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Factors associated with anti-retroviral therapy (ART) adherence among adult people living with HIV (PLWH): A 5-year retrospective multi-centre study in Kumasi, Ghana

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ABSTRACT

Background: Combined antiretroviral therapy (cART) is the recommended treatment regimen for people living with HIV (PLWH). Long-term HIV treatment of over 95% adherence inhibits increase in viral load and boosts immune system performance. On the contrary, non-adherence results in treatment failure, accelerated development of HIV drug-resistance and increased mortality. However, there is paucity of data on the prevalence of antiretroviral therapy (ART) adherence and its associated factors in Ghana. We assessed the prevalence, sociodemographic and clinical factors associated with ART adherence among registered PLWH.

Methods: In a multi-centre hospital-based retrospective study, we collected data on 720 registered PLWH 18 years and above, who attend the HIV clinic at the University Hospital (KNUST), Komfo Anokye Teaching Hospital (KATH), and the Bomso Clinic, on ART and with up-to-date medical records. They were enrolled using a multistage sampling technique. Adherence was assessed retrospectively using missed doses and prescriptions renewal. All analysis were done using SPSS Version 26.0 and GraphPad prism version 8.0.

Results: Of 720 registered PLWH, 51.8% had good ART adherence, 35.3% had fair ART adherence and 12.9% had poor ART adherence. Those diagnosed at WHO stage II (aOR = 0.45, 95% CI: (0.30-0.68); $p < 0.0001$) and stage III (aOR = 0.40, 95% CI: (0.27-0.59) < 0.0001) were independently associated with lower chances of good adherence to ART. Moreover, those treated with AZT/3TC/EFV (aOR = 0.33, 95% CI: (0.16-0.68); $p = 0.0030$), and AZT/3TC/NVP (aOR = 0.50, 95% CI: (0.26-0.98); $p = 0.0410$) were independently associated with lower likelihood of good ART adherence. On the contrary, PLWH who have been on treatment for 4 years (aOR = 3.56, 95% CI: (1.10-11.54); $p = 0.0340$) was an independent predictor of good ART adherence.

Conclusion: About half of PLWH on treatment have good adherence to ART. Being diagnosed at WHO stage II and stage III, being treated with AZT/3TC/EFV, and AZT/3TC/NVP ART combination are associated with lesser chances of good ART adherence. However, increased duration of ART among PLWH influence good ART adherence. PLWH on ART should be monitored to achieve over 95% ART adherence for effective management of HIV/AIDS.

Abbreviations: WHO, World health organization; HIV, Human immunodeficiency virus; PLWH, People living with HIV (PLWH); cART, Combined antiretroviral therapy; ART, Antiretroviral therapy; ARV, Antiretroviral; NNRTIs, Non-nucleoside reverse transcriptase inhibitors; AZT/3TC/EFV, Zidovudine/ Lamivudine/Efavirenz; AZT/3TC/NVP, Zidovudine/ Lamivudine/ Nevirapine; DTG, Dolutegravir.

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1. Introduction

Human Immunodeficiency Virus (HIV) continues to be a global cause of morbidity and mortality [1]. Globally, over 38 million people are living with HIV, with majority of incidence occurring in developing countries [2]. In Ghana, about 346,120 people are living with HIV (PLWH) and an estimated 13,616 have AIDS–related mortalities [3].

The introduction of anti-retroviral therapy (ART) has improved the quality of life of PLWH globally. ART is central to achieving viral suppression and positive health outcomes in HIV-infected individuals. Adherence is defined as a patient's ability to follow a treatment plan, take drugs at prescribed times and frequencies, and follow restrictions regarding food and other medications [4].

Evidence shows that long-term HIV treatment with over 95% adherence rate could reduce viral load augmentation and increase immune system performance [5,6], and also reduce HIV/AIDS-related mortality and morbidity [7]. However, non-adherence may result in treatment failure and even accelerated development of HIV drug-resistance [8], as well as more rapid progression to AIDS [9]. In addition, ART non-adherence poses risk of increased HIV morbidity and mortality thereby hampering achievement of the United Nations' agenda 95-95-95 targets and the eradication of AIDS by 2030. It is expected that 95% of people who are infected with HIV should know their status through testing, of whom 95% should be put on antiretroviral therapy (ART) and 95% of those on medication should achieve viral suppression [10].

Adherence is therefore, a good determinant of the quality of life and survival among people living with HIV (PLWH) [11,12]. Thus, to achieve optimal results from ART, high levels of patient adherence to ART is vital.

In Ghana, first-line, second-line, and third-line ART regimens have been adopted. First-line ART regimen has undergone modifications, thus; Tenofovir (TDF) + Lamivudine (3TC)/ Emtricitabine (FTC) + Efavirenz (EFZ) combination used to be the first line but currently has been changed to TDF + 3TC (or FTC) + Dolutegravir (DTG). Second line ART regimen includes; Zidovudine + Lamivudine (or Emtricitabine) + Lopinavir/r (or Atazanavir/r), with Tenofovir + Lamivudine (or Emtricitabine) + Lopinavir/r (or Atazanavir/r) as an alternative. The second line regimen is used when there is drug intolerance, contraindications or evidence of treatment failure with the first line regimen. This is confirmed by viral load monitoring or immunological function (CD4+ count). For those who have failed second-line treatment, a third-line therapy is recommended, which contains Darunavir/r [13].

Although studies have been conducted among PLWH on ART in order to measure their adherence to ART [14,15].Adherence factors have been related to four dimensions: the patient, the disease, the patient-physician relationship and treatment management [16]. However, despite prior studies on ART adherence, several challenges to adherence still exist, particularly in underdeveloped countries like Ghana where there is paucity of data on the prevalence and factors that influence adherence to ART. It is critical to identify factors that contribute to ART adherence and develop ways to improve HIV management. This study assessed sociodemographic and clinical factors associated with adherence to ART among PLWH enrolled in the HIV clinic at selected hospitals in Ghana.

2. Materials and methods

2.1. Study design

The current study employed a hospital-based retrospective study design and was conducted among PLWH in three-selected hospitals in Kumasi, Ghana. Data on study variables and factors were obtained from participants' medical records. This study collected a 5-year viral load records from registered PLWH on treatments from 2016 to 2020.

2.2. Study site

This study was conducted at the HIV clinics of three selected hospitals namely; Komfo Anokye Teaching Hospital (KATH), the University Hospital, Kwame Nkrumah University of Science and Technology (KNUST) and Bomso Clinic in Kumasi, Ghana. The Komfo Anokye Teaching Hospital (KATH) is the second-largest hospital in Ghana, and the only tertiary health institution in the Ashanti Region. KATH is located at the Bantama submetropolis with over 1200 bed capacity and a well-resourced HIV clinic. KATH HIV clinic is sub-divided into the pediatric (for ages of 0 to 17 years) and adult (for ages of 18 years and above) with 5311 registered adults PLWH on treatment. The University hospital (KNUST) provides health services to the university community and its surroundings with 2133 registered adult PLWH on treatment, and Bomso Clinic is a community-based clinic that renders service to residents of Bomso in the Oforikrom district with 556 registered adults PLWH on treatment.

2.3. Study population

This study included PLWH who regularly attend the HIV clinic of selected hospitals, were 18 years and above of age, on ART and had medical records from January 2016 to December 2020. However, PLWH who did not have up-to-date medical records were excluded from the study.

2.3.1. Sample size calculation

The sample size was calculated from the Cochran formula using prevalence from UNAIDS, 2020 global HIV & AIDS statistics [17]. 720 people living with HIV (PLWH) were recruited in the study.

2.3.2. Sampling technique

In a multistage sampling, stratified proportional and simple random sampling techniques were used to sample study participants from three hospitals in the Kumasi Metropolis. The number of participants selected from each hospital (stratum) was achieved by the stratified proportional sampling. In the stratified proportional sampling, the researcher collated all adult PLWH who were registered by health facilities in the years; 2016, 2017, 2018, 2019 and 2020. This summed up to give a total population (N) of 8000. The required participants selected from hospitals were proportional to size of the eligible registered PLWH in each hospital. Table 1 displays the stratified proportional sampling procedure used to calculate the number of participants selected from each hospital (stratum).

At the three selected hospitals, a simple random sampling technique was used to select study participants. Of 720 participants, 192, 478, 50 were recruited from the University hospital (KNUST), KATH and Bomso clinic respectively (Table 1).

2.4. Ethical consideration

This study was carried out with ethical approval from the Committee on Human Research, Publication and Ethics, School of Medical Sciences, Kwame Nkrumah University of Science and Technology (CHRPE/SMS/KNUST: CHEPE/AP/238/20). Study site approval was also obtained from healthcare management of the respective hospitals before data collection. A detailed explanation of the study protocol and assurance of anonymity was made to the subjects. All methods were carried out in accordance with relevant guidelines and regulations.

2.5. Collection of sociodemographic and clinical data

Medical files of study participants were inspected and information on sociodemographic factors and clinical factors such as gender, age, level of education, religion, occupation and marital status, history of co-infections, opportunistic infections, type of HIV infection, cART regimens, adherence to treatment, and WHO stages of HIV/AIDS were extracted. The date and time patients were diagnosed and started ART were recorded. The duration of which HIV patient has been on ART was also calculated using the date the patient started the ART to the most available current date on treatment. Moreover, medical records were checked for medical adherence taking into consideration number of doses missed, and attendance to HIV clinic.

Table 1
Distribution of study participants according to selected hospitals.

Study site	2016 (Jan–Dec)	2017 (Jan–Dec)	2018 (Jan–Dec)	2019 (Jan–Dec)	2020 (Jan–Dec)	Total (N)	Participants selected ($n = \frac{N}{8000} \times 720$)
University Hospital (KNUST)	338	392	405	485	513	2133	192
KATH	957	997	1063	1246	1048	5311	478
Bomso Clinic	99	101	108	131	117	556	50
TOTAL	1394	1490	1576	1862	1678	8000	720

N-Population size, n- sample size, Data were collected from HIV clinics of selected health facilities from January 2016 to December 2020, University hospital; Kwame Nkrumah University of Science and Technology (KNUST) Hospital, KATH; Komfo Anokye Teaching Hospital.

2.6. Measurement of adherence

Adherence was assessed retrospectively using two measurement tools;

i) Missed doses: Medical records were cross-checked and number of missed doses during the last months recorded by a medical doctor was assigned. In Ghana, PLWH on ART are requested to renew their treatment every month during the follow up appointment at the HIV care clinics at least three days before the end of their previous prescription. Adherence index was calculated by the formula [18];

$$\frac{\textit{Total number of ARV drugs taken}}{\textit{Total number of ARV drugs prescribed}} \times 100$$

Patients with a percentage of intake tablets or capsules equal to or greater than 95% were considered having good adherence and those with less than 95% were considered as having poor adherence

ii) The rate of prescriptions renewed, here expressed as the number of appointments honoured during the participants' years of treatment. Patients who did not fail any appointment were classified as good adherent whilst those who failed any was considered as poor adherent.

The grading of adherence was obtained by summing the outcomes of the two different measurement tools of adherence used in the study. Thus, adherence was classified into three categories namely: good adherence, fair adherence, and poor adherence.

2.6.1. Classification of adherence

Good adherence was defined as having good adherence to both number of ART doses and prescriptions renewal.

Fair adherence was defined as having either poor adherence to number of ART doses or prescriptions renewal.

Poor adherence was defined as having poor adherence to both number of ART doses and prescriptions renewal.

2.7. Statistical analysis

Collected data were entered, cleaned and coded into Microsoft Excel 2019. All analysis were done using the Statistical Package for Social Sciences (SPSS) Version 26.0 (Chicago IL, USA) and GraphPad prism version 8.0 (GraphPad software, San Diego California USA, www.graphpad.com). Categorical variables were represented as frequency and percentages. Bar chart was used to represent the proportion of ART adherence among study participants. A Chi-square test was used to determine the association between study variables and ART adherence. Univariate logistic regression analysis was performed to screen for potential socio-demographic and clinical characteristics associated with ART adherence and Multivariate logistic regression was used to determine independent predictors of good ART adherence among PLWH on treatment. A 95% confidence interval and p-value of <0.05 were considered statistically significant.

3. Results

3.1. Sociodemographic and clinical characteristics of study participants

Of 720 HIV patients on treatments included in the study, most were within the 40s (32.5%) and 30s (31.8%) with few who were 60 years and above (6.4%). Three-quarter of participants were females (74.4%) whilst one-fourth were males (25.6%). Most participants were married (44.6%), and had Junior High School education (33.2%). Moreover, majority of participants had informal occupation (73.2%) and were Christians (85.4%) (Table 2).

Furthermore, majority of participants had type 1 HIV infections (96.0%), few with type 2 (0.7%) and both type 1 and 2 infections (3.3%). Most participants were in the WHO stage I (33.8%) infection and similar numbers in stage I (26.8%) and stage II (26.8%) of HIV infection. Majority had no past ARV experience (97.9%), no other conditions (88.9%), but one-tenth with presence of opportunistic infections (10.8%). In addition, majority of participants were on efavirenz-based regimen (79.7%), with few on nevirapine-based (8.8%), integrase-based (6.5%) and lopinavir/ritonavir-based (5.0%). Majority were on TDF/3TC/EFV combination (71.7%), similar participants on zidovudine-based combinations; AZT/3TC/EFV and AZT/3TC/NVP (6.3%) for 2 years (33.1%) and 3 years (31.1%) [Table 3].

Table 2
Sociodemographic characteristics of study participants.

Variable	Frequency (n = 720)	Percentage (%)
Age group (Years)		
18–29	84	11.7
30–39	229	31.8
40–49	234	32.5
50–59	127	17.6
≥60	46	6.4
Gender		
Male	184	25.6
Female	536	74.4
Marital status		
Married	321	44.6
Single	197	27.4
Cohabiting	34	4.7
Widow(er)	75	10.4
Divorced	93	12.9
Educational level		
None	99	13.8
Primary	159	22.1
JHS	239	33.2
SHS	152	21.1
Tertiary	71	9.9
Occupation		
Unemployed	126	17.5
Informal	527	73.2
Formal	67	9.3
Religion		
Christian	615	85.4
Muslim	94	13.1
Traditionalist	1	0.1
Other religion	10	1.4

Other religion = any other religion in Ghana apart from the three main religion (Christian, Muslim or Traditionalist).

Table 3
Clinical characteristics of study participants.

Variable	Frequency (n = 720)	Percentage (%)
HIV types		
Type 1	691	96.0
Type 2	5	0.7
Type 1 and 2	24	3.3
WHO stage		
Stage I	243	33.8
Stage II	193	26.8
Stage III	258	26.8
Stage IV	26	3.6
Past ARV experience		
No	705	97.9
Yes	15	2.1
Presence of other conditions		
No	640	88.9
Yes	80	11.1
Presence of opportunistic infection		
No	642	89.2
Yes	78	10.8
cART regimen		
EFV-Based	574	79.7
NVP-Based	63	8.8
Lopinavir-Based	36	5.0
Integrase-Based	47	6.5
ARV combination		
TDF/3TC/EFV	501	71.7
AZT/3TC/EFV	44	6.3
TDF/3TC/NVP	34	4.9
AZT/3TC/NVP	44	6.3
TDF/3TC/LPV/r	29	4.1
TDF/3TC/DTG	47	6.7
Duration of ART treatment (Years)		
<1	31	4.3
1	199	27.6
2	238	33.1
3	224	31.1
4	28	3.9

HIV; human immunodeficiency virus, WHO; world health organization, cART; combination antiretroviral therapy, ARV; antiretroviral, TDF; tenofovir, 3TC; lamivudine, EFV; efavirenz, NVP; nevirapine, AZT; zidovudine, LPV/r; lopinavir/ritonavir, DTG; dolutegravir.

3.2. Proportion of ART adherence among people living with HIV (PLWH) on antiretroviral therapy (ART)

Of 720 study participants, 51.8% had good adherence to ART, about 35.3% had fair adherence to ART and 12.9% had poor adherence to ART (Fig. 1A).

Additionally, of 192 PLWH recruited from university hospital (KNUST), 478 from KATH and 50 from Bomso clinic 57.8%, 47.3% and 72.0% had good ART adherence respectively, whilst 42.2%, 52.7% and 28.0% had fair and poor ART adherence respectively (Fig. 1B).

3.3. Sociodemographic factors associated with ART adherence among PLWH on ART

This study found gender ($p = 0.004$) and religion ($p = 0.039$) of PLWH to be significantly associated with combination anti-retroviral therapy adherence.

On the contrary, age group of participants ($p = 0.145$), marital status ($p = 0.415$), educational level ($p = 0.411$) and occupation of participants ($p = 0.960$) were not significantly associated with ART adherence [Table 4].

3.4. Clinical factors associated with ART adherence among PLWH on ART

This study observed a significant association between WHO stage of PLWH ($p < 0.0001$), ART combination ($p = 0.0070$), duration of ART treatment ($p = 0.0020$) and ART adherence among study participants.

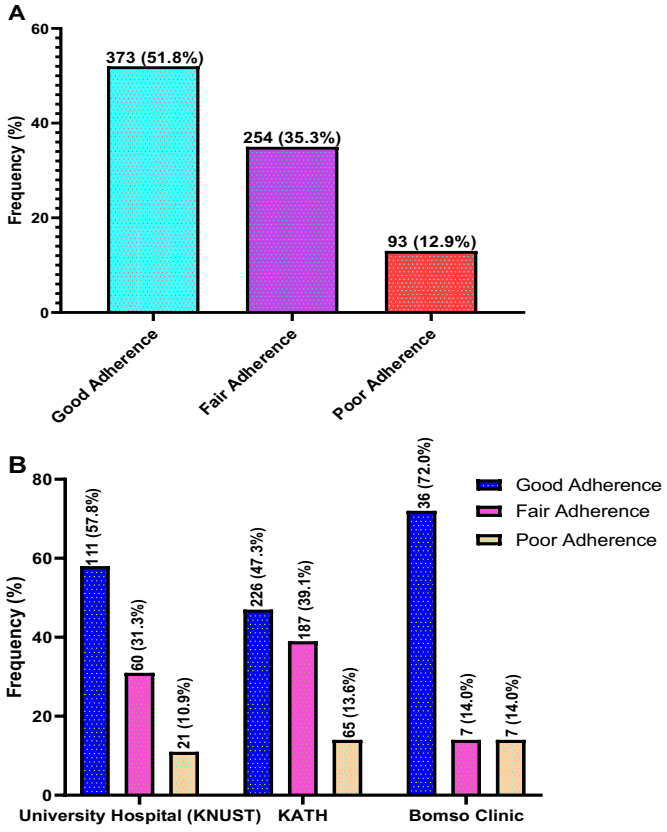

Fig. 1. Proportion of ART adherence among PLWH on ART treatment (A) and distribution of ART adherence among PLWH from various study sites (B).

Table 4
Sociodemographic factors associated with ART adherence among PLWH On ART.

	Art adherence			
Variable	Good ($n = 373$)	Fair ($n = 254$)	Poor ($n = 93$)	*p*-value
Age group (Years)				0.145
18–29	42 (11.3)	29 (11.4)	13 (14.0)	
30–39	127 (34.0)	74 (29.1)	28 (30.1)	
40–49	115 (30.8)	79 (31.1)	40 (43.0)	
50–59	65 (17.4)	53 (20.9)	9 (9.7)	
≥60	24 (6.4)	19 (7.5)	3 (3.2)	
Gender				0.004
Male	100 (26.8)	50 (19.7)	34 (36.6)	
Female	273 (73.2)	204 (80.3)	59 (63.4)	
Marital status				0.415
Married	163 (43.7)	113 (44.5)	45 (48.4)	
Single	106 (28.4)	71 (28.0)	20 (21.5)	
Cohabiting	15 (4.0)	10 (3.9)	9 (9.7)	
Widow(er)	38 (10.2)	29 (11.4)	8 (8.6)	
Divorced	51 (13.7)	31 (12.2)	11 (11.8)	
Educational level				0.411
None	52 (13.9)	34 (13.4)	13 (14.0)	
Primary	77 (20.6)	63 (24.8)	19 (20.4)	
JHS	119 (31.9)	84 (33.1)	36 (38.7)	
SHS	92 (24.7)	46 (18.1)	14 (15.1)	
Tertiary	33 (8.8)	27 (10.6)	11 (11.8)	
Occupation				0.960
Unemployed	65 (17.4)	43 (16.9)	18 (19.4)	
Informal	273 (73.2)	186 (73.2)	68 (73.1)	
Formal	35 (9.4)	25 (9.8)	7 (7.5)	
Religion				0.039
Christian	328 (87.9)	216 (85.0)	71 (76.3)	
Muslim	39 (10.5)	36 (14.2)	19 (20.4)	
Traditionalist	0 (0.0)	1 (0.4)	0 (0.0)	
Other religion	6 (1.6)	1 (0.4)	3 (3.2)	

Other religion = any other religion in Ghana apart from Christian, Muslim or Traditionalist, Bold values; statistically significant.

However, no significant association was found between HIV infection type (p = 0.8730), having past ARV experience (p = 0.7530), having other conditions (p = 0.6950), having opportunistic infection (p = 0.3610), ART regimen type (p = 0.1680) and adherence to ART [Tables 5 and Table 6.)

3.5. Predictors of good ART adherence among PLWH on treatments

In the univariate logistic regression analysis, compared to Christian, being a Muslim (cOR = 0.62, 95% CI: (0.40-0.96); p = 0.0330) significantly decreased the likelihood of good adherence to ART by 38%. Being diagnosed at WHO stage II (cOR = 0.42, 95% CI: (0.28-0.62); $p < 0.0001$), stage III (cOR = 0.38, 95% CI: (0.26-0.54); $p < 0.0001$), and stage IV (cOR = 0.43, 95% CI: (0.19-0.97); p = 0.0420) compared to WHO stage I were significantly associated with decreased likelihood of good adherence to ART by 58%, 62% and 57% respectively. Compared to being treated with TDF/3TC/EFV combination, being treated with AZT/3TC/EFV (cOR = 0.29, 95% CI: (0.15-0.58); $p < 0.0001$), AZT/3TC/NVP (cOR = 0.49, 95% CI: (0.26-0.93); p = 0.0280), TDF/3TC/DTG (cOR = 0.53, 95% CI: (0.29-0.98); p = 0.0420) significantly decreased the chances of good ART adherence by 71%, 51%, and 47% respectively.

However, compared to being on treatment for 1 year, being on ART treatment for 3 years (cOR = 2.19, 95% CI: (1.01-4.73); p = 0.0460), and 4 years (cOR = 3.34, 95% CI: (1.14-9.77); p = 0.0280) increased the chances of good adherence to ART by over 2- and 3-odds respectively.

In a multivariate logistic regression model, after adjusting for age and gender, compared to being diagnosed at WHO stage I, being diagnosed at WHO stage II (aOR = 0.45, 95% CI: (0.30-0.68); $P < 0.0001$) and stage III (aOR = 0.40, 95% CI: (0.27-0.59) < 0.0001) were independently associated with lower chances of ART adherence by 55% and 60% respectively. Moreover, compared to being treated with TDF/3TC/EFV combination, being treated with AZT/3TC/EFV (aOR = 0.33, 95% CI: (0.16-0.68); p = 0.0030), and AZT/3TC/NVP (aOR = 0.50, 95% CI: (0.26-0.98); p = 0.0410) were independently associated with 67% and 50% lower likelihood respectively of good ART adherence.

On the contrary, compared to being on treatment for 1 year, being on ART for 4 years (aOR = 3.56, 95% CI: (1.10-11.54); p = 0.0340) was independently associated with over 3-odds of having good ART adherence.

Table 5
Clinical factors associated with ART adherence among PLWH On ART.

Variable	Art adherence			p-value
	Good (n = 373)	Fair (n = 254)	Poor (n = 93)	
HIV types				0.8730
Type 1	357 (95.7)	243 (95.7)	91 (97.8)	
Type 2	3 (0.8)	2 (0.8)	0 (0.0)	
Type 1 and 2	13 (3.5)	9 (3.5)	2 (2.2)	
WHO stage at diagnosis				<0.0001
Stage I	162 (43.4)	67 (26.4)	14 (15.1)	
Stage II	88 (23.6)	77 (30.3)	28 (30.1)	
Stage III	111 (29.8)	100 (39.4)	47 (50.5)	
Stage IV	12 (3.2)	10 (3.9)	4 (4.3)	
Past ARV experience				0.7530
No	365 (97.9)	248 (97.6)	92 (98.9)	
Yes	8 (2.1)	6 (2.4)	1 (1.1)	
Presence of other Conditions				0.6950
No	331 (88.7)	224 (88.2)	85 (91.4)	
Yes	42 (11.3)	30 (11.8)	8 (8.6)	
Presence of opportunistic infection				0.3610
No	338 (90.6)	221 (87.0)	83 (89.2)	
Yes	35 (9.4)	33 (13.0)	10 (10.8)	
cART regimen				0.1680
EFV-Based	310 (83.1)	192 (75.6)	72 (77.4)	
NVP-Based	24 (6.4)	29 (11.4)	10 (10.8)	
Lopinavir-Based	20 (5.4)	13 (5.1)	3 (3.2)	
Integrase-Based	19 (5.1)	20 (7.9)	8 (8.6)	
ART combination				0.0070
TDF/3TC/EFV	281 (76.8)	160 (66.7)	60 (64.5)	
AZT/3TC/EFV	12 (3.3)	20 (8.3)	12 (12.9)	
TDF/3TC/NVP	21 (5.7)	9 (3.8)	4 (4.3)	
AZT/3TC/NVP	17 (4.6)	21 (8.8)	6 (6.5)	
TDF/3TC/LPV/r	16 (4.4)	10 (4.2)	3 (3.2)	
TDF/3TC/DTG	19 (5.2)	20 (8.3)	8 (8.6)	
Duration of ART treatment (Years)				0.0020
<1	12 (3.2)	16 (6.3)	3 (3.2)	
1	96 (25.7)	62 (24.4)	41 (44.1)	
2	116 (31.1)	93 (36.6)	29 (31.2)	
3	130 (34.9)	76 (29.9)	18 (19.4)	
4	19 (5.1)	7 (2.8)	2 (2.2)	

HIV; human immunodeficiency virus, WHO; world health organization, cART; combination antiretroviral therapy, ARV; antiretroviral, TDF; tenofovir, 3TC; lamivudine, EFV; efavirenz, NVP; nevirapine, AZT; zidovudine, LPV/r; lopinavir/ritonavir, DTG; dolutegravir, Bold values; statistically significant.

4. Discussion

HIV is currently a manageable chronic infection. However, treatment outcomes may be hampered by suboptimal adherence to ART. Despite prior studies on ART adherence, several challenges to adherence still exist, particularly in underdeveloped countries like Ghana where there is paucity of data on the factors that influence adherence to ART. This study assessed sociodemographic and clinical factors associated with adherence to ART among PLWH on treatment in Ghana. Of 720 study participants, 51.8% had good adherence to ART, 35.3% had fair adherence to ART () and 12.9% had poor adherence to ART. This study found being diagnosed at WHO stage II and stage III, being treated with AZT/3TC/EFV, and AZT/3TC/NVP were independently associated with lower chances of ART adherence. On the contrary, being on treatment for 4 years was independent predictor of ART adherence.

Half of the study participants had good adherence to ART. This is low compared to studies of Letta et al. (2015), and Shigdel et al. (2014), who found 85% and 86.7% level of ART adherence among Ethiopians and Nepalis respectively [19,20]. Moreover, the adherence level in the present study is also lower compared to the recommended WHO level of adherence. According to the WHO, at least 95% of ART adherence level is required to suppress viral replication, improve immunological function and increase CD4 count. This implies that maximal effort is still required to achieve the necessary degree of adherence. Although, educational level and occupation were not significantly associated with adherence in our study, the observed finding of this study may be due to lower educational level among study participants or most participants having informal occupation. Lower knowledge level may decrease the tendencies of good ART adherence due to a lack of understanding of the disease and its progression. Additionally, most informal employees have the tendency to miss their drug prescriptions due to unstructured workload [21]. Furthermore, non-adherence has been identified as one of the reasons for the failure of global treatment successes [22]. The significant proportion of non-adherence rate identified in this study indicates that stakeholders must put in a lot of effort to achieve the standard adherence level of 95% in order to avoid the complications associated with non-compliance such as increased severity of disease, drug resistance and poor outcomes.

In our study, being diagnosed at WHO stages II and III was independently associated with lower chances of ART adherence. This is consistent with studies by Angelo et al. (2021), and Negash et al. (2013), who also reported that WHO stages II and III were significantly associated with lower chances of adherence than in those with WHO clinical stage I [23,24]. This may be due to stigma and discrimination at advanced stages of HIV infection associated with overt manifestation of the disease. Such patients may not have the confidence to come out of their homes or attend clinics regularly, which can impact negatively on treatment adherence [25]. This calls for increased awareness among health care practitioners on the need

Table 6
Predictors of good ART adherence among PLWH on treatments.

Variable	Good adherence (n = 373)	cOR (95% CI)	p-value	aOR (95% CI)	p-value
Age group (Years)					
18–29	42 (11.3)	1.00	–	1.00	–
30–39	127 (34.0)	1.25 (0.76-2.06)	0.3910	1.43 (0.83-2.45)	0.1970
40–49	115 (30.8)	0.97 (0.59-1.59)	0.8930	1.15 (0.66-1.97)	0.6270
50–59	65 (17.4)	1.05 (0.60-1.82)	0.8670	1.35 (0.74-2.46)	0.3310
≥60	24 (6.4)	1.09 (0.53-2.24)	0.8130	0.98 (0.45-2.15)	0.9680
Gender					
Male	100 (26.8)	1.00	–	1.00	–
Female	273 (73.2)	0.87 (0.62-1.22)	0.4240	0.86 (0.60-1.24)	0.4120
Religion					
Christian	328 (87.9)	1.00	–	1.00	–
Muslim	39 (10.5)	0.62 (0.40-0.96)	0.0330	0.58 (0.36-0.93)	0.0230
Traditionalist	0 (0.0)	0.00 (0.00-inf)	>0.9999	0.00 (0.00-inf)	>0.9999
Other religion	6 (1.6)	1.31 (0.37-4.70)	0.6760	1.00 (0.26-3.84)	0.9960
WHO stage at diagnosis					
Stage I	162 (43.4)	1.00	–	1.00	–
Stage II	88 (23.6)	0.42 (0.28-0.62)	<0.0001	0.45 (0.30-0.68)	<0.0001
Stage III	111 (29.8)	0.38 (0.26-0.54)	<0.0001	0.40 (0.27-0.59)	<0.0001
Stage IV	12 (3.2)	0.43 (0.19-0.97)	0.0420	0.35 (0.15-0.82)	0.0160
ART combination					
TDF/3TC/EFV	281 (76.8)	1.00	–	1.00	–
AZT/3TC/EFV	12 (3.3)	0.29 (0.15-0.58)	<0.0001	0.33 (0.16-0.68)	0.0030
TDF/3TC/NVP	21 (5.7)	1.27 (0.62-2.58)	0.5190	1.16 (0.55-2.45)	0.6900
AZT/3TC/NVP	17 (4.6)	0.49 (0.26-0.93)	0.0280	0.50 (0.26-0.98)	0.0410
TDF/3TC/LPV/r	16 (4.4)	0.96 (0.45-2.05)	0.9230	0.95 (0.44-2.08)	0.9010
TDF/3TC/DTG	19 (5.2)	0.53 (0.29-0.98)	0.0420	0.61 (0.32-1.19)	0.1510
Duration of ART treatment (Years)					
<1	12 (3.2)	1.00	–	1.00	–
1	96 (25.7)	1.48 (0.68-3.20)	0.3250	1.33 (0.57-3.09)	0.5160
2	116 (31.1)	1.51 (0.70-3.24)	0.2950	1.47 (0.63-3.43)	0.3760
3	130 (34.9)	2.19 (1.01-4.73)	0.0460	2.14 (0.91-5.03)	0.0800
4	19 (5.1)	3.34 (1.14-9.77)	0.0280	3.56 (1.10-11.54)	0.0340

WHO; world health organization, cART; combination antiretroviral therapy, ARV; antiretroviral, TDF; tenofovir, 3TC; lamivudine, EFV; efavirenz, NVP; nevirapine, AZT; zidovudine, LPV/r; lopinavir/ritonavir, DTG; dolutegravir, Bold values; statistically significant.

to diagnose, treat, and address stigma-related issues among patients during all phases of ART administration.

This study also found that being treated with AZT/3TC/EFV and AZT/3TC/NVP was independently associated with lower likelihood of good ART adherence. This is in agreement with a previous study by Kwobah et al. (2012), who reported Zidovudine based ART was independently associated with treatment failure [26]. Zidovudine has been associated with more adverse effects including nausea and vomiting that may potentially reduce treatment adherence among participants [27,28]. This may explain why majority of patients who reported good adherence in our study were on non-AZT regimens.

Among our study participants, being on ART for 4 years was an independent predictor of ART adherence, contrary to a study by Gebrezgabher et al. (2017), who reported that increased duration of ART treatment was associated with lower adherence to ART [29]. The observed difference between our study and previous study may be due to the fact that most participants were on NNRTI-based therapy (predominantly Efavirenz) which has been reported to have lesser adverse effects and being the preferred choice of NNRTIs [30].

This study is limited by the inability to assess the reasons for participants' non-adherence to ART. This is due to the fact that study data was generated retrospectively from medical records.

5. Conclusion

About half of PLWH on treatment have good adherence to ART. Being diagnosed at WHO stage II and stage III, being treated with AZT/3TC/EFV, and AZT/3TC/NVP ART combination are associated with lower chances of good ART adherence. However, increased duration of ART among PLWH influence good ART adherence. PLWH on ART should be counseled continuously on treatment adherence and monitored to achieve over 95% ART adherence for effective management of HIV/AIDS.

Ethics approval and participate consent

The study was approved by The Committee on Human Research, Publication and Ethics, School of Medical Sciences, Kwame Nkrumah University of Science and Technology (CHRPE/SMS/KNUST: CHRPE/AP/238/20). Written informed consent was sought from healthcare management of selected hospitals before data collection. A thorough explanation of the study protocol and assurance of anonymity was made to the study subjects. All methods were carried out in accordance with relevant guidelines and regulations.

Data availability

All data generated or analyzed during this study are included in this article and its supplementary information files can be requested from the corresponding author.

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Declaration of Competing Interest

Authors declared that no conflicts of interest exist.

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