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

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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±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

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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

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↑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.

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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 (kg/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 ≥130 mmHg, and DBP ≥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 ≥ 130 mg/Dl, HDL <40 mg/Dl for men and <50 mg/dL for women, insulin level during fasting >25 µIU/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 ≥130 mmHg or DBP ≥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±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).

Disscusion

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 Njugnna 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

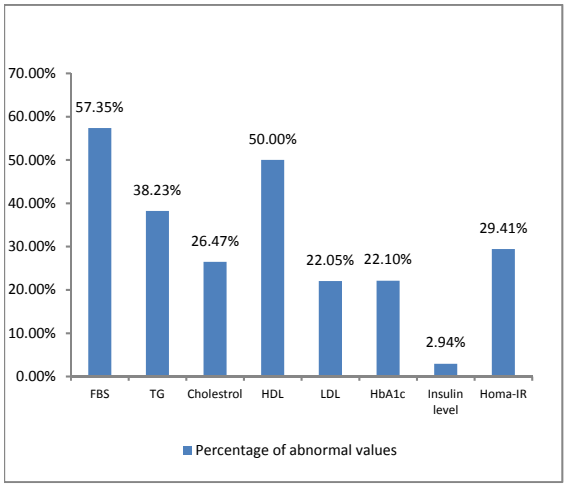

Figure 1. Laboratory findings of HIV-infected patients

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

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
[a] Mann-Whitney U test, [b] 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 β-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-1β, and tumor necrosis factor-α) 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.

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Conflict of Interests

The authors declare that they have no competing interests.

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