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Diabetes Research
and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres



International
Diabetes
Federation



Diabetes mellitus in Zambia and the Western Cape province of South Africa: Prevalence, risk factors, diagnosis and management

Sarah Lou Bailey^{a,c,*}, Helen Ayles^{a,b}, Nulda Beyers^c, Peter Godfrey-Faussett^a, Monde Muyoyeta^b, Elizabeth du Toit^c, John S. Yudkin^d, Sian Floyd^e

^a LSHTM TB Centre and Department of Clinical Research, London School of Hygiene and Tropical Medicine, Keppel Street, London, UK

^b Zambart, Ridgeway Campus, Lusaka, Zambia

^c Desmond Tutu TB Centre, Department of Paediatrics and Child Health, Stellenbosch University, South Africa

^d University College London, Gower Street, London, UK

^e LSHTM TB Centre and Department of Infectious Disease Epidemiology, London School of Hygiene and Tropical Medicine, Keppel Street, London, UK

ARTICLE INFO

Article history:

Received 30 March 2015

Received in revised form

27 April 2016

Accepted 2 May 2016

Available online 7 May 2016

Keywords:

Southern Africa

Cross-sectional study

Epidemiology

ABSTRACT

Aims: To determine the prevalence of and risk factors for diabetes mellitus and examine its diagnosis and management in the study communities.

Methods: This is a population-based cross-sectional study among adults in 24 communities from Zambia and the Western Cape (WC) province of South Africa. Diabetes is defined as a random blood glucose concentration (RBG) ≥ 11.1 mmol/L, or RBG < 11.1 mmol/L but with a self-reported prior diabetes diagnosis. For individuals with a prior diagnosis of diabetes, RBG < 7.8 mmol/L was considered to be an acceptable level of glycaemia.

Results: Among 45,767 Zambian and 12,496 WC participants the age-standardised prevalence of diabetes was 3.5% and 7.2% respectively. The highest risk groups identified were those of older age and those with obesity. Of those identified to have diabetes, 34.5% in Zambia and 12.7% in WC were previously unaware of their diagnosis. Among Zambian participants with diabetes, this proportion was lower among individuals with better education or with higher household socio-economic position. Of all those with previously diagnosed diabetes, 66.0% in Zambia and 59.4% in WC were not on any diabetes treatment, and 34.4% in Zambia and 32.7% in WC had a RBG concentration beyond the recommended level, ≥ 7.8 mmol/L.

Conclusions: The diabetes risk factor profile for our study communities is similar to that seen in high-income populations. A high proportion of individuals with diabetes are not on diabetes treatment and of those on treatment a high proportion have high glycaemic concentrations. Such data may assist in healthcare planning to ensure timely diagnosis and management of diabetes.

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* Corresponding author at: LSHTM TB Centre and Department of Clinical Research, London School of Hygiene and Tropical Medicine, Keppel Street, London, UK.

E-mail address: slbailey@doctors.org.uk (S.L. Bailey).

<http://dx.doi.org/10.1016/j.diabres.2016.05.001>

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1. Introduction

The number of adults with diabetes mellitus in sub-Saharan Africa (SSA) is predicted to rise from 19.8 million in 2013 to 41.5 million in 2035 [1–5]. Extensive data exist to guide diabetes public health policies and health systems planning in high income countries [6–8]. In contrast, systematic review suggests there are few data from SSA even for diabetes prevalence and risk factors [1,9–12].

The management of diabetes can be challenging for health systems, as it requires lifelong follow-up and a multidisciplinary approach [3,13,14]. Therefore, the aims of this study are

- to estimate the prevalence of, and identify risk factors for, diabetes mellitus in the study communities in Zambia and in the Western Cape province of South Africa; and
- to estimate the prevalence of undiagnosed diabetes, to determine the proportion of those with a prior diagnosis of diabetes who are on treatment for diabetes, and to determine the levels of glycaemia in those with a prior diagnosis of diabetes.

2. Methods

This population-based cross-sectional study was undertaken between January and December 2010 in 24 communities: 16 from 5 provinces in Zambia and 8 from the Western Cape province of South Africa. The study was nested into a prevalence survey that was conducted to measure the primary endpoint, prevalent tuberculosis, of a large 2×2 factorial cluster randomised trial (the ZAMSTAR study) [15–17]. The estimated total population in the study areas was 962,655, with an average population per community of 40,110. Within each community, a two-stage cluster sampling design was used to recruit participants. Exclusion criteria were age <18 years, inability to give informed consent due to disability/incapacitation, refusal to submit a respiratory sample – for purposes of the parent study – and any persons living in institutional settings.

Each participant was required to give written informed consent. Individuals and household heads were interviewed in their homes using structured questionnaires. Finger prick capillary blood was taken for HIV testing and random blood glucose (RBG) measurement, with pre- and post-test counselling for HIV tests. Determine™HIV-1/2 was used for HIV testing, plus UniGold™HIV-1/2 to confirm all positives. RBG concentration was measured using an Optium Xceed point-of-care glucometer. All research staff were trained on the use of this particular glucometer and were required to undergo proficiency testing. Standardised control solution was used for performance checks on test strips and meters. Height and weight were measured using standard operating procedures. All individuals identified to have abnormal blood glucose or to be HIV positive were referred to existing local health facilities for appropriate management.

Data were electronically entered directly onto personal digital assistants by field staff at the time of data collection, using pre-programmed questionnaires and result sheets. All information was downloaded daily into a SQL (structured query language) database and later exported into Stata.

Ethics approval was granted from the London School of Hygiene and Tropical Medicine Ethics Committee, the University of Stellenbosch Ethics Committee and the University of Zambia Ethics Committee.

2.1. Definitions

- Diabetes mellitus was defined as a random blood glucose concentration (RBG) ≥ 11.1 mmol/L, or RBG < 11.1 mmol/L but with a self-reported prior diabetes diagnosis.
- Body mass index (BMI) was defined as weight in kilograms divided by height squared in metres (weight (kg)/height²(m)).
- HIV status was defined by a combination of blood sampling and self-report for those with missing biological data.
- Exposures (risk factors) for diabetes were defined as proximal or distal factors. Distal factors include age, sex, household socio-economic position, education, smoking history, HIV status and community. The proximal factor, BMI, may be determined partly by the distal factors and so estimation of its direct effect on diabetes requires controlling for confounding by the more distal factors.
- For assessing the management of those with diabetes, RBG < 7.8 mmol/L was considered to be the recommended level of glycaemia, as specified by the International Diabetes Federation guideline for target postprandial glucose concentration [18].

2.2. Statistical analyses

Direct age standardisation for the prevalence of diabetes was calculated by applying the study age-specific diabetes rates (separately for Zambia and the Western Cape) to the 2013 International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH) sub-Saharan African standard population distribution. Univariable and multivariable logistic regression analyses were used to identify risk factors for diabetes, accounting for the cluster sampling design. Principal components analysis was used to create a measure of household socio-economic position separately for each country, using the following variables: main type of dwelling; main type of flooring; main type of household toilet; main source of household drinking water, and presence of household assets including radio, television, refrigerator, bicycle, motorcycle, car, domestic worker and mobile phone.

The variables considered *a priori* as potential risk factors were those known to be risk factors in other populations and settings [19,20]: age, sex, household socio-economic position, education, smoking, ethnicity and adiposity (measured

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