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Specific scores of glycated hemoglobin in the current diagnosis of cardiometabolic risk dysglycemia in Brazzaville, Republic of Congo

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Abstract

Background and aim: The increase in the incidence of diabetes mellitus is one of the constellations of cardiometabolic risk in the world. As the specific diagnostic thresholds for dysglycemia are absent among African Bantou de Brazzaville, Republic of Congo justified this study. The aim of the study was to determine the performance of glycated hemoglobin in the diagnosis of dysglycemia. **Methods:** The cross-sectional survey involved 500 apparently healthy adult participants. The glycated hemoglobin was modelled using a National Glycohemoglobin Standardization Propram certified method and correlated with the Diabetes Control and Complication Trial. Diagnostic performance was defined using analysis of the receptor's operating characteristics. **Results**: The study included 225 men and 275 women, the mean age was 47.4-13.7 years, the levels of hemoglobin glycated on an everan erate equal to 5.5-5.9% and 6.0% (Se-100% and Sp-100%) (p = 0.001) were characterized by perfect diagnostic performance and prevalence respectively for intermediate/prediabetes-sweetened hyperglycemia (13.8%) and diabetes mellitus (24.4%) with an area under curve equal to one. There was a positive and significant bivariate correlation between older age, fasting blood glucose, and increasing hemoglobin glyched to right Y (glycated hemoglobin) – 2.683; -0.077 - Age (years) - 0.789 - Glycemia (mmol/L). **Conclusion**: The epidemic of cardiometabolic risk was estimated to be 2/3 of prehypertension/high blood pressure, 4/10 of overweight/obesity and 1/4 of diabetes mellitus in 2018 and significantly higher than reported in 2004. This study showed that the recommended thresholds for diagnosing dysglycemia are not the same for Bantu populations.

Keywords: Glycated Hemoglobin, Performance, Prevalence, Diabetes Mellitus, Brazzaville.

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INTRODUCTION

Dysglycemia included diabetes mellitus and intermediate/prediabetes mellitus hyperglycemia [1]. The burden of chronic noncommunicable diseases (NCDs) is growing rapidly worldwide [1]. Diabetes mellitus (DM) is one of four priority NCDs targeted by world leaders [1]. The increase in the incidence of diabetes mellitus in association with overweight/obesity dyslipidemia and high blood pressure (HBP) is one of the constellations of cardiometabolic risk under the impact of the health transition (epidemiological/decrease of infectious diseases, population/life expectancy, nutritional/diet high in fats, salt and sugar against low fruit/vegetable consumption) worldwide and sub-Saharan Africa [1]. Contrary to an old and still widely held view of DM as a disease of rich countries and men, this condition is a major public health problem in developing countries including Brazzaville, Republic of Congo [2-5].

Normality (health/well-being) is defined by culture, gender, ethnicity, quality of life/mental state and the dynamics of epidemiological and biostatistical studies according to the usual diagnostic and therapeutic baseline [6]. With epidemiological data, the fasting blood glucose threshold - 140 mg/dL for the diagnosis of DM 20 years ago [7], lowered to fasting blood glucose levels of 126 mg/dL and post prandial or casual blood glucose levels, 200 mg/dL respectively, before the precocity of diabetic retinopathy according to the World Health Organization (WHO) and the American Diabetes Association (ADA) [1-8]. The same is true for glycated hemoglobin (HbA1c) which has also been introduced as a biomarker for the diagnosis of dysglycemia (intermediate hyperglycemia/prediabetes mellitus equal to 5.7-6.4% and DM - 6.5%) [1,8].

However, there are pitfalls, limitations, certain factors (oxidative stress, inflammation, pregnancy,

glycation, the presence of hemoglobinopathies, kidney failure) and several pathologies that recommend HbA1c instead as diagnostic means of DM or as a glycemic alteration test [9-13]. For the problem of screening and diagnosis of DM, the tests of both the case or the post prandial blood glucose are traditional sets of the Reference Diagnosis of DM [1.6, 14-23]. On the other hand, and with personalized medicine, some biomarkers such as the HbA1c test play predictive, early diagnostic roles (with precision, scientific evidence, early therapeutic initiation, follow-up treatment, patients and health professionals towards the prevention of DS and its complications [1.8].

The International Diabetes Federation (IDF) has estimated that globally, 451 million adults aged 18-99 are living with DM in 2017 [24]. In 2012, DM caused 1.5 million deaths and higher-than-normal blood sugar, which increases the risk of cardiovascular disease and other pathologies was the cause of 2.2 million additional deaths, for a total of 3.7 million deaths involved people under 70 years of age [1]. Percentage of deaths due to hyperglycemia or DS (43%) that occur before the age of 70 is higher in low- and middle-income countries than in high-income countries [1]. In the Republic of Congo, data from the 2004 STEP/WHO study conducted by Kimbally-Kaki *et al* found prevalence rates of DM at 7%, overweight at 18%, obesity at 8.6% and high blood pressure (HTA) at 32.5% [25].

Clinically impressionable, the prevalences of DM and intermediate hyperglycemia are underestimated on fasting blood glucose testing in BZ/RC hospitals in light of socio-economic and political disturbances (ethnic and military conflicts), changes in eating habits, environmental conditions and obesity caused by urbanization and migration of Congolese populations.

With the health transition, ruro-urban migration, globalization (globalization/westernization), wars, physical inactivity, exacerbation of poverty, chronic hyperglycemia complex (intermediate hyperglycemia/preglycemia and Diabetes), HTA, overweight/obesity (OW/OB), smoking by cigarette, and excess alcohol in an anxio-drepressive/psychological stress picture health centres in the Republic of Congo [5, 25-28]. The error in the management of cardiometabolic risk does not consider the specific thresholds for ethnicity or gender, capable of early definition of dysglycemia in the cosmopolitan city of BZ/RC.

Indeed, metabolic syndrome (Smet) is differently defined in the United States [29], in Europe for Caucasians [11, 30, 31] and in Asia [32]. Specific thresholds for dysglycemia are absent in African Bantou of Brazzavile, Republic of congo which justified the initiation of this study. The main objective was to determine the performance of glycated hemoglobin in the diagnosis of dysglycemia. The second objective was to determine the association between advancing age, increasing blood sugar and changes in glycated hemoglobin. The third objective was to assess the secular (evolutionary over time) trend in cardiometabolic risk between 2004 and 2018.

MATERIALS AND METHODS

Study Setting and Design

A joint study comprising an analytical cross-sectional survey (2018) and a retrospective literature study (2004) was conducted with bioclinical and STEP/WHO approaches recognized as standardized tools [33], replicable, flexible depending on the context of the BZ/RC population. Cross-sectional study period:this study took place from February 08 to 22, 2018. Study Framework:the documentary study [5.25] was conducted at the Brazzaville Hospital and University Centre (CHUB). However, this cross-sectional study was conducted at the Administrative Centre of the City of BZ/RC. The city of Brazzaville has a multi-ethnic population estimated at 1,838,348 at present [34]. It is divided into 9 boroughs (Makélékélé, Bacongo, Poto-poto, Moungali, Ouenze, Talangai, Mfilou, Ndjiri and Madibou).

Population of study

The population of study was a probabilistic sample from the general and eligible population of the city of Brazzaville according to the logogram (Figure 1). Participants were recruited from three Catholic churches in the north, centre and south of the city of Brazzaville. The selection criteria required for inclusion (any person aged at least 18 years of age who have lived in Brazzaville for at least one year, with informed consent) and for exclusion (all participants under the age of 20, DM on treatment, pregnancy, HIV/AIDS, kidney failure, stroke, ischemic heart disease, heart failure and hemoglobinopathy).

Sample size of the cross-sectional study

Random sample size was calculated using the following formula:$n_i = \frac{Z^2 * p * (1-p}{d^2}$; Z-parameter related to statistical risk of admitted error-1.96 for an error risk of 0.05%, q- assumed proportion of the target population not having the problem (q= p-1), p- expected prevalence for diabetes mellitus from a recent known, d- prevalence of absolute accuracy-0.05

Given that the prevalence of DM by glycated hemoglobin in the city of Brazzaville has never been studied, it is considered that p = 0.50 and q= 0.50. $n_i = \frac{1.96^2 * (0.5) * (0.5)}{0.05^2} = 384 = 400$. We add 25% possible loss which makes a total of 500 participants included. Thus 50 participants randomly drawn from lists from the 9 boroughs and the administrative center of the city of Brazzaville.

Variable Methods of Interest

Sociodemographic characteristics (sex, age, socioeconomic level by family income, diet (adequate diet rich in fibre, less salty fruits and vegetables less sweet and less fat, against Westernized diet and education) were collected according to the STEP/WHO questionnaire [33]. Measurements of participants in light clothing and bare feet standing by size (cm), weight (in kg) were obtained according to step/WHO criteria.

Thus, the size was measured using a vertical toise (type SECA 220) to the nearest half centimeter. Weight was measured using an electronic scale (type SECA 762), with an accuracy of 0.1 kg. Body mass index (BMI) is the most common method of assessing overweight and obesity in both men and women [7, 35].

Participants were divided according to BMI into underweight, normal weight, overweight and obese [7, 35]. This index corresponds to the ratio of an individual's weight to the square of his height (kg/m2). It identifies people whose weight status is associated with a health risk:

- BMI - 18.50 indicates underweight;
- BMI between 18.50 and 24.99, is considered normal weight;
- BMI between 25 and 29.99 indicates overweight (overweight);
- BMI 30 is considered obesity (general obesity).

Blood pressure values were obtained using an electronic type blood pressure monitor (OMRON M3 Comfort) after participants rested for at least 15 minutes in a sitting position. Systolic and diastolic pressure values have been replicated three times in a row to have precise blood pressure values.

Blood samples were taken by venous puncture at the bend of the elbow on heparinated tubes and at EDTA in the morning between eight and ten o'clock on subjects on an empty ingel for at least eight hours. Samples taken from heparinated tube were centrifuged to 4oC for 10 minutes at 4000 laps. The blood glucose was measured using the Trinder method using a KENZA MAX BioChemis Try spectrophotometer from BIOLABO, France (the coefficients of variation and reproducibility

were 1 and 1% to 2000 mAbs respectively). HbA1c dosages were performed on an A1CNow(R) drive in BAYER, Germany. This reader can be used to control HbA1c and total hemoglobin using two analytical techniques (immunochemistry and chemistry). When the diluted blood sample is applied, blue microparticles and HbA1c antibodies attach to the reagent. The amount of blue microparticles attached to the strip determines the amount of A1C present in the blood sample.

The percentage of total hemoglobin (Hb) is based on the transformation of hemoglobin into methemoglobin by the sample diluant. Indeed, the color intensity of methemoglobin measured on the reagent is proportional to the concentration of hemoglobin in the blood sample. The test results correspond to the percentage of A1C (A1C - total Hb x 100). The performance of the A1CNow drive was defined by analyzing blood samples taken from 118 normally non-diabetic individuals (fasting blood glucose - 127 mg/dL or 7 mmol/L) from three different sites in the United States. The average percentage of A1C was 5.2% - 0.71% (1 standard deviation). Confidence limits of 95% ranged from 3.9% to 6.5%. The 99% accuracy was verified on two total blood samples, one with low A1C levels (about 6%) and the other with a high A1C rate (about 9%) were analysed 4 times a day for 20 days. The coefficients of variation were 3% for the low rate and 4.02% for the high rate. The quality control procedures recommended by manufacturers for all biochemical tests were followed throughout the study.

Operational definitions

Potential risk factors for DM were defined as gender (men vs. women), advancing age (age 55), socio-economic level was categorized into two categories:those with a level low socio-economic (unemployed, out-of-school or low-income participants), and those with a high average socio-economic level.

The health transition (epidemiological, demographic and nutritional) was defined by the proportion of participants aged around 50, the ratio of OW-OB to underweight (UW) 2 and the proportion of participants with inadequate diet (poor food). The history of cardiovascular risk was defined by the coexistence of high blood pressure (HBP) (systolic blood pressure/diastolic blood pressure 130/85mmHg), stroke and ischemia.

Cardiometabolic heredity (history of obesity, HBP, stroke, ischemic heart disease, heart failure and DM) was related to family history. Cardiometabolic risk was defined by the coexistence (comorbidity) of OW/OB, HBP, and DM. The age-old trend was to compare the evolution of cardiometabolic risk in 2004 [25], 2007 [5] and 2018 (this study).

Statistical analyses

Category variables were presented in the form of frequency number (n) and proportions (%). Quantitative variables (continuous) were summarized as average, median, interquartile, minimum and maximum. In a univariate analysis, Pearson's Chi square test between two groups and the trend test (biological gradient) between several groups were used to compare percentages between the two groups, while Student's T test and variance analysis (ANOVA) were used respectively to compare averages between two groups and between higher or equal to three groups.

Non-parametric tests were used for abnormal or asymptomatic distribution. The mathematical model of receiver operating characteristics (ROC) calculated the area under the curve (AUC) using the following formula:

$$\text{ASC} = \frac{W1 - \frac{n1-(n1+1)}{2}}{n1-n0}$$

Blood glucose - 126mg/mL, baseline test, defined certain DM against HbA1c - 6.5% was the new test to be diagnosed if not screened for DM. The diagnostic performance of HbA1c was defined by sensitivity (Se) and specificity (Sp), and area below the curve (ASC).

The bivariate analysis was used to produce Pearson's single r correlation coefficients between fasting blood glucose and HbA1c blood levels. Multiple linear regression was performed to predict HbA1c variations by independent variables such as age, sex, fasting blood sugar, socioeconomic level. Multivariate logistic regression analysis was used to calculate independent associations between independent variables (sociodemographic, anthropometric and hemodynamic) and dependent variables (DS and all dysglycemias) after adjusting for confusion variables. Probability (P) - 0.05 defined the threshold for significance. All statistical analyses were carried out using statical Pachage for Social Sciences (SPSS) version 21.

Ethical Considerations

This study was conducted after receiving approval from the Ethics Committee on Health Sciences Research (ECHSR). The participants all agreed to take a blood test and complete the questionnaire. The results were given individually to the participants. The confidentiality of the information collected was respected.

RESULTS

Descriptive study (participant characteristic, socio-economic level, weight profile and health transition), diagnostic performance of glycated hemoglobin for dysglycemia, determinants of HbA1c, DM and risk cardiometabolic disorder were characterized by their magnitude in the cross-sectional study.

Characteristics of participants

A total of 500 participants, of whom 45% (n=225) men and 55% (n=275) women were recruited:sex ratio of 0.82 close to 1 man:1 woman. The average age of the study population was normally distributed from 47.4-13.7 years, with a median at 47 years, and from the extremes of 18 and 80 years, the interquartile was 37-57 years. The advancing age (age 55 years) represented 30.2% (n=151) of participants compared to 48.4% (n=242) of adult participants (35-54 years) and 21.4% (n=107) of young participants (35 years).

Socioeconomic level

63% (n=317) of participants were of low socioeconomic level compared to 37% (n=185) of medium-high socioeconomic level.

Weight profile of participants

The nutritional status of the population was characterized respectively by 3% (n-15) of underweight, 40.2% (n-201) of normal weight participants, 36.8% (n=184) of overweight participants and 20% (no.100) of obese participants.

Health transition

Among the entire study population, the majority (67%, n=335) were characteristic of the health transition (epidemiological, demographic and nutritional).

HbA1c determinants

There was a positive and significant bivariate correlation between age advancement and increased HbA1c (r -0.784; P-0.0001); the average rate of HbA1c was higher in men and at the low socio-economic level, respectively, than in women and at the high socio-economic level (p=0.0001; results not presented). In multiple linear regression, 63.1% (Adjusted OR=2) vs. 79.5% (unadjusted OR =2) p=0.001 variation in HbA1c concentration was predicted by advancing age and increasing fasting blood glucose levels after adjusting for sex, socioeconomic level and nutritional status (Figure 1) on the right:

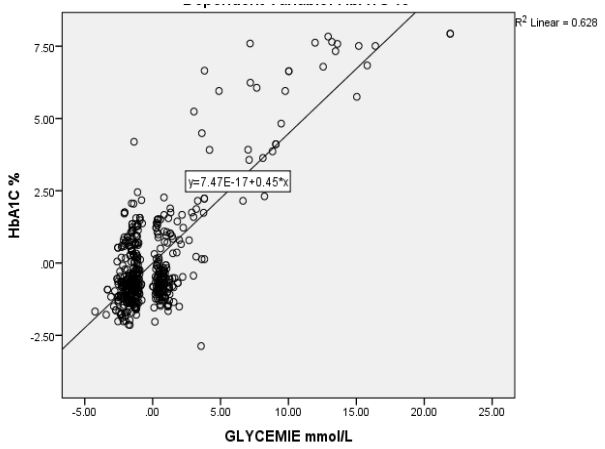

Figure 1: Prediction of glycated hemoglobin relative to age and fasting blood sugar.

Y (HbA1c) - 2.683 -0.077 - Age (years) - 0.789 - Glycemia (mmol/L)

Diagnostic performance of HbA1c

Compared to the fasting blood glucose test - 126 mg/dL, the 5.0% on-set HbA1c test was characterized by a perfect diagnostic performance of DM of around 24.4% with AUC=1, Se =100% and Sp=100%; p= 0.0001. Compared to the fasting blood glucose test of 100 mg/dL, the fasting HbA1c test was characterized by a perfect diagnostic performance of intermediate/prediabetes hyperglycemia (glucose intolerance) of 13.8% (n-69) with AUC=1, Se=100% and Sp=100%; p=0.0001. Reliability, validity and repeatability were demonstrated by the coefficient of variation of 4.8% for fasting blood glucose and 4.5% for HbA1c, respectively.

Prevalence of diabete mellitus

There was a discrepancy in the prevalence rate of DM according to the threshold used:17.8% (n-89) according to fasting blood glucose - 126 mg/dL versus 24.4% (n-122) according to HbA1c - 6%. The influence of sex was neutral (indifferent P-0.289) to 26.7% (n-60/225) in men, comparable to 22.5% (n-62/275) in women. The univariate analysis showed a significant association between socioeconomic level, age advancement and prevalence of DM according to HbA1c - 100%. The low socioeconomic level conferred a 3-times greater risk of DM according to HbA1c (OR-3.2 [IC 95%, 2-5.3]; P.0001). The prevalence rate of DM was estimated at 31.4% (n-99/315) among participants of low socioeconomic level compared to 12.4% (n-23/185) among participants of the medium-high socioeconomic level (p-0.0001).

There was a proportional and significant increase (Trend P-0.034) in HbA1c prevalence rates with increased age of participants (Figure 2). The effect of nutritional status was indifferent (P-0.559) on the prevalence rate of DM according to HbA1c:23.2% (n-71/306) in general obesity (BMI 25 kg/m2) compared to 26.3% (n-51/194) in the absence of general obesity.

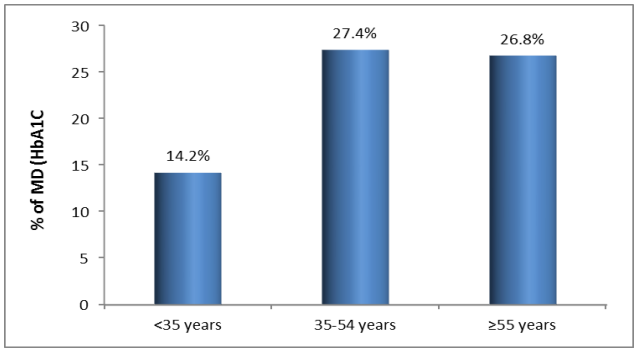

Figure 2: HbA1c prevalence rate by age.

The explanatory variables were male sex, age advancement and low socio-economic level. In multivariate analysis by logistic regression after male adjustment, low socioeconomic level and age - 35 years were identified as independent and significant determinants of the prevalence of Diabetes Sweetened by HbA1c (Table 1). Compared to the female sex, the male sex conferred a 2-fold risk of DM by HbA1c. While compared to the average-high socioeconomic level, the low socioeconomic level conferred a 4-percent greater risk of DM per HbA1c. Similarly, compared to age 35, age 35 conferred a 2-fold risk of DM per HbA1c.

Table 1: DS Determinants by HbA1c

Variables explicatives	Adjusted OR	95% CI	p
Sex Male	1.576	1.020-2.436	0,041
Low socioeconomic level	3.445	2.056-5.773	0,000
Age ≥55 ans	1.929	1.054-3.528	0,033

Cardiovascular Risk

Cardiovascular risk was 2%, 21%, 23% respectively in the age group - 35 years, 35-54 years, 35 years, 35 years. No participants without DM reported cardiovascular risk (0%/n-0), while cardiovascular risk was exclusively in diabetic participants with a biological gradient.

Secular trend of cardiometabolic risk

The evolution of the frequencies of individual components of cardiometabolic risk was summarized in Table 2. There was an exponential and significant trend (P-0.00001) respectively in the proportions of overweight/obesity and HBP between 2004 and 2018 against a sudden and significant increase (P-0.05) in DM between 2004-2007 and 2018 (incidence of multiplied DM 3) (Figure 3).

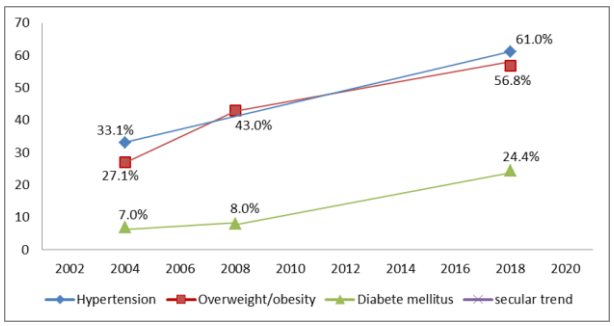

Figure 3: Proportion of cardiometabolic risk components of Kimbally-Kaky *et al* [20], Monabeka *et al* [22] to that of this study as time progresses.

Table 2: Frequency of individual cardiometabolic risk components between 2004 and 2018 in the city of Brazzaville

Risk factors	2004 [20]	2007[22]	2018
	n /N	n /N	n /N
Overweight/Obesity	563/2079	228/530	284/500
Diabetes mellitus	14/199	40/530	89/500
High blood pressure	675/2040		305/500

The epidemic of cardiometabolic risk was epidemic in appearance and estimated at 2/3 prehypertension/HBP, 4/10 Of SP/OB and a quarter of DM in the BZ/RC population in 2018 (present study) and significantly higher at the rate of 33.1%, 27.1% and 7% reported in 2004 to BZ/RC(P-0.0001). All participants (100%) was not informed about the interaction of heredity and environmental risk factors and risk behaviours (modifiable factors) in the DM.

DISCUSSION

Overall, both hypotheses in this study have been tested and confirmed. Indeed, the present study diagnoses optimal and specific thresholds of intermediate hyperglycemia (prediabetes) and DM. The associated factors and independent determinants of the DM are one of the components of the Smet in the world [29, 31, 36, 37] and in Sub-Saharan Africa [11, 30, 38]. Finally, the trend of epidemic pace of cardiometabolic risk has also been demonstrated.

HbA1c Determinants

The independent determinants of HbA1c (male sex, age advancement and low socio-economic level) were respectively the explanatory variables of the DM epidemic in this study. High-risk male lifestyle (smoking by cigarette, excess alcohol) [11, 14, 27, 39-41], advancing age in the epidemiological/demographic transition [42, 43] and low socioeconomic status were also identified as determinants of HbA1c in this study. Harmful quality of life, depression and anxiety (psychological stress) are well associated with advancing age (hyperinsulinemia) and DM2/Smet in the city of this study, which has suffered from several political-social crises and ethnic conflict in recent decades (1993-1998).

Diagnostic Performance of HbA1c

This study demonstrated an excellent correlation between fasting blood glucose and HbA1c with a simple correlation coefficient close to 1. Contrary to the fasting and HbA1c blood glucose values proposed by ADA and WHO to diagnose intermediate/prediabetes-sweetened hyperglycemia and DS [1.8]. Instead, this study established optimal HbA1c thresholds of 5.5-5.9% and 6% as a new diagnostic test respectively for intermediate/prediabetes mellitus and DM. These reference values varied according to Bantou ethnicity, HIV infection with or without antiretroviral therapy [18, 44] in Brazzaville as is the case for optimal thresholds of hypertriglyceridemia, HDL-c decrease, waist circumference, hip circumference and specific blood glucose for Smet in North America [29], Europe [9] and Asia [36, 45].

Ethnicity-specific thresholds were estimated at 5.85% in Nigeria [18] and 6.27% in Algeria [46] with prevalences close to 24.4% in BZ/RC before the epidemiological, demographic and nutritional transition on the one hand and by the methodology of the 2004 STEP/WHO study.

However, the diagnostic performance of HbA1c -6% for the diagnosis of DM was perfect if not excellent (Se 100% and Sp 100%) in this study and comparable to excellent diagnostic performance and close to Se 100% and Sp 100% of HbA1c - 5.85% (Se-63%, Sp-86%) [18], hbA1c - 6.0% (Se-75.4%, Sp-94.6%) [19] and HbA1c - 6.27% (Se-78%, Sp-88%) [46] for the diagnosis of DM. The use of the ROC curve also demonstrated a perfect diagnostic performance of HbA1c between 5.5% and 5.9% for the diagnosis of intermediate hyperglycemia/prediabetes sweetness (Se 100% and Sp 100%) in this study and comparable to excellent diagnostic performance and close to Se 100% and Sp 100% of HbA1c - 5.75% (Se-54% and Sp-84%) for the diagnosis of intermediate/prediabetes mellitus [18].

Prevalence and Determinants of Diabetes Sweets

The prevalence of DM according to HbA1c - 6% was in the order of 24.4% in this study and 3 times higher than the level of DM according to different method of blood glucose testing [47] (hair blood, venous/plasma) 7% to BZ/RC in 2004 [25] and 7-23% DM in population and clinical studies in Sub-Saharan Africa [15, 35, 48, 49]. Indeed, WHO defines intermediate hyperglycemia by fasting blood glucose - 110 mg/dL but 126 mg/dL [1], while the same WHO defines glucose intolerance by a blood glucose two hours after an oral load of 75 grams of glucose - 140 mg/dL and 200 mg/dL [1]. In addition, a blood glucose level of 200 mg/dL two hours after an oral load of 75 grams of glucose is often controversial because two fasting blood glucoses - 126 mg/dL are sufficient to make the diagnosis of dysglycemia [14, 15, 18, 39, 50].

However, univariate analysis and multivariate logistic regression-type analysis identified important major associated factors (age advancement, general obesity and low socio-economic level) and independent determinants (male sex, age advancement and low socio-economic level) of the epidemic of the present prevalence of DM to BZ/RC.

Despite its confusing nature, obesity was the tree that hid the forest from the dual epidemic/double nutritional burden-diabésité including type 2 diabetes mellitus (DM2) [42] not specified in this study. The migration of physical inactivity, the abrupt change in lifestyle, globalization/westernization according to the health transition (age advancement, nutritional transition) also explained the exponential trend of SP/OB from 2004 to 2018 to BZ/RC, as reported in other studies [35, 51, 52].

Prevalence of intermediate/prediabetes-sweetened hyperglycemia

The HbA1c rate of 13.8% between 5.5 and 5.9% in the present study was a state of intermediate/prediabetic sweet hyperglycemia between normal glucose homeostasis and future incidence of DM2 and its cardiometabolic complications. HbA1c reflects the lifetime exposure of red blood cells to glucose and reflects the average blood glucose values of the last 3 months [15, 20, 47]. As a result, it is difficult to compare the prevalence of intermediate/pre-diabetes mellitus in this study with other prevalence rates of intermediate/prediabetes mellitus from different countries and different test levels with blood glucose and HbA1c thresholds [53].

Cardiometabolic Risk Factors

The present study found a significant cardiometabolic risk burden close to 50% of participants. Overall, the average cardiometabolic risk burden of 47.4% is double the average burden of Kimbally-Kaki and al estimated at 22.2% in 2004 (p-0.001).

Indeed, pre-hypertension/HBP-OW/OB-dysglycemia comorbidity currently reported in Sub-Saharan Africa [30, 54, 55] and other countries [29, 50, 56] is emerging while the burden of cardiometabolic risk and Smet is decreasing in developed countries [1]. The absence of valid and specific Smet data in Sub-Saharan Africa had imposed specific thresholds on Caucasians [56].

Involvement of Medical biology and perceptive public health and research

Precise data around optimal HbA1c thresholds between 5.5% -5.9% and 6% established by this study will improve primary, primary, preventions, intermediate hyperglycemia and DM with or without micro and macro vascular complications in the Republic of Congo and other Sub-Saharan countries [2, 3, 4]. These Hba1c thresholds in combination with blood glucose levels 100 mg/dL and 126 mg and 126 will be organized for the detection and diagnosis of dysglycemia (intermediate hyperglycemia and DM) will be organized at all secondary and tertiary primary levels in the Republic of Congo and other sub-Saharan countries. Indeed, this study constitutes from the perspective of medicine with 5P (predictive, personalized, precise, participatory with evidence) [57].

So like other blood biomarkers [58, 59], the HbA1c threshold of this study will improve the management of dysglycemia (intermediate hyperglycemia and DM) with an early and scientific diagnosis if not accurate, early prophylactic and pharmacological treatment, and rational therapeutic follow-up for cost-effectiveness in continuing education, public health prospects and research at BZ/RC and sub-Saharan Africa.

The integrated and holistic global approach that brings understanding of pathophysiological mechanisms with psychological, cultural (contextualization) and behavioural (information, education and change around factors) associated with DM) and sustainable development (poverty reduction and gender consideration) will ensure the success of controlling projected cardiometabolic syndrome more than an epidemic in the year 2045 [24].

Inaccessibility to care, physical inactivity [1], increasein in smoking per cigarette [1.41], universal absence of health promotion [1], psycho-social stress [1], pollution [1], inappropriate nutrition [1], poverty [1] and ignorance of DS, intermediate hyperglycemia, MS/OB (considered a mark of social well-being) and fear of stigmatization of HIV/AIDS underlie the age-old trend of cardiometabolic risk noted between 2001 and the fear of stigmatization of HIV/AIDS underlie the age-old trend of cardiometabolic risk noted between 200and1 BZ/RC, which demonstrated an epidemic allure of DM in nearly 1/5 of the participants living in BZ cosmopolitan and multiethnic city. These optimal HbA1c thresholds will be taught and validated in health centres and universities focused on clinical biology, early treatment and therapeutic follow-up of intermediate/prediabetes mellitus and DM. The HbA1c threshold between 5.5 and 5.9% specific for the Bantou population of BZ/RC avoided inaccuracy, underestimation and overestimation of moderate fasting hyperglycemia (JGH) and glucose intolerance (IAG). Thus, intermediate/prediabetes-sweet endosm and DM according to HbA1c respectively between 5.5 and 5.9% and 6% are proposed for subsequent validation on a much larger sample in both the Republic of Congo and other African countries.

Strengths and limitation of the study

Hba1c does not experience variations in the nycthemer, it is much more stable than fasting blood glucose [9, 46]. This study in a valid and factual medicine, established for the first time the optimal thresholds (HbA1c between 5.5 and 6%) in the screening and diagnosis of dysglycemia (intermediate hyperglycemia and DM) in Sub-Saharan Africa.

The second strength of this study was the consideration of traps and limitations [9.10] related to dosage and interpretation (adequate material) of Hba1c prior to the initiation of this study. The 3rd strength of this study is in working with health professionals at each of the participants' respective residences for confirmation of persistent hyperglycemia (3 months) without neglecting the medical records of participants referred for hyperglycemia and DM at the population level BZ/RC. Health professionals are responsible for following the principles of good practice and evidence-based and up-to-date medicine for the management of dysglycemia at BZ/RC and other poor sites in Sub-Saharan Africa.

Nevertheless, its cross-sectional nature has included limitations for not integrating time (only cohort studies or interventions demonstrate causal association between determinants and DM) or lack of control of intra-individual variability fasting blood sugar, which is often dependent on room temperature. Heredity of cardiometabolic risk (family history of obesity and DM) was not reported by all participants (100%) who are ignorant of the place of heredity in the appearance of DM2 related to insulin resistance also predicted by HBP and smoking by cigarette [60] and remains ignorant of the interaction between heredity and environmental and behavioral factors to risk in DM and other cardiovascular risk factors; one last limitation of this study. Indeed, the thresholds of HbA1c between 5.5 and 5.9% and 6% respectively were respectively unable to discriminate against the presence and absence of insulin resistance in black hypertensive patients in West Africa [19].

CONCLUSION

This study determined the essential if not necessary place of specific and specific HbA1c thresholds between 5.5 and 6% in diagnoses of epidemic rates of intermediate/prediabetes hyperglycemia and DM in BZ/RC and Central Africa. The age-old trend of epidemic gaits of concomitant dysglycemia with other cardiovascular risk factors has been the burden of cardiometabolic risk in a poor BZ/RC environment. This cardiometabolic burden of BZ/RC is comparable to that currently reported in rich and developing countries, including those in Sub-Saharan Africa.

Subsequent validation of HbA1c's specific threshold between 5.5 and 5.9% and 6% will be integrated into a multi-displinarand and collaborative approach between medical biology, policy makers and health professionals. For public health in the Republic of Congo, priorities will be modifiable and preventable associated factors (while advancing non-modifiable factors in age) of DM initiated and exaggerated by the health transition (OW/OB, intermediate hyperglycemia/prediabetes, HBP), geriatric development, poverty reduction (health insurance), information on cardiometabolic risk reduction.

Conflicts of interest

The authors do not declare any conflict of interest.

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