

# Prevalence of Dysglycemia, Dyslipidemia, and Metabolic Syndrome among Patients with HIV Infection: a Cross-sectional Study from Iran

Marjan Shakiba<sup>1,2</sup>, Shervin Shokouhi<sup>1,3</sup>, Fariba Alaei<sup>4</sup>, Amirreza Keyvanfar<sup>1</sup>, Hanieh Najafiarab<sup>5</sup>, Mehrdad Yasaei<sup>2\*</sup> 

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## Abstract

**Background:** Human immunodeficiency virus (HIV) resulted in considerable morbidity and mortality. Following antiretroviral therapy (ART), the life expectancy of HIV-infected patients increased; however, they were more at risk of developing chronic diseases such as endocrinopathies. This study aimed to determine the prevalence of dysglycemia, dyslipidemia, and metabolic syndrome among patients with HIV infection.

**Methods:** This cross-sectional study was conducted on HIV-infected patients referring to Loghman Hakim Hospital (Tehran, Iran) between April 2020 and April 2021. We examined demographic features, medical history, and laboratory tests indicating the metabolic status of the patients. Eventually, collected data were processed using SPSS version 23.

**Results:** The mean age of 68 confirmed HIV patients was  $39.85 \pm 10.54$  years and 64.7% were male. BMI (MD = 2.57, 95% CI = [0.25, 4.88],  $P = 0.035$ ), cholesterol (MD = 22.73, 95% CI = [4.70, 40.76],  $P = 0.014$ ), HDL (MD = 8.54, 95% CI = [2.06, 15.02],  $P = 0.011$ ), and LDL of women was significantly higher than men (MD = 22.43, 95% CI = [7.60, 37.27],  $P = 0.004$ ). Additionally, 30 patients (44.1%) suffered from metabolic syndrome. The prevalence of metabolic syndrome differed significantly between men (34.1%) and women (62.50%) ( $P = 0.024$ ).

**Conclusion:** Dysglycemia, dyslipidemia, and metabolic syndrome are common among HIV-infected patients. Thus, periodic evaluation of the patients can be advantageous in early diagnosis and timely treatment.

**Keywords:** Dyslipidemias, Glucose Metabolism Disorders, HIV Infections, Metabolic Syndrome

**Conflicts of Interest:** None declared

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## Introduction

Since the emergence of human immunodeficiency virus (HIV), it has infected more than 79.3 million people and caused more than 36.3 million deaths. About two-thirds of HIV-infected cases live in African countries (1). Nevertheless, the incidence of HIV infection has also recently increased in European, American, and Asian countries (2).

Following antiretroviral therapy (ART), HIV infection

converts to a manageable chronic disease. Availability, potency, and few adverse events of ART increased the life expectancy of HIV-infected patients. As the life expectancy of patients prolonged, some chronic complications such as metabolic disorders, developed (3, 4). On the other hand, developing metabolic disorders in HIV-infected patients can aggregate their health condition (5). Experts believe

**Corresponding author:** Dr Mehrdad Yasaei, [mehrdad.yasaei@gmail.com](mailto:mehrdad.yasaei@gmail.com) / [myasaei@mrjd.ac.ir](mailto:myasaei@mrjd.ac.ir)

<sup>1</sup> Infectious Diseases and Tropical Medicine Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>2</sup> Department of Pediatric Endocrinology and Metabolism, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>3</sup> Department of Infectious Diseases and Tropical Medicine, Loghman Hakim Hospital, Shahid Beheshti Medical University, Tehran, Iran

<sup>4</sup> Department of Pediatric Cardiology, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>5</sup> Preventative Gynecology Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

### ↑What is "already known" in this topic:

Following antiretroviral therapy, HIV infection converts to a manageable chronic disease. As the life expectancy of HIV-infected patients prolonged, chronic complications such as metabolic disorders developed. Limited studies have been conducted on the metabolic profile of HIV-infected patients in Iran.

### →What this article adds:

Many Iranian HIV-infected patients suffer from dysglycemia, dyslipidemia, and metabolic syndrome.

that medications mainly caused a flare-up of metabolic disorders among these patients. Also, medications increase the risk of diabetes mellitus (DM) through insulin resistance. Despite ART being associated with metabolic disorders in HIV-infected patients, we should not underestimate the effect of lifestyle, diet, and genetics (4, 6).

Most studies on metabolic disorders of HIV-infected patients have been conducted in African countries (7). Carrying out a similar study in Iran can help estimate the prevalence of metabolic disorders among HIV-infected patients in Iran and compare it with other countries. Thus, this study aimed to determine the prevalence of dysglycemia, dyslipidemia, and metabolic syndrome among patients with HIV infection.

## Methods

This cross-sectional study was conducted from April 2020 to April 2021 at Loghman Hakim Hospital, Tehran, Iran. The study population included HIV-infected patients referred to the behavioral disorders clinic of Loghman Hakim Hospital. The inclusion criteria were: confirmed cases of HIV using two 4th generation ELISA or the 3rd generation ELISA followed by western blot, age at least 18 years, and willingness to participate in the study.

Data collection was based on the census method. Age, gender, body mass index (BMI), and medical history of the patients were collected by reviewing the medical records. Also, waist circumference, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured on physical examination. In terms of BMI ( $\text{kg}/\text{m}^2$ ), patients were categorized into the following groups: underweight ( $<18.5$ ), normal ( $18.5$ - $24.9$ ), overweight ( $25.0$ - $29.9$ ), and obese ( $30.0$ ) (8). We considered the following physical examinations abnormal: waist circumference  $>102$  cm for men and  $>88$  cm for women, SBP  $\geq 130$  mmHg, and DBP  $\geq 85$  mmHg. Additionally, blood samples were taken from the patients at Adib laboratory (Tehran, Iran) to measure: fasting plasma glucose (FPG), hemoglobin A1c (HbA1c), triglyceride (TG), cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), insulin level, and homeostatic model assessment for insulin resistance (Homa-IR) –multiply insulin level in FPG by 405–. We considered the following laboratory results abnormal: FPG  $>100$  mg/dL, HbA1c  $>5.6\%$ , TG  $>150$  mg/dL, cholesterol  $>200$  mg/dL, LDL  $\geq 130$  mg/dL, HDL  $<40$  mg/dL for men and  $<50$  mg/dL for women, insulin level during fasting  $>25$   $\mu\text{IU}/\text{mL}$ , and Homa-IR  $>2.5$ . Individuals with three or more of the following criteria were considered to have metabolic syndrome: 1) waist circumference  $>102$  cm for men and  $>88$  cm for women, 2) TG  $>150$  mg/dL or specific medication, 3) HDL  $<40$  mg/dL for men and  $<50$  mg/dL for women or specific medication, 4) SBP  $\geq 130$  mmHg or DBP  $\geq 85$  mmHg or specific medication, 5) FPG  $>125$  mg/dL or specific medication or previously diagnosed DM type II (9).

Data were analyzed using IBM SPSS software (version 23). Data were reported by frequency, percentage, mean, standard deviation, mean difference (MD), and 95% confidence interval (CI). The normality of continuous variables was assessed using the Shapiro-Wilk test. The independent-

sample t-test and Mann-Whitney U test were used to compare continuous variables between gender groups. The Chi-square test was used to analyze categorical variables. In this study,  $P$ -value  $< 0.05$  was considered statistically significant.

This study was approved by the ethics committee of Shahid Beheshti University of Medical Sciences (ID: IR.SBMU.RETECH.REC.1398.211) and performed in accordance with the Helsinki Declaration.

## Results

The mean age of 68 confirmed HIV-infected patients was  $39.85 \pm 10.54$  years (range: 21-74 years), and 44 (64.7%) were male. Hypertriglyceridemia was the most common underlying disease (7.4%), followed by hypertension (3.3%), hypercholesterolemia (2.9%), and DM (2.9%).

Based on physical examination, most patients (48.5%) had normal blood pressure. Meanwhile, 41.2% and 10.3% of them were categorized into pre-hypertension and stage I hypertension groups. Most patients had normal BMI (51.5%), and others had overweight (29.4%) and obesity (14.7%). Figure 1 depicts the laboratory findings of the patients. As shown in Table 1, we compared the metabolic profile of the patients based on gender. BMI (MD = 2.57, 95% CI = [0.25, 4.88],  $P = 0.035$ ), cholesterol (MD = 22.73, 95% CI = [4.70, 40.76],  $P = 0.014$ ), HDL (MD = 8.54, 95% CI = [2.06, 15.02],  $P = 0.011$ ), and LDL of women was significantly higher than men (MD = 22.43, 95% CI = [7.60, 37.27],  $P = 0.004$ ). Other metabolic indicators did not differ significantly between gender groups ( $P > 0.05$ ). Furthermore, 30 patients (44.1%) suffered from metabolic syndrome. The prevalence of metabolic syndrome differed significantly between men (34.10%) and women (62.50%) ( $P = 0.024$ ).

## Discussion

Our results revealed a high prevalence of DM and pre-diabetes among HIV-infected patients, which is in agreement with previous studies (10, 11). In a review article by Njuguna et al., the prevalence of blood glucose within the diabetic and pre-diabetic range was 1-26% and 19-47%, respectively. In this study, old age and high BMI were risk

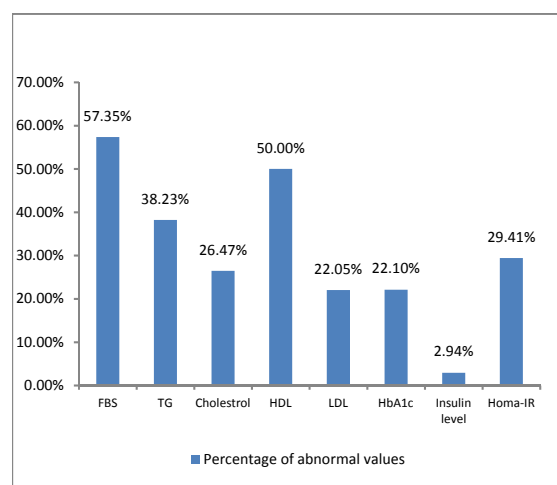


Figure 1. Laboratory findings of HIV-infected patients

Table 1. Metabolic profile of the patients based on gender

Variable	Male (n=44)	Female (n=24)	Mean difference & 95% CI (n=68)	P-value
BMI (kg/m <sup>2</sup> )	24.50±4.20	27.02±5.16	2.57 (0.25, 4.88)	0.035 <sup>a</sup>
Waist circumference (cm)	97.39±17.17	100.50±17.79	3.11 (-5.70, 11.92)	0.549 <sup>a</sup>
SBP (mmHg)	121.36±11.78	114.79±15.07	-6.57 (-13.75, 0.615)	0.038 <sup>a</sup>
DBP (mmHg)	77.16±12.82	74.38±10.45	-2.78 (-8.89, 3.32)	0.322 <sup>b</sup>
FPG (mg/dL)	103.50±14.09	102.63±14.09	-0.87 (-6.14, 4.39)	0.807 <sup>b</sup>
TG (mg/dL)	171.82±140.13	153.13±88.22	-18.69 (-81.78, 44.39)	0.908 <sup>b</sup>
Cholesterol (mg/dL)	166.98±33.77	189.71±38.76	22.73 (4.70, 40.76)	0.014 <sup>a</sup>
HDL (mg/dL)	40.70±12.60	49.25±13.15	8.54 (2.06, 15.02)	0.011 <sup>a</sup>
LDL (mg/dL)	99.73±28.54	122.17±30.60	22.43 (7.60, 37.27)	0.004 <sup>b</sup>
HbA1c (%)	5.24±0.47	5.28±0.46	0.04 (-0.20, 0.28)	0.822 <sup>b</sup>
Insulin level (μIU/mL)	9.02±8.84	11.39±11.48	2.36 (-2.62, 7.35)	0.077 <sup>a</sup>
Homa-IR	2.32±2.28	2.95±3.12	0.63 (-0.68, 1.95)	0.085 <sup>a</sup>

BMI, Body mass index; SBP, Systolic blood pressure; DBP, diastolic blood pressure; FPG, fasting plasma glucose; TG, Triglyceride; HDL, High-density lipoprotein; LDL, Low-density Lipoprotein; Homa-IR, Homeostatic model assessment for insulin resistance; CI, Confidence interval

Values are reported as mean ± standard deviation

<sup>a</sup> Mann-Whitney U test, <sup>b</sup> independent-samples t-test

factors for dysglycemia among HIV-infected patients as well as the general population (10). Many patients with HIV infection have increased serum levels of pro-inflammatory cytokines, for instance, C-reactive protein (CRP) and Interleukine-6 (IL-6), which lead to glucose intolerance (10, 12). In another study conducted in Kenya, the prevalence of DM and prediabetes among HIV-infected patients was 5.0% and 14.2%, respectively. Furthermore, the amount of glycosylated hemoglobin was associated with age, history of hypertension, abdominal obesity, and treatment with efavirenz (one of the first-line drugs for the treatment of HIV infection). It can impair pancreatic endocrine cell function and lead to environmental resistance to insulin. Dysglycemia following the administration of efavirenz has been reported in previous studies (11).

Besides, some behavioral factors, such as alcohol consumption, increase the risk of dysglycemia. Many patients with HIV infection are heavy drinkers. In a study by Primeaux et al., heavy alcohol drinkers had higher blood glucose levels compared with the general population (13, 14). Chronic alcohol abuse causes dysfunction of pancreatic  $\beta$ -cells and impairs the insulin response to blood glucose. Thus, these patients are at high risk of developing DM over time (15).

Moreover, our results demonstrated a high prevalence of dyslipidemia among HIV-infected patients, which is in line with the previous studies (16, 17). In a study by Dave et al., 32.2% of HIV-infected patients had above-normal cholesterol, 45.7% had below-normal HDL, and 9.5% had above-normal LDL. It has been documented that the high prevalence of dyslipidemia among HIV-infected patients is caused by the side effects of ART (16).

In the present study, the lipid profile of women had a greater deviation from the normal range compared with men, which is inconsistent with the previous studies (17, 18). This discrepancy may be attributed to the differences in the lifestyles of different populations. For example, in Iran, women are not employed and consequently have less physical activity than men. Furthermore, female sex hormones play a protective role against dyslipidemia only before menopause (18). In our study, the lipid profile of the patients might be skewed by age and menopausal status.

Based on our findings, the prevalence of metabolic syndrome was 44.1%. Previous studies have also reported the metabolic syndrome among HIV-infected patients in different countries with a high prevalence: India (40.1%) (19), South Ethiopia (42.5%) (20), Zambia (26.3%) (21), Taiwan (28.0%) (22), and Singapore (23.6%) (23).

HIV infection as well as age, unhealthy diet, and inadequate physical activity, increase the risk of developing metabolic syndrome. HIV infection induces apoptosis through mitochondrial dysfunction. Following apoptosis pro-inflammatory cytokines (e.g., IL-6, IL-1 $\beta$ , and tumor necrosis factor- $\alpha$ ) are released. Chronic inflammatory states inhibit the function of adiponectin, a pivotal protein in the homeostasis of carbohydrates and fatty acids, contributing to glucose intolerance, dyslipidemia, and metabolic syndrome (24).

In the present study, metabolic syndrome was more common among women, which conforms with the literature (21, 25, 26). Most women in developing countries are housewives. Hence, they have a sedentary lifestyle and are more likely to develop metabolic syndrome (25).

Our study had some limitations. First, this study was conducted on 68 HIV-infected patients. It is recommended to carry out further studies with a larger sample size in the future. Second, due to the study design, we could not investigate risk factors of metabolic disorders. For this purpose, analytical studies should be performed. In addition, we had no control over confounding variables. Third, it would have been better to evaluate thyroid hormones, but it did not get done due to financial limitations.

## Conclusion

In conclusion, dysglycemia, dyslipidemia, and metabolic syndrome are common among HIV-infected patients. Thus, periodic evaluation of these patients can be advantageous in early diagnosis, timely treatment, and preventing metabolic disorders.

## Acknowledgment

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**Conflict of Interests**

The authors declare that they have no competing interests.

**References**

- HIV/AIDS [2022 Jul 02]. Available from: <https://www.who.int/data/gho/data/themes/hiv-aids>.
- Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2018;392(10159):1789-858.
- Tiozzo E, Rodriguez A, Konefal J, Farkas GJ, Maher JL, Lewis JE. The Relationship between HIV Duration, Insulin Resistance and Diabetes Risk. *Int J Environ Res Public Health*. 2021;18(8).
- Zaid D, Greenman Y. Human Immunodeficiency Virus Infection and the Endocrine System. *Endocrinol Metab (Seoul)*. 2019;34(2):95-105.
- Girma D, Dejene H, Geleta LA, Malka ES, Tesema M, Awol M, et al. Metabolic syndrome among people living with HIV in Ethiopia: a systematic review and meta-analysis. *Diabetol Metab Syndr*. 2023;15(1):1-10.
- Masenga SK, Elijovich F, Koethe JR, Hamooya BM, Heimbürger DC, Munsaka SM, et al. Hypertension and Metabolic Syndrome in Persons with HIV. *Curr Hypertens Rep*. 2020;22(10):78.
- Nguyen KA, Peer N, Mills EJ, Kengne AP. A meta-analysis of the metabolic syndrome prevalence in the global HIV-infected population. *PLoS One*. 2016;11(3):e0150970.
- BMI classification percentile and cut off points. 2019.
- Nilsson PM, Tuomilehto J, Rydén L. The metabolic syndrome—what is it and how should it be managed? *Eur J Prev Cardiol*. 2019;26(2\_suppl):33-46.
- Njuguna B, Kiplagat J, Bloomfield GS, Pastakia SD, Vedanthan R, Koethe JR. Prevalence, Risk Factors, and Pathophysiology of Dysglycemia among People Living with HIV in Sub-Saharan Africa. *J Diabetes Res*. 2018;2018:6916497.
- Njoroge A, Augusto O, Page ST, Kigundu C, Oluka M, Puttkammer N, et al. Increased risk of prediabetes among virally suppressed adults with HIV in Central Kenya detected using glycated haemoglobin and fasting blood glucose. *J Endocr Diab Metab*. 2021;4(4):e00292.
- Nkinda L, Patel K, Njuguna B, Ngangali JP, Memiah P, Bwire GM, et al. C - reactive protein and interleukin - 6 levels among human immunodeficiency virus -infected patients with dysglycemia in Tanzania. *BMC Endocr Disord*. 2019;19(1):77.
- Primeaux SD, Simon L, Ferguson TF, Levitt DE, Brashear MM, Yeh A, et al. Alcohol use and dysglycemia among people living with human immunodeficiency virus (HIV) in the Alcohol & Metabolic Comorbidities in PLWH: Evidence Driven Interventions (ALIVE-Ex) study. *Alcohol Clin Exp Res*. 2021;45(9):1735-46.
- Ferguson TF, Theall KP, Brashear M, Maffei V, Beauchamp A, Siggins RW, et al. Comprehensive Assessment of Alcohol Consumption in People Living with HIV (PLWH): The New Orleans Alcohol Use in HIV Study. *Alcohol Clin Exp Res*. 2020;44(6):1261-72.
- Simon L, Ferguson TF, Vande Stouwe C, Brashear MM, Primeaux SD, Theall KP, et al. Prevalence of Insulin Resistance in Adults Living with HIV: Implications of Alcohol Use. *AIDS Res Hum Retroviruses*. 2020;36(9):742-52.
- Dave JA, Levitt NS, Ross IL, Lacerda M, Maartens G, Blom D. Anti-Retroviral Therapy Increases the Prevalence of Dyslipidemia in South African HIV-Infected Patients. *PLoS One*. 2016;11(3):e0151911.
- Mizushima D, Dung NTH, Dung NT, Matsumoto S, Tanuma J, Gatanaga H, et al. Dyslipidemia and cardiovascular disease in Vietnamese people with HIV on antiretroviral therapy. *J Glob Health Med*. 2020;2(1):39-43.
- Kemal A, Teshome MS, Ahmed M, Molla M, Malik T, Mohammed J, et al. Dyslipidemia and Associated Factors Among Adult Patients on Antiretroviral Therapy in Armed Force Comprehensive and Specialized Hospital, Addis Ababa, Ethiopia. *HIV/AIDS (Auckland, NZ)*. 2020;12:221-31.
- Mallya SD, Reddy TS, Kamath A, Pandey AK, Saravu K. Determinants of Metabolic Syndrome and 5-Year Cardiovascular Risk Estimates among HIV-Positive Individuals from an Indian Tertiary Care Hospital. *AIDS Res Treat*. 2020;2020:5019025.
- Bune GT, Yalew AW, Kumie A. The extents of metabolic syndrome among Antiretroviral Therapy exposed and ART naïve adult HIV patients in the Gedeo-zone, Southern-Ethiopia: a comparative cross-sectional study. *Arch Public Health*. 2020;78:40.
- Hamooya BM, Mulenga LB, Masenga SK, Fwemba I, Chirwa L, Siwingwa M, et al. Metabolic syndrome in Zambian adults with human immunodeficiency virus on antiretroviral therapy: Prevalence and associated factors. *Medicine*. 2021;100(14):e25236.
- Lu WL, Lee YT, Sheu GT. Metabolic Syndrome Prevalence and Cardiovascular Risk Assessment in HIV-Positive Men with and without Antiretroviral Therapy. *Medicina (Kaunas)*. 2021;57(6).
- Ang LW, Ng OT, Boudville IC, Leo YS, Wong CS. An observational study of the prevalence of metabolic syndrome in treatment-experienced people living with HIV in Singapore. *PLoS One*. 2021;16(6):e0252320.
- Mohan J, Ghazi T, Chuturgoon AA. A Critical Review of the Biochemical Mechanisms and Epigenetic Modifications in HIV- and Antiretroviral-Induced Metabolic Syndrome. *Int J Mol Sci*. 2021;22(21).
- Costa CRB, Melo ES, Antonini M, Jesus GJ, Pontes PS, Gir E, et al. Association between sociodemographic and behavioral factors with metabolic syndrome in people living with HIV. *Rev Gaucha Enferm*. 2019;40:e20180379.
- Masyuko SJ, Page ST, Kinuthia J, Osoti AO, Polyak SJ, Otieno FC, et al. Metabolic syndrome and 10-year cardiovascular risk among HIV-positive and HIV-negative adults: A cross-sectional study. *Medicine*. 2020;99(27):e20845.