Less than 19	17	9	9.030976	0.060330
19- less than 25	206	33		
25- less than 30	22	3		
30 and over	2	0		
Child	3	0		

The prevalence of viral load suppression among PLHIV in Rutsiro District was 84.7% based on their sixth-month viral load test after being initiated on ART. It was revealed the significant association between marital status (χ2=8.984187, P-value 0.029502), alcohol consumption (χ2=9.160790, P-value: 0.002473), and adherence to ART (χ2=121.504314, P-value: <.001) with viral load suppression and it had no observed association with other studied socio-demographic, lifestyle and clinical factors.

Table 3: Clinical factors related to viral load suppression

Variables	**Viral load suppression at 6 months**		**χ2 Statistique**	**P-values**
	Yes	No		
Admission mode				
VCT	148	31	2.117399	0.346907
PMTCT	53	9		
PIT	49	5		
Length for enrolment				
Within the first month	228	39	2.550090	0.279418
1-3 months	13	2		
Over 3 months	9	4		
Pre ART prophylaxis				
Yes	22	4	0.000375	0.984552
No	228	41		
Baseline WHO stage				
Stage I	206	32	5.188777	0.158485
Stage II	31	7		
Stage III	8	3		
Stage IV	5	3		
ART regime changes				
Yes	91	13	0.942576	0.331616
No	159	32		
Reasons for regimes changes				
Interaction	0	1	7.136764	0.067664
Side effects	2	0		
Guideline changes	89	12		
Not applicable	159	32		
Associated health conditions				
Asthma	1	0	6.854798	0.076673
Epilepsy	1	2		
Modern family planning	26	3		
No associated condition	222	40		
Adherence				
Very Good or 95% and more	229	13	121.504314	<.001
Good or 85-94%	20	17		
Poor or less than 85%	1	15		
ART Regime				
TDF+3TC+EFV	82	23	7.202288	0.302544
ABC+3TC+EFV	14	3		
AZT+3TC+EFV	1	0		
AZT+3TC+NVP	1	0		

TDF+3TC+DTG	133	15		
ABC+3TC+DTG	8	2		
Other	11	2		

After the marital status, adherence, and alcohol consumption were identified to have been associated with viral load suppression after cross-tabulation and chi-square test, they have been subject to adjustment to eliminate confounders, and results with the binary logistic regression found that the significantly viral load suppression factors were only adherence to ART and alcohol consumption as PLHIV with very good adherence of 95% and the more good adherence of 85-94%, were .005 (CI: .001-.041, P-value <.001) and .074 (CI: .008-.657, P-value: .019) less likely to have unsuppressed viral load respectively while those who drink alcohol were 3.254 times (CI: 1.310-8.084, P-value: .011) less likely to have the viral load suppression.

Table 4: Factors associated with viral load suppression at binary logistic regression analysis

Factors	OR	95% Confidence Interval	P-values
Marital status			
Single	1.518	.410-5.627	.532
Married	.703	.204-2.422	.577
Separated/divorced	.513	.050-5.272	.574
Widow	1		
Alcohol consumption			
Yes	3.254	1.310-8.084	**.011**
No	1		
Adherence			
Very Good or 95% and more	.005	.001-.041	**<.001**
Good or 85-94%	.074	.008-.657	**.019**
Poor or less than 85%	1		

4. DISCUSSIONS

The viral load test results showed viral load suppression in 250 patients (84.7%) which was below the UNAIDS 90-90-90 target [9]. However, this finding is quite similar to the findings of the study conducted in Uganda where 85.7% had achieved viral load suppression [10] but higher compared with 69% reported by Lokpo et al., (2020) in Ghana. In contrast, this prevalence is lower than 93% found in Vietnam [12], 89% in Uganda [13], and 91.8% found in South Africa [14].

Most participants (64.4%) were aged between +24-49 years, and many of the participants 163(62.0%) were female. These findings are almost similar to that of a study conducted in 5 countries (Eswatini, Lesotho, Malawi, Zambia, and Zimbabwe) where 64.2% were female and 62.9% were aged between +24-49 years [15]. And also it is in the same trends with other various studies which reported a big number of HIV infected female like in Uganda [10], Ghana [11], and Ethiopia [16]. According to the UNAIDS, this high prevalence of HIV observed among females is due to socio-cultural, economic and political inequality they face [17].

About a half of the participants (50.8%) were married and the majority of participants 244 (82.7%) did not reveal their HIV status to their family. This is in line with the fact that PLVIH tends to hide their HIV status to others as well as their family members due to fear of stigma and discrimination [18].

Previous studies conducted in Ho Municipality hospital in Ghana [11] and in Bulambuli district in eastern Uganda [10] revealed no considerable pattern in the rate of viral load suppression within the different age groups and this was supported by this current study.

In addition, the literature says that the distance from someone's residence to health facility has no effect on viral load suppression [10] but contrasted with the previous studies reported that sex [16] [19] [14], marital status, and residences [10] have the significant interaction with viral load suppression.

PLHIV tends to smoke and use alcohol in a harmful ways due to overwhelming stress and social isolation [20]. In this study, there was a slight difference between the alcohol consumers (48.1%) and those who didn't consume alcohol (51.9%). In addition to that, the number of smokers was much smaller (2.4%) compared to 11.2% reported in South Africa [14]. Similar to the report of Mogosetsi and colleagues, this study found that sexual partners and smoking had no significant link with viral load suppression [14].

On other hand, the cross-tabulation and chi-square test demonstrated a significant association between alcohol consumption and viral load suppression. Thereafter, the binary logistic regression revealed that those who consumed alcohol were 3.254 times more likely to have an unsuppressed viral load. This confirms the previous studies conducted in Rwanda and Morocco which had revealed that alcohol consumption increases the chance of not adhering to ART [21] and unsuppressed viral load [19] respectively.

Some previous studies [22] reported that the increase in BMI while on high active ART is a good sign for body rebuilding following ART usage. In this context lower BMI is associated with ART failure [23] which is consistent with the findings of this current study.

The majority (60.7%) was admitted through VCT, which is consistent with previous studies that revealed that VCT is the cornerstone in HIV services including prevention, risk reduction, treatment, and care provision[18]. Almost all participants (90.5%) had enrolled in ART within the first month following the diagnosis. This is a good indication of effective HIV management and prevention because early ART initiation, even on the day of diagnosis, improves the clinical outcomes especially for the clients with low CD4+ cell count [24] [22] and reduces the risk of transmission among discordant couples [25].

According to WHO staging, the biggest portion of participants (80.7%) were in the first stage. This was much greater when compared to 3% observed in South Africa [14] but in the same trends with studies done in Kenya [26] and Vietnam [12] where 83.6% and 94% of participants were in the first WHO baseline stage consecutively.

Several lines of evidence established that ART change is caused by drug toxicity, stock-out, associated health condition, and treatment failure [27] [28][29]. This study revealed that the ART regimen had been changed on 35.3% of participants and the most reasons were due to change in ART guidelines (97% or 101/104). In this line, no case of ARV toxicity had been reported and accused to be the causes for regimen change unlike in two studies conducted in Ethiopia [28][29] drug toxicity was reported as the most common cause of ART regimen change.

The findings demonstrated that one out of a hundred (1%) and three out of a thousand (0.03%) had tuberculosis and epilepsy respectively. This is different from the finding of JIMA and colleagues who reported only Tuberculosis as the only co-morbidity in their study conducted among patients on highly active ART in Ethiopia [30].

Regarding adherence to ART, 82% of participants had very good adherence (≥95%) which is in concordance with the previous study conducted in Rwanda that reported a high level of adherence to the ART program among Rwandans [21]. Similarly, the studies conducted in Northern Ethiopia [31] and Eastern Uganda [10] revealed that 94.84% and 85.7% had good adherence, respectively.

Among clinical factors, only adherence had a significant relationship with viral load suppression during cross-tabulation and chi-

square tes. The binary logistic regression showed that very good adherence to ART regimen or having a good adherence reduces the odds of unsuppressed viral load by 99.5 and 99.24 chances respectively if compared with poor adherence. This was found to be in concordance whith what was reported in Uganda where people with poor adherence were 4.55 times more likely to have an unsuppressed viral load compared to those who had good adherence [10]. Similarly, many others studies [31],[32],[13] have echoed crucial adherence as a factor for viral load suppression.

5. CONCLUSIONS

To sum up, the findings of this present study revealed the short prevalence of viral load suppression below the third 90 UNAIDS target. Indeed, alcohol consumption and adherence to ART were revealed as the main factors influencing the viral load suppression and they should be closely monitored among PLHIV to the extent level their influences on viral load suppression prevalence is well controlled. People living with HIV have to be encouraged to quitting alcohol consumption and health care providers should encourage, guide, and monitor them to make sure they address any concern that can interfere with adherence to ART on time.

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References

[1] UNAIDS, "Global HIV statistics. Fact sheet- world AIDS day 2019," 2019.

[2] CDC, "HIV Prevention Progress Report, 2019. Includes national and state-level data for 2010 through 2017 where available," 2019. [Online]. Available: https://www.cdc.gov/hiv/pdf/policies/progressreports/cdc-hiv-preventionprogressreport.pdf.

[3] PEPFAR, "Rwanda Country Operational Plan (COP) 2019 Strategic Direction Summary," 2019.

[4] Ministry of Health, "RWANDA POPULATION-BASED HIV IMPACT ASSESSMENT," 2019.

[5] Mira Desai, Geetha Iyer, "Antiretroviral drugs: Critical issues and recent advances," *Indian J Pharmacol.*, vol. 44(3), pp. 288–298., 2012, doi:10.4103/0253-7613.96296.

[6] Ministry of Health, "National Guidelines for Prevention and Management of HIV and STIs Edition 201 6," Kigali, 2016.

[7] Ministry of Health, "Health Management Information System," Rutsiro, 2019.

[8] Rutsiro District, "District Development Strategies 2018-2024," Rutsiro, 2018.

[9] UNAIDS, "An ambitious treatment target to help end the AIDS epidemic," 2014.

[10] P. Wakooko, Y. Gavamukulya, and J. N. Wandabwa, "Viral load Suppression and Associated Factors among HIV Patients on Antiretroviral Treatment in Bulambuli District, Eastern Uganda : A Retrospective Cohort Study," *Infect. Dis. Res. Treat.*, vol. 13, p. 7, 2020, doi: 10.1177/1178633720970632.

[11] S. Y. Lokpo *et al.*, "Viral Suppression and Its Associated Factors in HIV Patients on Highly Active Antiretroviral Therapy (HAART): A

Retrospective Study in the Ho Municipality , Ghana," *AIDS Res. Treat.*, vol. 2020, no. 3, p. 3, 2020.

[12] S. Rangarajan *et al.*, "Factors associated with HIV viral load suppression on antiretroviral therapy in Vietnam," *J. Virus Erad.*, vol. 2, p. 98, 2016.

[13] L. Bulage *et al.*, "Factors Associated with Virological Non- suppression among HIV-Positive Patients on Antiretroviral Therapy in Uganda , August 2014 – July 2015," *BMC Infect. Dis.*, vol. 17, no. 326, pp. 1–11, 2017, DOI: 10.1186/s12879-017-2428-3.

[14] N. J. Mogosetsi, L. H. Mabuza, and G. A. Ogunbanjo, "The Prevalence of HIV Load Suppression and Related Factors Among Patients on ART at Phedisong 4 Clinic , Pretoria , South Africa," *Open Public Health J.*, vol. 11, p. 140, 2018, doi: 10.2174/1874944501811010135.

[15] A. D. Haas *et al.*, "Prevalence of Nonsuppressed Viral Load and Associated Factors Among Adults Receiving Antiretroviral Therapy in Eswatini, Lesotho, Malawi, Zambia, and Zimbabwe (2015-2017): Results from Population-Based Nationally-Representative Surveys," 2020.

[16] J. H. Ali and T. G. Yirtaw, "Time to viral load suppression and its associated factors in a cohort of patients taking antiretroviral treatment in East Shewa zone, Oromiya, Ethiopia," *BMC Infect. Dis.*, vol. 19, no. 1084, p. 4, 2019.

[17] UNAIDS, "Women and girls and HIV," Geneva, Switzerland, 2018.

[18] A. Cloete, A. Strebel, L. Simbayi, B. Van Wyk, N. Henda, and A. Nqeketo, "Challenges Faced by People Living with HIV / AIDS in Cape Town , South Africa : Issues for Group Risk Reduction Interventions," *AIDS Res. Treat.*, vol. 2010, no. 420270, p. 5, 2010, DOI: 10.1155/2010/420270.

[19] T. Hicham *et al.*, "Risk Factors Associated with Unsuppressed Viral Load in HIV - 1 Infected Patients at the First Antiretroviral Therapy in Morocco," *Int. J. Mycobacteriology*, vol. 8, no. 2, p. 114, 2019, doi: 10.4103/ijmy.ijmy.

[20] WHO, "Consolidated guidelines on Hiv prevention, diagnosis, treatment and care for key populations," 2016.

[21] B. Elul *et al.*, "High Levels of Adherence and Viral Suppression in a Nationally Representative Sample of HIV-Infected Adults on Antiretroviral Therapy for 6 , 12 and 18 Months in Rwanda," *PLoS One*, vol. 8, no. 1, p. 6, 2013, DOI: 10.1371/journal.pone.0053586.

[22] G. Ssekalembe, M. I. Atoillah, and S. Hendick, "Current Status Towards 90-90-90 UNAIDS Target and Factors Associated with HIV Viral Load Suppression in Kediri City , Indonesia," *HIV/AIDS–Research Palliat. Care*, vol. 12, p. 54, 2020.

[23] A. Endalamaw, M. Mekonnen, D. Geremew, F. A. Yehualashet, and H. Tesera, "HIV / AIDS treatment failure and associated factors in Ethiopia : meta-analysis," *BMC Public Health*, vol. 20, no. 82, p. 8, 2020.

[24] N. Ford *et al.*, "Benefits and risks of rapid initiation of antiretroviral therapy," *AIDS*, vol. 32, no. 1, p. 21, 2017, DOI: 10.1097/QAD.0000000000001671.

[25] P. Liu, Z. Tang, G. Lan, Q. Zhu, H. Chen, and Y. You, "Early antiretroviral therapy on reducing HIV transmission in China : strengths , weaknesses and next focus of the program," *Sci. Rep.*, vol. 8, no. 3431, pp. 1–7, 2018, DOI: 10.1038/s41598-018-21791-2.

[26] J. M. Kangethe *et al.*, "Virological Suppression among HIV Infected Adolescents and Youths Receiving ART in the National Teaching and Referral Hospital in Kenya," *Clin. J. HIV AIDS*, vol. 4, no. 1, p. 40, 2020, DOI: 10.36959/695/567.

[27] M. Sisay, D. Edessa, and Y. Ayele, "Pattern of and reasons for antiretroviral therapy regimen change among adult HIV / AIDS patients at regional hospital in Eastern Ethiopia : A 10-year retrospective study," *SAGE Open Med.*, vol. 7, no. 1, pp. 1–11, 2019, DOI: 10.1177/2050312119827092.

[28] Y. T. JIMA, M. T. ANGAMO, and N.-T. WABE, "Causes for antiretroviral regimen change among HIV / AIDS patients in Addis Ababa , Ethiopia," *Tanzan. J. Health Res.*, vol. 15, no. 1, p. 7, 2013.

[29] G. Fekadu, L. Bati, and H. Gebeyehu, "Reasons for Antiretroviral Treatment Change Among Adult HIVAIDS Patients at Nedjo General Hospital , Western Ethiopia Abstract :," *Open AIDS J.*, vol. 13, pp. 65–73, 2019, DOI: 10.2174/1874613601913010065.

[30] B. Woldemedhin and N. T. Wabe, "The Reason for Regimen Change Among HIV / AIDS Patients Initiated on First Line Highly Active

Antiretroviral Therapy in Southern Ethiopia," *N. Am. J. Med. Sci.*, vol. 4, no. 1, p. 22, 2012, DOI: 10.4103/1947-2714.92898.

[31] A. A. Desta *et al.*, "HIV virological non-suppression and factors associated with non-suppression among adolescents and adults on antiretroviral therapy in northern Ethiopia : a retrospective study," *BMC Health Serv. Res.*, vol. 20, no. 4, pp. 4–5, 2020.

[32] M. Ahmed, H. Merga, and H. Jarso, "Predictors of virological treatment failure among adult HIV patients on first-line antiretroviral therapy in Woldia and Dessie hospitals , Northeast Ethiopia : a case-control study," *BMC Infect. Dis.*, vol. 19, no. 305, pp. 5–6, 2019.