

Magnitude of Viral Load Suppression and Associated Factors among Clients on Antiretroviral Therapy in Public Hospitals of Hawassa City Administration, Ethiopia

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Background: A majority of clients on first-line antiretroviral therapy with an initial high viral load will resuppress following an adherence intervention. Some sociodemographic and clinical characteristics were found to affect resuppression. Few reports on the outcome of the intervention and its associated factors in our country, with inconsistent results and some missed clinical factors of potential association, have compelled this study. The study aimed to assess the proportion of viral load suppression and associated factors among clients on antiretroviral therapy in public hospitals of Hawassa City Administration, Ethiopia.

Methods: An institution-based cross-sectional study with retrospective document review was conducted among 342 participants on antiretroviral therapy enrolled for counseling since its start in November 2016. Data were captured using a pretested and structured checklist from all client charts with complete data, entered into EpiData 3.1.0 and exported to SPSS 27 for analysis. The proportion of viral load suppression was determined. Bivariate and multivariate logistic regressions were performed to identify associated factors. Statistical significance was determined at a 95% CI and $P < 0.05$.

Results: The proportion of viral load suppression was found to be 40.9% (35.7%–46.5%). Nevirapine-based antiretroviral treatment regimens (AOR 0.125, 95% CI 0.034–0.464), malnutrition (AOR 0.565, 95% CI 0.329–0.971), poor adherence (AOR 0.504, 95% CI 0.287–0.886), lower CD4 count (AOR 0.149, 95% CI 0.071, 0.314), and fewer counseling sessions (AOR 0.330, 95% CI 0.149–0.729) were significantly associated with viral load suppression.

Conclusion: The proportion of viral load suppression is lower than that recommended by the World Health Organization. Nevirapine-based regimens, poor nutritional status, poor adherence, lower CD4 count, and fewer counseling sessions risk a lower proportion of viral load suppression. This calls for the need to devise strategies to address these factors and to revisit program implementation.

Keywords: viral load suppression, antiretroviral therapy, enhanced adherence counseling, Hawassa, Ethiopia

Introduction

A major global public health problem, HIV has been made a manageable chronic condition with the use of antiretroviral therapy (ART). Besides the significant reduction in the overall mortality, first ART regimen has offered the best opportunity for viral load (VL) suppression.^{1,2} As part of global efforts against the burden, the “90–90–90” target aimed for 90% of those on ART to attain VL suppression by 2020 as the third target. Since then, different trends have been seen, among which was an estimated 59% by the end of 2019. Huge disparity was also noted among countries, ranging from 68% (Switzerland) to 7% (China).^{3,4}

VL suppression is a measure of treatment outcome based on which adherence support is provided for the sustained engagement of clients in the care and their adherence. Therefore, VL testing is recommended at 6 and 12 months and then

yearly. Based on the results, enhanced adherence counseling (EAC) is provided for those who still have high VL (>1000 cells/mL of blood) after a minimum of 6 months on ART.^{5–8} With this, a viral suppression rate of 46.1% was reported in a systematic review, though rates have varied from as low as 9% to 58.9% in different countries.^{8–13} Better yet, around 70% of patients on first-line ART who have an initial high VL will resuppress following such adherence interventions.² However, in Africa, lower rates of VL suppression from suboptimal monitoring and poor adherence have been seen along with ART drug resistance of relatively higher prevalence estimates (7.2%–11.0%).^{6,14–16}

In Ethiopia, only 65% of people living with HIV were on treatment in 2018. Even worse, data were lacking for the VL suppression target.¹⁷ A study in the southwest (using surrogate markers) revealed a 66% suppression rate, making the target unlikely to be attained by the set year 2020, as was also predicted by a study in northern Ethiopia.^{18,19} Adding to this burden, lower VL-suppression rates after EAC were seen in Bahir Dar (38.7%), in contrast to the substantial rates reported by a study in North Wollo (66.4%).^{20,21}

With regard to factors associated with VL suppression after EAC, age, sex, marital status, occupation, level of education and residence are among the sociodemographic characteristics.^{2,8,10,12,14,20–28} Clinical factors, nutritional status, duration on ART, ART regimen, WHO clinical stage, adherence, initial CD4 count, initial VL, count and EAC sessions completed have also been reported to have significant associations.^{7–10,12,14,20–24,27–37} Some important variables of potential association (ie, prophylaxis against opportunistic infections and nutritional status) with VL suppression were not considered in previous studies.

Studies in Ethiopia have been limited as to the knowledge of the researchers, and their reports on outcomes of EAC have also shown inconsistency. In addition to the clinical variables not studied yet, there has been no similar study done in the area, resulting in lack of evidence regarding VL suppression and associated factors among patients receiving EAC intervention. As such, this study aimed to assess the level VL suppression and associated factors among clients on ART in public hospitals of Hawassa City Administration, Ethiopia.

Methods

Study Area and Period

The study was conducted in public hospitals of Hawassa City Administration, Ethiopia. The city administration has three public hospitals and five health centers under it. Among these, all the public hospitals and some of the health centers provide HIV/AIDS treatment and follow-up services. Adare General Hospital (AGH) and Hawassa University Comprehensive Specialized Hospital (HUCSH) have run an EAC program since November 2016. There were a total of 294 clients enrolled for EAC in HUCSH and 272 clients in AGH from 2016 to 2021. The study was conducted from May 24 to June 25, 2021.

Study Design

This was an institution-based cross-sectional study with retrospective document review.

Population

All clients on ART who had been enrolled for follow-up were considered the source population. The study population comprised clients on ART who had been enrolled for EAC. Finally an individual on ART who had been enrolled for EAC from 2016 to 2021.

Eligibility Criteria

Clients on ART enrolled for EAC sessions with high VL (>1000 cells/mL) were recruited. Clients who were lost to follow-up or transferred before completing all three EAC sessions and those who had incomplete records, ie, no second VL result, were excluded from the study.

Sample-Size Determination

The sample size for the first objective of the study (to determine the proportion of VL suppression) was computed with assumptions of 95% CI of 1.96, VL suppression 66.4%,²⁰ and margin of error 5% using OpenEpi, which gave us 342. For calculating the sample size for the second objective of the study which was to identify factors associated with VL suppression, assumptions were 95% CI and 80% power. The proportion of VL suppression (the outcome variable) in the exposed group and unexposed group of associated factors were taken from previous studies²⁰ (Table 1).

Sampling Technique

The study participants were taken proportionally from the public hospitals that have been providing EAC since the start of the program based on the number of clients enrolled. All client records fulfilling the inclusion criteria — 179 from HUCSH and 163 from AGH — were included in the final review. As record incompleteness was the challenge during the pilot study, every client with a second VL record was automatically included and further completeness checks undertaken subsequently in order to capture data from other sources, ie, VL registers, EAC registers, and laboratory log books. Finally, all client records with complete information were included in the review.

Data-Collection Tools and Techniques

Identification numbers of medical records for clients started on EAC were obtained from the EAC registers at the ART clinic. By using the identification numbers, medical record charts were drawn by card-room workers. After thorough screening of all the client charts based on the eligibility criteria, trained data collectors identified client charts meeting the inclusion criteria and collected all the required information from only those records. The data-collection form contained both sociodemographic and clinical factors and was completed by chart abstraction. Different registers, follow-up forms, and laboratory results were also used to get the most recent as well as full data for incomplete charts.

Data Quality Control

Two diploma nurses were recruited as data collectors and one supervisor monitored the overall data-collection process. The supervisor and data collectors were trained for 2 consecutive days on the requirements of the protocol and data to be collected. The training also focused on the purpose of the study, familiarization with the tools and further clarity, techniques of data collection and confidentiality, and respective roles and responsibilities. The data-collection form was pretested on 34 client charts retrieved in order to minimize problems with the tool. It was carried out at Bushilo Health Center which was outside the study area. During the data-collection process, both groups were regularly supervised by the principal investigator. Each data-collection form was audited for completeness and legibility at the end of each day by the principal investigator and supervisor to ensure accuracy.

Data Management and Analysis

After the collected data had been checked for consistency and completeness, it was entered into EpiData 3.1.0, then exported to SPSS 27 for analysis. Descriptive statistics, ie, frequencies and percentages, were computed. Binary logistic regression analysis was used to fit each independent variable into a bivariate logistic regression model separately to explore the association with the dependent variable (viral suppression). Independent variables with $P < 0.25$ on bivariate logistic regression analysis were considered for multivariate logistic regression analysis. Hosmer and Lemeshow's goodness-of-fit test was used

Table 1 Sample-size calculation for the second objective of the study

		Ratio (unexposed: exposed)	% Outcome in unexposed group	% Outcome in exposed group	Maximum sample size output (EpiInfo 7.2.5)
1	Education	2.54	37.5	15.8	186
2	Duration on ART	0.55	26.9	46.2	236
3	Initial viral load	2.625	50.6	7.7	54

to check model fitness. Multivariate logistic regression was carried out to identify factors independently associated with VL suppression. The level of significance was ascertained by OR with 95% CI at $P < 0.05$.

Variables and Measurement

The outcome variable of the study was VL suppression. As a measurement tool, VL is used to identify people on ART in need of an adherence interventions, a majority of which resuppress and are able to continue their treatment after adherence support.^{36,38} High VL is regarded as >1000 copies/mL of blood and is confirmed 6 months after initiation of ART. VL suppression is said to be attained when the count is ≤ 1000 copies/mL of blood.^{7,14,20} Independent variables comprised both sociodemographic (age, sex, marital status, residency, religion, education, and occupation) and clinical characteristics (duration on ART, ART regimen, initial CD4 count, initial VL count, functional status, nutritional status, WHO clinical stage, opportunistic infections at first enrollment, co-trimoxazole preventive therapy, isoniazid preventive therapy, and number of EAC sessions attended).

Enhanced Adherence Counseling

EAC is an intervention provided in monthly sessions for 3 months (EAC 1–3) by an adherence counselor who understand clients' drug administration, the barriers to adherence (ie, substance abuse), social support (ie, depression evaluation,) and opportunities to improve adherence using the five As (assess, advise, assist, agree, arrange).^{7,18} It is said to be completed after an optimum level of adherence to treatment for 3 months, when the second VL is determined, but for those with significant barriers to adherence, it is advised to extend the counseling for 6 months.³⁹

Ethics

Ethics clearance was obtained from the Institutional Review Board of College of Health Sciences and Medicine, Wolaita Sodo University. As the study was a retrospective analysis of deidentified data, a waiver of consent was obtained given that it was conducted in accordance with the Declaration of Helsinki.

Results

Baseline Characteristics

Sociodemographic Characteristics

Of the 342 study participants, 101 (29%) were aged 30–39 years and 173 (50.6%) were female. Around half (40.9%) were single and 45.3% had an education of secondary and above. Unemployed participants numbered 133 (38.9%). With regard to residence, a majority (87.7%) resided in urban areas (Table 2).

Clinical Characteristics

Among the 342 participants, 197 (57.6%) had been taking ART medication for ≥ 5 years. Efavirenz (EFV)-based regimens were the most commonly prescribed (57.3%). At the time of their enrollment for EAC, around 43% of the participants were diagnosed with at least one opportunistic infection and 56.7% had WHO clinical stage 1 illness, 31.6% had CD4 counts < 200 cells/mL, and 44.4% had VL $> 10,000$ copies/mL. About two-thirds (63.5%) had good adherence, and most (84.2%) had completed all three sessions of the EAC (Table 3).

Factors Associated with Viral Load Suppression among Clients Enrolled for Enhanced Adherence Counseling

On bivariate analysis, marital status, occupation, ART regimen, opportunistic infection, nutritional status, baseline adherence level, initial CD4 and VL count, and EAC sessions attended had $P < 0.25$. After running the multivariate analysis, the ART regimen, nutritional status, baseline adherence level, initial CD4 count, and number of EAC sessions attended were the ones that showed significant associations with VL suppression. Participants on NVP-based ART regimens at the time of EAC enrollment were less likely to have suppressed VL later than those on a protease inhibitor (PI)-based regimen (AOR 0.125, 95% CI 0.034–0.464). Those on an EFV-based regimen at

Table 2 Sociodemographic characteristics (n=342)

		n	Proportion
Age, years	<10	11	3.2%
	10–19	60	17.5%
	20–29	72	21.1%
	30–39	101	29.5%
	≥40	98	28.7%
Sex	Male	169	49.4%
	Female	173	50.6%
Marital status	Single	140	40.9%
	Married	130	38.0%
	Widowed	29	8.5%
	Divorced	43	12.6%
Education	Cannot read or write	42	12.3%
	Primary	145	42.4%
	Secondary and above	155	45.3%
Occupation	Government employee	53	15.5%
	Self-employed	112	32.8%
	Privately employed	44	12.9%
	Unemployed	133	38.9%
Religion	Orthodox	173	50.6%
	Muslim	26	7.6%
	Protestant	134	39.2%
	Catholic	4	1.2%
	Other	5	1.5%
Residence	Urban	300	87.7%
	Rural	42	12.3%

enrollment had a lower probability of VL suppression than those on a PI-based regimen (AOR 0.223, 95% CI 0.063–0.795).

Participants who did not have normal nutritional status had a 43.5% lower probability of resuppressing than those with normal nutritional status (AOR 0.565, 95% CI 0.329–0.971). Poor adherence was also found to decrease the probability of viral suppression by nearly 50% from that among those with good adherence (AOR 0.504, 95% CI 0.287–0.886). Compared to those with a CD4 count ≥ 500 cells/mL, participants in each group of the decreasing CD4-count categories (350–499, 200–349, <200 cells/mL) showed an increasing significance of association and a lower probability of resuppression (58.3%, 62.5%, and 85.1%, respectively). With regard to EAC sessions attended, it was obvious that those who had attended only one or two of the scheduled sessions had a lower probability of VL suppression than those who had completed them (AOR 0.330, 95% CI 0.149–0.729; Table 4).

Table 3 Clinical characteristics (n=342)

		n	Proportion
Duration on ART (months)	<12	14	4.1%
	12–24	31	9.1%
	25–59	100	29.2%
	≥60	197	57.6%
ART regimen	DTG-based	21	6.1%
	NVP-based	107	31.3%
	EFV-based	196	57.3%
	PI-based	18	5.3%
Opportunistic infection(s)	Yes	148	43.3%
	No	194	56.7%
Co-trimoxazole prophylaxis	Yes	296	86.5%
	No	46	13.5%
INH prophylaxis	Yes	189	55.3%
	No	153	44.7%
WHO stage	1	194	56.7%
	2	47	13.7%
	3	71	20.8%
	4	30	8.8%
Nutritional status	Normal	212	62.0%
	Malnourished	130	38.0%
Functional status	Working	282	82.5%
	Ambulatory	50	14.6%
	Bedridden	10	2.9%
Adherence	Poor	111	32.5%
	Fair	14	4.1%
	Good	217	63.5%
Initial CD4 count	<200 cells/mL	108	31.6%
	200–349 cells/mL	77	22.5%
	350–499 cells/mL	71	20.8%
	≥500 cells/mL	86	25.1%
Initial viral load count	1000–5000 copies/mL	130	38.0%
	5001–10,000 copies/mL	60	17.5%
	>10,000 copies/mL	152	44.4%
Completed session(s)	One	13	3.8%
	Two	41	12.0%
	Three	288	84.2%

Table 4 Sociodemographic and clinical characteristics associated with viral suppression

		Viral load		COR (95% CI)	AOR (95% CI)
		Suppressed (1000 copies/mL), n=140	Unsuppressed (≥1000 copies/mL), n=202		
Marital status	Married	56	74	1	1
	Single	59	81	0.936 (0.594–1.560)	0.790 (0.418–1.493)
	Widowed	11	18	0.808 (0.353–1.846)	0.858 (0.333–2.214)
	Divorced	14	29	0.638 (0.309–1.319)	0.522 (0.227–1.197)
Occupation	Unemployed	59	74	1	1
	Government employee	23	30	0.962 (0.506–1.827)	1.491 (0.675–3.294)
	Self-employed	38	74	0.644 (0.383–1.083)	0.797 (0.412–1.540)
	Privately employed	20	24	1.045 (0.527–2.073)	1.143 (0.509–2.567)
ART regimen	PI-based	14	5	1	1
	DTG-based	16	5	0.914 (0.204–4.008)	0.993 (0.189–5.218)
	NVP-based	34	72	0.133 (0.041–0.435)	0.125 (0.034–0.464)*
	EFV-based	76	120	0.181 (0.057–0.570)	0.223 (0.063–0.795)*
Opportunistic infections	No	89	105	1	1
	Yes	51	97	0.620 (0.399–0.964)	0.735 (0.429–1.260)
Nutritional status	Normal	98	114	1	1
	Malnourished	42	88	0.555 (0.352–0.876)	0.565 (0.329–0.971)*
Adherence	Good	104	113	1	1
	Fair/poor	6	8	0.815 (0.274–2.427)	0.504 (0.287–0.886)*
Initial CD4 count	≥500 cells/mL	23	85	1	
	<200 cells/mL	32	45	0.153 (0.081–0.288)	0.149 (0.071–0.314)*
	200–349 cells/mL	30	41	0.401 (0.213–0.754)	0.375 (0.182–0.772)*
	350–499 cells/mL	55	31	0.412 (0.216–0.786)	0.417 (0.197–0.881)*
Initial VL count	1000–5000 copies/mL	65	65	1	1
	5001–10,000 copies/mL	26	34	0.765 (0.413–1.415)	0.803 (0.389–1.660)
	>10,000 copies/mL	49	103	0.476 (0.293–0.772)	0.608 (0.347–1.063)
EAC sessions attended	3	129	159	1	1
	≤2	11	43	0.370 (0.100–1.372)	0.33 (0.149–0.729)*

Note: *P<0.05.

Abbreviations: ART, antiretroviral therapy; BMI, body mass index; CPT, co-trimoxazole preventive therapy; EAC, enhanced adherence counseling; IPT, isoniazid preventive therapy; PI, protease inhibitor; VL, viral load; WHO, World Health Organization.

Discussion

Findings from the study revealed that VL suppression among clients on ART enrolled for EAC was 40.9% (35.7%–46.5%). Moreover, NVP-based ART regimens, malnutrition, poor adherence, lower CD4 counts, and fewer EAC sessions were significantly associated with VL suppression. Our finding on the proportion of VL suppression reveals a much

lower figure than the recommended 70% by the WHO and even the 66.4% reported in North Wollo, Ethiopia.^{2,20} The disparity with the latter study can be explained by differences in study population, sample size, and the period covered. Consistent results were also seen in a systematic review of mostly African studies (46.1%) and even a similar study done in Bahir Dar, Ethiopia (38.7%).^{8,21}

Despite the fact that our finding stood behind the target recommendation, it is still higher than the 28% seen in India and 10% in Tanzania.^{11,12} This is possibly due to differences in the study population, a smaller sample (ie, the Tanzanian study, where only around 50 clients who were enrolled for EAC were studied), and the study period. An even lower figure (<10%) from a Ugandan study revealed the existence of mutation in most clients who failed to resuppress.¹³ This can explain why results from the current study have figures far exceeding that.

NVP- and EFV-based ART regimens showed almost 90% and 77.7% lower probability of VL suppression than the PI-based regimen, respectively. Similarly, a study from UK and Ireland among children revealed durable suppression in those on PI-based regimens than those on non-nucleoside reverse transcriptase inhibitor-based regimens.⁹ In contrast, our finding stands against a study in Sierra Leone, where a PI-based regimen was associated with failure in VL suppression.³⁰ This can be attributed to the study population, which included adults aged >18 years, who take a PI-based regimen only in special circumstances, making them more liable to other potential factors, ie, adherence problems from pill burden.

Poor nutritional status resulted in a 46% lower probability of resuppression than normal nutritional status. This is supported by findings from a previous study in northeast Ethiopia.²⁹ Participants with poor adherence at the time of EAC enrollment had at least a 50% lower probability of attaining VL suppression following EAC than those with good adherence. Suboptimal adherence has demonstrated similar outcomes in other studies.^{12,14,21,22,24,29,30,33} Lower CD4 count was associated with failing VL suppression following EAC. As per other studies in Ethiopia, low current and baseline CD4 T-cell count predict failure in VL suppression.^{21,28,29} This is supported by studies in Sierra Leone and Zimbabwe.^{30,34} Approximately 70% lower probability of attaining VL suppression was seen among those who had attended only one or two sessions of EAC. Similar results have been reported from studies in Swaziland and Zimbabwe.^{10,34}

Strengths and Limitations

The strength of this study lies basically in the study area, as both public hospitals have been providing the service since the implementation of the EAC program. The large sample is believed to increase the validity of the results. The study also included all age-groups, which makes it sound for analysis and brings a wider range of evidence. Some limitations, ie, capturing data from patients' charts, made it difficult to find records of exact times. In those cases, even though data collectors tried to use recent data, it is not unlikely that this might have caused some variation in outcomes. The wider range of age-groups, which actually increased the number of participants, including children and adolescents, may also have affected outcomes, as ART regimens, adherence, and other factors, ie, nutritional status, vary among these groups.

Conclusion

The proportion of VL suppression among clients enrolled for EAC is far lower than that recommended by the WHO. NVP-based ART regimens, poor nutritional status, poor adherence, lower CD4 counts, and fewer EAC sessions were identified as risk factors that lower proportion of VL suppression in such clients.

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Disclosure

The authors declare no conflicts of interest in this work.

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