Blood glucose as a predictor of glycaemic control by glycosylated haemoglobin in Gaborone, Botswana

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Abstract
The fasting blood glucose (FBG) level is used as a common test of diabetic control in Africa. This study assessed the correlation between FBG and glycosylated haemoglobin (HbA1c) in 365 diabetic patients from Botswana. Though there was a good correlation (r = 0.48) and sensitivity (94%), FBG had a low specificity (37%) and positive predictive value (36%). Thus FBG is not as effective a control test as HbA1c.

Introduction
Glycaemic levels can be measured by fasting or random blood glucose (FBG or RBG) and HbA1c levels. Glycosylated haemoglobin (HbA1c) indicates the level of glycaemia up to the last 120 days. Adequate information about glycaemia is needed to tailor the management of diabetic patients. In a study from Kenya, RBG had high sensitivity (86–98%) in patients with good glycaemic control (HbA1c <7.8%) but the sensitivity fell to 66% when it was used to predict higher glycaemic levels. In another study from South Africa among type 2 diabetic patients, for a cut-off point for HbA1c >8%, random venous plasma glucose of >14.0 mmol/L demonstrated a sensitivity of 56%, specificity of 97%, and a positive predictive value of 99%. In an American study, a plasma glucose of >11.1 mmol/L reflected poor control with an HbA1c >8.0% – a predictive value approximately 90% if done fasting, and of 80–85% if random. In a study done in The Netherlands among type 2 diabetic patients, it was shown that predicting HbA1c from FBG was difficult, especially if the FBG value fell between 5.0 and 12.0 mmol/L. Some of the above mentioned studies indicate that FBG or RBG can perhaps be used in resource-poor settings, while others advise caution when interpreting the results.

Diabetic patients in the Gaborone clinics, Botswana, usually come once a month and have their FBG measured. No diabetic patient is followed using HbA1c. So it is important to know if FBG measurement is valid in estimating glycaemic control.

Patients and methods
This was a cross-sectional study done between December 1, 2003 and February 28, 2004 in Gaborone, Botswana. The study subjects were all diabetic patients from 14 Gaborone City Council (GCC) clinics. Data were collected using questionnaire and laboratory investigations. FBG was determined by a Bayer Elite glucometer, and a Cobas Integra 400 was used to measure HbA1c (reference range 4.5–5.7%). All study subjects were asked for written consent. The questionnaire was coded and analysed using Epi Info 2002.

Results
There were 91% (n=365) with type 2 diabetes and 9% (n=35) with type 1 diabetes; 336 (84%) were using oral hypoglycaemic drugs. The mean FBG was 9.0±3.6 mmol/L and mean HbA1c was 9.6±2.6%.

FBG and HgbA1c are closely related as shown in Figure 1 (r=0.48, F-test=368, p<0.001). When using 8.0 mmol/L as a cut-off for FBG and 7.0% for HbA1c, the sensitivity of using FBG as an index of glycaemic control was 94%, while the specificity was 37%. The positive predictive value was 36% while the negative predictive value was 2%.

Only 18% of patients had an HbA1c <7.0% and 48% an FBG <8.0 mmol/L. There were 17% with an FBG <8.0 mmol/L and HbA1c <7.0% and 51% with an FBG >8.0 mmol/L and HbA1c >7.0%. There were 30% with an FBG <8.0 mmol/L but HbA1c >7.0%, and only 1% with an FBG >8.0 mmol/L and HbA1c <7.0%.

Discussion
Measurement of HbA1c is expensive and not immediately available. For this reason the FPG is the most common diabetic control test. FBG has high sensitivity but low specificity when used alone to monitor glycaemic control. Its positive predictive value is also low. While acknowledging that HbA1c is a better way of monitoring glycaemic control among diabetic patients, this test is not routinely used for various reasons and FBG measurement remains the main way of assessing glycaemic control.

Ideally, the FBG should be used to tailor diabetic medication so as to get optimum control, and then patients should have an HbA1c level measure. Further studies should address the optimal frequency and cost of HbA1c measurement, as well as that of alternative control parameters.
Acknowledgments
We are grateful to the Gaborone City Council Laboratory staff, National Health Laboratory, Ministry of Health Research Department, Mrs Ategegeb G Habtemariam, Mrs Sheenaz Halabi, Dr Eyob Tsegaye, and Dr Zelalem Temtime.

References