Section: Medicine

Original Research Article

PREVALENCE AND FACTORS ASSOCIATED WITH NON-ALCOHOLIC FATTY LIVER DISEASE AMONG HIV INFECTED PATIENTS IN A TERTIARY CARE HOSPITAL

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Received : 25/07/2025
Received in revised form : 06/09/2025
Accepted : 29/09/2025

Keywords:
NAFLD, NASH, Cirrhosis, metabolic syndrome, HIV.

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DOI: 10.47009/jamp.2025.7.5.133

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (5); 687-694

ABSTRACT

Background: Non-alcoholic fatty liver disease (NAFLD) or build up of extra fat in liver cells not related to alcohol, is becoming the most common cause of chronic liver disease (CLD) globally, and it is expected that it will become the primary cause of end-stage liver disease in the not-too-distant future. The development of NAFLD to non-alcoholic steatohepatitis (NASH), cirrhosis and hepatocellular carcinoma is of primary health concern. According to certain studies, NASH is a common cause of unexplained impaired liver function in patients chosen for liver biopsy, and NAFLD is commonly seen in HIV-infected patients. Regardless of HIV characteristics, metabolic problems are important risk factors. High body mass index (BMI), waist circumference, type 2 diabetes, hypertension, triglycerides, and a high CD4 cell count were all linked to NAFLD, according to a meta-analysis of risk variables. Hence, we conducted a cross-sectional study in order to ascertain the prevalence of NAFLD in people living with HIV (PLHIV) and evaluate the risk factors for NAFLD in PLHIV. **Materials and Methods:** The present study was a cross sectional Hospital based study conducted in the Department of Medicine, Regional Institute of Medical Sciences (RIMS), Imphal from March, 2023 to March, 2025. All HIV positive patients above 18 years of age,admitted in Medicine ward, attending Medicine OPD and Centre of Excellence (CoE) ART Centre, RIMS were recruited in the study. Routine blood investigations along with Ultrasonography of whole abdomen, CD4 cell count and viral load determination were done for every patient. SPSS (IBM) version 21 was used for statistical analysis. P-value <0.05 was taken as statistically significant.**Result:** A total of 133 patients were enrolled with majority males (78.9%, 105) and mean age of 43.76 ± 10.79 years. Maximum patients were under ART with 73.7% (98) with maximum patients in WHO clinical stage I (48, 36.1%). Most of the study subjects were overweight (65, 48.9%) followed by normal (45, 33.8%) and obese (23, 17.3%). Diabetes mellitus (33, 24.8%), dyslipidemia (49, 36.8%) and hypertension (50, 37.6%) were present in the study. Mean CD4 count of the patients was 419.25 ± 171.56 cells/mm3 and the mean viral load was 513.14 ± 884.48 copies/ml. Patients with NAFLD had significantly higher serum AST, triglycerides and random blood sugar normal patients. Majority of the patients who were obese (14, 60.9%) were found to have NAFLD in comparison to those of overweight (26, 40%) and normal BMI (8, 17.8%) patients and the finding was found to be statistically significant. Patients with diabetes (22, 66.7%), dyslipidemia (26, 53.1%) and hypertension (25, 50%) had NAFLD than those without co- morbidities. **Conclusion:** In the present study, NAFLD was present in 48 out of 133(36.1%)of the HIV patients and majority of the study subjects had diabetes, dyslipidemia, hypertension, increased BMI and thus more commonly affected with NAFLD. Liver ultrasound assessment should be considered for screening NAFLD among PHIV in routine clinical practice. Screening for NAFLD should be implemented as a means of early intervention and to prevent complications.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) has emerged as a significant global public health concern, affecting more than thirty per cent of individuals all over the world.[1,2] In around 20% patients, NAFLD develops into non-alcoholic steatohepatitis (NASH)5 which could later develop into cirrhosis and hepatocellular carcinoma.[3-5]

In India, there are 2.5 million people with as per 2023 report. Prevalence of adult Human immunodeficiency virus (HIV) is 0.2%.[6] The "Golden Triangle," which comprises Myanmar, Thailand, Laos, and the Yunnan Province of China, is known to be the world's most prominent source of illicit heroin and opium. These areas are closer to Manipur, which also has a lengthy international border with Myanmar.[7] The estimated adult HIV prevalence in Manipur among those aged 15 to 49 is 1.43%, higher than the national average.[8]

NAFLD in people living with HIV (PLHIV) was analyzed by Maurice et al. in 2017, with a prevalence of 35%.[9] Steatosis of the liver, which is the buildup of triglycerides in the hepatocytes, indicates the presence of NAFLD when there is no secondary etiology, such as excessive alcohol intake. Cirrhosis, fibrosis, NAFLD and NASH are all disorders that fall under the umbrella of this condition. In patients who do not have HIV, NAFLD is primarily the hepatic manifestation of the metabolic syndrome. It manifests itself in insulin resistance, central obesity, and dyslipidemia. The disease's progression is influenced by several complex factors that interact with one another, including genetic susceptibility, oxidative stress, and dysbiosis factors. Worldwide, 25% people are affected with NAFLD, increasing with rising rates of obesity, type 2 diabetes mellitus (T2DM), and metabolic syndrome.[10]

Patients who are infected with HIV typically have deranged liver function tests (LFTs),[11] of which are frequently attributed to co-infections with viral hepatitis (B and C) or the effects of antiretroviral therapy (ART). Several hepatobiliary illnesses can be caused by HIV infection and include elevated liver enzymes, hepatomegaly, and liver steatosis.[12]

The direct connection between HIV and different cell types of the liver, as well as the influence of HIV glycoproteins on hepatic stellate cells, which stimulate collagen synthesis, are two of the putative processes that are responsible for the damage that HIV causes to the liver. The spectrum of liver illness in people living with HIV/AIDS has shifted to include drug-induced liver disease, simultaneous infections with HCV and HBV hepatitis, NAFLD, and alcohol addiction, due to the widespread deployment of ART.

In HIV infected individuals, the pathogenesis of NAFLD is characterized by two hits: the first "hit" is insulin resistance, which is accompanied by the release of free fatty acids from adipose tissue, which is then followed by hepatic triglyceride accumulation, and oxidative stress-cytokine-mediated injury.[13] During the initial "hit," HIV patients frequently have elevated levels of lipid and glucose abnormalities. These abnormalities might be a consequence of either the HIV infection itself or the antiretroviral drugs they are taking. Nucleoside agents can potentially cause direct hepatotoxicity and steatosis due to their inhibition of mitochondrial DNA polymerase-γ. This is in addition to the metabolic side effects that various antiretroviral medications may cause. The overexpression of the sterol regulatory protein, SREBP-1, is another mechanism by which protease inhibitors have the potential to induce steatosis. This group may potentially be affected by NAFLD due to the increased prevalence of diabetes and obesity among HIV-positive individuals. When it comes to the second "hit," HIV patients may be in danger due to the virus, which causes a persistent inflammatory state (such as elevated TNF-α levels), may be the cause of the condition.[14]

There is a dearth of information about NAFLD in the HIV-positive population. Studies have shown that the prevalence of NAFLD, NASH, and fibrosis is both increased and decreased when compared with the general population. Manipur has one of the highest HIV prevalence rates among the six Indian states. Manipur accounts for 8% of HIV-positive infections in India, although making up a very small percentage of the nation's total population.[8] There is still a knowledge gap on the prevalence of NAFLD in people living with HIV (PLHIV), even though it is a significant problem in the general population. On the other hand, there is evidence that CLD is the second most important cause of mortality among people living with HIV which is not due to HIV.[15] The present knowledge gaps surrounding the comorbidity burden in people living with HIV were recently addressed by an expert panel review, which identified NAFLD/NASH as a research priority.[16] This study was undertaken to determine the prevalence of NAFLD among HIV-infected patients attending RIMS Imphal and study the risk factors associated with the condition.

MATERIALS AND METHODS

This was a cross sectional Hospital based study conducted in the Department of Medicine, Regional Institute of Medical Sciences (RIMS), Imphal for a period of two years from March, 2023 to March, 2025. HIV positive patients ≥ 18 years of age ,admitted in Medicine ward, attending Medicine OPD and Centre of Excellence (CoE) ART Centre, Regional Institute of Medical Sciences, Imphal were enrolled in the study.

Inclusion Criteria

Patients ≥ 18 years of age with HIV infection and those willing to give an informed consent were included in the study.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Exclusion Criteria

HIV patients with significant alcohol consumption (determined by Alcohol Use Disorders Identification Test-Consumption questionnaire),[17] patients with positive viral serology (HBsAg and HCV antibody), Other causes of liver disease (Eg: Autoimmune hepatitis, Wilsons disease),pregnancy or lactation and refusal to participate were excluded from the study.

Sample Size: The sample size for the study was based on a study by Crum-Cianflone N et al,[18] who reported the prevalence of NAFLD among HIV mono-infected patients to be 31% (67 out of 216 patients) by ultrasound. The sample size was calculated according to the formula:

Sample size, N = 1.962PQ/L2, Taking Prevalence of NAFLD among HIV patients as 31% (Crum-Cianflone N et al(18), Precision (L)= 8%,Alpha = 1.96. Therefore, N = 133.

Based on the formula given above, using the mentioned values, the sample size required is 133.

Study Variables: Socio-demographic characteristics like age, sex, religion, body mass index (BMI), occupation, marital status, HIV status of partner and ART history. WHO clinical staging, diabetes mellitus, hypertension, dyslipidemia and alcohol consumption were the independent variables. Outcome variables were NAFLD, CD4 cell count and viral load.

Study tools: Weighing machine- Equinox BR-9201 Analog weighing scale. Maximum weight 130 kg (1 division = 500gm) made in India.

b) Stadiometer – Seca portable stadiometer which ranges from 20 to 205 inches. (Calibration – 1 mm) made in India.

- USG whole abdomen
- CD4 count cell analyser
- HIV viral load by Real Time PCR
- ELISA: HIV infection: Diagnosed by Enzyme linked Immunosorbent assay including both HIV-1 and HIV-2 infection

Study procedure: A detailed structured proforma was used. The proforma included detailed clinical history, clinical examination and blood investigations. Routine blood investigations included complete hemogram with peripheral blood smear, random blood sugar, liver function test, kidney function test, lipid profile, etc Ultrasonography of whole abdomen,CD4 cell count and Viral load determination were done for every patient.

- Alcohol use disorders identification test (AUDIT)[17]

Questions	Scoring system					Your score
	0	1	2	3	4	
How often do you have a drink containing alcohol?	Never	Monthly or less	2 to 4 times per month	2 to 3 times per week	≥4 times per week	
How many units of alcohol do you drink on a typical day when you are drinking?	0 to2	3 to 4	5 to 6	7 to 9	10 or more	
How often have u had 6 or more units if female or 8 or more units if male, on a single occasion in the last year?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you failed to do what was normally expected from you because of your drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you needed an alcohol drink in the morning to get yourself going after a heavy drinking session ?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you been unable to remember what happened the night before because you had been drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
Have you or somebody else been injured as a result of your drinking?	No		Yes, but not in last year		Yes, but during last year	
Has a relative or friend, doctor or other health worker been concerned about your drinking or suggested that you can cut down?	No		Yes, but not in last year		Yes, but during last year	
Total AUDIT score						

ISSN (O): 2687-5365; ISSN (P): 2753-6556

- WHO Clinical staging and clinical monitoring of HIV.[19]

Stages	Stage I	Stage II	Stage III	Stage IV
Signs and symptoms	Asymptomatic Persistent generalized lympadenopathy (PGL)	Moderate unexplained weight loss (<10% body weight) ,recurrent respiratory tract infections , herpes zoster, angular cheilitis, recurrent oral ulcers, popular pruritic eruptions, seborrhoeic dermatitis, fungal nail infections of fingers	Severe weight loss (>10% body weight) Unexplained chronic diarrhea>1month Unexplained persistent fever>1 month Oral candidiasis Oral hairy leukoplakia Pulmonary tuberculosis diagnosed in last 2 years, Severe presumed bacterial infections(eg; pneumonia, empyema,pyomyositis, bone or joint infection, meningitis, bactremia) acute necrotizing stomatitis, gingivitis or periodontitis	Conditions where a presumptive diagnosis can be made on the basis of clinical signs or simple investigations • HIV wasting syndrome • Pneumocystis pneumonia • Recurrent severe or radiological bacterial pneumonia • Chronic herpes simplex infection (orolabial, genital or anorectal >1 month duration) • Esophageal candidiasis • Extra pulmonary TB • Kaposi's sarcoma • Central nervous system toxoplasmosis • HIV encephalopathy

Working Definition

- Human immuno-deficiency virus infection: Diagnosed by Enzyme linked Immunosorbent assay including both HIV-1 and HIV-2 infection
- NAFLD was diagnosed by an ultrasound showing steatosis described as diffusion in hepatic echogenicity. The levels of diffusion for hepatic steatosis were classified accordingly in this study as mild, moderate and severe.
  - Mild- Hepatic echogenicity is slightly increased with normal visualization of diaphragm and intrahepatic vessel borders.
  - Moderate- hepatic echogenicity is moderately elevated with slightly impaired visualization of intrahepatic vessels and diaphragm
  - Severe - Hepatic echogenicity is significantly increased accompanied by inadequate penetration of posterior section of right liver with little to no visualization of the diaphragm and hepatic arteries.
- Body mass index (BMI): categorized using, The National Institute of Health (NIH) criteria - obesity (≥ 30 kg/m2), overweight (25.0–29.9 kg/m2), normal weight (18.5–24.9 kg/m2) and underweight (<18.5 kg/m2).
- Alcoholics(determined byAlcohol Use Disorders Identification Test-Consumption questionnaire), cut-points of ≥8 for men age 65 years or younger, and ≥7 for women of all ages as well as men over age 65 years, are recommended for identifying individuals with medium levels of alcohol-related problems, as an indicator of hazardous and harmful use of alcohol.[17]

Statistical Analysis: SPSS (IBM) version 21 was used for statistical analysis. Summarizations of data were carried out by using descriptive statistics such as mean, standard deviation and percentages. Independent t test was used to test the association between mean biochemical parameters, mean CD4 count, mean viral load with NAFLD. Chi-square test and Fisher's exact test were employed to test the association between gender, age, comorbidities and BMI with NAFLD. P-value <0.05 was taken as statistically significant.

Approval of research ethics board: Ethical approval for this study was obtained from the Research Ethics Board, Regional Institute of Medical Sciences, Imphal[No.A/206/REBComm(SP)/RIMS/2015/1019/50/2023]. A unique code number was given and no names were taken to maintain confidentiality. All the information collected for the study were utilized only for the purpose and not disclosed to anyone outside the research team.

RESULTS

A cross-sectional study was conducted to determine the prevalence of NAFLD in HIV patients and to study the risk factors for NAFLD in HIV infected patients. The baseline characteristics of the study subjects were given in [Table 1].The study included 133 patients with majority males (78.9%, 105) while females were 21.1% (28). The mean age of the patients was 43.76 ± 10.79 years and most of them belonged to the age group of 31-40 years (43, 32.3%). Alcohol consumption history was present in most of the patients (54.1%, 72). ART was taken by majority of the study subjects (73.7%, 98). Distribution of patients by liver echogenicity on USG was shown in [Table 2].NAFLD was present in 48 (36.1%) patients. Majority of the patients were in WHO clinical stage I (75, 56.4%) followed by stage II (44, 33.2%) and stage III (14, 10.5%). None of the patients were in stage IV. The highest percentage of participants (65, 48.9%) were overweight, followed by normal (45, 33.8%) and obese (23, 17.3%). The prevalence of NAFLD was higher in patients with higher BMI. Hypertension (50, 37.6%), diabetes mellitus (33, 24.8%) and dyslipidemia (49, 36.8%) patients were present. Mean CD4 count of the patients was 419.25 ± 171.56 cells/mm3 and the mean viral load was 513.14 ± 884.48 copies/ml, as shown in [Table 3]. Associations between NAFLD and biochemical parameters were given in [Table 4]. Serum AST, triglycerides and random blood sugar was significantly higher and haemoglobinand platelets

ISSN (O): 2687-5365; ISSN (P): 2753-6556

were lower in patients with NAFLD as compared to patients without NAFLD (P <0.005). There was no significant association between NAFLD with CD4 count and viral load, as given in [Table 5]. Majority of the patients who were obese (60.9%) were found to have NAFLD in comparison to those of overweight (40%) and normal BMI (17.8%) patients and the finding was found to be statistically significant, as shown in [Table 6]. NAFLD was significantly present in most of the diabetic patients (22, 66.7%), patients with dyslipidemia (26, 53.1%) and hypertension (25, 50%) in comparison to those without co morbidities, which were statistically significant, as given in [Table 7]. Comparable findings were seen among gender and NAFLD. NAFLD has no significant association with age and gender, given in [Table 8].

Table 1: Baseline characteristics of the study subjects (N = 133).

Characteristics	Study subjects (n, %)
Age (in years)	
18-30	12(9%)
31-40	43(32.3%)
41-50	42(31.6%)
51-60	27(20.3%)
>60	9(6.8%)
Gender	
Male	105(78.9%)
Female	28(21.1%)
Marital status	
Married	103(77.4%)
Unmarried	30(22.6%)
History of alcohol consumption	
Yes	72(54.1%)
No	61(45.9%)
Drug history	
ART	98(73.7%)
ART naive	35(26.3%)
WHO clinical stage	
Stage I	75(56.4%)
Stage II	44(33.2%)
Stage III	14(10.5%)
Stage IV	0(0%)
BMI (body mass index) (kg/m2)	
Normal ((18.5- 24.9 kg/m2)	45(33.8%)
Overweight (25.0-29.9 kg/m2)	65(48.9%)
Obese (≥ 30 kg/m2)	23(17.3%)
Co morbidities	
Diabetes mellitus	33(24.8%)
Dyslipidemia	49(36.8%)
Hypertension	50(37.6%)
DM,HTN&Dyslipidemia	14(10.5%)
DM & HTN	17(12.8%)
HTN &Dyslipidemia	8(6%)
DM &Dyslipidemia	0(0%)
None	1(0.7%)

*ART- anti retroviral therapy, BMI- body mass index, DM- diabetes mellitus, HTN- Hypertension, WHO – World Health Organisation

Table 2: Distribution of patients by liver echogenicity on USG (N=133).

Sl.no.	Echogenicity	No. of patients	Percentages (%)
1.	Normal	85	63.9
2.	Mild	26	19.5
3.	Moderate	14	10.5
4.	Severe	8	6.0

Table 3: Mean CD4 count and viral load of patients (N=133)

Sl.no.	Characteristics	Mean	Standard deviation
1.	CD4 count (cells/mm3)	419.25	171.56
2.	Viral load (copies/ml)	513.14	884.48

Table 4: Association between NAFLD and biochemical parameters (N=133)

Sl.no.	Parameters	Mean ± SD		p value
		NAFLD	Normal	
1.	Haemoglobin(gm/dl)	9.80 ± 1.01	10.33 ± 1.02	0.005
2.	Platelets (per microlitre)	1.03 ± 0.37	1.24 ± 0.41	0.004
3.	ALT (IU/L)	70.71 ± 31.67	64.75 ± 27.32	0.257
4.	AST (IU/L)	81.40 ± 28.53	68.94 ± 27.67	0.015
5.	INR	1.41 ± 0.19	1.43 ± 0.18	0.487

ISSN (O): 2687-5365; ISSN (P): 2753-6556

6.	PT(seconds)	18.8 ± 2.08	19.1 ± 2.02	0.484
6.	Blood Urea (mg/dl)	38.9 ± 8.16	39.6 ± 8.5	0.661
7.	S.Creatinine (mg/dl)	1.02 ± 0.19	1.05 ± 0.19	0.396
8.	Triglycerides (mg/dl)	264.3 ± 129.04	174.84 ± 63.05	< 0.001
9.	Random blood sugar (mg/dl)	130.0 ± 29.9	116.5 ± 25.6	0.010

*NAFLD- nonalcoholic fatty liver disease AST- Aspartate Aminotransferase, ALT- Alanine Aminotransferase,PT- Prothrombin time, INR- International normalized ratio (PT INR).

Table 5: Association between NAFLD with CD4 count and Viral load (N=133).

Sl.no.	NAFLD	Mean ± SD CD4 count(cells/mm3)	p value
1.	Yes	400.42 ± 164.04	0.343
2.	No	429.89 ± 175.71	
	NAFLD	Viral load -Mean ± SD (copies/ml)	
3	Yes	582.90 ± 955.01	0.496
4	No	473.74 ± 845.35	

Table 6: Association between NAFLD with BMI (N=133).

Sl.no.	BMI	NAFLD		p value
		Yes	No	
1.	Normal	8 (17.8%)	37 (82.2%)	
2.	Overweight	26 (40.0%)	39 (60.0%)	0.001
3.	Obese	14 (60.9%)	9 (39.1%)	

Table 7: Association between co morbidities and NAFLD (N=133)

Sl.no.	Comorbidities		NAFLD, n(%)		p value
			Yes(48)	No (85)	
1.	Diabetes mellitus	Yes(33)	22(66.7%)	11(33.3%)	<0.001
		No(100)	26(26%)	74(74%)	
2	Dyslipidemia	Yes(49)	26(53.1%)	23(46.9%)	
		No(84)	22(26.2%)	62(73.8%)	0.003
3	Hypertension	Yes(50)	25(50%)	25(50%)	
		No(83)	23(27.7%)	60(72.3%)	0.015

Table 8: Association between NAFLD with Age and Gender (N=133).

Sl.no.	Gender	NAFLD		p value
		Yes	No	
1.	Male	39(37.1%)	66(62.9%)	0.399
	Female	9(32.1%)	19(67.9%)	
2.	Age	Yes-48(36%)	No-85(64%)	0.533
	18-30	2(4.2%)	10(11.8%)	
	31-40	19(39.6%)	24(28.2%)	
	41-50	15(31.3%)	27(31.8%)	
	51-60	9(18.8%)	18(21.2%)	
	>60	3(6.3%)	6(7.1%)	

DISCUSSION

A total of 133 HIV patients were included with majority males 105(78.9%). Similar male preponderance was reported by Maurice JB et al,[9] and Crum-Cianflone N et al,[18] suggesting that male gender is commonly affected by HIV. In this study, the mean age of the patients was 43.76 ± 10.79 years which was comparable to the studies done by Rasoulinejad M et al,[20] (39.9 years) and Riebensahm C et al,[21] (45.7 ± 11.5 years). Most of participants belonged to the age group of 31-40 years (32.3%) similar to the study conducted by Ram R et al,[22] [31-40 age group (46.7)]In the current study, we found that most patients were married 103(77.4%), and the remaining were unmarried 30(22.6%). Chihota BV et al.[23] also reported half of their HIV study population was married (50%), 38% separated/divorced and 12% unmarried. In this study, most patients were under ART, 98(73.7%), which was much higher than other studies done by Crum-Cianflone N et al.[18] (72%) and Torgersen J et al,[24] (91%). In this study, we found prevalence of NAFLD in HIV patient to be 36.1% (48 out of 133) higher than the studies done by Crum-Cianflone N et al,[18] (31%) and Michel M et al,[25](26.6%). While a higher prevalence of 68% hepatic steatosis was reported by Debroy P et al.[26] On ultrasound of the whole abdomen in this study, mild liver echogenicity was seen in 19.5% of the patients, moderate in 10.5% and severe in 6%. Crum-Cianflone N et al,[18] reported 18.5% mild steatosis, 8.8% moderate steatosis and 3.7% severe steatosis on ultrasound sonography in their study, which is more or less similar to this study. As per WHO clinical staging, majority study subjects (56.4%) belonged to stage I, followed by stage II (33.2%), stage III (10.5%) and none in stage IV. Ram R et al,[22] reported of the WHO clinical stage I, II, III, IV in 16.6%, 30%, 30% and 23.3% patients respectively. In the present study, mean CD4 count of the patients was 419.25 ± 171.56 cells/mm3 and the mean viral load was 513.14 ± 884.48 copies/ml. Torgersen J et al,[24] also reported

ISSN (O): 2687-5365; ISSN (P): 2753-6556

a median CD4 count of 462 (300 to 673) and a median viral load of 48 (40 to 72) copies/ml. This variation in the number of viral loads may be due to the patient's selection, as there were ART naïve patients of 26.3% in this study compared to 9% of Torgersen J et al.[24] This study found no significant association between mean CD4 count and mean viral load with NAFLD, which was consistent with the study done by Crum-Cianflone N et al.[18]

The mean Hb (9.80 ± 1.01) and platelet count were significantly less in patients with NAFLD than in those who did not have NAFLD. Serum ALT, serum urea, serum creatinine, PT and INR were more or less equally distributed among the patients with NAFLD and normal patients. There were higher levels of serum AST (81.40 ± 28.53), triglycerides (264.3 ± 129.04) and RBS (130.0 ± 29.9) in patients with NAFLD as compared to patients without NAFLD (AST -68.94 ± 27.67, TG-174.84 ± 63.05 and RBS-116.5 ± 25.6, respectively). Kalligeros M et al,[27] did a meta-analysis of HIV patients and found serum AST and serum cholesterol to be significantly associated with NAFLD. Cervo A et al[28], also concluded significantly elevated serum ALT and triglycerides in NAFLD patients.

There were significant associations between diabetes mellitus (66.7%), dyslipidemia (53.1%) and hypertension (50%) with NAFLD in this study, which was consistent to the study conducted by. Cianflone N et al,[18] who reported dyslipidemia and abdominal obesity to be the main culprits for NAFLD development in PLHIV. In the present study, males (37.1%) were more commonly affected with NAFLD when compared with females (32.1%), but the difference was not statistically significant. Similarily, the association of age and NAFLD was not statistically significant.

In this study, the majority of the subjects were overweight with 48.9%, followed by normal BMI (33.8%) and obese (17.3%), which was more or less similar to the findings by Crum-Cianflone N et al (obese - 14.8%, overweight- 42.6% and normal BMI -42.6%).[18] As per Riebensahm C et al, overweight and obese were present in >50% study population.[21] Maximum patients who were obese (60.9%) were found to have statistically significant NAFLD in comparison to those of overweight (40%) and normal BMI (17.8%) patients, suggesting that obesity to be significantly associated with NAFLD, which was consistent with the findings by Riebensahm C et al[21] and Guaraldi G et al.[29] Cianflone N et al reported in their study that increased waist circumference, an indirect indicator of central adiposity or obesity, is significantly associated with NAFLD, similar to this study's findings.[18]

NAFLD can lead to fibrosis, cirrhosis, and liver failure in the general population.[30,31] NAFLD is rapidly being recognized as the cause of idiopathic cirrhosis in HIV patients.[32] In addition, NAFLD is not only a cause of liver illness but also a predictor of cardiac disease and a lower survival rate [30,33,34].

In this study, 36.1% HIV patients had NAFLD, therefore considering the increased prevalence of NAFLD among HIV patients it is imperative that the impact of NAFLD as a marker for excess morbidity and mortality among HIV patients needs to be studied prospectively.

CONCLUSION

Non-alcoholic fatty liver disease is commonly seen in patients with HIV infection more so among the middle-aged male HIV patients. Haemoglobin, platelet count, serum AST and serum triglyceride and RBS were significantly deranged with NAFLD individuals. There was no significant association between mean CD4 count and mean platelet count with NAFLD. Majority of the diabetic (66.7%), dyslipidemic (53.1%) and hypertensive(50%) patients had NAFLD as compared to normal patients. There was no association between age and NAFLD. Patients with increased BMI were more commonly affected with NAFLD. This study highlights the need for routine screening and early intervention strategies for NAFLD in HIV patients to prevent progression to more severe liver disease. Future research should focus on longitudinal studies to assess the long term impact of NAFLD in this population and potential therapeutic approaches.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556