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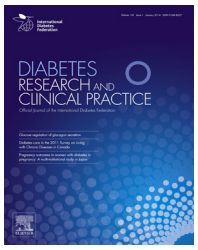

Determinants of fructosamine levels in a multi-ethnic Sub-Saharan African population

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ABSTRACT

Background and purpose: Fructosamine provides an estimate of diabetes control over a shorter period than HbA_{1c}, and has been proposed as a suitable parameter to monitor glycemic control in low-income countries. The aim of this study was to investigate determinants of fructosamine levels in an urban non-diabetic population of Cameroon.

Methods: This was a cross-sectional study including 437 healthy adults with no known history of diabetes mellitus, aged 40 years and above, recruited from the ten administrative regions, representing major ethnic groups in the country. Plasma glucose and fructosamine were measured after an overnight fasting. Univariable and multivariable analyses were used to investigate the factors associated with fructosamine measurements.

Results: Fructosamine levels ranged from 68.2 to 940.8 μmol/l with a mean (standard deviation) of 294.4 (131.3) μmol/l. These levels varied significantly across regions and were higher in men than in women ($p = 0.001$) and in those with screen-detected diabetes than in those with normoglycemia ($p < 0.0001$). There was a negative correlation between fructosamine and body mass index ($r = -0.15$, $p = 0.009$), and a positive correlation with fasting plasma glucose (FPG) ($r = 0.37$, $p < 0.0001$) and total bilirubinemia ($r = 0.21$, $p < 0.0001$). In multivariable model, sex, BMI, FPG, total bilirubine and screen-detected diabetes were no longer associated with fructosamine levels.

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Conclusion: Fructosamine was not independently associated with age, sex, ethnicity, and the glycemic status. Further studies need to be carried out to better elucidate all the factors determining the measurement of fructosamine in order to accurately interpret its values in diabetic populations.

Introduction

The onset and progression of major complications related to diabetes mellitus can be delayed by achieving and maintaining near-normal metabolic control of the disease [1,2]. Accordingly, tight metabolic control is the basis of contemporary diabetes management. For this purpose, simple, reliable, affordable and easily reproducible tests are needed to monitor the outcomes of diabetes care and provide timely feedback to the management.

Short-term diabetes control monitoring has been traditionally based on fasting or post-prandial blood glucose measurements. Unfortunately, blood glucose concentrations fluctuate substantially and a single spot sample is insufficient to accurately characterize glycemic control status, and implementing multiple blood glucose testing appears to be cumbersome to patients. Medium term diabetes control parameters are less sensitive to daily fluctuation in blood glucose levels, thus obviating the need for too frequent testing.

Glycated hemoglobin (HbA_{1c}) is the most widely known and popularized medium term diabetes control parameter. Its measurement provides an estimate of the average blood glucose level over a period of 2 to 3 months [3] and HbA_{1c} levels correlate well with the risk of long term diabetes complications [1,2]. Nevertheless HbA_{1c} measurement can be tedious, time consuming, relatively expensive and therefore less appropriate for immediate feedback to management [4]. Moreover, HbA_{1c} is also imprecise in the presence of alteration of the quality and/or quantity of red blood cells [5,6].

Fructosamine measurements provide an estimate of diabetes control over a shorter period than HbA_{1c} (2–3 weeks) and may therefore be more appropriate for monitoring when acute glycemic changes matter [7]. Fructosamine measurement is also quick, technically simple, inexpensive, precise, fairly free of interferences, unaffected by red blood diseases and easily automated for use with micro-sample volumes [5,6,8,9]. Therefore, fructosamine has been proposed as a suitable parameter to monitor glycemic control in low-income countries [10]. However, both the normal range and factors that may affect levels of fructosamine in those settings and accordingly fructosamine-based diabetes control monitoring have not been extensively investigated. In order to identify such parameters, preliminary studies need to be undertaken focusing on non-diabetic subjects.

Equatorial Africa comprises essentially low-income countries and has the highest global population with sickle cell disease and sickle cell trait [11], and appears therefore as one of the regions in the world that may benefit the most from fructosamine measurement for diabetes monitoring. Initial data on healthy non-diabetic subjects are therefore needed to determine both the normal ranges and factors that may impact levels of fructosamine locally. In this study, we investigated the determinants of fructosamine levels in an urban non-diabetic population of Cameroon, an Equatorial African country.

Participants and methods

This was a cross-sectional study conducted in the Department of Biochemistry of the Yaounde University Teaching Hospital from April to August 2011. The study hospital which is located in the Capital city of Cameroon (Yaounde) has been described in details elsewhere [12]. Participants were 437 voluntary adults, non-smokers, with no known history of diabetes mellitus, aged 40 years and above, and were all recruited after sensitization in churches and public gathering places targeting from the 10 administrative regions of the country, reflecting the major ethnic communities in the country. All participants signed an informed consent form and the study was approved by the Cameroon National Ethics Committee.

Clinical examination

Participants were recruited on a consecutive basis, i.e. exhaustively enrolled as they fulfilled our inclusion criterions. Each participant received an interview with data collection on age (in years), sex, ethnicity, past medical history including history of known diabetes, hypertension, chronic liver disease, and symptoms related to diabetes. Blood pressure was measured. Anthropometric variables included body weight (to the nearest kilogram), and height (to the nearest centimeter). Body mass index (BMI) was then derived as weight (kg)/height × height (m).

Laboratory investigations

Fasting blood sample was afterwards collected and processed for biochemical determinations including the serum creatinine by Jaffe's method (normal range 6–13 mg/l), albuminemia by the green bromocresol colorimetric method (normal range 38–56 g/l), serum total proteins by the Biuret's method (normal range 63–82 g/l), total bilirubinemia by the modified Jendrassik–Grof's method (normal values less than 10 mg/l), triglyceride by the glycerol-3-phosphate oxidase colorimetric method (normal range 0.46–1.50 g/l) and glycemia by the glucose-oxidase colorimetric method (normal values 0.6–1.1 g/l). Fructosamine assay was performed by the nitro-blue-tetrazolium (NBT) colorimetric method (SGM Laboratories, Italia). Glomerular filtration rate was estimated using the Cockroft and Gault formula [13].