ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 01 | January - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STUDY ON METABOLIC SYNDROME IN HIV PATIENT ON DIFFERENT NACO RECOMMENDED REGIMENS

Medicine

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ABSTRACT

Background And Aims: Metabolic syndrome (MS), a cluster of conditions including insulin resistance, dyslipidemia, hypertension, and central obesity, poses a significant health challenge in people living with HIV (PLHIV). The dual impact of HIV infection and antiretroviral therapy (ART) exacerbates metabolic disturbances. This study aims to assess the prevalence and characteristics of MS in PLHIV under different NACO-recommended ART regimens and evaluate their metabolic impacts. **Methods:** This prospective cohort study was conducted at B.R.D. Medical College, Gorakhpur, over one year. A total of 150 PLHIV aged 18–65 years were recruited. Ethical clearance was obtained, and written informed consent was secured. Clinical parameters, including waist circumference, blood pressure, lipid profile, fasting blood sugar, HbA1c, and CD4 count, were measured at baseline and after six months. Statistical analysis was performed using SPSS v21.0, with P-values <0.05 considered significant. **Results:** The TLD regimen accounted for 58% of participants and demonstrated a favorable metabolic profile, with significant reductions in waist circumference (P = 0.003) and triglycerides (P = 0.003) over six months. Conversely, ALD regimens were associated with higher waist circumference and triglycerides. Older patients (>50 years) exhibited greater susceptibility to metabolic derangements, with significantly higher waist circumference and triglycerides and lower HDL levels compared to younger patients (<50 years). The overall prevalence of MS in the study population was 19.2%, highlighting its clinical relevance in PLHIV. **Conclusion:** We concluded that TLD regimens are associated with improved metabolic outcomes, whereas ALD regimens adversely affect lipid and metabolic profiles. Age and ART regimens significantly influence metabolic parameters, emphasizing the need for age-specific and regimen-tailored management strategies to mitigate MS risks in PLHIV.

KEYWORDS

Metabolic Syndrome, HIV, Antiretroviral Therapy, TLD Regimen, Dyslipidemia

INTRODUCTION

Metabolic syndrome (MS), a cluster of conditions including insulin resistance, dyslipidemia, hypertension, and central obesity, is a growing global health concern. [1] Among people living with HIV (PLWH), the risk of MS is notably heightened due to a complex interplay between the virus itself and the long-term use of antiretroviral therapy (ART). Studies suggest a global prevalence of MS in HIV patients ranging from 15% to 45%, with Indian data reflecting similar trends, reporting rates between 20% and 30%. In northern India, particularly in Uttar Pradesh, these numbers align with national estimates but exhibit regional variations influenced by lifestyle, socioeconomic factors, and access to healthcare. [2,3]

The metabolic disturbances in HIV patients arise from the dual impact of chronic HIV infection and ART. Persistent inflammation and immune activation caused by the virus are compounded by the adverse effects of ART, especially regimens involving protease inhibitors and nucleoside reverse transcriptase inhibitors. These drugs are known to exacerbate insulin resistance, dyslipidemia, and fat redistribution, creating a metabolic profile that predisposes patients to cardiovascular diseases, diabetes, and other complications. The drugs commonly used under National AIDS Control Organisation (NACO) guidelines, including ritonavir, zidovudine, and efavirenz, have been particularly associated with metabolic complications.[4,5]

Despite progress in understanding the association between HIV, ART, and MS, significant gaps remain. Current evidence underscores the heightened risk of MS due to both HIV infection and ART. However, there is limited information on how various NACO-recommended ART regimens differentially affect metabolic health. Additionally, the long-term metabolic consequences of newer ART drugs remain poorly understood. [6,7]

This study aims to address these knowledge gaps by exploring the prevalence and characteristics of MS in HIV patients on different NACO-recommended ART regimens. By investigating how specific regimens contribute to metabolic disturbances, this research seeks to provide actionable insights for optimizing ART protocols to minimize metabolic complications, ultimately improving the quality of life and health outcomes for PLWH in India.

MATERIAL AND METHODS

Study Area And Design

This prospective cohort study was conducted in the Department of Medicine, B.R.D. Medical College, Gorakhpur, with participant enrollment from the ART Centre. The study spanned one year, focusing on people living with HIV (PLHIV) on different ART regimens.

Sample Size And Population

A total of 150 HIV-positive patients attending the outpatient department of the Medicine Department were included. Participants were aged 18–65 years, newly diagnosed, or already on ART. Exclusion criteria included patients on medications affecting carbohydrate or lipid metabolism, pregnant or lactating women, those with acute illness, moribund patients, and those unwilling to participate.

Patient Recruitment And Consent

Eligible patients were approached during the study period. The study's purpose and protocol were explained, and written informed consent was obtained. Baseline demographic and clinical data were collected through predesigned, pretested questionnaires ensuring confidentiality and anonymity.

Clinical And Laboratory Procedures

On enrollment, a focused medical history was obtained, and physical and clinical measurements were recorded, including:

- **Weight And Height**: Measured using standardized electronic weighing machines and stadiometers.
- **BMI**: Calculated as weight (kg) divided by height squared (m^2).
- **Waist Circumference**: Measured at the midpoint between the lowest palpable rib and the iliac crest using a non-stretchable tape.
- **Blood Pressure**: Taken in the left arm after 5 minutes of rest using a calibrated digital blood pressure apparatus.

Blood samples were collected aseptically for the following laboratory tests:

- Lipid profile
- Fasting blood sugar
- HbA1c
- CD4 count
- HIV RNA viral load

Follow-Up

Participants were followed up at six months. At each visit, all clinical and anthropometric measurements were repeated, and blood samples collected for reassessment of baseline parameters.

Outcome Variables

The primary outcomes were levels of lipid profile, fasting blood sugar, HbA1c, CD4 count, and HIV RNA viral load.

Ethical Considerations

The study protocol was ethically reviewed and approved by the Institutional Ethics Committee of B.R.D. Medical College. Participants were assured of the voluntary nature of the study, confidentiality of personal information, and their right to withdraw at any point.

Statistical Analysis

Data were entered into MS Excel and analyzed using SPSS v21.0. Descriptive statistics summarized demographic and clinical characteristics. The chi-square test was used for qualitative data. For quantitative data, independent t-tests (for normally distributed data) or Mann-Whitney U tests (for non-normal data) were employed. Correlations were assessed using Pearson or Spearman coefficients, depending on data distribution.

RESULTS

Table 1 represents that the majority of participants were on the TLD regimen (58%), followed by ZLD (30%), while ALD and ZL/ALTVr accounted for smaller proportions. Metabolic syndrome was present in 19.2% of the study population, highlighting its significant prevalence among patients.

Category	Frequency	Percent
ALD	15	10.0%
TLD	87	58.0%
ZL/ALTVr	3	2.0%
ZLD	45	30.0%
Metabolic Syndrome (Present)	23	19.2%
Metabolic Syndrome (Absent)	97	80.8%

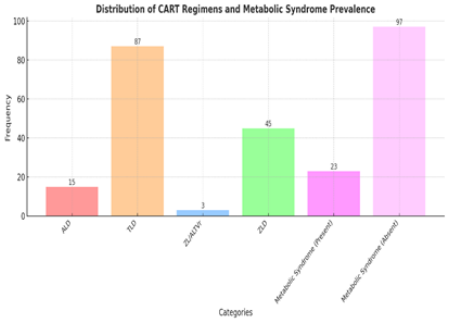

Table 2 compares key clinical parameters at baseline and after 6 months of follow-up. Significant improvements were observed in waist circumference, triglyceride levels, and CD4 counts, indicating positive metabolic and immune responses over time.

Parameter	Baseline Mean ± SD	6-Month Mean ± SD	P Value
Blood Pressure [Systolic]	119.33 ± 7.849	117.67 ± 6.261	0.344
Blood Pressure [Diastolic]	78.93 ± 5.349	80.0 ± 3.714	0.335
Waist Circumference [CM]	79.27 ± 6.113	73.43 ± 5.752	0.003
Fasting Blood Glucose [mg/dl]	94.6 ± 16.13	100.27 ± 16.588	0.093
HBA1c	4.58 ± 0.66	4.8 ± 0.94	0.043
Triglyceride Level [TG]	168.3 ± 42.236	150.83 ± 60.169	0.003
High Density Lipoprotein [HDL]	47.1 ± 8.454	44.57 ± 13.227	0.279
Cd4 COUNT	325.17 ± 163.718	341.0 ± 101.585	0.002

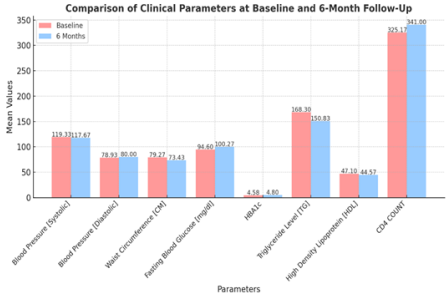

Table 3 illustrates the comparison of clinical parameters across individuals categorized by substance use. While minor variations are observed, none of the parameters, including HDL, triglycerides, and CD4 counts, showed statistically significant differences across the groups.

Parameter	Tobacco (Mean ± SD)	Alcohol (Mean ± SD)	Tobacco & Alcohol (Mean ± SD)	N/A (Mean ± SD)	P Value
HDL	40.06	41.87	47.20	43.78	0.182
TG	143.47	171.00	145.70	154.73	0.606
WC [cm]	79.50	80.07	80.50	77.76	0.232
Systolic BP	117.19	121.33	120.00	118.71	0.406
Diastolic BP	79.69	79.33	80.00	79.78	0.973
CD4 COUNT	383.94	382.93	325.40	400.23	0.490
HBA1c	4.681	4.867	4.670	4.780	0.936
FBS	102.53	99.93	95.90	98.27	0.859

Table 4 compares key clinical parameters across different ART regimens. Significant differences were observed in waist circumference (P = 0.040), triglycerides (P = 0.035), and CD4 counts (P = 0.037), indicating regimen-specific metabolic and immunological impacts.

Parameter	TLD (Mean ± SD)	ZLD (Mean ± SD)	ALD (Mean ± SD)	ZL/ATVr (Mean ± SD)	P Value
Systolic BP	117.70 ± 8.450	120.22 ± 6.567	118.67 ± 5.164	126.67 ± 23.094	0.123
Diastolic BP	79.31 ± 3.975	80.67 ± 3.303	80.00 ± 3.780	76.67 ± 5.774	0.125
Waist Circumference (WC)	76.52 ± 6.477	79.71 ± 5.743	81.07 ± 3.693	78.33 ± 2.887	0.040
Fasting Blood Sugar (FBS)	100.23 ± 31.670	97.93 ± 18.531	99.87 ± 17.844	84.33 ± 8.505	0.765
HBA1c	4.83 ± 1.17	4.72 ± 0.99	4.50 ± 0.54	4.60 ± 1.04	0.713
Triglyceride (TG)	142.20 ± 60.855	151.44 ± 77.064	195.87 ± 58.424	177.00 ± 110.531	0.035
HDL	44.41 ± 12.113	41.38 ± 7.414	40.80 ± 7.243	38.67 ± 1.155	0.277
CD4 Count	416.38 ± 167.475	349.91 ± 114.748	357.80 ± 85.275	389.00 ± 86.626	0.037

Table 5 compares clinical parameters across age groups and duration on ART. Notable differences were observed in waist circumference, triglycerides, and HDL levels, particularly between older and younger patients and those with varying durations on ART.

Parameter	>50 Years (Mean ± SD)	<50 Years (Mean ± SD)	<8 Years on ART (Mean ± SD)	>8 Years on ART (Mean ± SD)	P Value
WC (cm)	79.10 ± 6.03	72.75 ± 6.48	79.45 ± 5.89	75.18 ± 3.66	0.005
FBS	97.55 ± 29.62	99.50 ± 23.18	104.68 ± 21.33	98.36 ± 11.59	0.856
HBA1c	4.65 ± 0.93	4.55 ± 0.97	5.26 ± 1.48	4.47 ± 0.46	0.766
TG	147.80 ± 65.42	112.00 ± 20.98	187.42 ± 79.03	137.91 ± 39.91	0.028
HDL	35.50 ± 7.75	43.13 ± 10.18	45.03 ± 11.68	41.91 ± 9.09	0.041

Cd4 COUNT	394.35 ± 148.40	416.63 ± 155.62	361.90 ± 123.20	410.73 ± 203.69	0.685
Systolic BP (6 Months)	117.60 ± 6.53	116.25 ± 5.18	122.26 ± 10.87	120.91 ± 11.36	0.570
Diastolic BP (6 Months)	79.70 ± 3.88	77.50 ± 4.63	80.00 ± 3.65	80.91 ± 3.02	0.131

DISCUSSION

The study provides valuable insights into the metabolic profile of PLHIV under various NACO-recommended ART regimens. Our findings are consistent with previous studies that have explored the impact of ART on metabolic syndrome and its components, including waist circumference (WC), triglycerides (TG), fasting blood sugar (FBS), HbA1c, HDL, and blood pressure.

In our study, **ART-naive patients** exhibited significant improvements in metabolic parameters after six months of treatment, particularly reductions in WC (79.27 ± 6.113 cm to 73.43 ± 5.752 cm) and TG levels (168.3 ± 42.236 mg/dL to 150.83 ± 60.169 mg/dL). These findings align with **Sinha P et al. (2022) [8],** who reported reduced abdominal fat accumulation and improved lipid profiles with newer regimens like Tenofovir and Lamivudine compared to older protease inhibitor (PI)-based regimens. **Matos A. Se et al. (2009) [10]** also noted significant TG reductions in ART-naive patients initiated on therapy, further supporting our findings.

Among **patients on ART for more than six months**, our study observed variations across regimens. TLD, the most commonly used regimen (58%), had the most favorable metabolic profile, with lower WC (76.52 ± 6.477 cm) and TG levels (142.20 ± 60.855 mg/dL). Conversely, patients on ALD demonstrated the highest WC (81.07 ± 3.693 cm) and TG levels (195.87 ± 58.424 mg/dL), indicating a significant adverse metabolic impact of abacavir-containing regimens. These results are consistent with **Sinha et al. (2022) [8],** who highlighted unfavorable metabolic outcomes and potential cardiovascular risks associated with abacavir exposure. **Obirikorang C et al. (2016)[9]** reported similar findings, noting that regimens containing zidovudine, lamivudine, and dolutegravir were associated with increased visceral fat deposition and dyslipidemia. Additionally, NRTIs such as stavudine and zidovudine have been linked to mitochondrial toxicity, lipodystrophy, and insulin resistance, as described in **Kerr SJ (2007)[13].**

The **prevalence of metabolic syndrome** in our study population was 19.2% among patients on ART for more than six months. This rate is lower than the 61.6% reported by **Obirikorang et al. (2016)[9],** likely due to differences in ART regimens and study populations. The higher prevalence in their study may be attributed to older regimens with a greater propensity for metabolic derangements. Our findings also suggest that TLD regimens are associated with improved metabolic outcomes compared to older regimens like ALD and ZLD, highlighting the benefits of transitioning to modern therapies.

Age-related differences were evident in our study, with patients over 50 years exhibiting significantly higher WC (79.10 ± 6.03 cm vs. 72.75 ± 6.48 cm), TG levels (147.80 ± 65.42 mg/dL vs. 112.00 ± 20.98 mg/dL), and lower HDL levels (35.50 ± 7.75 mg/dL vs. 43.13 ± 10.18 mg/dL) compared to younger patients. These findings are consistent with **Bhagwat et al. (2018) [12],** who identified age as a significant risk factor for dyslipidemia, and **Nduka CU et al. (2016) [11],** who observed an increasing prevalence of metabolic syndrome with advancing age in PLHIV. Elevated TG and WC levels are known risk factors for cardiovascular disease, reflecting age-related changes in lipid metabolism and the long-term effects of ART.

Duration of ART did not significantly influence metabolic parameters in our study. Comparisons between patients on ART for less than and more than eight years showed no statistically significant differences. This is consistent with **Nduka et al. (2016) [11],** who found no significant metabolic changes associated with ART duration. These findings suggest that the metabolic effects of ART are more closely tied to the specific regimen rather than treatment duration.

The role of **substance use** in metabolic profiles was also explored. Although alcohol users had marginally higher TG levels, the differences were not statistically significant. This aligns with **Obirikorang et al. (2016) [9],** who found no significant association between smoking or substance use and metabolic syndrome in PLHIV.

In terms of comorbidities, 12% of patients were hypertensive, 6% were diabetic, and 2.6% had hypothyroidism. These findings emphasize the complex interplay between ART-related effects and pre-existing conditions. Our study corroborates findings from **Nduka et al. (2016) [11],** who reported similar rates of hypertension and diabetes in PLHIV.

Overall, our study highlights the favorable metabolic profile of TLD regimens compared to older ART regimens like ALD, which were associated with significant adverse effects on WC and TG levels. Advanced age was a significant risk factor for dyslipidemia and metabolic syndrome, underscoring the need for tailored cardiovascular risk management in older PLHIV. While modern ART regimens have mitigated some metabolic risks, further research with larger sample sizes and longer follow-up is needed to fully understand the long-term metabolic impacts of ART.

Limitations

- Findings are limited to a single facility, affecting generalizability.
- Six-month follow-up may not capture long-term metabolic changes.
- Confounding factors like diet and activity were not accounted for, potentially influencing outcomes.

Recommendations

- **Extended Monitoring:** Longer follow-up is needed to assess the long-term effects of ART on metabolic syndrome.
- **Multicentric Approach:** Conduct multicentric studies for broader insights.
- **Preventative Measures:** Integrate metabolic screenings and lifestyle interventions into HIV care.
- **Policy Updates:** Revise HIV treatment guidelines to address and manage metabolic syndrome effectively.

CONCLUSION

We concluded that antiretroviral therapy (ART) has a significant impact on the metabolic health of people living with HIV (PLHIV). Among the NACO-recommended regimens, TLD demonstrated a favorable metabolic profile, whereas ALD was associated with adverse effects such as increased waist circumference and triglyceride levels. Older patients were more prone to metabolic derangements, including dyslipidemia and abdominal obesity, highlighting the influence of age on metabolic outcomes. The duration of ART did not show a significant impact, and substance use had minimal effects on the parameters studied. These findings emphasize the need for regimen-specific and age-sensitive approaches to optimize the metabolic health of PLHIV.

Conflict Of Interest: The authors declare no conflicts of interest.
Funding: No funding was received.
Consent: Written consent from participants has been obtained and preserved.
Ethical Approval: Ethical approval was obtained and documented as per institutional guidelines.

REFERENCES

1. Taramasso L, Bonfanti P, Ricci E, et al. Metabolic syndrome and body weight in people living with HIV infection: analysis of differences observed in three different cohort studies over a decade. HIV Med. 2022;23(1):70-79.
2. Alberti KGMM, Eckel RH, Grundy SM, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circulation. 2009;120(16):1640-1645.
3. Naidu S, Ponnampalvanar S, Kamaruzzaman SB, Kamarulzaman A. Prevalence of metabolic syndrome among people living with HIV in developing countries: a systematic review. AIDS Patient Care STDs. 2017;31(3).
4. Carr A, Samaras K. Metabolic syndrome in HIV: clinical associations, pathophysiology, and management strategies. AIDS. 2003;17(1).
5. Palella FJ Jr, Delaney KM, Moorman AC, et al. Declining morbidity and mortality among patients with advanced human immunodeficiency virus infection. HIV Outpatient Study Investigators. N Engl J Med. 1998;338(13):853-860.
6. Salam R, Bajaj S, Kapoor N, Saboo B, Dasgupta A. Diabetes and HIV. J Soc Health Diabetes. 2019;7(2):97-103.
7. Van Leth F, Phanuphak P, Stroes E, et al. Nevirapine and efavirenz elicit different changes in lipid profiles in antiretroviral-therapy-naive patients infected with HIV-1. PLoS Med. 2004;1(1).
8. Sinha P, Chatterjee N, Ghatak S, Maity P, Das K, Mukherjee S, et al. An observational study on metabolic derangements in people living with HIV. J Assoc Physicians India. 2022;70(10):14-16. doi:10.5005/japi-11001-0109.
9. Obirikorang C, Quaye L, Osei-Yeboah J, Odame EA, Asare I. Prevalence of metabolic syndrome among HIV-infected patients in Ghana: a cross-sectional study. Niger Med J. 2016;57(2):86-90. doi:10.4103/0300-1652.182082.
10. Matos Almeida SE, Borges M, Fiegenbaum M, et al. Metabolic changes associated with antiretroviral therapy in HIV-positive patients. Rev Saude Publica. 2009;43(2):283-290. doi:10.1590/S0034-89102009000200010.

11. Nduka CU, Stranges S, Sarki AM, Kimani PK, Uthman OA. Evidence of increased blood pressure and hypertension risk among people living with HIV on antiretroviral therapy: a systematic review with meta-analysis. J Hum Hypertens. 2016;30(6):355-362. doi:10.1038/jhh.2015.97.
12. Bhagwat P, Ofotokun I, McComsey GA, Brown TT, Moser C, Sharma A, et al. Changes in waist circumference in HIV-infected individuals initiating a raltegravir or protease inhibitor regimen: effects of sex and race. Open Forum Infect Dis. 2018;5(11).
13. Kerr SJ, Duncombe C, Avihingsanon A, Suksawek S, Piyavong B, Ruxrungtham K, et al. Dyslipidemia in an Asian population after treatment for two years with protease inhibitor-containing regimens. J Int Assoc Physicians AIDS Care. 2007;6(1):36-46. doi:10.1177/1545109706297346.