

Research Article

Viral Suppression and Its Associated Factors in HIV Patients on Highly Active Antiretroviral Therapy (HAART): A Retrospective Study in the Ho Municipality, Ghana

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Background. The WHO targets to end HIV/AIDS as a public health problem by 2030. The introduction of the ambitious “90-90-90” strategy to attain this target is expected to be achieved by the year 2020. However, there is lack of regional data, especially on the third “90.” This study sought to assess the rate and associated factors of viral suppression among people living with HIV (PLWH) on highly active antiretroviral therapy (HAART) at the Antiretroviral Therapy (ART) Clinic in a Ghanaian health facility. **Method.** The study design was a retrospective analysis of secondary data of 284 HIV registrants on HAART for at least 6 months at the ART Clinic from July 2016 to April 2019. Data on sociodemography including age, gender, marital status, education, and occupation as well as pharmacological (type of medication and duration on medication) and laboratory variable (current viral load results) were extracted from patients’ folders. Viral suppression and failure were determined using the WHO definitions (viral suppression as viral load <1000 copies/ml and virologic failure ≥1000 copies/ml). Regular clinic attendance (used as a proxy measure for medication adherence) was defined as consistent monthly clinic attendance for HAART medication and other clinical management within the past 12 months. **Results.** Out of the 284 HIV patients, 195 (69%) achieved viral suppression. Of the 195 who were virally suppressed, 77 (39.5%) had undetectable levels, with a similar proportion (39.5%) achieving viral load results ranging from 20 to 200 copies/ml. Moreover, 27 (13.8%) patients had viral load ranging from 201 to 500 copies/ml while 14 (7.2%) recorded viral load from 501 to 1000 copies/ml. No clear pattern in the viral suppression rate was associated with the age groups ($p = 0.1152$). However, regular clinic attendance (used as proxy for medication adherence) ($p < 0.0001$) and being on HAART for more than three (3) years ($p = 0.03$) were associated with viral suppression. **Conclusion.** The rate of viral suppression among PLWH on HAART in the Ho municipality fell short of the WHO target. However, the study identified regular ART clinic attendance and treatment >3 years as factors associated with viral suppression.

1. Introduction

The human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) menace continues to threaten the lives of many worldwide. In the year 2017, 1.7 million people were newly infected with HIV resulting in a total of 36.9 million HIV infected people globally [1, 2]. Africa is the most affected with 25.7 million HIV infected individuals, thus contributing to more than two-thirds of new HIV infections globally [2, 3]. In Ghana, the HIV incidence declined from 1.25 per 1000 population in 2005 to 0.68 per 1000 population in 2017 while the prevalence in the Volta Region in 2017 stood at 2.3%, with Ho recording a prevalence of 2.6% [1]. Owing to the high global HIV burden, the Joint United Nations Programme on HIV/AIDS (UNAIDS) in 2014 declared the “90-90-90” strategy, where 90% of people who are infected should know their status through testing, of whom 90% positive individuals be put on antiretroviral medication and of those on medication, 90% should achieve viral load suppression by the year 2020 [4, 5]. With less than a year to attaining the “90-90-90” target, current records show that only 47% of people living with HIV (PLWH) have achieved viral suppression worldwide [2, 6]. In Africa, the rate of viral suppression among PLWH in the Eastern and Southern regions are reported to be 52% [1]. Notwithstanding, with additional 4.0 million PLWH recorded in 2017, the Eastern and Southern Africa countries could be confronted with enormous challenge to achieving the third 90 [7, 8]. North, Central, and West Africa are far behind with an estimated proportion of 29% who achieved viral suppression in 2017 [1]. Recent national statistics from the Ghana AIDS Commission (GAC) show that the country achieved 55.3% in the first 90, 61.2% in the second 90, and 64.3% in the third 90 [9]. Attaining viral load suppression is very necessary for controlling vertical and horizontal transmission of the virus within the population [10, 11]. Studies have shown that early diagnosis, prompt introduction to HAART, and retention in HIV care provide opportunity for HIV patients to achieve viral suppression and sustain it [7, 8]. There has been a scale up of HAART activities in Ghana over the years [1], but surveillance on the rate of viral suppression is needed to assess the effectiveness of this initiative. Moreover, there is a potential of a future upsurge in HIV transmission if control measures are not put in place since affected people would continue to remain an important source for the viral transmission. Thus, the present study is designed to provide information on the rate of viral suppression and its associated factors among PLWH on HAART assessing care at a health facility in the Ho municipality. The findings could provide the basis for informing policies and strategies in improving care and achieving the “90-90-90” goal in the Ho municipality.

2. Methods

2.1. Study Site and Study Area. This study was carried out at the Ho Municipal Hospital located in the Ho municipality. Ho Municipal is the capital of the Volta Region established

under the Legislative Instrument (LI) 2074 of 2012. The municipality shares boundaries with Adaklu and Agotime Ziope districts to the south, Ho West District to the north and west, and the Republic of Togo to the east. The land area of the municipality is 2,361 square kilometers forming 11.5% of the total land area of the Volta Region. According to the 2010 population census, the Ho municipality has a population of 192,871 and a growth rate of 1.17% [12].

2.2. Study Design and Study Population. This was a retrospective study. The records of 284 HIV patient 18 years and above on HAART for at least 6 months with HIV RNA viral load results available at the ART Clinic between July 2016 and April 2019 were reviewed.

2.3. Sample Size Calculation. Using an online Raosoft sample calculator (<http://www.raosoft.com/samplesize.html>), a minimum sample size of 270 was calculated with a confidence interval of 95%, a response distribution of 50%, and a margin of error of 5% from a total population of 900 HIV registrants at the ART Clinic of the Ho Municipal Hospital.

2.4. Data Collection. Archival data on HIV patients on HAART from July 2016 to April 2019 were obtained from the hospital’s ART unit. Data were retrieved from clients’ folders and the database of the ART unit. Relevant information included sociodemography, date of HIV test, HIV type, date HAART was started, type of current HAART regimen administered, date on which last viral load was tested, and viral load results.

2.5. Viral Load Estimation. Viral load was estimated in 1.1 ml of plasma using methods prescribed by the reagent manufacturers (COBAS AmpliPrep/COBAS Taqman HIV-1 Quantitative Test, v2.0, Roche Diagnostic GmbH, Germany).

2.6. Definition of Viral Suppression and Clinic Attendance. Viral suppression was defined as viral load <1000 copies/ml and virologic failure ≥ 1000 copies/ml and undetectable levels as viral load <20 copies/ml according to WHO guidelines [13]. Other levels of viral suppression used in the Public Health Agency of Canada (PHAC) study based on cut-off levels between 200 and 400 copies/ml, 201–500 copies/ml, and 501–1000 copies/ml [14] were also adopted in this study. Regular clinic attendance was defined as consistent monthly clinic attendance for HAART medication and other clinical management within the past 12 months, whereas those who had defaulted in the scheduled monthly clinic attendance were considered to be irregular.

2.7. Statistical Analysis. Microsoft Excel 2013 spreadsheet was used to collect data. The data obtained were cleaned and analyzed using IBM Statistical Package for the Social Sciences (SPSS Inc., Chicago, USA (<http://www.spss.com>))

version 23. Data were presented as frequency and corresponding percentage where appropriate. A Chi-square test statistic was used to determine the association between study variables and viral suppression. Multinomial logistic regression analysis was employed to determine variables independently associated with viral suppression. A p value of <0.05 was considered to be statistically significant.

2.8. Ethical Considerations. Ethical clearance was sought from the Ethical Review Committee of the University of Health and Allied Sciences (UHAS) with the reference number UHAS-REC A.4 (191) 18-19. Permission was obtained from the management of the Ho Municipal Hospital to use data available at the ART Clinic. Patients' names were not retrieved from the archives. Data retrieved were anonymous and not linked to any patient.

3. Results

From a total of 284 HIV patient folders selected for this study, majority (231 (81.3%)) were females, infected with HIV-1 (270 (95.1%)), and single or currently not married (separated, divorced, and widowed) (135 (47.5%)) at the time of this study. The age of the patients ranged from 19 to 80 years, while majority (99 (35%)) were aged 40 to 49 years. More than half of the HIV patients (155 (54.6%)) had attained basic education, whereas 248 (87.3%) were informally employed. The median duration on HAART was 3.0 (IQR 2–6) years (see Table 1).

Out of a total of 195 HIV patients who achieved viral suppression, 77 (39.5%) had undetectable viral loads (<20 copies/ml), with a similar proportion (39.5%) achieving viral load results based on the cut-off levels of 20–200 copies/ml. Moreover, 27 (13.8%) had viral load ranging from 201 to 500 copies/ml while 14 (7.2%) recorded viral load ranging from 501 to 1000 copies/ml (Figure 1).

From Table 2 below, 195 (69%) patients were observed to have achieved viral suppression while 89 (31%) demonstrated virologic failure. The Chi-square test showed that, there was no significant association of gender, marital status, educational status, and occupation with viral suppression. However, regular ART Clinic attendance (used as proxy for medication adherence) was associated with viral suppression ($p < 0.0001$). Patients initiated on HAART for more than three (3) years were significantly associated with viral suppression ($p = 0.03$). In terms of medication, there was no significant association between the current HAART regimen and viral suppression ($p = 0.0987$). However, nevirapine-based regimens (30 (82.93%)) were found to proportionally record higher viral suppression compared to efavirenz-based regimens 165 (57.76%).

Using a multinomial logistic regression analysis, it was observed that age category, marital, and educational statuses as well as occupation were not significantly associated with viral suppression (see Table 3).

TABLE 1: Demographic and HIV status of HIV patients at the ART Clinic.

Parameter	Frequency (n)	Percentage (%)
Total	284	100
Gender		
Male	53	18.7
Female	231	81.3
Type of HIV infection		
HIV-1	270	95.1
HIV-2	2	0.7
HIV-1 and 2	12	4.2
Marital status		
Single	135	47.5
Cohabiting	23	8.1
Married	126	44.4
Age category		
<20	3	1.1
20–29	14	4.9
30–39	77	27.1
40–49	99	34.9
≥50	91	32.0
Educational status		
None	14	4.9
Basic	155	54.6
Secondary	102	35.9
Tertiary	13	4.6
Occupation		
None	21	7.4
Informal	248	87.3
Formal	9	3.2
Retired	6	2.1
HAART duration (years)		
Median	3.0	2.0–6.0*

*Data are presented in figures and percentages or median and interquartile range.

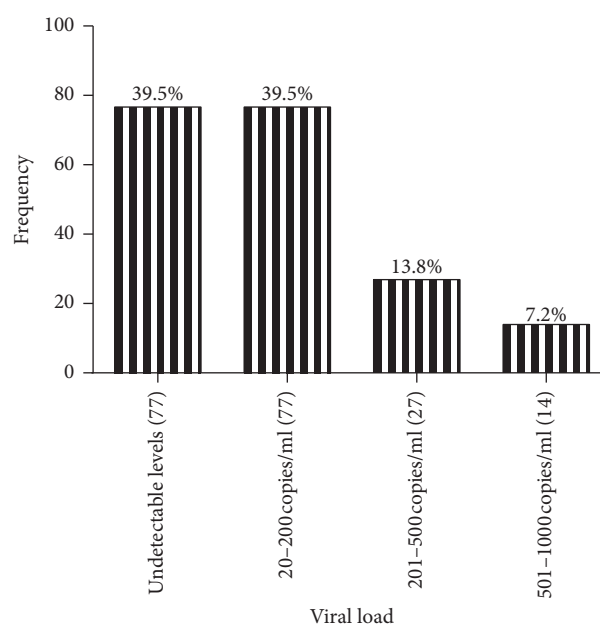


FIGURE 1: Proportion of HIV participants who achieved various levels of viral suppression.

TABLE 2: Chi-square test analysis of factors associated with viral suppression among HIV patients at the ART Clinic.

Variable	No viral suppression	Viral suppression	<i>p</i> value
Treatment outcome			
Suppression rate	89 (31)	195 (69)	
Gender			
Male	22 (41.51)	31 (58.49)	0.0999
Female	67 (29.00)	164 (71.00)	
Age category (years)			
<40	34 (36.34)	60 (63.83)	0.1152
40–49	34 (34.34)	65 (65.66)	
≥50	21 (23.08)	70 (76.92)	
Marital status			
Single	43 (31.85)	92 (68.15)	0.6397
Married	37 (29.37)	89 (70.63)	
Cohabiting	9 (39.13)	14 (60.87)	
Educational status			
None	3 (21.43)	11 (78.57)	0.8743
Basic	49 (31.61)	106 (68.39)	
Secondary	33 (32.35)	69 (67.65)	
Tertiary	4 (30.77)	9 (69.23)	
Occupation			
None	7 (33.33)	14 (66.67)	0.7970
Formal	2 (22.22)	7 (77.78)	
Informal	79 (31.85)	169 (68.15)	
Retired	1 (16.67)	5 (83.33)	
Clinic attendance			
Regular	32 (14.10)	195 (85.90)	<0.0001
Not regular	57 (100.00)	0 (0.00)	
Treatment duration			
≤3 years	55 (37.16)	93 (62.84)	0.0300
>3 years	34 (25.00)	102 (75.00)	
Current HAART regimen			
EFV-based regimen	68 (42.24)	165 (57.76)	0.0987
NVP-based regimen	21 (17.07)	30 (82.93)	

Data are presented as figures and percentages in parentheses; *p* value is significant at <0.05. EFV-based regimen = AZT/3TC/EFV and TDF/3TC/EFV, NVP-based regimen = TDF/3TC/NVP, D4T/3TC/NVP and AZT/3TC/NVP 3TC = lamivudine, AZT = zidovudine, EFV = efavirenz, NVP = nevirapine, D4T = stavudine, and TDF = tenofovir.

TABLE 3: Multinomial logistic regression analysis of factors associated with viral suppression among HIV patients at the ART Clinic.

Variable	OR	95% CI	<i>p</i> value
Age category (years)			
<40	Ref		
40–49	1.083	0.599 to 1.956	0.880
≥50	1.889	0.992 to 3.597	0.056
Marital status			
Single	Ref		
Married	1.124	0.663 to 1.905	0.689
Cohabiting	0.727	0.292 to 1.811	0.483
Educational status			
None	Ref		
Basic	0.590	0.157 to 2.211	0.554
Secondary	0.570	0.149 to 2.184	0.545
Tertiary	0.614	0.108 to 3.487	0.678
Occupation			
None	Ref		
Formal	1.750	0.285 to 10.75	0.681
Informal	1.070	0.415 to 2.755	1.000
Retired	2.500	0.243 to 25.73	0.633

Data are presented as odd ratios (OR) with confidence intervals (CI); *p* value is significant at <0.05.

4. Discussion

In this study, females (231 (81.3%)) constituted a majority of the total study population (Table 1). The result is consistent with a study by Kwarisiima and colleagues, who reported a preponderance of HIV infected female patients among PLWH in Uganda and Kenya [15]. The higher proportion of females with HIV observed in our study could be attributed to factors related to the anatomic structure of the reproductive organ which could render them more susceptible to infection or the higher health seeking behaviour among the female population in developing countries [2, 16]. Approximately, 270 (95.1%) of the study participants were infected with HIV-1, while 12 (4.2%) recorded both HIV-1 and 2 infections and only 2 (0.7%) were infected with HIV-2 (Table 1). In the Guinean-Bissau population, new HIV-1 infections were found to be predominant (225 (72.1%)) after 23 years of follow-up of a cohort of 872 security officers [17], similar to our finding. However, the proportion of HIV-2 infection (87 (27.9%)) recorded in the Guinean-Bissau study was more than what we observed in our study. The relatively low HIV-2 infection rate observed in the current study could be due to the lower prevalence in the Ghanaian population [18, 19].

The main strategy adopted by the UN to eliminating the HIV/AIDS pandemic by 2030 was to increase access and coverage of HAART across the globe [1, 2, 20]. Currently, less than half of the world's HIV population undergoing HAART medication are virally suppressed [1, 2]. In our study, using the WHO recommended definition of viral load less than 1000 copies/ml [13], we observed 196 (69%) of PLWH on HAART having achieved viral suppression (Table 2). The observed viral suppression rate in this study is comparable to the national statistics (64.3%) [9], but higher than the 24% and 41% reported in Sierra Leone and Senegal, respectively [1]. The current figure is, however, lower than the Botswana and Eswatini reports of 81% and 74%, respectively [1]. The key challenges confronting the achievement of the 90% viral suppression among Ghanaian PLWH were identified to include stigma, discrimination, abandoning of treatment for prayer camps, and false claims of cure by some herbalists [9].

According to the Malawi Population-Based HIV Impact Assessment (MPBHIA) 2017 report, the viral suppression rate of 91.2% was observed among 15–65-year-old adults living with HIV based on the viral suppression definition of less than 1000 HIV RNA copies/ml [21]. On the contrary, the Public Health Agency of Canada (PHAC) study in 2015 employed the viral load threshold of less than 200 copies/ml but achieved a suppression rate of 94% among PLWH on HAART in Ontario (Canadian province) [14]. The reduced cut-off levels for viral suppression (less than 200 copies/ml and 400 copies/ml) were adopted in previous studies due to their relationship with a significant reduction in the risk of HIV transmission [22]. In our study, the rate of virally suppressed PLWH based on the cut-off levels <200 copies/ml and <400 copies/ml were 54.2% and 62%, respectively, which were far lower than the results obtained in Ontario. The lower viral suppression rate observed in this study

compared to the Ontario study could be explained by the sharp disparities in the systems for the management of PLWH including treatment access and coverage as well as disease surveillance between developed and developing countries.

Of the 195 (65%) HIV individuals who achieved viral suppression, 77 (39.5%) demonstrated undetectable levels of viral suppression (Figure 1). Findings from the PHAC study reported 89% of PLWH to have undetectable viral load levels, which was higher than the proportion we observed in our study [14]. Several lines of evidence have established that virally suppressed HIV individuals have a reduced risk of transmitting HIV to their HIV negative partners (discordant partners) and those with undetectable viral levels pose no risk of HIV transmission [22–24]. In this study, the evidence of undetectable viral load levels among PLWH may be signs to the effect that the UN's 2030 objective of controlling the risk of HIV transmission could be achieved. Nonetheless, this would require massive interventions including increased enrollment of PLWH on HAART and consistent surveillance of treatment outcomes.

Previous studies have reported that the younger age is associated with poor antiretroviral adherence and viral load suppression [25–27]. Among factors put forward to be responsible for the unfavourable outcomes included higher CD4 count prior to HAART intervention [26] and delayed HAART initiation [27]. In contrast to our study, we observed statistically no clear pattern in the rate of viral suppression with respect to the various age groups (Tables 2 and 3). While it is quite unclear why we observed the phenomenon of insignificant association between age and viral suppression in the present study, it can be attributed to the skewed nature of our data which tends to favour older adults compared to adolescents and youth recruited in this study (Table 1).

According to Luque-Fernandez et al. [28], medication adherence is an important factor for achieving viral suppression. Though data on medication adherence were limited in this study, patients who were regular ART Clinic attendants (used as a proxy measure for medication adherence) were found to be significantly associated with viral suppression ($p < 0.0001$) (Table 2). However, a previous report indicates that individuals with poor adherence to antiretroviral medication were less likely to achieve viral suppression [7]. In this study, we found that all HIV patients (57 (100%)) who were not regular ART Clinic attendants failed to achieve viral suppression (Table 2). The failure to regularly attend the ART Clinic could be due to long distances patients would have to travel, lack of funds for transportation to the clinic, or inadequate knowledge on the importance of medication adherence.

The WHO 2015 Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection indicate that viral suppression can be achieved upon initiation and adherence to treatment for at least 12 months [29], and this was corroborated in a latter study by McMahon et al. [23]. In our study, HIV patients initiated on HAART for more than three (3) years were significantly associated with viral suppression ($p = 0.03$) (Table 2). The

current finding seems to support the evidence from clinical practice that suggests that prolonged HAART use can reduce viral load below the limit of detection for a long-term period [30, 31]. First line HIV drug regimens are effective, with an AZT/3TC/EFV regimen found to be highly associated with viral suppression [7]. On the contrary, our study found no significant association between current HAART regimen used and viral suppression ($p = 0.0987$) (Table 2). The result could suggest that treatment with efavirenz and nevirapine-based regimens demonstrated similar therapeutic potency with respect to viral suppression among the PLWH in this study. The result is in line with previous clinical trials which reported comparable HIV suppression rates between nevirapine-based regimens and protease inhibitors (PIs) [32, 33] or efavirenz [34].

We have identified some important limitations worth discussing in the present study. The retrospective nature of the study only permitted a review of records available in patients' folders but did not allow for the comprehensive assessment of potential factors that could be associated with viral suppression. The study findings were also based on a single measurement of viral load due to nonavailability of data on viral load measurement three (3) months apart after HAART initiation as recommended by the WHO. There was paucity of information on medication adherence; hence, we decided to use regular clinic attendance as a proxy measure for adherence which might affect the findings of the current study.

5. Conclusion

The rate of viral suppression among PLWH on HAART in the Ho municipality fell short of the WHO target. Regular ART Clinic attendance and being on HAART for more than three years were factors associated with achieving viral suppression.

Data Availability

The datasets used during the current study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare there are no conflicts of interest.

Authors' Contributions

This work was carried out in collaboration with all authors. All authors have read and reviewed the content of the final manuscript and have approved the manuscript for submission.

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