

Serum Fructosamine Assessment, A Possible Index of Glycometabolism in Nomoglycaemic Subjects: An Observation in a Nigerian Tertiary Hospital

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Abstract: Serum fructosamine, albumin and fasting plasma glucose were measured in 500 apparently healthy non-diabetic, nomoglycaemic Nigerians. The concentration of fructosamine was found to be between 1.95 and 2.5 mmol/l with a mean (\pm SD) of 2.16 \pm 0.23 mmol/l and correlated significantly with fasting plasma glucose ($r = 0.67$; $P < 0.05$). No sex-related difference ($P > 0.05$) was observed in male and female serum fructosamine levels, also no significance correlation was found between mean serum fructosamine and albumin concentrations ($r = 0.13$; $P > 0.05$). This result showed that serum fructosamine concentration can be used as an index of glycometabolic control in normal and diabetic subjects in North-eastern Nigeria.

Keywords: Diabetes, fructosamine, albumin, glucose, glycation

1. Introduction

Fructosamine is the trival name for 1-amino-1-deoxyfructose, a ketoamine and a derivative of the non-enzymatic reaction product of glucose and a protein. The degree of nonenzymatic post-translational modification of proteins is dependent upon the prevailing plasma glucose concentration [1]. The rise in plasma glucose which is a feature of diabetic state leads to an increase in the concentration of glycated protein in diabetes as compared to non-diabetic subjects [2].

Diabetes mellitus is a universal health problem and may occur at any age [3]. The traditional biochemical measurements for initially detecting patients with diabetes mellitus and subsequent management are fasting or random estimation of blood and urine glucose concentrations [4]. Fasting blood glucose is inconvenient for patients though it gives some idea of glycaemic control in non insulin dependent diabetes mellitus (NIDDM) patients, it remains unreliable in Insulin dependent diabetes mellitus (IDDM) patients [5] Despite their common use, both test are fairly non-specific, being influenced by a wide variety of drugs and conditions [6], [7] and have proven to be unsuitable for large population surveys because of high incidence of misdiagnosis.

Glycation affects many proteins and may lead to changes in both physical structure and biological functions of the parent

proteins [8]. Recent data on the late stages of glycation suggest its role in the development of late complication in diabetes [9]. The measurement of glycated haemoglobin has been widely used as an index of diabetic control, although established, it is expensive and time consuming to perform [10]. Because of the relative long half-life of haemoglobin, the concentration of glycated haemoglobin reflects the average level of glycaemic control over a period of the preceding two to three months [11] and is not suitable for monitoring of early changes in glycaemic control [12].

An easy, reliable simple to perform and inexpensive assessment of glycaemic control over a shorter period of time would be of value in certain situation. Fructosamine like the assay of glycated haemoglobin, can be interpreted as an integrated glycaemic index during the last two to three weeks preceding the assay and has been used in some specific clinical cases such as screening for diabetes mellitus, [13] type II diabetic patients during change of therapy [14] type I diabetic patients in multiple within-day blood analysis [15] and during pregnancy where good control of glycaemic status reduces the foetal problems associated with diabetic pregnancy [16], [17].

Despite such a large body of information, there is paucity of information on the reference range of fructosamine level in apparently healthy non-diabetic Nigerians. This study was undertaken to determine the reference range of fructosamine concentration in apparently healthy non-diabetic Nigerians.

2. Materials and Methods

Healthy non-diabetic Nigerians comprising of 350 males and 150 females aged between 18 and 50 years (mean age 29 years) were recruited from students, traders, farmer, artisans and lecturers, all had no history of diabetes and had normal random blood glucose level. All the subjects were requested to fast overnight (from 10.00pm the previous night). Samples were collected before 10.00am in the morning of the study. Fasting blood sample were obtained from the antecubital vein without venostasis using fluoride vacutainer (for glucose assay) and plain vacutainer (for albumin and fructosamine assay) bottles. All assays were carried out the same day.

Analytical Techniques

Serum fructosamine assay was based on the method of Johnson et al 1982, [18] serum albumin was determined using the method of Batholomew and Delaney 1966, [19] while the plasma glucose concentration was assayed using the modified method of Trinder 1969 [20]. PYE Unicam SP6-200 spectrophotometer (Technicon Instruments USA) was used.

Statistical Analysis

The mean, standard error of mean, standard deviation, coefficient of variation and correlation coefficient were calculated. Test of significance were assessed by student "t" test [21] Correlation coefficient between the interdependent biochemical variables were calculated. A value of $P < 0.05$ was accepted as significant.

3. Results

The reference range of serum fructosamine concentration assayed in the subjects were between 1.95 and 2.5mmol/l with a mean (\pm SD) value of 2.16 (\pm 0.23) mmol/l (Table 1). The mean serum fructosamine concentration correlated significantly ($r = 0.67$; $P < 0.05$) with fasting plasma glucose concentration. Serum fructosamine concentration is independent of sex of the subjects (Table 2) and there was no significant correlation ($r = 0.13$; $P > 0.05$) between mean serum fructosamine and mean serum albumin concentrations.

Table 1: Fructosamine, albumin, and fasting plasma glucose concentrations in the subjects

	Serum Fructosamine (mmol/l)	Fasting plasma glucose (mmol/l)	Serum Albumin (g/l)
n	500	500	500
x	2.16	4.1 [*]	40.5 ^{**}
\pm SD	0.23	0.92	5.0
Range	1.95 – 2.5	3.0 – 5.6	30 – 50

* $P < 0.05$ vs Fructosamine; ** $P > 0.05$ vs Fructosamine; ^{*} $r = 0.67$ btw Fructosamine and Fasting plasma glucose; ^{**} $r = 0.13$ btw Fructosamine and Albumin.

Table 2: Effect of sex on fructosamine concentration in the subjects

	Male	Female	P value
n	350	150	
x	2.20	2.22	> 0.05
\pm SD	0.11	0.14	
Range	2.1 – 2.5	1.95 – 2.43	

4. Discussion

In this study, the reference range of fructosamine concentration in apparently healthy non-diabetic Nigerians was found to be between 1.95 and 2.5 mmol/l with a mean (\pm SD) of 2.16 ± 0.23 mmol/l. This result compares favourably with the result of others [11], [22], [23], [24], [25], [26]. The non-significant sex related differences in the mean serum fructosamine concentration between male and female ($P > 0.05$) subjects was in agreement with similar previous studies [27], [28].

It has been reported in previous studies [24], [28] that serum fructosamine concentration is independent of albumin concentration if greater than 30g/l. This was confirm in this study as there was no significant correlation ($r = 0.13$; $P > 0.05$) between the mean albumin concentration of 40.5 ± 5.0 g/l and mean serum fructosamine concentration of 2.16 ± 0.23 mmol/l.

The statistically significant correlation observed in this study between mean serum fructosamine and fasting plasma glucose concentrations ($r = 0.67$; $P < 0.05$) is in agreement with other study [8].

This study showed that serum fructosamine concentration can be use as an index of short glycometabolic assessment in normal subjects and in the management of diabetic patients as it correlate well with fasting plasma glucose. The procedure is simple to perform with good precision and can be easily adopted into routine laboratory procedure.

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