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Burden of Viral Hepatitis and Syphilis Coinfections and Association with Virological Status of HIV-infected Patients Undergoing Antiretroviral Therapy

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Abstract

Background

Human immunodeficiency virus (HIV) infection significantly impacts the immune system, making individuals more susceptible to various infections, including viral hepatitis and syphilis. Coinfections pose substantial challenges for public health due to the complexity of managing multiple infections concurrently. This study, assessed the burden of viral hepatitisand syphilis coinfections among people living with HIV (PLHIV) in Nepal

Methodology:

A hospital based cross-sectional study was conducted at the Shukraraj Tropical and Infectious Disease Hospital, Teku. For this study, 5 ml of blood samples were collected from 241 HIV infected patients undergoing antiretroviral therapy. HIV-1 RNA was quantified by Real-Time PCR. A rapid screening was done for Hepatitis B surface antigen, anti-HCV, and anti-HEV using an immunochromatographic assay, and was confirmed by enzyme-linked immunosorbent assay and RPR/Syphilis antibody test for syphilis.

Results

Overall, 59 out of 241 participants (24.5%) were co-infected with viral hepatitis and syphilis. Categorically, the seroprevalences of viral hepatitis mono-infections were 3.3% (HBV), 6.6% (HCV), and 1.2% (HEV) among the participants. Syphilis coinfection was observed in 10.8% of participants. Meanwhile, 0.4% of participants were co-infected with HIV-HBV-HCV and HIV-HBV-Syphilis, while 1.7% were co-infected with HIV-HCV-Syphilis. Notably, age ($p = 0.013$), and sex ($p = 0.003$), were associated with increased HCV coinfection rates. Furthermore, individuals with syphilis coinfections exhibited poorer adherence to ART. Although virological failure rates were relatively low (5%), good adherence (> 95%) was associated with better virological outcomes.

Conclusion

The study highlights the substantial burden of viral hepatitis and syphilis coinfections in PLHIV, and there was no association with virological status. These findings emphasize the importance of sustained efforts to optimize ART adherence and virological monitoring in PLHIV with coinfections.

Introduction

Human Immunodeficiency Virus (HIV) remains a major global public health issue, with an estimated 39 million people living with HIV (PLHIV) at the end of 2022. In that year, there were 1.3 million new HIV infections and 630,000 deaths due to HIV-related causes. Regionally, Southeast Asia accounted for an estimated 3.9 million HIV-positive individuals. By the end of 2022, around 110,000 people had newly acquired HIV, and HIV-related causes contributed to approximately 85,000 fatalities in the region.[1,2] The first case of HIV in Nepal was reported in 1988, and since then, the epidemic has largely remained concentrated among key populations—including people who inject drugs, sex workers and their clients, men who have sex with men and transgender people, male labor migrants and their wives, and prison inmates. Despite this, heterosexual transmission remains dominant, accounting for approximately 69% of cases.[3]

Effective ART can significantly extend the lifespan of people living with HIV (PLHIV) and reduce the risk of HIV transmission. In 2013, the WHO recommended HIV-1 viral load testing as the preferred method for monitoring treatment effectiveness and detecting ART failure.[1,3–6]

Viral hepatitis, primarily caused by hepatitis B and C, is a leading cause of mortality from communicable diseases worldwide. It is the main contributor to liver cirrhosis, liver cancer, and other related deaths, affecting hundreds of millions of people. Globally, as of 2019, the WHO estimates that 296 million people were living with chronic hepatitis B infection, and 58 million people have chronic hepatitis C virus infection.[7,8]

These coinfections can worsen the progression of both HIV and viral hepatitis, increasing the risk of liver disease, hepatocellular carcinoma, and premature death. PLHIV (people living with HIV) are more likely to become chronic carriers of HBV and have poorer clearance of HCV, leading to higher viral loads, faster disease progression, and up to a 50% increase in AIDS-related mortality when co-infected with HCV.[9–13]

Acute viral hepatitis is most commonly caused by Hepatitis E Virus (HEV) globally, with around 20 million infections, 3.3 million symptomatic cases, and 44,000 deaths annually.[14] People living with HIV (PLHIV) are particularly vulnerable to HEV due to immune suppression, frequent coinfections with HBV and HCV, and often limited access to clean water and sanitation.

Syphilis is a curable bacterial sexually transmitted disease (STD), but if left untreated, it can lead to serious health complications. The infection significantly increases the risk of acquiring or transmitting other STIs, particularly HIV, due to mucosal disruption, immune alterations, and changes in the genital tract environment.

The main objective of this study is to determine viral hepatitis coinfections and syphilis coinfections and viral load to find the association of these coinfections in people living with HIV AIDS on ART.

Methodology

A hospital-based cross-sectional study was conducted in Shukraraj Tropical and Infectious Disease Hospital (STIDH), Teku, Kathmandu, Nepal, among 241 people living with HIV/AIDS undergoing ART for at least 6 months after taking the written consent, who were ready to be part of the study voluntarily.

Screening of HBsAg, anti-HCV, anti-HEV & RPR/Syphilis Ab and confirmed by ELISA.

According to WHO criteria, patients with an HIV-1 viral load level < 1000 copies/milliliter were classified as suppressed, and those with a level ≥ 1000 copies/milliliter were classified as not suppressed. Adherence level was calculated by dividing the number of doses of ART taken by the number of prescribed doses of ART and was expressed in a percentage. It was then categorized as good adherence (> 95%), fair adherence (85–95%), and poor adherence (< 85%).[11]

Data Analysis

All collected data was checked, reviewed, and organized, and tabulated for accuracy and completeness. Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics 20. Sociodemographic and clinical characteristics of HIV patients were presented as frequency and percentages. Chi-square, Fisher's Exact test were used to find out the association of co-infections with virological status. A p-value of ≤ 0.05 was used to declare statistical significance.

Results

Seroprevalence of HBV, HCV, HEV, and Syphilis

Overall, 59 out of 241 (24.5%) participants were co-infected with viral hepatitis and syphilis coinfections. Specifically, the seroprevalences of viral hepatitis, i.e., HBV, HCV, and HEV mono-infection were 8(3.3%),16(6.6%), and 3(1.2%), respectively, and syphilis coinfection was26(10.8%). 1(0.4%) participants was co-infected with both HBV and HCV, 1(0.4%) participants was co-infected with both HBV and Syphilis, and 4(1.7%) participants were co-infected with both HCV and syphilis. (Fig. 1)

Sociodemographic and clinical characteristics

The sociodemographic and clinical characteristics of the participants are summarized in Table 1. Briefly, of the 241 HIV-positive individuals were enrolled in the study, 144 (59.8%) were male and rest were female, with a mean ±standard deviation age of 41 ± 11 years. More than half of the participants, 137 (56%), were within the age group of 38–57 years, while 16 (6.6%) were above 57 years of age. The majority of the participants, 223 (92.5%), were married. Similarly, more than three-quarters of the participants, 192 (79.9%), were illiterate and/or undergraduate. In terms of ethnicity, the participants were evenly distributed among the Brahmin, Tamang, and Newar groups, with each group comprising 51 (21.2%) of the total sample. Geographically, only 2 (0.8%) were from Karnali Province, whereas the majority, 161 (66.8%), were from Bagmati Province. More than half of the participants, 125 (51.9%), had been receiving antiretroviral therapy (ART) for a duration of 1–5 years.

Table 1
Sociodemographic and clinical characteristics of HIV-infected patients with HBV, HCV, HEV, and Syphilis co-infections (n = 241)

Characters	HBV coinfection		HCV coinfection		HEV coinfection		Syphilis coinfection		Total
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Coinfections	231 (95.9)	10 (4.1)	220 (91.3)	21 (8.7)	238 (98.8)	3 (1.2)	210 (87.1)	31 (12.9)	241(100.0)
Sex									
Male	137 (59.3)	7 (70)	125 (56.8)	19(90.5)	142 (59.7)	2 (66.7)	120 (57.1)	24 (77.4)	144 (59.8)
Female	94 (40.7)	3 (30)	95 (43.2)	2 (9.5)	96 (40.3)	1 (33.3)	90 (42.9)	7 (22.6)	97(40.2)
Age (years)									
18–37	87 (37.7)	3 (30)	87 (39.5)	3 (14.3)	88 (37)	2 (66.7)	71 (33.8)	19 (61.3)	90 (37.3)
38–57	128 (55.4)	7 (70)	118 (53.6)	17(81.0)	134 (56.3)	1 (33.3)	125(59.5)	10 (32.3)	135 (56)
> 57	16 (6.9)	0 (0)	15 (6.8)	1 (4.8)	16 (6.7)	0 (0)	14 (6.7)	2 (6.4)	16(6.6)
Marital Status									
Unmarried	18 (7.8)	0 (0)	18 (8.2)	0 (0)	17 (7.1)	1 (33.3)	16 (7.6)	2 (6.5)	18 (7.5)
Married	213 (92.2)	10(100)	202 (91.8)	21 (100)	221 (92.9)	2 (66.7)	194 (92.4)	29 (93.5)	223 (92.5)
Educational level									
Illiterate/ Undergraduate	184 (79.7)	8 (80)	178 (80.9)	14(66.7)	190 (79.8)	2 (66.7)	167 (79.5)	25 (80.6)	192 (79.7)
Graduate	42 (18.2)	2 (20)	38 (17.3)	6 (28.6)	43 (18.1)	1 (33.3)	38 (18.1)	6 (19.4)	44 (18.3)
Postgraduate	5 (2.2)	0 (0)	4 (1.8)	1 (4.8)	5 (2.1)	0 (0)	5 (2.4)	0 (0)	5 (2.1)
Ethinicty									
Brahmin	51 (22.1)	0 (0)	47 (21.4)	4 (19.0)	51 (21.4)	0 (0)	44 (21.0)	7 (22.6)	51 (21.2)
Chhetri	39 (16.9)	2 (20)	38 (17.3)	3 (14.3)	41 (17.2)	0 (0)	33 (15.7)	8 (25.8)	41 (17.0)
Tamang	50 (21.6)	1 (10)	49 (22.3)	2 (9.5)	48 (20.2)	3 (100)	46 (21.9)	5 (16.1)	51 (21.2)
Newar	50 (21.6)	1 (10)	44 (20.0)	7 (33.3)	51 (21.4)	0 (0)	45 (21.4)	6 (19.4)	51 (21.2)
Limbu	26 (11.3)	4 (40)	27 (12.3)	3 (14.3)	30 (12.6)	0 (0)	28 (13.3)	2 (6.5)	30 (12.4)
Others	15 (6.5)	2 (20)	15 (6.8)	2 (9.5)	17 (7.1)	0 (0)	14 (6.7)	3 (9.7)	17 (7.1)
Province									
Koshi	18 (7.8)	0 (0)	15 (6.8)	3 (14.3)	18 (7.6)	0(0)	16 (7.6)	2 (6.5)	18 (7.5)
Madhesh	10 (4.3)	2 (20)	12 (5.5)	0 (0)	12 (5.0)	0(0)	10 (4.8)	2 (6.5)	12 (5.0)
Bagmati	155 (67.1)	6 (60)	145 (65.9)	16(76.2)	158 (66.4)	3 (100)	141 (67.1)	20 (64.5)	161 (66.8)
Gandaki	25 (10.8)	1 (10)	25 (11.4)	1 (4.8)	26 (10.9)	0(0)	24 (11.4)	2 (6.5)	26 (10.8)
Lumbini	16 (6.9)	1 (10)	16 (7.3)	1 (4.8)	17 (7.1)	0(0)	13 (6.2)	4 (12.9)	17 (7.1)
Karnali	2 (0.9)	0(0)	2 (0.9)	0 (0)	2 (0.8)	0(0)	1 (0.5)	1 (3.2)	2 (0.8)
Sudur Paschim	5 (2.2)	0(0)	5 (2.2)	0 (0)	5 (2.1)	0(0)	5 (2.4)	0 (0)	5 (2.1)
Duration on ART (in a year)									
1–5	117 (50.6)	8 (80)	118 (53.6)	7 (33.3)	123 (51.7)	2 (66.7)	106 (50.5)	19 (61.3)	125(51.9)
6–10	49 (21.2)	1 (10)	45 (20.5)	5 (23.8)	50 (21)	0 (0)	43 (20.5)	7 (22.6)	50 (20.7)
11–15	49 (21.2)	1 (10)	43 (19.5)	7 (33.3)	49 (20.60	1 (33.3)	47 (22.4)	3 (9.7)	50 (20.7)
16–20	15 (6.5)	0 (0)	14 (6.4)	1 (4.8)	15 (6.3)	0 (0)	13 (6.2)	2 (6.5)	15 (6.2)
> 20	1 (0.4)	0 (0)	0 (0)	1 (4.8)	1 (0.4)	0 (0)	1 (0.5)	0 (0)	1 (0.4)
ART Regimen currently used									
1st line regimen	226 (97.8)	10 (100)	217 (98.6)	19 (90.5)	233 (97.9)	3 (100)	205 (97.6)	31 (100)	236 (97.9)

Characters	HBV coinfection		HCV coinfection		HEV coinfection		Syphilis coinfection		Total
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive	
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
2nd line regimen	5 (2.2)	0 (0)	3 (1.4)	2 (9.5)	5 (2.1)	0 (0)	5 (2.4)	0 (0)	5 (2.1)
ART adherence level									
Good adherence	215 93.1)	8 (80)	205 (93.2)	18(85.7)	220 (92.4)	3 (100)	194 (92.4)	29 (93.5)	223 (92.5)
Fair adherence	12 (5.2)	2 (20)	11 (5.0)	3 (14.3)	14 (5.9)	0 (0)	14 (6.7)	0 (0)	14 (5.8)
Poor adherence	4 (1.7)	0 (0)	4 (1.8)	0 (0)	4 (1.7)	0 (0)	2 (1.0)	2 (6.5)	4 (1.7)
Viral Load									
< 1000 cps/ml	220 (95.2)	9 (90)	221 (95.9)	18 85.7)	226 (95)	3 (100)	200 (95.2)	29 (93.5)	229 (95.0)
≥ 1000 cps/ml	11 (4.8)	1 (10)	9 (4.1)	3 (14.3)	12 (5)	0 (0)	10 (4.8)	2 (6.5)	12 (5.0)

Association of virological status with adherence level and antiretroviral therapy duration and status.

Table 2 shows the effect of virological status with age, sex, adherence level, ART duration with regimen currently in use, and baseline of HIV-1 viral load suppression. Briefly, there was a significant association between HIV-1 viral load suppression rate with adherence level ($p = 0.001$) as well as a baseline of HIV-1 viral load suppression rate($p = 0.013$). Participants with a higher baseline HIV-1 viral load were significantly more likely to have a higher viral load.

Association of Hepatitis B, C virus and Syphilis coinfections with virological status

There was a significant association between the effect of Hepatitis C virus coinfection and with age ($p = 0.013$) and sex ($p = 0.003$). The adherence level ($p = 0.03$), sex ($p = 0.032$), and age ($p = 0.001$) were significantly associated with syphilis coinfections in individuals undergoing ART treatment. (Table 3).

Table 2

Association of virological status with adherence-level antiretroviral therapy duration and status

Characteristics	Virological status		Chi-Square Tests	
	< 1000 cps/ml (n = 229)	**≥ 1000 cps/ml (n = 12)**		**p-value**
ART Duration (years)				
< 5 (n = 125)	120	5	0.526	0.468
≥ 5 (n = 116)	109	7		
Adherence level				
Good adherence	218	5		0.001[#]
Fair adherence	10	4		
Poor adherence	1	3		
Sex of Participants				
Male	137	7	0.011	0.918
Female	92	5		
Age of Participants (years)				
< 40	116	4	1.369	0.242
≥ 40	113	8		
ART Regimen				
1st line regimen	225	11		0.227[*#]
2nd line regimen	4	1		
Baseline of Viral Load				
< 1000 cps/ml	212	8		0.013[*#]
≥ 1000 cps/ml	17	4		

[#]Significant at $p < 0.05$

* Fisher exact test

Table 3
Association of Viral hepatitis and Syphilis coinfections with virological status

Characteristics	HBV coinfections		Chi-Square Tests	p-value	HCV coinfection		Chi-Square Tests	p-value	Syphilis coinfection		Chi-Square Tests	p-value
	Negative n = 231	Positive n = 10			Negative n = 220	Positive n = 21			Negative n = 210	Positive n = 31		
ART Duration (years)												
< 5 (n = 125)	117	8		0.105*	118	7		0.108*	106	19	1.265	0.261
≥ 5 (n = 116)	114	2			102	14			114	12		
Adherence level												
Good adherence	215	8	3.967	0.138	215	8	3.343	0.188	194	29	6.992	0.03#
Fair adherence	12	2			12	2			14	0		
Poor adherence	4	0			4	0			2	2		
Sex of Participants												
Male (144)	137	7		0.744*	125	19	9.030	0.003#	120	24	4.618	0.032#
Female (97)	94	3			95	2			90	7		
Age of Participants (years)												
< 40 (120)	116	4		0.749*	115	5	6.212	0.013#	96	24	10.861	0.001#
≥ 40 (121)	115	6			105	16			114	7		
ART Regimen												
1st line regimen	226	10		1.0*	217	19		0.062*	205	31		1.000*
2nd line regimen	6	0			3	2			5	0		
Virological status												
< 1000 cps/ml	220	9		0.406*	211	18		0.075*	200	29		0.656*
≥ 1000 cps/ml	11	1			9	3			10	2		
Liver Enzymes												
AST												
≤ 37 IU/L	165	5		0.157*	158	12	2.088	0.148				
> 37 IU/L	65	5			61	9						
ALT												
≤ 40 IU/L	142	5		0.516*	136	11	0.763	0.382				
> 40 IU/L	88	5			83	10						
#Significant at p < 0.05												
* Fisher exact test												

Discussion

HIV primarily targets CD4 + T cells, which weaken the immune system and render the body less capable of fighting off infections. Since the majority of medications are designed to treat and manage a single infection, coinfection with viruses can pose a substantial threat to public health. In this study, we accessed the burden of viral hepatitis and syphilis coinfections in PLHIV, the overall prevalence of viral hepatitis i.e. HBV, HCV, and HEV co-infection were

8 (3.3%), 16 (6.6%), and 3 (1.2%), respectively, and syphilis coinfection was 26 (10.8%). 1 (0.4%) participants were co-infected with both HBV and HCV, 1 (0.4%) participants were co-infected with both HBV and Syphilis, and 4 (1.7%) participants were co-infected with both HCV and syphilis. None of the participants were infected with both viral hepatitis (HBV, HCV, and HEV) and syphilis coinfections.

The findings of our study were consistent with other studies from Nepal. In a systematic review study of Nepal from 1990 to 2020, by Shrestha et al., the pooled prevalence of co-infection with HBV, HCV, and combined HBV and HCV was 4.6%, 19.7%, and 1.3%, respectively.[12] Similarly, in 2017, Ionita et al. conducted the first nationally representative research on the prevalence of HIV-HBV, HIV-HCV, and HIV-HBV-HCV co-infection among PLWH in Nepal, which was 4.4%, 19%, and 1% respectively.[13] A similar study conducted by Shrestha et al. reported the proportions of co-infections for HIV-HBV, HIV-HCV, and HIV-HBV-HCV as 2.95%, 18.14%, and 2.53%, respectively.[9]. None of the participants was coinfected with both HBV and HCV.[11] In A study in Central India by Pradhan et.al, in people living with HIV/ AIDS (PLHA) patients 4.20% were co-infected with HBV, and 0.84% were co-infected with HCV.[15] In North India, the prevalence of HBV and HCV co-infection among PLHIV was 5.32% and 2.43%, respectively, by Gupta et.al.[16] Similarly, HIV patients in Ghana had co-infections with HIV-HBV, HIV-HCV, and HIV-HBV-HCV at rates of 12.5%, 5.5%, and 18.0%, respectively, according to studies by Boateng et al.[17] and 6.1%, 0.5%, and 0.0%, by Pappoe et al.[18].

We found in our study that the seroprevalence of HBV is low (4.1%), which aligns closely with findings from other studies in Nepal, where reported rates range between 2.95% and 4.6%[9,12,13,19] while inconsistent globally, i.e., varied from 4.2% to 12.5%.[11,15–18,20] According to National HIV Testing and Treatment Guidelines 2022, there is a provision for testing for hepatitis B at baseline as well as the use of vaccines for the prevention of hepatitis B in people living with HIV; this proactive approach to prevention likely contributes to the low observed seroprevalence of HBV coinfection among HIV-infected individuals.[6] Due to the low seroprevalence of hepatitis B coinfections, the virological status and liver enzymes (AST and ALT) did not show statistically significant associations with HBV coinfection in this study population ($p > 0.05$).

Hepatitis C virus (HCV) infection can lead to acute hepatitis C, and in 50–80% of cases, it progresses to chronic infection. Chronic HCV infection initiates a persistent inflammatory response, which may result in liver fibrosis, cirrhosis, hepatocellular carcinoma, and ultimately death.[21] In the present study, a significant association was observed between gender and HCV coinfection ($p = 0.003$). Males exhibited a significantly higher proportion of HCV coinfection compared to females. This finding aligns with the other studies from Nepal.[9,12,13] Male sexual promiscuity and high-risk behaviors like intravenous drug usage might be a probable explanation. Likewise, there was a significant association between age and HCV coinfection ($p = 0.013$). Individuals aged ≥ 40 years showed a significantly higher proportion of HCV coinfection compared to those aged < 40 years. This finding is compatible with a study conducted by Bhattarai et. al, while incongruous with other studies from Nepal.[9,13] Because the HIV patients who were above 18 years old were included in this study might be the reason.

Individuals with ART duration of ≥ 5 years showed a higher proportion of HCV coinfection compared to those with < 5 years of ART. This suggests that a longer duration of ART may be associated with an increased likelihood of HCV coinfection, although the association was not statistically significant ($p = 0.108$). Likewise, individuals on the second-line ART regimen showed a slightly higher proportion of HCV coinfection compared to those on the first-line regimen, although the association was not statistically significant ($p = 0.062$). Concerning the associations between virological status, liver enzymes, and HCV coinfection, the p-values (> 0.05) suggest that these associations are not statistically significant in this study population, which is congruent with previous findings.[22]

It's debatable that HIV-positive people are susceptible to HEV infection. While some research has not shown this correlation, some investigations have demonstrated a comparatively high seroprevalence of HEV in HIV-positive individuals. We did not find higher HEV prevalence (1.2%) in subgroups previously considered at higher risk of HEV infection. The findings of our study were congruous with a study conducted in Switzerland by Kenfak-Foguena et. al, the seroprevalence of HEV coinfection was 2.6%, in HIV-infected patients.[23] However, the findings of our study were incompatible with epidemiological data on co-infections of HEV in HIV-infected patients from Nepal. A study by Shrestha et. al. found a high prevalence of HEV IgM (15.3%) in HIV patients [24].

Syphilis coinfections among individuals living with HIV present additional challenges in managing and treating both infections effectively. We found that people with HIV had a higher incidence of syphilis coinfections (12.9%), in line to the fact that they are at a higher risk of developing the disease as a result of syphilis and HIV having a mutually beneficial synergistic relationship. The findings of our study were consistent with other studies from Nepal conducted by Jaiswal et. al, the prevalence was 12.2%.[25] Likewise in China, the overall prevalence of syphilis among PLHIV was 19.9%.[26] In Ethiopia: a nationwide community-based study conducted by Getaneh et.al, the prevalence of HBV and syphilis co-infection was 5.5% and 2.2%, respectively. HBV and syphilis (double co-infection) were 5.9%.[27].

In our study, we examined the association between syphilis coinfections and various demographic and treatment-related factors, as well as virological status categorized as < 1000 cps/ml or ≥ 1000 cps/ml. Our analysis revealed a significant association between syphilis coinfections and adherence levels to antiretroviral therapy (ART) ($p = 0.045$). Specifically, individuals with syphilis coinfections were more likely to have poorer adherence to ART compared to those without coinfections. This suggests a need for tailored interventions to improve adherence among individuals with comorbid HIV and syphilis infections. Several demographic factors were found to be associated with syphilis coinfections. The gender of participants emerged as significant ($p = 0.032$), similar findings of Jaiswal et. al, Wu et. al, and Getaneh et. al, with males being more likely to have syphilis coinfections compared to females.[25–27] Additionally, age was significantly associated with syphilis coinfections ($p = 0.001$), with individuals aged < 40 years being at a higher

risk of syphilis coinfections. These findings highlight the importance of targeted screening and prevention efforts, particularly among younger male populations.

The virological failure rate observed in our study was 5%, the results were harmonious with the other studies conducted in Nepal (9.9%) and another country (12%).[3,28] The ART regimens used in Nepal had shown a good response in reducing the HIV-1 viral load. The virological failure may be attributed to factors like poor adherence to the drug, timely unavailability of drugs, the difference in baseline viral load, duration of treatment, and nutritional status.

Conclusion

The study found a significant burden of coinfections among people living with HIV, with notable prevalence of hepatitis B, hepatitis C, hepatitis E, and syphilis, as well as some cases of multiple infections. Male gender and age ≥ 40 were linked to higher hepatitis C coinfection rates. Although longer duration of ART showed a trend toward higher HCV coinfection, it was not statistically significant. Overall virological failure was low, and strong treatment adherence was associated with better outcomes. The study emphasizes the need for targeted interventions, adherence support, and consistent monitoring to manage coinfections effectively.

Limitation

The mode of transmission of HIV was not included.

Declarations

Ethical approval

Ethical approval was taken from the Institutional Review Committee, Pokhara University (Ref No: 045-081/82).

Consent for publication

Not applicable

Format for informed consent

I …… . give my consent for information about myself to be publication. The study will focus on Burden of coinfections and their association with virological status of HIV-infected patients undergoing antiretroviral therapy

I understand that the information will be published without my name attached, but that full anonymity cannot be guaranteed.

I understand that the text and any pictures or videos published in the article will be freely available on the internet and may be seen by the general public. The pictures, videos, and text may also appear on other websites or in print, may be translated into other languages or used for commercial purposes. I have been offered the opportunity to read the manuscript.

Signing this consent form does not remove my rights to privacy.

Availability of supporting data

The datasets generated and/or analysed during the current study are not publicly available due to patient privacy and confidentiality concerns. Additional details are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Figures

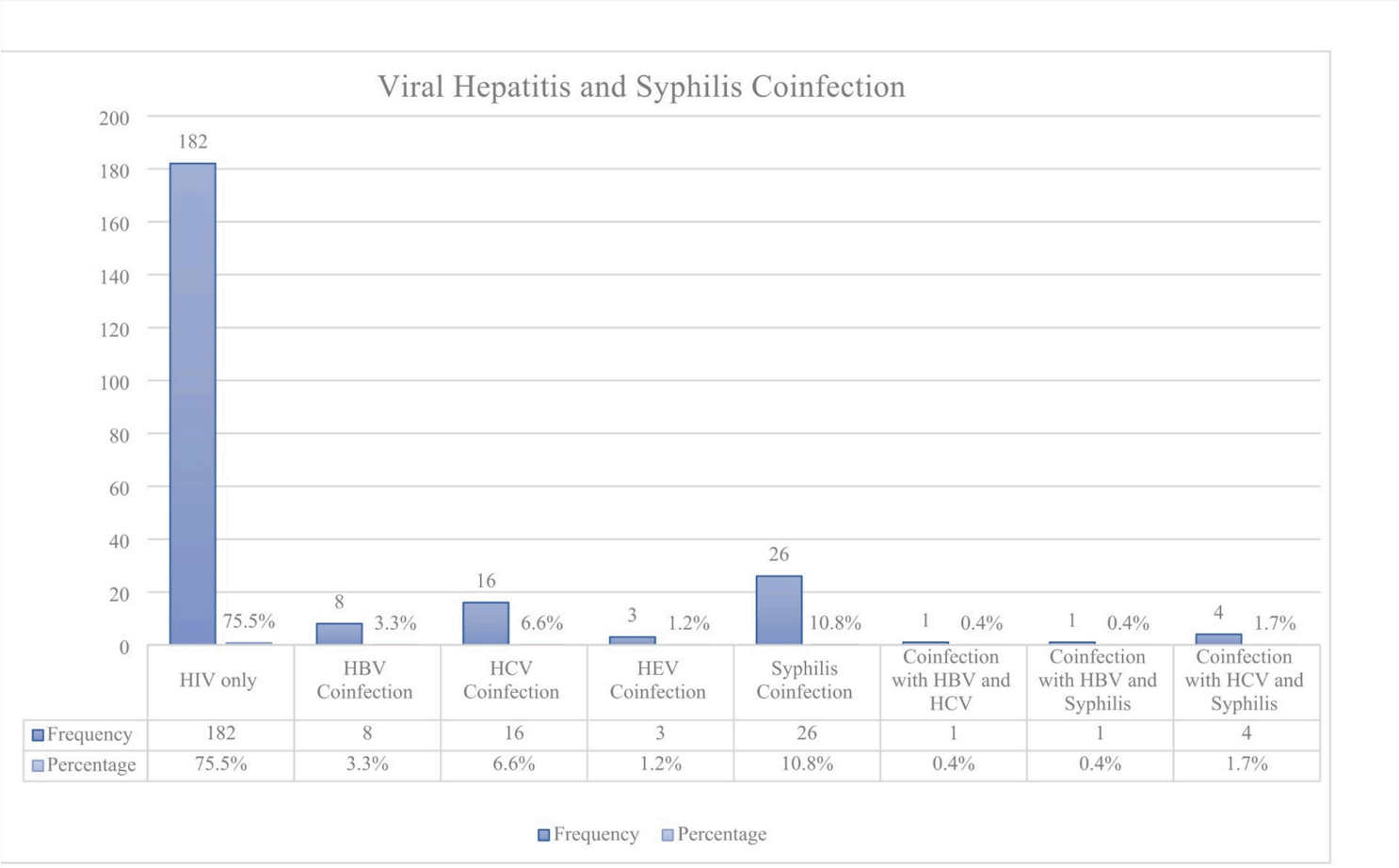


Figure 1

Seroprevalence of viral hepatitis (Hepatitis B, hepatitis C, and Hepatitis E) and Syphilis coinfections (n=241)

Supplementary Files

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- FinalData.xlsx