Diabetes in Nigeria – a translational medicine approach

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Introduction

The prevalence of diabetes mellitus in Nigeria has increased from 2.2% as reported by Akinkugbe in 1997 from a national survey to 5.0% by 2013 estimates of the International Diabetes Federation (IDF).[1,2] Complications of diabetes are common at the time of presentation in Nigeria: neuropathy 56%, erectile dysfunction 36%, nephropathy 9%, and retinopathy 7%.[3] This is partly because diabetes is a progressive illness with an initial asymptomatic phase associated with on-going tissue damage and decline in pancreatic beta cell mass and function.

The United Nations (UN) recognises diabetes as a chronic debilitating and costly disease associated with severe complications, which poses severe risks to families, member states and the entire world; and serious challenges to the achievement of internationally agreed developmental goals, including the Millennium Development Goals (MDGs).[4,5] The prevalence of the varying types of diabetes is increasing globally, including in Nigeria. Type 2 diabetes is increasing in adolescents, and gestational diabetes mellitus (GDM) is also more recognised now. Type 1 diabetes is often misdiagnosed or undiagnosed and may result in coma and death. Annual diabetes-related expenditure per patient in Nigeria is very low – US$137; this compares with US$4054 in Japan; US$3994 in the UK; and US$9800 in the UK.[2]

Translational medicine is a discipline within biomedical and public health research that aims to improve the health of the individual and the community by translating research findings into diagnostic tools, medicines, procedures, policies, and education. This article aims to analyse the various local and international studies and policies on diabetes mellitus with a view to providing preventive and care strategies for Nigeria. The Diabetes Association of Nigeria (DAN) has in the past few years harnessed local and international efforts on diabetes; leading a strong advocacy to the Federal Ministry of Health

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(FMOH) in Nigeria, to adopt international best practices to stem the tide of the diabetes epidemic in Nigeria.

Epidemiology

Nigeria has the largest population in Africa (about 170 million); and of this the adult population (aged 20–79 years), is approximately 79 million.[2] One third of all the cases of diabetes are in the rural communities, while the rest are in the urban centres. About two million of the cases of diabetes in Nigeria are undiagnosed. Deaths related to diabetes in Nigeria in 2013 were estimated to be 105,091 cases.[2] Nigeria has the highest burden of diabetes in Africa, followed by South Africa with 2.6 million cases, Ethiopia 1.9 million, and Tanzania 1.7 million.

The global (whole world) prevalence of diabetes by 2013 estimates is 382 million cases, a large population of it (175 million) undiagnosed, and the global prevalence about 8.3%. More than half of the deaths due to diabetes occur in people less than 60 years old. Studies in Nigeria show that up to 73% of diabetes patients do not practice self-monitoring of blood glucose.[6,7] In a recent study the prevalence of hypertension and peripheral neuropathy in Nigeria was more than 50%, while the prevalance of retinopathy was 35%, cataract 25%, cardiovascular disease 5%, foot ulcers 16%, and nephropathy 3%.[7] It was obvious from this and other surveys that the status of glycaemic control and other targets such as lipids, glycated haemoglobin (HbA1c), blood pressure and education were below expectations.[7,8]

Risk factors

More than 95% of cases of diabetes in Nigeria are type 2 diabetes. Many cases of type 1 diabetes may die of acute complications, be misdiagnosed, or may not present to hospital due to poverty and lack of health insurance. Gestational diabetes is increasingly being recognised and diagnosed. Most antenatal clinics do glucose meter capillary blood glucose on the first antenatal visit. Diabetes has a strong genetic component, and this is even stronger in type 2 diabetes, which has links with insulin resistance and dyslipidaemia.[9-11]

A National Health and Nutrition Examination Surveys (NHANES) in the USA between 1976 and 2010 showed ethnicity/race, ageing, and obesity as the principal risk factors for type 2 diabetes.[12] The prevalence of diabetes in men rose from 4.7% to 11.2% during this period, and

from 5.7% to 8.7% in females. Body mass index (BMI) was found to be the major factor in the increased prevalence of diabetes.[12] In this study, physical activity, waist circumference and mortality were not measured, which may be a limitation. The various risk factors for type 2 diabetes are as outlined below:[12-14]

1. Unhealthy diet (fast food, excess refined sugar, excess salt, low fibre)
2. Overweight/obesity
3. Lack of regular physical exercise
4. Excessive use of alcohol
5. Advancing age
6. Hypertension
7. Family history
8. History of previous impaired glucose tolerance (IGT) or impaired fasting glucose (IFG)
9. Dyslipidaemia
10. History of GDM or large babies
11. Ethnicity

Diet

Food contains nutrients necessary for growth and health. However, a balance of the components of food and the energy needs of each person has to be worked out in order to maintain normal weight for height and sex. The macronutrients are carbohydrate, protein and fat. One gram of carbohydrate when metabolised gives 4 calories of energy and the same for protein; fat gives 9 calories, while alcohol gives 7 calories. However, alcohol has no nutrients and its metabolic products if in excess in the blood can damage cells and tissues.[15]

The micronutrients are vitamins and minerals. A balanced diet has all these nutrients. The World Health Organization (WHO) recommends that all people should limit the intake of refined sugar to less than 10% of the total calories, and those with diabetes should avoid all simple sugar. Daily salt intake should be less than 2.3 mg (one teaspoonful). Eight glasses of water are advocated (about 2.5 litres) daily. A fibre-rich diet helps the normal functioning of the gastrointestinal system and also helps to prevent weight gain and constipation. In addition, a fibre-rich diet reduces the glycaemic index of food items, thereby preventing post-prandial hyperglycaemia. WHO recommends 25–35 g (14 g/1000 calories) of fibre in food, daily. This is equivalent to 3–5 servings of vegetables and/or fruit daily.[15]

Good sources of fibre are oats, apples, oranges, wheat, garri, and vegetables. Fibre also reduces serum cholesterol, thereby reducing cardiovascular risks and mortality. A daily excess of 500 calories of energy will cause a weight gain of about 0.5 kg weekly. There are 3500 calories in 0.5 kg of stored fat. To lose weight in order to have a normal weight for height and sex, there should be a daily calorie deficit of at least 500 calories. This is best achieved by a combination of diet and regular exercise. A normal diet should contain the required calories for the patient to achieve normal weight in the following

proportions: 50–60% complex fibre carbohydrate, 20–30% protein, 10–20% mono- and polyunsaturated fat, adequate vitamins and minerals.[15-17]

Glycaemic index (GI)

The glycaemic index (GI) is a measure of how quickly carbohydrate (CHO) is digested and absorbed into the bloodstream after ingestion. This is measured on a scale of 0–100. Pure glucose has a GI of 100. A GI of equal or less than 55 is low; 56–69 is medium, and equal or greater than 70 is high.[18] Low GI diets are generally recommended for diabetic patients, this helps to control appetite, delay hunger, and reduce post-prandial hyperglycaemia. The GI and calorie content of some Nigerian foods are shown in Tables 1–3.[15]

Food	Glycaemic index
Apple	38
Baked potato	85
Banana	55
Boiled potato	63
Brown rice	55
Coca Cola (regular)	63
Glucose	100
Honey	58
Mangoes	56
Milk	27
Orange	44
Pineapple	66
Orange juice	52
Table sugar	65
White rice	64
Yogurt (whole milk)	45

Table 1. Glycaemic indices (GI) of common foods

Food	Glycaemic index	Calories
White bread (1 slice)	70	84
Corn flakes (45g)	84	167
Beef burger (108g)	66	254
Banana (150g)	70	143
Chicken breast (140g)	55	162
2 Weetabix (37g)	69	129
Beer (600ml)	66	180
Cassava flour (100g)	59	341
Maize flour (100g)	55	370
Yam flour (amala) 100g	50	175
Whole wheat flour (100g)	70	345
Millet flour (100g)	68	345

Table 2. Glycaemic indices (GI) and calories of some Nigerian foods

Anthropometry

Measurement of body shape and weight, are important in understanding the changes associated with diabetes and other co-morbidities, such as described in the metabolic syndrome.[15-17] These can also be used to monitor

Food	Calories	Food	Calories
White bread	245	Beans	158
Brown bread	244	Plantain	64
Semolina	348	Tomato	23
Wheat flour	345	Mango	44
Soya beans	432	Potato	97
Greens peas	93	Sweet potato	120
Cabbage	27	Tapioca	157
Lettuce	21	Yam	111
Carrot	48	Cucumber	13

Table 3. Caloric values of some foods per 100g

treatment and the patient's response to diet, exercise, and drugs. The measurements include height, weight, body mass index (BMI), waist circumference (WC), hip circumference (HC), waist hip ratio (WHR), and saggital abdominal diameter (SAD).

(a) **Weight.** Weight could be low, normal, or high. If high it is classified as overweight or obese. Weight is often related to age, sex, and height. A man with a height of 1.70 m will have an ideal weight of about 70 kg, and with a height of 1.80 m, this will be a weight of about 80 kg. This is sometimes called the Brocas index. Weight in excess of 10% above ideal is described as overweight and more than 20% over the ideal weight is classified as obese.[15]

(b) **Body mass index (BMI).** Also called the Quetelet's index, the BMI is derived from the individual's weight in kilograms, divided by their height in metres squared. The normal range is 18.5–24.9 kg/m^2. BMI values below 18.5 suggest underweight and/or malnutrition. From 25.0–29.9 is overweight, 30–39.9 is obese, while 40.0 and above is severe obesity. BMI, however, as a measure of excess weight does not differentiate lean body mass from fat.

(c) **Waist circumference (WC).** Excess fat around the midriff or trunk is associated with cardiovascular disease. However, this does not differentiate subcutaneous fat from visceral fat. Excess visceral fat generates injurious inflammatory chemicals such as cytokines and adipokines. It is measured at the widest abdominal girth, which is about the umbilicus, or at the midpoint between the lower margin of the ribs and the upper margin of the iliac crest. For males, a WC greater than 102 cm is abnormal, while values greater than 88 cm in females are abnormal. These values have been reviewed recently, and values above 94 cm for males and 80 cm for females are now considered abnormal.[16,17]

(d) **Waist to hip ratio (WHR).** The normal WHR for females are values less than 0.9, and in males less than 1.0. Some clinicians use lower cut off points for males (less than 0.9), and for females less than 0.8.[17,19]

(e) **Saggital abdominal diameter (SAD).** This is a more recent measurement that correlates well with the measurement of visceral adiposity using imaging techniques. The patient is placed in the supine position, a position that ensures that the subcutaneous fat gravitates to the sides making it easy to measure the visceral fat across the abdominal diameter.[15]

Prevention of diabetes

The prevention or steady decline in the prevalence of diabetes in Nigeria will entail a multisectoral, co-ordinated, monitored, and well-funded programme as advocated by the IDF, WHO, DAN and other bodies.[20-22] DAN has championed a lot of activities, such as the provision of a National Guideline for Diabetes Management in Nigeria, which the Federal Ministry of Health of Nigeria has acknowledged as a working tool.[3] DAN as a member of the IDF produced and launched a book in 2013.[23] DAN has also started a training curriculum for health workers in Nigeria – the first edition was held at Abuja in November 2013. The following was advocated to reverse the increasing prevalence of diabetes in Nigeria:

1. National survey every 5 years to determine the burden and pattern of diabetes.
2. Diabetes health education in primary and secondary schools (with emphasis on nutrition, exercise, and healthy lifestyle).
3. National plan for good diet, avoiding smoking and excess alcohol.
4. Checking of blood glucose yearly from age 30 years.
5. Checking blood pressure yearly from age 25 years.
6. Checking serum cholesterol profile yearly from 35 years.
7. Eye examination every 5 years.
8. Compulsory and free primary education nationally.
9. An increase of health insurance coverage from the current less than 5%, to 50% in the next 5 years.
10. Making health and physical education a compulsory and practical course at primary and secondary school level.

Treatment recommendations

1. Universal and free primary healthcare for all Nigerians, provided by Local Governments. This would fulfil the recommended care in the IDF Clinical Guideline 2012.[21]
2. Free Secondary Health Care, provided by State Governments. This is also in line with the care recommended by IDF Guidelines of 2012.[21]
3. Tertiary healthcare covered by a National Health Insurance Scheme (NHIS), provided by the Federal Government of Nigeria, and consistent with the comprehensive care stated in the IDF Guidelines.[21]

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