ORIGINAL ARTICLE

Evaluation of glycated haemoglobin and hepatitis B antigenic markers in people living with HIV in Ilorin, north-central Nigeria

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Abstract

Background: Metabolic and viral co-morbidities, particularly Hepatitis B Virus (HBV) infection and dysglycemia, are increasingly recognized among People Living with HIV (PLHIV) in sub-Saharan Africa. Antiretroviral Therapy (ART) improves survival but may alter glucose metabolism, while HBV co-infection exacerbates hepatic and metabolic complications. *Aim and Objectives:* To determine the prevalence of Hepatitis B surface Antigen (HBsAg) positivity and assess glycated haemoglobin (HbA1c) levels among HIV-positive patients on ART in Ilorin, North-Central Nigeria. *Material and Methods:* A case-control study was conducted among 150 participants (80 HIV-positive on ART, 70 HIV-negative controls). HIV status was confirmed serologically. HBV antigenic markers were identified using commercial immunoassay kits (Rapid Labs, UK). HbA1c was determined by cation-exchange chromatography. Diabetes and prediabetes were defined using ADA criteria: HbA1c $\geq$ 6.5% and 5.7-6.4%, respectively. Data were collected by trained laboratory scientists under faculty supervision and analyzed with SPSS v25 using t-tests and ANOVA (significance set at $p < 0.05$). *Results:* The mean HbA1c was similar between HIV/HBV co-infected, HIV-only, and control groups ($p = 0.162$). HIV patients on ART for < 1 year had significantly higher HbA1c (5.01 ± 0.84%) than those on ART > 1 year (4.56 ± 0.99%) ($p = 0.031$). The prevalence of HIV/HBV co-infection was 35%. No HIV patient met the HbA1c threshold for diabetes. *Conclusion:* HIV/HBV co-infection was common, while HbA1c values suggested that HbA1c may underestimate glycemia in PLHIV. Strengthening HBV screening and using glucose-based tests for glycemic monitoring are essential for improved patient management.

Keywords: HIV, Hepatitis B, glycated Haemoglobin (HbA1c), antiretroviral therapy, Nigeria, co-infection

Introduction

Antiretroviral Therapy (ART) has markedly improved survival and quality of life among people living with HIV [1, 2]. However, as HIV infection transitions into a chronic condition, the long-term complications of treatment and co-infections have emerged as major health challenges. Among these, metabolic disorders such as dysglycemia and chronic viral hepatitis are particularly important

because they significantly contribute to morbidity and mortality [3, 4]. HIV-infected individuals are at increased risk of developing Diabetes Mellitus (DM), partly due to the metabolic effects of ART. Large cohort studies have shown that cumulative ART exposure increases the incidence of DM, with HIV-infected populations having up to a two-fold higher risk compared to the general population [5-7]. Poor glycemic control further raises the risk of cardiovascular disease, renal impairment, and dyslipidemia, making routine monitoring essential [4,8]. Glycated Hemoglobin (HbA1c) is widely used to assess glycemic control and diagnose DM [9], though concerns have been raised about its accuracy in HIV-infected patients due to factors such as altered red blood cell turnover and haemolysis [10,11]. At the same time, Hepatitis B Virus (HBV) co-infection is common among people living with HIV because of shared transmission routes [12]. Globally, about 10% of HIV-infected individuals are estimated to be co-infected with HBV, with prevalence rates in sub-Saharan Africa reaching 15–60% in some populations [13-14].

HIV/HBV co-infection accelerates liver disease progression, increases HBV replication, and raises the risk of cirrhosis and hepatocellular carcinoma compared to HBV infection alone [15-17]. Nigeria, where both HIV and HBV are highly prevalent, faces a particular burden of these overlapping infections [18, 19]. Despite the recognized risks, there are limited data from Nigeria on the combined burden of dysglycemia and HBV co-infection among HIV patients receiving ART. Understanding these risks is essential for designing effective screening, preventive, and treatment strategies in resource-limited settings.

HIV and HBV co-infection is common in sub-Saharan Africa due to shared transmission routes, leading to increased liver-related morbidity and mortality [12, 15-17]. Concurrently, ART has been linked to metabolic complications such as dysglycemia [5-7]. Despite these dual risks, few Nigerian studies have examined both metabolic and viral co-morbidities in HIV patients on ART. This study therefore aimed to determine the prevalence of HBV co-infection and evaluate HbA1c levels among HIV-positive patients on ART in Ilorin, Nigeria, to assess potential interactions between ART duration, HBV co-infection, and glycemic status.

Material and Methods

Study area

The study was conducted at the HIV clinic of Sobi Specialist Hospital, Ilorin, Kwara State, Nigeria. Ilorin is a major city in north-central Nigeria with a population engaged mainly in commerce and small-scale industry [20].

Ethical considerations

Ethical approval was obtained from the Ethics and Research Committee of the Kwara State Ministry of Health, Ilorin, Nigeria, and the management of Sobi Specialist Hospital. Written informed consent was obtained from all participants, and confidentiality was maintained throughout the study.

Study design and participants

This was a comparative case-control study conducted over three months. A total of 150 participants were recruited by random sampling: 80 HIV-positive patients on ART and 70 apparently healthy controls. The HIV-positive group was further divided into patients on ART for less than one year (n = 40) and those on ART for more than one year (n = 40).

Operational definitions

Diabetes was defined as HbA1c $\geq$ 6.5%, prediabetes as 5.7-6.4%, and normal glycemia as < 5.7% according to the American Diabetes Association

criteria [11]. HBV positivity was defined as serologic detection of HBsAg. HIV-positive status was confirmed by parallel rapid testing using Determine™ HIV-1/2 and Uni-Gold™ kits per national guidelines.

Inclusion criteria: HIV-seropositive patients aged 18–50 years receiving ART for at least one year (experienced) or less than one year (naïve).

Exclusion criteria: Pregnancy, extremes of age, HIV/TB co-infection, use of anticoagulants, cytotoxic chemotherapy, or radiotherapy, as well as self-reported conditions that might alter immune status.

Sample size determination

The minimum sample size was calculated using the Cochran Sample Size Formula:

$$N = \frac{Z^2 \times P\,(1-P)}{d^2}$$

where P = prevalence of HIV/HBV co-infection in Nigeria (10%) [21], d = desired precision (0.05), and Z = 1.96 at 95% confidence interval.

$$N = \frac{1.96^2 \times 0.10\,(1-0.10)}{0.05^2}$$

$$N = \frac{3.8416 \times 0.09}{0.0025}$$

The calculation yielded 138, which was rounded up to 150 to improve statistical power.

Sample collection and laboratory analysis

Venous blood (2 mL) was collected into EDTA tubes. HbA1c was measured using the A1c cation exchange method on a Beckman Coulter Chemistry Analyzer (Beckman Coulter, USA). HIV screening was performed only for the control group to confirm HIV-negative status using Determine™ HIV-1/2 (Abbott Laboratories, USA), with reactive samples confirmed using Uni-Gold™ HIV (Trinity Biotech, Ireland), following national testing algorithms [22, 23]. HBV infection was screened using a rapid HBsAg Bioline™ Hepatitis test kit, and positive samples were further evaluated with a multi-marker HBV rapid test (detecting HBsAg, anti-HBs, HBeAg, anti-HBe, and anti-HBc) according to manufacturer's instructions.

Statistical analysis

All samples and data were collected by certified medical laboratory scientists under supervision of senior faculty from the Department of Medical Laboratory Science, Kwara State University, Malete. Data integrity and test reliability were ensured through double-entry verification and daily calibration of analytical instruments. Socio-demographic and clinical data were obtained through interviewer-administered questionnaires. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 22.0 (IBM Corp., USA). Descriptive statistics were used to summarize participant characteristics. Differences between groups were tested using Student's t-test and one-way ANOVA where appropriate. Pearson's correlation coefficient was applied for relationships between continuous variables. Statistical significance was set at $p < 0.05$.

Results

Participant characteristics

A total of 150 participants were included in the study: 80 HIV-positive patients on ART and 70 HIV-negative controls. The mean age of HIV patients was 39.7 ± 13.1 years, significantly higher than that of controls (29.2 ± 12.6 years; $p < 0.001$). Females predominated among HIV patients (67.5%), while males predominated among controls (48.6%), a difference that approached statistical significance ($p = 0.05$).

Coexistence of HIV, HBV and glycaemic status

Table 1 presents a summary of demographic and biochemical findings. The mean HbA1c did not

differ significantly among HIV-only patients (4.58 ± 0.59 %), HIV/HBV co-infected patients (4.63 ± 0.81 %), and HIV-negative controls (4.86 ± 1.00 %) (p = 0.162). The proportion of participants in the pre-diabetic HbA1c range (≥ 5.7 %) was higher among HIV-infected individuals (21.3 %) than in controls (11.4 %), but the difference was not statistically significant (p > 0.05). When ART duration was considered, patients on therapy for < 1 year had significantly higher mean HbA1c (5.01 ± 0.84 %) than those on ART > 1 year (4.56 ± 0.99 %) (p = 0.031), suggesting an early treatment-related rise in glycemia that stabilised over time.

Table 1: Coexistence of HIV, HBV, and HbA1c status

Parameter	HIV Only (n=52)	HIV + HBV (n=28)	Controls (n=70)	*p*
Age (years, mean ± SD)	39.4 ± 13.2	40.1 ± 12.9	29.2 ± 12.6	<0.001
Sex (Male %)	32.5	30.2	48.6	0.05
HbA1c (%) ± SD	4.58 ± 0.59	4.63 ± 0.81	4.86 ± 1.00	0.162
HbA1c ≥ 5.7 % (Prediabetic)	17 (21.3 %)	0 (0 %)	8 (11.4 %)	-
ART < 1 year	26 (50 %)	14 (50 %)	-	0.031

HIV – Human immunodeficiency virus; HBV – hepatitis B virus; HbA1c – glycated haemoglobin; ART – antiretroviral therapy

Table 2: Distribution of Hepatitis B markers by ART duration

ART Duration	HBsAg+	HBsAb+	HBeAg+	HBeAb+	HBcAb+	Total HBV+ (%)
< 1 year	19	0	0	14	19	67.9
> 1 year	9	0	0	3	9	32.1
Total (n=28)	-	-	-	-	-	100

HBsAg = hepatitis B surface antigen; HBsAb = hepatitis B surface antibody; HBeAg = hepatitis B envelope antigen; HBeAb = hepatitis B envelope antibody; HBcAb = hepatitis B core antibody; ART – antiretroviral therapy

Discussion

This study examined the coexistence of HBV co-infection and HbA1c levels among people living with HIV receiving ART in Ilorin, North-Central Nigeria. The analysis showed a high prevalence of HIV/HBV co-infection and a modest rise in HbA1c during early ART exposure, with normalization over time. These findings have important implications for metabolic monitoring and integrated management of viral co-infection in HIV patients.

Glycemic status and ART duration

No participant met the diagnostic threshold for diabetes (HbA1c ≥ 6.5%), and only about one-fifth of HIV patients were in the prediabetic range. The mean HbA1c levels did not differ significantly

between HIV-only, HIV/HBV co-infected, and HIV-negative participants, suggesting that HBV co-infection did not significantly affect glycemia. However, patients on ART for less than one year had significantly higher HbA1c than those on therapy for more than one year (p = 0.031). This pattern implied an early metabolic effect of ART initiation, which appeared to attenuate with prolonged therapy. Similar transient dysglycemic responses have been reported in other cohorts, particularly with Nucleoside Reverse Transcriptase Inhibitor (NRTI)-based regimens [7–9,]. The reduction of HbA1c values after extended ART use could reflect adaptation of glucose metabolism or regimen changes minimizing mitochondrial toxicity [10, 11]. The absence of overt diabetes in this cohort supported earlier observations that HbA1c tends to underestimate glycemia in people living with HIV due to shortened red blood cell lifespan, haemolysis, or macrocytosis. This finding reaffirmed the need for periodic fasting glucose or oral glucose tolerance testing in this population, as recommended by clinical guidelines.

HIV/HBV Co-infection and ART

The prevalence of HIV/HBV co-infection in this study (35%) was higher than previous Nigerian reports ranging between 10% and 20% [16-18]. Such variation may result from differences in diagnostic sensitivity, sampling frame, or regional endemicity. All co-infected patients were HBsAg positive and HBsAb negative, reflecting incomplete immune clearance and chronic infection. The absence of HBeAg with persistent HBcAb positivity suggested a low-replicative state, consistent with earlier observations of immune-tolerant or inactive carrier phases in HIV co-infection [13, 15].

Interestingly, HBV co-infection was twice as frequent among participants on ART for less than one year compared with those on ART for longer durations. This pattern might indicate immune reconstitution unmasking occult HBV in the first months of ART or gradual suppression of viral replication with sustained treatment [12,13]. Reduced HBeAb positivity in patients with longer ART exposure further supported the hypothesis of partial viral suppression.

Clinical and public health implications

The concurrent burden of metabolic and viral co-morbidities among people living with HIV underscores the importance of comprehensive monitoring. The data suggested that early ART may transiently disturb glucose regulation, while prolonged ART appeared to confer hepatic and metabolic stability. Routine HBV screening, vaccination for susceptible individuals, and periodic assessment of glycemia are therefore critical components of HIV care in Nigeria and similar settings [21, 22, 24-26].

Study limitations

This study was cross-sectional and could not establish causal relationships between ART duration, metabolic changes, and HBV infection patterns. The reliance on HbA1c alone to assess glycemia might have underestimated true glucose intolerance, and the absence of molecular HBV testing limited full characterization of viral replication. Nonetheless, rigorous laboratory procedures, adequate sample size, and internal validity strengthen the credibility of the findings.

Strengths of the study

This study was among the few to simultaneously examine HBV co-infection and glycemic status in Nigerian HIV patients using standardized assays and verified data collection protocols. The inclusion of ART duration provided new insights into the temporal interaction between therapy and metabolic

response, while regional focus contributed valuable epidemiological data for Ilorin and the wider North-Central zone.

Implications

Despite the limitations, our findings provide important local data. Routine use of HbA1c in HIV patients should be interpreted cautiously, and confirmatory glucose-based testing is advisable. The high prevalence of HIV/HBV co-infection highlights the need for expanded HBV vaccination, routine screening, and coordinated management strategies. Together, these interventions could reduce long-term cardiovascular and liver-related complications in HIV populations in Nigeria.

Conclusion

HBV co-infection was prevalent among HIV-positive patients on ART in Ilorin, affecting over one-third of participants. HbA1c levels indicated a low prevalence of diabetes and no significant difference between HIV-only and HIV/HBV co-infected patients. However, patients within the first year of ART had significantly higher HbA1c levels compared to those on longer treatment. These findings suggest that HBV co-infection did not influence glycemic status, while early ART exposure was associated with transient elevations in HbA1c.

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