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Magnitude of Viral Load Suppression and Associated Factors among HIV-positive Patients Receiving Antiretroviral Therapy

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ABSTRACT

Background: Viral load assessment is the preferred method for diagnosing and confirming virologic failure for patients on antiretroviral therapy. This study aimed to assess the proportion of viral load suppression and identify associated factors among HIV-positive patients receiving antiretroviral therapy at the Pokhara academy of health science in Nepal.

Methods: This institution-based retrospective cohort study was conducted at Pokhara academy of health science in Pokhara, Nepal. The study included 567 HIV patients who were enrolled between January 2016 and December 2019 and had their viral load measured within a one-year period. Statistical analysis was performed using STATA version 13.0. The proportions of viral load suppression and non-suppression were determined. Bivariate and multivariate logistic regressions were performed to identify factors associated with viral load suppression. Statistical significance was determined at a 95% confidence interval and $p < 0.05$

Results: Out of the 567 HIV patients, 95.76 % (95% CI: 94.10-97.42) achieved viral suppression. In multivariate analysis, longer duration of antiretroviral therapy treatment (> 3 years) was independently associated with higher odds of achieving viral suppression compared to those on antiretroviral therapy for less than 6 months (adjusted odds ratio [aOR] = 11.98, 95% confidence interval: 1.32-108.81, $p < 0.0027$). Conversely, individuals in second-line treatment had significantly lower odds of viral suppression compared to those in first-line treatment (aOR = 0.19, 95% CI: 0.05-0.66, $p < 0.009$).

Conclusions: Our study demonstrated a high rate of viral suppression among HIV patients receiving antiretroviral therapy, exceeding the UNAIDS 90-90-90 target. Longer duration of antiretroviral therapy and being in second-line treatment were identified as factors influencing viral load suppression. These findings emphasize the importance of early initiation and adherence to first-line treatment for optimal outcomes.

Keywords: ART; HIV/AIDS; viral load suppression

INTRODUCTION

Globally, about 38 million people have HIV, of whom approximately 62% are on life-saving ART and 53% are virally suppressed.[1] Initiating ART is critical to maintain HIV viral load suppression, improve immunologic function and reduce HIV-related morbidity and mortality.[2,3] Despite the unprecedented scale up of ART coverage in the so -called treat all era, HIV remains the important public health problems in Nepal as there are raising concern over the sustainability of lifelong ART for all people with HIV due to the restricted capacity of the health care system.[4,5] HIV viral load is significantly associated with the degree of active HIV replication, and a high viral load predicts faster disease progression to AIDS and death.[6] Monitoring of the viral load level after ART initiation to assess effectiveness of treatment has been used increasingly in recent years.[7,8] In Nepal, the scale-up of ART has played a crucial role in enhancing HIV treatment and care.[9] However, there is limited

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study regarding the rate of viral suppression and its associated factors, which is essential for assessing the effectiveness of ART initiatives. To ensure the success of ART programs and monitor their impact, it is essential to conduct surveillance and gather data on the extent of viral suppression among individuals receiving treatment. Thus, the present study is designed to provide information on the rate of viral suppression and its associated factors among patient receiving ART at PoAHS.

METHODS

This institution-based retrospective cohort study design was conducted at PoAHS. PoAHS is a tertiary health facility with a 500-bed capacity, serving as a referral center for both private and public health facilities in the Gandaki province. It offers comprehensive services for the diagnosis, treatment, and prevention of HIV, including free counseling and testing.

The study participants included children, adolescent and adult living with HIV. The study was conducted among 567 HIV patients who were enrolled between January 2016 to December 2019 and performed the viral load within 1 years of period. Face to face, interview with the patient was conducted by using the standard questionnaire with each patient prior or during pill pick up. Patient's data included age (children (<10), adolescent (10-19), adult (20 and above), sex (male, female), education (illiterate, primary, secondary, graduate), employment status (employed, non-employed), duration of ART treatment (>6 month, 1-2 years, 2-3 years,>3 years), alcohol habit (yes, no, occasionally, yes; previously but completely stop now, not documented). The clinical and immunological data including ART regimens (first, second) CD4 count (not available, =>350, <350), WHO clinical staging (I, II, III, IV), and TB-HIV co-infection (yes, no).

All patients with complete information on date of sample collection, age, date of ART start and current ART regimen; together with a VL result were included. In our study, patients who were on treatment for less than 6 months and those with missing key information were excluded from the analysis.

The primary outcome was virological suppression, defined as having ≤1000 copies of viral RNA/ml of blood for plasma, as provided by the WHO guideline for treatment and control of HIV/AIDS. The virological non-suppression after six months following initiation of ART, defined as viral load greater than 1000 copies/ml of blood. Secondary outcome of this study was factors associated with viral suppression

The collected data were entered and cleaned in Microsoft Excel 2013. All statistical analyses were performed using STATA V.13.0 (StataCorp). A bar chart was used to illustrate the prevalence of viral suppression and non-suppression among study participants. The association between the viral suppression statuses (yes vs. no) and the different independent variables was analyzed using Chi-square and Fisher's exact test, as appropriate. All explanatory variables in the bivariate analysis were inserted into the multivariate binary logistic regression model to assess the independent effect of each variable on the occurrence of viral suppression and non-suppression.

Ethical clearance and approval were obtained from the Institutional Review Board of PoAHS (reference no. 15.2077/078). Permission to use the data was obtained from the ART center of PoAHS. The data were obtained from a secondary database on HIV-infected patients for viral load monitoring during treatment. The data were anonymized and handled confidentially throughout all phases of the research. All people living with HIV (PLWH) attending the PoAHS prior to or during pill pick-up were informed about the study. Those interested in participating were directed to a research team member, who then further explained the study and obtained informed consent from the participants. All methods were carried out in accordance with relevant guidelines and regulations.

RESULTS

Table 1. Socio-demographic characteristics of study participants (N=567).

Age categories	N	Percentage
Children(<10)	11	1.9
Adolescent(10-19)	29	5.1
Adult (20+)	527	92.6
Sex		
Male	297	52.4
Female	270	47.6
Education		
Illiterate	57	10.1
Primary school	118	20.8
Secondary school	353	62.3
Graduate	39	6.9
Employment status		
Employed	297	52.4
Unemployed	270	47.6

A total of 567 study participants who had been on

antiretroviral therapy for at least 6 months and had a viral load done in the last 12 months were analyzed. Of the 567 study participants, majority 527 (92.6%) were adult aged 20 years and above years and 297 (52.4%) were female. More than half 353 (62.3%) of participants had an education of secondary school level and employed 297(52.4%). (Table 1).

Table 2. clinical characteristics of HIV infected participants.

Duration on ART (months)	N	Percentage
>6 month	44	7.8
1 to 2 years	54	9.5
2 to 3 years	105	18.5
>3 years	364	64.2
ART regimen		
First-line antiretroviral therapy	529	93.3
Second line antiretroviral therapy	38	6.7
Alcohol consumption		
Yes	136	24.0
No	333	58.7
Occasionally	65	11.5
Yes, previously but completely stop now	13	2.3
Not documented	20	3.53
TB HIV Co-infection		
Yes	16	2.8
No	551	97.2
CD4 count		
Not Available	140	24.7
=>350 copies cell/mm3	61	10.8
<350 copies cell/mm3	366	64.5
WHO stage		
1	111	19.6
2	110	19.4
3	335	59.1
4	11	1.9

Among the 567 participants, 364 (64.2%) had been taking ART medication for >3 years. The majority of the patients were on first line 529 (93.3%) treatment. At the time of their enrollment for ART, around 3% of the participants were diagnosed with TB HIV co-infection and 59.1% had WHO clinical stage 3 illness, 64.5% had CD4 counts <350 cells/mL (Table 2).

Of 567 participants that were analyzed in this study, the proportion of participants that achieved viral suppression and viral non-suppression was 95.76 % (95% CI: 94.10-97.42) and 4.24 % (95% CI: 2.57-5.89) respectively (Figure 1).

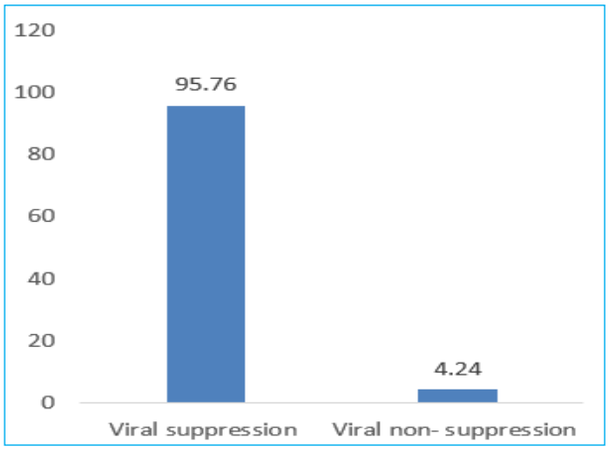

Figure 1. Proportion of viral suppression and viral non suppression.

In the binary logistic regression, being an adult [cOR = 11.25 (95% CI: 2.74-46.17), p < 0.001], being on ART for more than three years [cOR = 4.53 (95% CI: 1.47-13.95), p < 0.008], having no documented alcohol habit [cOR = 0.15 (95% CI: 0.03-0.62), p < 0.009], having no available CD4 count [cOR = 0.36 (95% CI: 0.15-0.85), p < 0.021], and not having TB-HIV co-infection [cOR = 5.82 (95% CI: 1.54-21.99), p < 0.009] were significantly associated with higher and lower odds of attaining viral suppression compared to their reference group (Table 3). After adjusting for possible confounders in a multivariate logistic regression model, a longer duration of ART treatment (> 3 years) [aOR = 11.98 (95% CI: 1.32-108.81), p < 0.0027] was independently associated with increased odds of viral suppression compared to those on ART for >6 months, whereas being in second-line treatment [aOR = 0.19, 95% CI: (0.05-0.66), p < 0.009] was independently associated with lower odds of viral suppression compared to first-line treatment (Table 3).

Table 3. Factors associated with viral suppression among HIV Patients on treatment.

Variable	cOR (95% CI)	p value	aOR (95% CI)	p value
Children(<10)	reference		reference	
Adolescent (10-19)	2.34(0.43-12.77)	0.325	1.43(0.07-26.11)	0.808
Adult (20+)	11.25(2.74-46.17)	0.001	7.30(0.26-204.02)	0.242
Sex				
Male	reference		reference	
Female	1.28(0.56-2.94)	0.552	1.47(0.57-3.81)	0.422
Education				
Illiterate				

Primary school	2.17(0.60-7.83)	0.236	2.19(0.49-9.67)	0.300
Secondary school	2.73(0.92-8.07)	0.069	2.25(0.59-8.55)	0.233
Graduate	1.77(0.32-9.67)	0.505	1.61(0.22-11.62)	0.633
Employment status				
Employed	reference		reference	
Unemployed	0 .76(0.33-1.72)		1.09(0.39-2.99)	0.372
ART duration				
>6 month	reference		reference	
1 to 2 years	1.25(0.33-4.65	0.733	1.99(0.43-9.02)	0.372
2 to 3 years	3.23(0.82-12.68)	0.092	6.27(0.95-41.40)	0.056
>3 years	4.53(1.47-13.95)	0.008	11.98(1.32-108.81)	0.027
ART regimen				
First line	reference		reference	
Second line	0.24(0.08-.69)	0.009	0.19(0.05-0.66)	0.009
Alcohol consumption				
yes	reference			
No	1.2(0.22-6.36)	0.829	0.92(0.29-2.95)	0.901
Occasionally	0.93(0.32-2.68)	0.907	1.26(0.21-7.55)	0.799
yes, previously but completely stop now	-	-	-	-
Not documented	0.15(0.03-0.62)	0.009	0.78(0.04-13.36)	0.867
TB HIV Co-infection				
Yes	reference		reference	
No	5.82 (1.54-21.99)	0.009	4.01(0.83-19.31)	0.083
CD4 count				
<350 copies cell/mm3	reference		reference	
Not Available	0.36(0.15-0.85)	0.021	1.22(0.14-10.32)	0.851
=>350 copies cell/mm3	0.91(0.19-4.22)	0.908	1.99(0.30-13.00	0.473
WHO stage				
1	reference		reference	
2	1.78(.50-6.27)	0.367	0.54(0.10-2.81)	0.473
3	1.66(.64-4.28)	0.289	0.48(0.11-2.07)	0.329
4	-	-	-	

DISCUSSION

The present study aimed to assess viral load suppression among patients on antiretroviral therapy (ART) and explore associated factors at PoAHS. Our findings revealed a high rate of viral load suppression; with 542 out of 567 participants achieving viral load suppression, yielding a suppression rate of 95.76 %(95% CI: 94.10-97.42)

The overall viral suppression rate reported in this study was high and it falls within the global target of 90% viral suppression among PLHIV on HAART by UNAID.[10]

Viral suppression in our study was much higher than results from earlier systematic review studies enrolling similar populations in program based care[11] and the 82% reported global Viral Suppression performance status.[12] This level is higher compared with the study conducted in -western part of Nepal.[13] High level of viral suppression in this study are comparable with the reports from Uganda where a level of 95% was observed for viral suppression after 12 months of HAART among PLHIV.[14]

The high level of viral suppression and low viral non-suppression rate observed in this study provide critically important data on HIV clinical service delivery performance across Nepal. The improved viral suppression rates may reflect a high level of adherence among those patients retained in care. Our findings also suggest that the goal of achieving a 90% level of viral suppression is achievable in a resource-limited setting such as ours, and the current approach to HIV management should be sustained.

In the multivariate analysis, we identified several factors independently associated with viral suppression. One significant finding was the duration of ART treatment. Patients who had been on ART for more than 3 years had significantly higher odds of achieving viral suppression compared to those on ART for less than 6 months. This finding suggests that prolonged treatment duration plays a crucial role in achieving optimal viral suppression, potentially due to improved treatment adherence, drug effectiveness, and immune recovery over time.

Conversely, individuals in second-line treatment had significantly lower odds of viral suppression compared to those in first-line treatment. This observation raises important considerations regarding factors such as drug resistance, treatment failure, or suboptimal adherence among individuals on second-line therapy. Further research is warranted to explore the underlying reasons

for the decreased odds of viral suppression in this specific treatment group.

Our findings regarding the association between longer treatment duration and increased odds of viral suppression is in line with a retrospective study conducted in Ghana, which found that being on ART for more than 3 years was a factor associated with achieving viral suppression.[15] Additionally, a systematic review by Ferrand et al. consistently supported the positive impact of longer treatment duration on achieving viral suppression.[16]

Our study identified that, being on the second line HAART was associated with lower viral suppression when compared with those on the first line. This is similar with the observation in Borno State, northeast Nigeria where being on the second line HAARTs was associated with high viral load counts.[17] In contrast, our finding of lower odds of viral suppression among individuals in second-line treatment contradicts some previous studies. For instance, Cao, Pi, et al. (2018) reported no significant differences in viral suppression rates between first-line and second-line ART recipients.[18] These discrepancies might be due to differences in the study design, differences in the definition and assessment of viral suppressions well as the sociodemographic characteristics of the study participants. More research is warranted to reconcile these contradictory findings and gain a comprehensive understanding of the factors influencing viral suppression across different treatment lines

Viral suppression was varied in relation to the age of the participants. Adult (20 years and above) were more likely to be virally suppressed in compared to children (0-10 years), consistent with the study conducted among Ugandan children and adult.[19]

There are several strengths to this study. Our data are from routinely collected laboratory information, which can reflect the actual progress of the viral load monitoring programme and done in relatively higher sample size with appropriate analysis technique that provides important information regarding viral load assessment. The study was also inclusive; it included all age groups (children, adolescents and adults), a key subgroup. These results could, therefore be generalizable to many health care service facilities within the similar setting. However, our study is limited being a single center study, on-treatment methodology does not account for patients who have been lost to follow-up or died while on ART which may affect the estimate of viral suppression.. Finally, the limited number of available variables did not allow us to measure whether other factors - including comorbid medical or psychiatric conditions and income - were associated with viral suppression.

CONCLUSIONS

Our study demonstrated a good viral suppression among HIV patient receiving ART at PoAHS. Longer duration of ART treatment (>3 years) is associated with higher odds of achieving viral suppression, highlighting the importance of treatment continuity. However, individuals in second-line treatment show lower odds of viral suppression compared to those in first-line treatment, indicating the need for targeted interventions to improve outcomes in this subgroup. Thus, strategies towards improved monitoring of patient with second line treatment and long-term treated patients are crucial in maximizing viral suppression.

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CONFLICT OF INTEREST

The authors declare no conflict of interest

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