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Prevalence of Diabetes Mellitus in Persons Living with HIV in Yaounde: A Cross-Sectional Study

Prévalence du diabète sucré chez les personnes vivant avec le VIH à Yaoundé : étude transversale

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ABSTRACT

Introduction. PLHIV are thought to be more likely to develop diabetes than HIV-negative people because of many risk factors including diabetes in the family, being overweight, age, gender and socio-economic conditions. To date, HIV and diabetes have received worldwide attention. The aim of this study was to determine the prevalence of diabetes mellitus among PLHIV on ART in Yaounde. **Material and methods.** In a cross-sectional study, we included 45 PLHIV aged 21 years or over receiving ART, between September 2019 and February 2020. Diabetes was measured by the glucose tolerance test (OGTT). We classified the test results into three levels: normal, prediabetes, and diabetes mellitus respectively for blood glucose of ≤ 7.7 mmol/l; 7.8 to 11.0 mmol/l, and ≥ 11.1 mmol/l. SPSS statistical software, version 22.0 was used for the statistical analysis. By using Fisher's exact test for all comparisons and a P-value, < 0.05 was considered significant. **Results.** Forty-five patients with mean age 33.4 ± 6.8 years including 57.8% men and 42.2% women, consented to participate in the study. Overall, 21 (46.6%) patients had diabetes, 14 (31.1%) had prediabetes and 10 (22.2%) were normal. Regarding viral load, 14 (73.7%) patients had a viral load ≥ 40 copies of RNA (P=0.008). All diabetic and prediabetic patients had more than 1 year of ARV exposure (P<0.0001). **Conclusion.** Our results underscore the need for systematic screening and assessment of diabetes in PLVIH on ART.

RÉSUMÉ

Introduction. Les PVVIH seraient plus susceptibles de contracter le diabète que les personnes séronégatives en raison de nombreux facteurs de risque que sont le diabète dans la famille, l'embonpoint, l'âge, le sexe et les conditions socioéconomiques. À ce jour, le VIH et le diabète font l'objet d'une attention dans le monde. Cette étude avait pour but de déterminer la prévalence du diabète sucré chez les PVVIH sous TARV à Yaoundé. **Méthodes**: Dans une étude transversale, nous avons inclus 45 PVVIH âgés de 21 ans et plus sous TARV, entre septembre 2019 et février 2020. Le diabète a été mesuré par le test de tolérance au glucose (OGTT). Nous avons classé les résultats des tests en trois niveaux: normal, prédiabète et diabète sucré, respectivement pour une glycémie de 7,7 mmol/l, 7,8 à 11,0 mmol/l et 11,1 mmol/l. La version 22.0 du logiciel statistique SPSS a été utilisée pour l'analyse statistique. En utilisant le test exact de Fisher pour toutes les comparaisons et une valeur P< 0,05 a été considéré comme significatif. **Résultats**: Quarante-cinq patients âgés en moyenne de 33,4±6,8 ans, dont 57,8 % d'hommes et 42,2 % de femmes, ont consenti à participer à l'étude. Dans l'ensemble, 21 patients (46,6 %) avaient le diabète, 14 (31,1 %) avaient le prédiabète et 10 (22,2 %) étaient normaux. En ce qui concerne la charge virale, 14 patients (73,7 %) avaient une charge virale de 40 copies d'ARN (P=0,008). Tous les patients diabétiques et prédiabétiques ont été exposés au ARV pendant plus d'un an (P<0,0001). **Conclusion**: Nos résultats soulignent la nécessité d'un dépistage et d'une évaluation systématiques du diabète en PVVIH sous TARV.

INTRODUCTION

At the end of 2020, 37.7 million people were living with Human Immunodeficiency Virus (PLHIV), more than 1.5 million people have contracted the virus and 680,000 people have died from it [1]. The African Region World Health Organization (WHO) alone supports more than 25.7 million PLHIV, with an estimated 1.1 million people infected with HIV [2]. While in 2021 there were close to 24 million people living with diabetes in the African Region of the International Diabetes Federation (IDF). Experts estimate that number will rise to 55 million by 2045. Diabetes alone was responsible for more than 416,000 deaths in this region during the year 2021 [3]. PLHIV are more likely to contract diabetes than healthy people because of their immunological status. They could also face many other risk factors such as diabetes in the

family, being overweight, age, sex, socio-economic conditions [4] Diabetes have a greater impact on the health of people with chronic and immunocompromising diseases [5] such as HIV whose prevalence in Cameroon is estimated at 3.4% [6] and diabetes whose prevalence is estimated at 6% in Cameroon.[7] HIV and diabetes are the subject of great attention around the world. The association of these diseases is common, in particular, in low-income settings and developing countries[8,9]. In this context, diabetes and HIV are fueled by socio-political factors, to which are added the impacts of antiretroviral treatments [10–12]. In another context, to date in our context, we observe a lack of systematic diagnosis of diabetes in patients on Antiretroviral treatment (ART) [13] yet taking antiretroviral (ARV) containing protease inhibitors, inhibitors of reverse transcriptase, which have demonstrated their influence on carbohydrate metabolism leading to type II diabetes [10]. It is therefore to be feared diabetes in a PLHIV and increased workload for caregivers. Because this important double challenge opens the doors to cardiovascular complications and the premature deaths. A study done in Cameroon on children under five years old showed that PLHIV on ART had a good immune recovery after six months but also had a significant change in their glycemic profile [14]. Parts of this finding our study investigated the burden of diabetes mellitus in patients with HIV on ART in our context. The aim of this study was to determine the prevalence of diabetes mellitus among PLHIV on ART in Yaounde.

MATERIAL AND METHODS

Type of study and participant

We conducted a cross-sectional study over a period of 6 months with PLHIV aged 21 or over, exempt from all other infectious diseases and receiving their ART in Central and General hospitals of Yaoundé between September 2019 to February 2020. During this period, any PLHIV who fasted for at least 10 hours came for consultation in these hospitals, the study was explained to him. Each of the participants who agreed to take part in this study signed an informed consent prior to data collection.

Sample size calculation

The sample size was calculated by considering a prevalence of 3.8% rate of Diabetes in HIV [15]. According to the following formula.

$$N = \frac{P(1-P)(Z_{1-\alpha})^2}{i^2} \qquad [16]$$

Z = the level of statistical significance with a 95% confidence interval (CI) of 1.96 and a level of precision of 0.05

The minimum sample size obtained was 56 by adding 10% to account for non-responders, 62 PLHIV on ART were expected in this study.

Data collection and measurements in the laboratory

Participants were interviewed using a pre-tested structured questionnaire. During the interview, the patients were given an identification number and then data were collected on socio-demographic, behavioural (smoking and alcoholism), clinical characteristics and then their anthropometric data such as body mass index (BMI) was calculated by dividing the weight (kg) by the square of the height (meters). Clinical measures, including duration of HIV infection, duration of ART. Blood samples was taken early in the morning after an overnight fast.

Diabetes measures

The reliable measure of diabetes in this study was with a glucose tolerance test (OGTT). Once the patient certified their fast to the researcher, it gave 82.5 g of dextrose monohydrate diluted in 250 ml of drinking water to drink within 5 minutes for the OGTT. A catheter was placed on each patient, and then 1 ml was taken after 0 minutes, 30 minutes, 60 minutes and 120 minutes. But here only the 120-minute OGTT data was analysed [17]. At 120 minutes we classified the test results into three levels: normal, prediabetes, and diabetes mellitus respectively for a blood glucose of ≤7.7 mmol/l; 7.8 to 11.0 mmol/l and ≥11.1 mmol/l [18].

CD4 examination

CD4 count were measured using the BD FACSCOUNT system (Becton Dickenson and Company, CA, USA) on all the participants after collected whole blood samples.

Statistical Analysis

Data curation were made with Excel 2016 and analyses were performed with the statistical software SSPS, version 22.0 (SPSS, Chicago, Illinois, USA). We conducted a bivariate analysis using Fisher's exact test for categorical variables. All comparisons were two-sided and a P-value < 0.05 was considered significant.

Ethical considerations

This study was approved and authorized by the administration of the Central and General Hospitals of Yaoundé

RESULTS

Sociodemographic and Clinical characteristics of the study participants

Of the 75 PLHIV that we proposed a study, 45 PLHIV consented to participate a study, which gave us a response rate of 60%. Among the 45 PLHIV included in this study, we had 57.8% men and 42.2% women. The mean age was 33.4 ± 6.8 years and ranging between 20 and 46 years (Table 1).

Table 1: sociodemographic and clinical characteristics of 45 PLHIV included in this study

Variables		n=45(%)	CI at 95%
Sex	female	26(57.8)	[40.0-75.6]
	male	19(42.2)	[24.4-60.0]
Age	20-29	13(28.9)	[16.3-43.7]
	30-39	21(46.7)	[33.3-65.1]
	40-49	11(24.4)	[15.6-37.0]
Marital status	single	27(60.0)	[46.7-75.6]
	Married	10(22.2)	[11.1-39.2]
	Divorced	2(4.4)	[0.0-12.6]
	Widower	6(13.3)	[4.4-25.9]
Hypertension	yes	31(68.9)	[54.1-83.7]
	no	14(31.1)	[16.3-45.9]
Profession	employed	18(40.0)	[24.4-61.4]
	unemployed	27(60.0)	[38.6-75.6]
History of alcohol drinking	Yes	19 (42.2)	[31.1-58.5]
	no	26 (57.8)	[41.5-68.9]
History of tobacco smoking	yes	2(4.4)	[0.0-12.6]
	no	43(95.6)	[87.4-100.0]
Year of HIV Infection known and ART duration	≤1 year	10(22.2)	[8.9-33.3]
	> 1 year	35(77.8)	[66.7-91.1]
Family history	history of Diabetes family known	18(40.0)	[23,7-56,3]
	known hypertension in the family	10(22.2)	[11.1-35.5]
	unknown history	17(37.8)	[22.2-55.6]

CI: Confidence interval at 95%; ART: Antiretroviral treatment

Sixty percent of participants were single, 40% were unemployed, 68.9% had above normal hypertension. Four percent said they smoked, while 42.2% said they consumed alcohol before known their status. More than 77% of participants knew their HIV status and where on treatment for more than a year. Forty percent had a family history of diabetes and 22% had a family history of hypertension (Table 1).

Prevalence of diabetes and associated factors

Overall, 21 (46.6%) patients had diabetes, 14 (31.1%) had prediabetes and 10 (22.2%) were normal out of 45 patients included to this analyse. Of these patient's no one knew about their diabetes status. Regarding the viral load, 14 (73.7%) of the patients had a viral load ≥40 copies of RNA while 3 (15.8%) of patients had prediabetes (P=0.008). Regarding body mass index, 9 (45%) diabetics and 6 (30%) prediabetics had a body mass index between 25–29.9 kg/m^2 (P= 0.9). Regarding the rate this CD4, we noted 17 (48.6%) of diabetics and 12 (34.3%) of prediabetics had a quantity of CD4 <500 cell/mm^3 (P = 0.2). All diabetic and prediabetic patients had more than one year of ART exposure (P<0.0001) (Table 2).

Table 2: prevalence of type 2 Diabetes among 45 PLHIV included in this study

		Diabete mellitus n=21(%)	Normal n=10 (%)	Prediabete n=14 (%)	P-value
Viral load	≥40 copies of RNA	14(73.7)	2(10.5)	3(15.8)	0.008
	<40 copies of RNA	7(26.9)	8(30.8)	11(42.3)	
BMI	normal/underweight (BMI < 25 kg/m2)	6(46.2)	3(23.1)	4(30.8)	0.9
	obese (BMI ≥ 30 kg/m2)	6 (50.0)	2(16.7)	4(33.3)	
	overweight (BMI 25–29.9 kg/m2)	9(45.0)	5(25.0)	6(30.0)	
CD4	≥500 cell/mm^3	4 (40.0)	4(40.0)	2(20.0)	0.2
	<500 cell/mm^3	17 (48.6)	6 (17.1)	12 (34.3)	
ART duration	1 ≤year	/	10(100)	/	<0.0001
	> 1 year	21(100)	/	14(100)	

BMI= body mass index; ART= Antiretroviral treatment

DISCUSSION

Our study showed that overall, 40% of PLHIV had a family history of diabetes, 46.6% patients had diabetes and 31.1% had prediabetes. Seventy three percent had a viral load ≥40 copies of RNA P=0.008. Regarding BMI, 45% of diabetics and 30% of prediabetics had a body mass index between 25–29.9 kg/m^2 (P= 0.9). When considering CD4, 48.6% of diabetics and 34.3% of prediabetics had CD4<500 cell/mm^3 (P= 0.2). All diabetic and prediabetic patients had more than one year of ART exposure (P<0.0001). When considering studies in Cameroon, our

study showed a higher prevalence than those obtained by the majority of studies conducted in Cameroon, whose prevalence ranged from 3.5 to 26.5% [19]. This variability can be explained by the difference in diabetes screening technique used in these studies. Whereas, our results were consistent to those found by Ngatchou et al (43.5%) [20]. The prevalence of diabetes among PLHIV obtained in our study was much higher than that obtained in other countries such as Uganda, 7.4% [21], 6.6% from Malawi [22], 5.0 % from Zambia [23], 14.5% from Senegal [24] and 18.0% from Tanzania [25]. The differences observed could be due to the different lifestyles, the ART combination and the mode of distribution of the participants according to their ages [26].

Our study shows that the risk of diabetes was high in PLHIV with a family history, a history of hypertension and those who took ART for more than one year. Our results suggest that the prevalences of diabetes and prediabetes among PLHIV receiving ART for more than one year may have been overestimated. It would therefore be urgent to conduct longitudinal studies on the groups exposed or unexposed to ART and the risk of developing diabetes in our setting in order to determine the antiretroviral molecules at risk.

Health care professionals should be aware of the risk of diabetes that can result from the long-term use of ART in PLHIV. It would therefore be wise to consider an appropriate ART regimen for each cardiometabolic profile of a PLHIV [27]. Our results also highlight the need for systematic screening and assessment of diabetes risk factors in PLHIV on ART in our setting. This suggests the systematic inclusion of diabetes screening among PLHIV, but this can only be effective with the involvement and decision of health and political decision-makers in order to improve the management of PLHIV on ART. This study aims to strengthen routine screening for metabolic diseases such as diabetes mellitus in PLHIV, which suggests that the OGTT should be the gold standard for diagnosing diabetes in this population category [28].

One of the strengths of our study was the fact that it took place in two referral hospitals in Yaoundé and we examined the associations between risk factors and diabetes. In addition, we used the OGTT method, the most reliable method of screening Diabetes Mellitus. Due to the cross-sectional nature our study, we could not determine the temporal sequence of the conditions or the progression of diabetes in these patients. We also note the small size of our sample. We remain cautious not to overinterpret our results because we were unable to measure diabete type I, which would have been important in our participants given their young age [29]. Since ART has been studied in combinations; we have not been able to identify which of the molecules is associated with an elevated risk of diabetes. Having to interview participants related to diabetes risk factors, we could be limited by recall bias. Our sampling technique was non-probability and consecutive and took place in a one city, therefore our sample could not be considered representative of PLHIV receiving ART in our entire country [19]. A potential problem with our results is the lack of reliable data on diet and physical activity among participants in this study, as these factors are significant predictors of incident diabetes. A major limitation of the study was the lack of an HIV-negative control group, but we were able to compare the burden of diabetes in diabetics and prediabetics.

CONCLUSION

Our study showed a high prevalence of diabetes (46,6%) among PLHIV receiving their ART in Central and General hospitals of Yaoundé. Duration of ART administration, and viral load where risk factors found to be associated which this high prevalence of diabetes. Our findings highlight the need for routine screening and assessment of diabetes in PLHIV receiving ART.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

SHRE, JNB, SCS: Conceived, designed and supervised all field activities of the study. LTF: collated the data. DSM, CAMM, AEM, and JNB: Assisted in developing the data analysis plan. DSM, EMN, OJE: wrote the first draft of the manuscript. all authors reviewed it and provided comments. All authors read and approved the final version of the manuscript.

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