	1					
No	0.3064	0.213-0.440	0.000*			

*****Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-1 Reference Category

Comorbidities and COVID 19 Vaccination Uptake Among PLWHIV

The results under this section present the impact of comorbidities on COVID-19 vaccination uptake among people living with HIV, with the latter serving as the outcome variable. The logistic regression analysis identified determinants of COVID-19 vaccination uptake within this group (Table 10).

At unadjusted level, the presence of comorbidities and specifically hypertension were significantly associated with COVID-19 vaccination uptake among people living with HIV. The results from this study indicated that individuals without comorbidities were 1.567 times more likely to receive a COVID-19 vaccine, a finding that was statistically significant (P-value=0.030; 95% CI: 1.044-2.352). Furthermore, at this level, individuals with hypertension were less likely to be vaccinated against COVID-19 (OR 0.331; 95% CI: 0.160-0.687), with a P-value of 0.003.

At the adjusted stage, the only variable that remained significant was the presence of comorbidities, whereas specific types of comorbidities did not reach the final model. According to Table 11, individuals without comorbidity had higher odds of being vaccinated against COVID-19 (OR 1.347; 95% CI: 0.174-1.692), with a statistically significant P-value of 0.003 (Table 10).

Table 10: Un-Adjusted and Adjusted Logistic Regression of Comorbidities and COVID 19 Vaccination Uptake

Variable Name	Unadjusted Odds Ratio			Adjusted Odds Ratio Model 2		
	OR	95% CI	P-value	OR	95% CI	P-Value
Has comorbidities						
Yes	1					
No	1.567	1.044-2.352	0.030	1.3469	0.174-0.692	0.003
Cormobidity Type						
Nothing	1					
Heart disease	1.546	0.342-6.996	0.578			
Hypertension	0.331	0.160-0.687	0.003			
Diabetes	0.671	0.312-1.447	0.309			
Other	1.276	0.530-3.070	0.587			
Tuberclosis	0.750	0.343-1.642	0.472			

*****Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-1 Reference Category

Influence of Health Facility Related Characteristics on COVID 19 Vaccination

Status Among People Living with HIV

The results illustrate the impact of various comorbidities on COVID-19 vaccination uptake among individuals living with HIV. Considering the uptake of COVID-19 vaccinations among this population as the outcome variable, the logistic regression findings for the determinants of COVID-19 vaccination uptake are presented. At the unadjusted level, factors such as understanding of COVID-19, awareness of COVID-19 vaccinations,

Information, Education, and Communication (IEC) provided, waiting time, and satisfaction with the service had a statistically significant relationship with the uptake of COVID-19 vaccinations among people living with HIV. However, all these variables had lower odds of influencing COVID-19 vaccination uptake among people living with HIV, except for un-satisfaction with the service provided, which had higher odds of influence (OR 6.7757: 95% CI 4.553-10.082), with a P-value of 0.000 (Table 11).

At the adjusted stage/level, variables like understanding of COVID-19, awareness about COVID-19 vaccinations, IEC provided, the provider of IEC, waiting time, and quality of service/satisfaction with service made it to the final model. The results indicate that clients who understood or were knowledgeable about COVID-19 vaccinations had higher odds of uptake compared to those who did not understand (OR 1.125: 95% CI 1.052-2.299), with a statistically significant association (P-value=0.000). Similarly, clients aware of the COVID-19 vaccinations had higher odds of uptake among people living with HIV (OR 2.021: 95% CI 1.001-3.652), with a P-value of 0.028 (Table 11).

Clients who reported receiving IEC had higher odds of influencing COVID-19 vaccination uptake (OR 4.366: 95% CI 1.869-5.297), with a statistically significant association (P-value=0.006). Categories related to waiting time showed lower odds of influencing vaccination uptake: 20 to 40 minutes (OR 0.123: 95% CI 0.028-0.538) with a P-value of 0.005, 40 to 60 minutes (OR 0.225: 95% CI 0.085-0.5967) with a P-value of 0.003, and above 1 hour (OR 0.225: 95% CI 0.071-0.507) with a P-value of 0.001. The table also indicates that clients unsatisfied with the services offered had higher odds of influencing COVID-19 vaccination uptake among people living with HIV (OR 2.444: 95% CI 1.390-4.298), with a statistically significant association (P-value=0.002) as compared to those that were satisfied with the service (Table 11).

Table 11: Unadjusted and Adjusted Analysis of the Logistic Regression for Health-Related Characteristics on COVID 19 Vaccination Uptake Among PLWHIV

Variable Name	Unadjusted Odds Ratio			Adjusted Odds Ratio Model 2		
	OR	95% CI	P-value	OR	95% CI	P-Value
Understanding of COVID 19 vaccinations						
Does not have knowledge on the vaccinations	1			1		
Has knowledge of the vaccinations	1.147	0.025-1.190	0.000*	1.125	1.052-2.299	0.000*
Awareness About COVID 19 vaccinations						
No	1			1		
Yes	2.148	0.069-0.317	0.000	2.021	1.001-3.652	0.028*
IEC Given						
No IEC given	1			1		
Yes IEC given	2.168	0.081-3.346	0.000	4.368	1.869-5.297	0.006*
Who gives the IEC						
Health professional S	1			1		
Treatment supporter/c	0.959	0.679-1.354	0.813	0.683	0.402-1.163	0.160
Waiting Time						
Below 20 minutes	1			1		
Between 20 to 40 minutes	0.051	0.019- 0.140	0.000*	0.123	0.028-0.538	0.005*
Between 40 to 60 minutes	0.057	0.030-0.108	0.000*	0.225	0.085-0.597	0.003*
Above 1 hour	0.065	0.034-0.126	0.000*	0.190	0.071-0.507	0.001*
Staff Attitude						
Very good	1					
good	0.921	0.477-1.780	0.807			
Neutral	0.953	0.521-1.742	0.876			
Bad	0.850	0.440-1.641	0.628			
Very bad	0.845	0.493-1.449	0.541			
Drug Availability						
Yes	1					
No	1.0875	0.753-1.570	0.654			

Satisfaction with service provided						
Satisfied	1			1		
Un-satisfied	6.7757	4.553-10.082	0.000*	2.444	1.390-4.298	0.002*

*****Sig at *P<0.05 Odds Ratios, CI-Confidence Interval, RC-1 Reference Category

Discussion of Findings

The aim of this research was to investigate the determinants of COVID 19 vaccination uptake among people living with HIV in Chongwe, Lusaka Province of Zambia. The study provides an op¬portunity for future research, as well as efforts focused on reducing the spread of COVID 19 pandemic especially among People living with HIV.

Socio-Demographic characteristics and Vaccination Uptake Among People Living with HIV

In this study the findings revealed that people living with HIV who earn higher monthly income levels (above 500 kwacha) are more likely to get vaccinated against COVID-19. PLWHIV earning higher incomes are more likely to get vaccinated as compared to the PLWHIV with low incomes this might be due to the fact that People with higher incomes often have better access to healthcare services, including vaccination clinics and information about COVID-19 vaccines as compared to people who earn less. This heightened access can lead to greater awareness of the importance of vaccination and easier logistical arrangements to receive the vaccine. Moreover, higher-income individuals may perceive the potential consequences of COVID-19 infection, such as medical expenses or lost income due to illness, as more significant, thereby motivating them to get vaccinated to safeguard their health and financial well-being.

These findings are consistent with the notably, two US studies conducted in the general Population [30]. Found that as reported income increased, so did the proportion of people who received vaccination, ranging from 15.4% (14.6–16.2) among those with an income of < 25,000$ to 33.0% (32.2–33.8) for those with an income of ≥ 200,000$ the more the income the more likely. While (14) reported odds ratios of respondent level data and noted that participants with an income of <25,000$ had significantly lower odds of having been vaccinated with at least one vaccine dose (OR = 0.67, $p < 0.05$), (14). Lower odds were also noted for those within the 25,000–34,999$ (OR = 0.81, $p < 0.05$) and 35,000–49,999$ (OR = 0.87, $p < 0.05$) income range.

Additionally, found that financial well-being independently contributes to vaccine uptake, with individuals with high incomes being more willing to be vaccinated than those with low incomes [25]. However, this correlation may be influenced by other respondent characteristics, particularly their level of education.

Clinical Characteristics and COVID 19 Vaccinations Uptake

The findings of this current study indicate that individuals with a CD4 count between 200-500 cells/mm3 had positively significantly relationship with vaccine uptake but had less odds to influence uptake of COVID-19 vaccinations among people living with HIV compared to those with a CD4 count above 500 cells/mm3 who had higher odds of influencing COVID 19 vaccine uptake, meaning individuals with CD4 count between 200-500 cells have less influence on the uptake of COVID 19 vaccinations. This might be due to the fact that Individuals with lower CD4 counts may be dealing with more immediate health concerns related to their HIV status, such as managing opportunistic infections or other complications. As a result, vaccination against COVID-19 might not be perceived as a top priority compared to addressing their primary health needs.

Those with lower CD4 counts may perceive themselves to be at lower risk of severe illness from COVID-19 compared to individuals with higher CD4 counts or those with other underlying health conditions. This perception could lead to decreased motivation to seek out vaccination. This finding from the study is backed by a study conducted by who found that Higher COVID-19 vaccine hesitancy was associated with, lower CD4+ T cell counts [31]. Lower CD4+ T cell counts, was associated with a lower vaccination rate. When compared to vaccinated participants, those who were not hesitant but nevertheless unvaccinated had a higher presence of lower CD4+ T cell count.

Findings from this current study also indicates that individuals with unsuppressed viral load are significantly less likely to influence COVID-19 vaccinations among people living with HIV compared to those with a suppressed viral load if though with a positive association. This might be due to the fact that Individuals with unsuppressed viral loads may already be dealing with complex healthcare needs related to their HIV status. They may prioritize managing their HIV and associated complications over seeking out or receiving COVID-19 vaccination. There may be a perception among individuals with unsuppressed viral loads that they are already at increased risk of health complications due to their HIV status, leading them to underestimate the additional risk posed by COVID-19. This perception could decrease their motivation to seek out vaccination. This is backed by a South African study conducted by who found that vaccine uptake was higher among PLHIV with evidence of viral suppression and clinic attendance in the past 6–12 months, compared to those with poor adherence or unsuppressed viral load [32].

The findings from this current study further suggests that individuals who did not miss clinical visits are positively associated with higher chances of COVID-19 vaccination uptake among people living with HIV meaning people who do not miss clinical visits are more likely to get vaccinated as compared to the people who miss clinical visits. This is due to a fact Individuals who attend clinical visits regularly are more likely to have established relationships with healthcare providers. These relationships may foster trust and confidence in the healthcare system and its recommendations, including the recommendation to receive COVID-19 vaccination. Clinical visits provide opportunities for healthcare providers to educate patients about preventive health measures, including the importance of vaccination. Individuals who attend clinical visits regularly may have better access to accurate information about COVID-19 vaccines and be more informed about their benefits and safety. Healthcare facili-

ties often offer vaccination services during clinical visits or have mechanisms in place to facilitate vaccine uptake among patients. Individuals who attend clinical visits regularly are more likely to be offered vaccination opportunities and may find it more convenient to receive the vaccine during these visits.

The findings also indicate that individuals who did not miss pharmacy pick up had significantly positively associated higher odds of influencing COVID-19 vaccination uptake among PLWHIV compared to those who did miss pharmacy pick up. Meaning PLWHIV who don't miss pharmacy uptake are more likely to get vaccinations as compared to people who miss pharmacy pick-ups. This might be due to the fact that Individuals who consistently pick up their medications from the pharmacy may demonstrate a higher level of adherence to their HIV treatment regimen. This adherence behaviour could extend to other aspects of their healthcare, including vaccination uptake. Regularly picking up medications from the pharmacy may indicate a pattern of consistent engagement with healthcare services. These individuals may have more frequent interactions with healthcare providers, providing more opportunities for discussions about COVID-19 vaccination and encouragement to get vaccinated.

Comorbidities and COVID 19 Vaccination Uptake

The findings in this study revealed that not having comorbidities was found to be associated with COVID-19 vaccination uptake among people living with HIV, with individuals without comorbidities was positively associated with higher odds of getting vaccine uptake as compared to those with comorbidities. This might be due to the fact that Individuals with comorbidities may have personally experienced the impact of their underlying health conditions on their vulnerability to infectious diseases. People with comorbidities (for example diabetes, hypertension) might fear vaccine side effects more as compared to those without comorbidities, especially if they think the vaccine could worsen their existing condition or interact with their medications. These findings are in line with the findings of the study conducted by who found that that higher COVID-19 vaccine hesitancy was associated with chronic diseases [31].

This is however in contradiction with the study conducted by who found that having a history of comorbidities are associated with higher COVID-19 vaccine acceptance. also found that, the intention to take covid-19 vaccine among HIV-positive patients was 33.7%. the probability of PLWHIV to take covid-19 vaccine was two (aor = 2 (1.08-3.44)) times higher among those who have been diagnosed with chronic diseases as compared with those who have not been diagnosed [33, 34].

The overall intention to receive the COVID-19 vaccine among PLWHA is low. Therefore, there is a need to improve the intention to receive the COVID-19 vaccine among HIV-positive patients to achieve the 2021 goal of Ethiopia for 20% of the population vaccination. Patients with chronic illness, knowledge of the COVID-19 vaccine, and sex were factors associated with the intention to receive COVID-19 vaccine.

Facility Related Factors and COVID 19 Vaccination Uptake

The findings from this study reveals that having an understanding or knowledge about COVID-19 vaccinations was positively associated with higher COVID-19 vaccination uptake compared to those who had poor knowledge about COVID-19 vaccinations. This finding underscores the importance of education and awareness campaigns in promoting vaccination uptake, as individuals who are informed about the benefits and safety of vaccinations are more likely to get vaccinated.

This is in line with a study by who found that the odds of intention to take the COVID-19 vaccine were higher among those participants who had good knowledge of COVID-19 practice compared with those who had poor knowledge [34]. Furthermore, found that patients having good knowledge and practice towards COVID-19 preventive measures were more likely to receive the vaccine compared to their counterparts who didn't [34]. The author also assessed that the patients who had good knowledge of COVID-19 preventive practice were highly intended to receive the vaccine compared with those who had poor knowledge.

The findings for this current study further found that being aware of COVID-19 vaccinations is Positively associated with higher odds of COVID-19 vaccination uptake among people living with HIV. This finding underscores the importance of education and awareness campaigns in promoting vaccination uptake, as individuals who are informed about the benefits and safety of vaccinations are more likely to get vaccinated. Data suggests that clients who are aware of COVID-19 vaccinations have higher chances of COVID-19 vaccination uptake among people living with HIV. This is similar to the study done by the author recommends empowering an educational intervention about the COVID-19 vaccine [35]. On top of that, vaccine campaigns should be started to deliver adequate insights about the importance of the COVID-19 vaccine, especially in immune-compromised patients. According to in order to control and prevent the spread of COVID-19, people must have adequate knowledge, a positive attitude, and practice basic preventive procedures towards the disease [36].

The findings for this current study suggested that there is a Positively associated higher odds between receiving IEC and COVID-19 vaccination uptake among people living with HIV. Individuals who reported receiving IEC had positively higher chances of influencing COVID-19 vaccination uptake compared to those who did not receive IEC. This finding underscores the importance of information and education campaigns in promoting vaccination uptake among this population. This is in line with a KAP study conducted by who recommended that in order to control and prevent the spread of COVID-19, people must have adequate knowledge, a positive attitude, and practice basic preventive procedures towards the disease [36].

The findings of this study indicated that waiting time experienced at a facility had negative influence on COVID-19 vaccination uptake among people living with HIV. This might be due to the fact that the relationship between waiting time at healthcare facilities and COVID-19 vaccinations among PLWHIV is complex and influenced by various factors related to accessibility, patient satisfaction, trust in healthcare providers, healthcare system capacity, health literacy, and community support. Addressing barriers related to waiting times and enhancing vaccination services' accessibility and quality can contribute to improving vaccination uptake among PLWHIV.

Lastly, under the facility-related factors, the findings for this study suggested that Unsatisfied clients are more likely to positively influence vaccination uptake. This counterintuitive result might indicate that dissatisfaction with general facility services does not necessarily deter vaccine uptake. In fact, it could reflect heightened health awareness or vigilance among these clients perhaps their dissatisfaction stems from being more health-conscious, critical, or proactive in seeking care. These individuals might also be more engaged or assertive in making independent decisions about their health, including getting vaccinated as compared to the satisfied.

Study Conclusion

This study identified several key determinants that significantly positively influence COVID-19 vaccination uptake among people living with HIV (PLWHIV). Notable among these were higher income levels, consistent clinical attendance/visit, consistent pharmacy pick-ups, absence of comorbidities, adequate knowledge of COVID-19 vaccination, exposure to vaccination awareness campaigns, provision of information, education and communication (IEC) materials, and satisfaction with health facility services.

Importantly, the findings suggest that while some clinical and socio-demographic characteristics play a role, information and knowledge about COVID 19 vaccinations appear to have a more substantial impact on vaccination uptake among PLWHIV. This underscores the critical importance of the healthcare environment in shaping vaccine-related behaviors and decisions. These insights have important implications for public health policy and programming. Interventions aiming to increase COVID-19 vaccination coverage in this population should extend beyond addressing individual-level clinical or socio-economic barriers. Instead, they should prioritize strengthening health facility-based services thereby improving the quality of care, patient-provider communication, and accessibility of vaccination services.

To enhance vaccine uptake among PLWHIV in Zambia, targeted strategies are needed. These may include tailored outreach and education campaigns, addressing vaccine-related misinformation, building trust in health systems, and ensuring that vaccination services are both accessible and responsive to the unique needs of PLWHIV. By implementing these approaches, it is possible to improve COVID-19 vaccine uptake among PLWHIV, reduce their risk of severe disease outcomes, and contribute to the broader goal of pandemic control within this vulnerable population [37-44].

Study Strengths and Limitations

The Strengths that Where in this Study Include

The study specifically focused on people living with HIV (PLWHIV) which provided valuable insights into how this specific group responds to COVID-19 vaccination, considering their unique health challenges and potential immunocompromised status.

The use of SmartCare as ssecondary data collection minimized recall bias and reporting errors, as the data is recorded by healthcare professionals at the time of patient visits.

The use of both Secondary and primary data helped in gathering direct feedback from PLHIV which helped to understand their specific needs and concerns, allowing for more patient-centered approaches in vaccination campaigns and healthcare services.
SmartCare provided comprehensive data: SmartCare likely contains extensive and detailed health records, providing a rich dataset for analysis. This included demographics, clinical history, laboratory results, medication records, and vaccination status.

However, the Study had Some Potential Limitations Worth Noting.

Firstly, the potential study limitations for the study included: Firstly, the timing of data collection in relation to vaccine rollout and the changing coverage made study outcomes different to what was on the ground by the time the report was done. The coverage of COVID 19 Vaccination in ART changed overtime due to campaigns earmarked to raise the coverage.

Generalizability: Findings from a study conducted within the SMARTCARE program might not be generalizable to broader populations of individuals receiving ART. Factors such as demographics, access to healthcare, and comorbidities could vary among different populations, influencing of COVID-19 vaccine uptake.

Incomplete or missing information in some records from SmartCare data made the ability to analyze outcomes effectively difficult. This is because quality of secondary data collected in SmartCare may vary, as it relies on accurate and consistent entry by healthcare providers.

The uptake of Covid 19 vaccines among ART clients on treatment was based on the ART client's available data in the SmartCare system. This somewhat resulted in an underestimation of the uptake, as what was in SmartCare would have been taken as the only clients on treatment who had been vaccinated against COVID 19. To lessen this, all the clients who were on ART in different facilities were being called to verify if they had been vaccinated or not. In addition, the respondents were asked to be truthful as the information they provided would have been used to plan future interventions for the COVID 19 vaccinations among ART clients.

Researcher did not have control over how and why the data was originally collected, which introduced inconsistencies and limited the scope of the analysis.

Declarations

Ethical Approval and Consent to Participate

Ethical clearance was also obtained from the University of Zambia Biomedical Research Ethics Committee (UNZABREC). In addition, approval to conduct the study at the various Health facilities was sought from Chongwe district health office administration. Authorization was also sought from the National Health Research Authority (NHRA). For individuals aged 18 years and above, written informed consent was obtained while for those aged 10 to 17 years, assent, as well as parental informed consent, were obtained before taking part in the Study. In order to ensure distributive justice, all trained health personnel working and handling PLWHIV through ART services in the eight health facilities in Chongwe were consulted under the study to facilitate interviews with ART clients.

Consent for Publication
Not applicable

Availability of Data and Materials
The dataset analyzed during the current study is available in STATA dta Lusaka Zambia, and a do file is available

Competing Interests
The authors declare that they have no competing interests.

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Author' Contributions
ECK was involved in the conceptualization, data curation, data analysis, and drafting of the manuscript under the supervision of RLN and THN were involved in the conceptualization of the study. RLN and THN, were involved in the conceptualization of the study, reviewing, and editing of the manuscript. AS was involved in data curation and data analysis. All the authors read and approved the final manuscript.

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Authors' Information
This research was part of a thesis for ECK who was pursuing a Master of Public health in Population studies and global health from the University of Zambia, School of Public Health, Department of Population studies and global health.

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