From the Journals

GFR estimation in diabetes

Agoons DD, Balti EV, Kaze FF et al. Performance of three glomerular filtration rate estimation equations in a population of sub-Saharan Africans with Type 2 diabetes. *Diabetic Medicine* 2016; 33: 1291–1298.

Estimated glomerular filtration rate (eGFR) is an increasingly used tool in modern diabetes care. It is used to measure the decline in renal function in those with advanced nephropathy, and also is the main guide to oral agent use or dosage (notably metformin). Current eGFR equations have been validated only in white populations, and there are concerns that ethnicity may affect the validity of some models. Researchers from Cameroon, South Africa and Australia have now trialled three equations, and compared them with creatinine clearance (CrCl) measured with 24-hour urine collections (as the 'gold standard'). The equations tested were the Cockroft-Gault (CG), the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI), and the Modification of Diet in Renal Disease (MDRD). All had relatively weak correlations with CrCl, with r values of 0.58 (MDRD), 0.55 (CKD-EPI), and 0.61 (CG) . There was no statistically significant difference between the three correlations. The authors felt that the MDRD had slight advantages over the other two equations in African type 2 diabetic patients, but also concluded that better equations are needed.

Beyond the body mass index

Tanamas SK, Lean MEJ, Combet E et al. Changing guards: time to move beyond body mass index for population monitoring of excess adiposity. *Quart J Med* 2016; 109: 443–446.

Obesity and overweight are recognised as significant risk factors for cardiovascular disease and type 2 diabetes. The traditional index of adiposity is the body mass index (BMI), but this does not give information on body composition or fat distribution. Researchers from Australia and the UK have recently reviewed this problem. They point out that BMI has only a 50% sensitivity in predicting excess body fat. Also, athletes may have a raised BMI but low total body fat. Finally, for the same BMI, white Caucasians have less body fat than Asians, but more than Africans. An alternative to BMI is waist circumference (WC) or waist:hip ratio (WHR). WC is the simplest measure but is still prone to observer error, though it does reflect central obesity and is at least as good as BMI in predicting adverse health outcomes. If 'high risk' BMI is defined as >30.0 Kg/m^2, and WC as >102 cm for men and >88 for women; interesting patterns emerge. BMI and WC will agree in 57%, BMI alone will predict risk in 5%, and WC alone in 38%. Though BMI remains a useful demographic tool, the authors of this paper argue that other measures such as WC should be included in individual and population risk assessment.
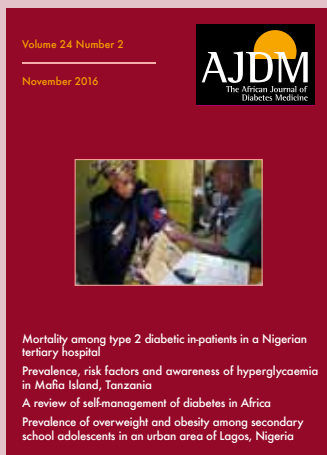
Global diabetes prevalence

NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. *Lancet* 2016; 387: 1513–1530.

The respected international group, the NCD Risk Factor Collaboration, has published a major pooled-data analysis of worldwide trends in diabetes prevalence. Data was taken from 751 studies including 4 372 000 adults from 146 countries. Overall prevalence globally rose from 4.3% in 1980 to 9.0% in 2014 in males, and 5.0% to 7.9% in women over the same period. The total numbers in the world with diabetes was 108 million in 1980, rising to 422 million in 2014. An interesting breakdown of these figures was that 29% of the rise was due to a true increase in prevalence, 40% was to population aging, and 31% was an interaction between these two effects. Polynesia and Micronesia had the highest diabetes prevalence (about 25%), and north-west Europe the lowest. The Middle East and north Africa had relatively high rates. These figures suggest that the current diabetes 'epidemic' is not being contained, with a near-quadrupling of the numbers with diabetes in the world since 1980. Urgent action is needed to promote weight control and exercise. This needs to be at all levels – from individuals and families, to national governments and global health organisations.

High strength insulins

Dashora U, Castro E. Insulin U100, 200, 300 or 500? *Brit J Diabetes* 2016; 16: 10–15.

Type 2 diabetes is a disease marked by insulin resistance. When insulin is used to treat the disease, not surprisingly, large doses may be needed. Large doses mean larger volumes, and as well as being uncomfortable, insulin absorption from high volume injections can be erratic. Also, a number of currently used injection pens have relatively low limits to the maximum number of units that can be injected at one time. Because of these problems, a number of high strength insulins have been recently introduced, with more to be released in the near future. The short-acting analogue insulin Lispro is now available in a U200 formulation (200 units per ml). Glargine is a long-acting analogue insulin and a U300 preparation is on release. It is cost-effective and there is some evidence that it is associated with less weight gain and hypoglycaemia risk than the U100 preparation of the same insulin. The ultra-long acting insulin Degludec now has a U200 strength and appears to have a lower risk of nocturnal hypoglycaemia than the U100 strength. Thus, reduction of injection volume can have potential advantages in terms of hypoglycaemia risk.

Mortality among type 2 diabetic in-patients in a Nigerian tertiary hospital

Prevalence, risk factors and awareness of hyperglycaemia in Mafia Island, Tanzania

A review of self-management of diabetes in Africa

Prevalence of overweight and obesity among secondary school adolescents in an urban area of Lagos, Nigeria

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Editorial

The cost of insulin

A well-known and serious problem for patients with diabetes in Africa, their families and healthcare workers, is the high cost of insulin. Some time ago it was estimated that about 10% of most African countries drug budget is spent on insulin. This problem has been raised again in the medical literature – last year the *New England Journal of Medicine* ran an editorial entitled 'Why is there no generic insulin?',[1] and the *British Medical Journal* (BMJ) this year published a feature article headed 'The travesty of expensive insulin'.[2]

Both articles make the point that insulin was introduced in 1922, but no cheap generic brand exists. As the BMJ comments, 'it's as if Bayer still owned the rights to insulin and charged us a fiver a pill'.[2] For those not used to British slang 'fiver' means £5 sterling! One reason for the high price of insulin is that manufacturers have regularly refined their products to maintain patent rights. Thus, beef insulins gave way to pork, pork to human and human to analogue. The benefits of these insulin alterations can be debated, but the financial cost is high; in the UK analogue insulins have cost the NHS an estimated extra £625 million over the last 10 years.

All is not bad news however. A number of small pharmaceutical companies (in India for example) still produce inexpensive human insulins. Also, to be fair on the major insulin producers, many offer their products at significantly lower cost to resource-limited countries. Finally, the patents are beginning to expire on many analogue insulins, and a range of (presumably cheaper) 'biosimilar' insulins will emerge.

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Front cover: Santé Diabète Bamako centre diabetique. By Olivier Hébrard
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In the news

Type 1 diabetes originates in the gut but could probiotics offer a cure?

Two separate pieces of research have found that the development of type 1 diabetes is likely caused by the gut, and therefore, a type of probiotic could be the cure.

Scientists from several European and US institutions studied 33 Finnish infants over three years from birth who were genetically predisposed to type 1 diabetes.

Their study, entitled 'The Dynamics of the Human Infant Gut Microbiome in Development and in Progression toward Type 1 Diabetes' is published in the Cell Host & Microbe journal.

They discovered that four children in the group that developed type 1 diabetes had 25% less types of bacteria in their guts than other children.

The same four infants were also found to have more amounts of a specific bacteria that is known to trigger gut inflammation. This could be a prelude to type 1 diabetes as the bacteria causes the immune system to mistakenly attack and destroy beta cells in the pancreas that usually make insulin and monitor glucose levels.

'We know from previous human studies that changes in gut bacterial composition correlate with the early development of type 1 diabetes, and that the interactions between bacterial networks may be a contributing factor in why some people at risk for the disease develop type 1 diabetes and others don't,' said Jessica Dunne, Director of Discovery Research at Juvenile Diabetes Research Foundation (JDRF), a UK charity which funded the study.

Cornell University researchers have a similar idea, but they have been working on a treatment that involves regulating insulin by engineering the bacteria found in our guts.

Their study, entitled 'Engineered Commensal Bacteria Reprogram Intestinal Cells Into Glucose-Responsive Insulin-Secreting Cells for the Treatment of Diabetes' is published in the Diabetes journal.

The scientists took a strain of bacteria known as *Lactobacillus gasseri* – a type of bacteria found in probiotic yoghurts – and engineered the bacteria to be able to secrete a hormone called glucagon-like peptide-1 (GLP-1).

When they fed this engineered probiotic to a group of diabetic rats for 90 days, they discovered that the bacteria triggered the upper intestinal epithelial cells in the rats to convert into cells that acted a lot like the pancreatic beta cells.

The rats had up to 30% lower blood glucose than diabetic rats that did not receive the probiotic, and the probiotic was shown to reduce glucose levels in diabetic rats the same way the levels would be reduced in normal rats.

The next step for March and his team is to prove that their method of engineering bacteria to move insulin production to the intestine will work in humans too.

They aim to develop a pill that patients suffering from both type 1 and type 2 diabetes can take daily, that will be available within the next two years.

High unmet need for diabetes diagnosis and care across sub-Saharan Africa

Health systems in sub-Saharan Africa fail to identify the majority of patients with diabetes, and a large unmet need for diabetes counselling and treatment remains, according to an analysis of population-based surveys.

'The burden of diabetes and overweight/obesity are very substantial in the sub-Saharan African countries included in this piece, but much of the need for diagnosis, lifestyle counselling and treatment is not being met by the current systems of care,' Jennifer Manne-Goehler, MD, DSc, a resident in medicine at Beth Israel Deaconess Medical Centre, clinical fellow at Harvard Medical School and research fellow at the Harvard T.H. Chan School of Public Health. 'In particular, younger and less educated people with diabetes in this region are most in need of these health services.'

Manne-Goehler and colleagues analysed individual-level data from nationally representative population-based surveys conducted between 2005 and 2015 across 12 countries in sub-Saharan Africa, including Benin, Comoros, Guinea, Kenya, Liberia, Mozambique, Seychelles, Tanzania, Togo and Uganda (n = 38,311; mean age, 39 years; 58% women; 57% currently employed).

Researchers assessed self-reported data to quantify the met and unmet needs for screening and diagnosis of diabetes. Three measures were defined: patients with overweight or obesity having ever received a blood glucose measurement; individuals defined as having diabetes ever having received a blood glucose measurement; and individuals defined as having diabetes having been told by a healthcare provider about diabetes diagnosis, a measure of awareness of diagnosis.

Across the 12 surveys analysed, single-country diabetes prevalence ranged from 2% in Mozambique to 14% in the Seychelles; median prevalence in the region was 5%. Among respondents aged 55 to 64 years, median prevalence of diabetes was 9%. Across surveys, a median of 27% of respondents had overweight or obesity; among those, a median of 22% reported ever having received a blood glucose test. Among respondents with diabetes, a median of 36% self-reported receiving a blood glucose test; a median of 27% reported being told of their diabetes diagnosis.

Responses also suggested an unmet need for care. A median of 15% of respondents reported that they were counselled by a health care provider to lose weight; 15% reported that they received counselling regarding exercise. A median of 25% of respondents reported the use of oral diabetes drugs; 11% reporting using insulin.

'Our analysis of pooled, individual-level data across 12 nationally representative population-based surveys shows strikingly high levels of unmet need across several key indicators of diabetes diagnosis and care,' the researchers wrote. 'Taking the median of country means as a summary statistic, among all people with diabetes, only a third reported having ever received a blood sugar measurement and only a third recalled being diagnosed as having diabetes. Similarly, only small proportions of overweight or obese people reported being screened for diabetes, despite their high risk for the disease.'

A review of self-management of diabetes in Africa

S C Iregbu and F U Iregbu

Introduction

Diabetes is a chronic disease caused by a genetic or acquired deficiency in the production of insulin by the pancreas (type 1) or the ineffective use of insulin by the body cells (type 2).[1] It is characterised by high levels of blood glucose. Uncontrolled diabetes increases the risk of cardiovascular disease, stroke, nerve damage, foot ulcers leading to lower limb amputations, kidney failure, blindness, and premature death.[2] Diabetes requires lifestyle adjustments such as weight management, physical exercise, and appropriate diet, as well as use of medications to maintain normal glycaemia and reduce the risk of long-term complications.[3]

Due to the complex nature of diabetes management, and the need to alter everyday practice and choice to accommodate the disease, treatment rests primarily with the sufferers.[4] Self-management is a process in which individuals are actively involved in their disease management. This article seeks to explain the concept of self-management, and examine existing empirical literature on the self-management of diabetes in Africa. It will also highlight gaps in knowledge as well as implications for research.

The burden of diabetes

Diabetes is one of the most prevalent chronic diseases affecting about 422 million adults worldwide.[5,6] Its overall prevalence quadrupled from 108 million in 1980 to 422 million in 2014,[7] and is expected to reach 642 million by 2040.6 According to the International Diabetes Federation (IDF),[8] 14 million people had diabetes in Africa in 2015 and the figure is projected to reach 34 million by 2040. The above prediction shows a 142% surge in the prevalence of diabetes in Africa by 2040, compared with an expected 52% increase in the rest of the world. In Africa, 321 000 deaths were attributed to diabetes in 2015 and 79% of those deaths occurred in people under 60 years old.[8]

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Type 2 diabetes, accounting for 90% of all cases of diabetes, has health, social, and psychological implications. It is the leading cause of non-traumatic amputations, blindness, and end-stage renal disease, and one of the principal causes of death from cardiovascular complications such as myocardial infarction.[9,10] Prolonged uncontrolled high blood glucose levels lead to damage to the heart, blood vessels, eyes, kidneys, and nerves leading to disability and premature death.[5] It doubles the risk of different types of cardiovascular diseases, such as coronary heart diseases and stroke.[11] It is also associated with many non-vascular diseases such as cancer, mental and nervous system disorders, infections, and liver disease.[12]

Diabetes like other chronic illnesses disrupts the physical, psychological, and social balance of an individual's life.[13] The disruption results from the physical limitations imposed on the affected individuals by the disease, as well as from the social and cultural implications of living with diabetes.[14] The need for modification of lifestyle such as a change in dietary patterns, maintaining blood glucose balance, and constant body watching/listening limits socialisation. The financial cost associated with diabetes also adds additional strain. Kralik et al[15] describe the chronic illness experience as living a restricted life, experiencing social isolation, and burdening others. Furthermore, complications of diabetes such as loss of sexual function, blindness, and loss of limb result in loss of sense of identity in individuals and change in social relationships.[14,16] Participants in the Diabetes Attitude Wishes and Needs (DAWN) study reported anxiety, fear, and worry about diabetes complications, depression, and a sense of hopelessness as challenges; they also reported being discriminated against in the work place.[17]

Diabetes has no cure, but is managed throughout the life of affected individuals with medications and lifestyle modification measures to maintain good glycaemic control, reduce the risk of complications, and improve the quality of life.[5] Funnell and Anderson explained that the chronic nature of diabetes, the complexity of its management, and the personal choices and daily decisions required in its management mean that just being adherent to medical advice is not enough for adequate management of the disease.[18] Many of the decisions and choices made in the daily management of the disease are done by affected individuals between hospital visits.

Self-management is therefore promoted as the foundation of diabetes management.

Self-management of diabetes

Self-management is the ability of an individual to manage the symptoms and consequences (physical, social, and lifestyle changes) of living with a chronic disease.[19] It is the ability of a person in conjunction with family, community and health professionals to manage symptoms, treatments, lifestyle changes, and psychosocial, cultural, and spiritual consequences of a health condition.[20] In a qualitative metasynthesis of 101 studies, Schulman-Green et al[21] identified three major themes that represent processes of self management: focusing on illness needs (medical management); activating resources (identifying and benefiting from health, psychological, spiritual, social, and community resources); and living with chronic illness (processing emotions, adjusting to illness and the new self, integrating illness into daily life, and personal growth). Likewise, Corbin and Strauss, as cited in Schulman-Green et al,[21] described the work related to living with a chronic illness as illness-related work (medical management), everyday life work (maintaining, changing or creating new behaviours or roles), and biographical work (regaining altered sense of identity). Both findings describe three principal components of self-management as: taking care of ones' health and illness needs; learning new roles and learning to utilise resources to help one deal with day to day health, social and psychological consequences of living with chronic illness; and lastly learning to adjust to the new self by recognising and accepting the limitations imposed by the illness. Major tasks involved in diabetes self-management include healthy eating, being physically active, monitoring blood glucose, taking prescribed medications, good problem-solving skills, healthy coping skills, and risk-reduction behaviours.[22]

Studies have shown that self-management promotes adequate glycaemic control, reduces healthcare costs, prevents complications, and enhances quality of life.[23–27] However, the seemingly simple task of engaging in self-management is not without challenges. Poor self-management, resulting in high rates of diabetes-related morbidity and mortality among different ethnic groups as well as in developing countries, has been reported.[8] A systematic review, in which 80 studies were analysed to determine barriers to diabetes self-management, showed that negative attitude and beliefs about diabetes and its treatment, ignorance, differing cultural beliefs and values, financial resources, co-morbidities, and social support could facilitate or hinder self-management of diabetes.[28] This is the case in many developing countries.

A review of empirical studies on self-management of diabetes in Africa revealed that poor glycaemic control was recorded among more than 50% of persons living with diabetes across different settings.[29–36] Poverty, differing cultural and religious beliefs, and ignorance often undermines self-management.[29–31] Poverty is recorded as a key factor that inhibits diabetes self-management.[31, 32, 37] In a cross-sectional study carried out at the University College Hospital Ibadan (the largest tertiary health institution in Nigeria) to explore the level of glycaemic control and adherence to diabetes self-management practices, only 44% of cohorts had adequate glycaemic control and 59% of participants were non-adherent to prescribed anti-diabetes drugs due to lack of finances.[29] Similarly, in another study to identify reasons for patients' non-adherence to prescribed oral hypoglycaemic medications in a 200-bed secondary healthcare facility in south-west Nigeria, more than two-thirds of respondents (82%) had never engaged in self-monitoring of blood glucose due to lack of affordability of equipment and lack of knowledge of its use. Also 35% of participants reported non-adherence to anti-diabetes drugs due to the high cost of medication.[32]

In addition, cultural beliefs and practices,[30,31] as well as family dynamics,[30] affect diabetes self-management in Africa. Family members have been known to play both a supportive and inhibitory roles in diabetes self-management, especially in the areas of meal planning and financial support. For instance, in many African households, meals are prepared centrally by the mother or sisters. This could affect diabetes self-management negatively in a situation where the person preparing the meals is not knowledgeable or inclined to accommodate the diabetic patient.

Differing health beliefs regarding causes of diabetes and expected treatment affect self-management. Researchers in Ghana[38] noted conflicting explanatory models of diabetes among persons living with diabetes in three urban communities in the country. Different understanding and beliefs regarding the causes and treatment of diabetes between healthcare professionals and patients often lead to conflicting expectations, poor self-management, and consequently poor disease outcomes.[39] For instance, the belief that diabetes is caused by supernatural causes may undermine care as patients may prefer to seek for solutions in prayer houses.

Other factors that affect self-management of diabetes among persons living in Africa include poor knowledge and practices of self-management,[29,31,38,40] little social support, and psychological distress.[35,41] Poor knowledge could result from low literacy levels or poor understanding, which could arise from lack of education by health professionals.[42] Many healthcare settings in Africa do not have structured diabetes self-management programmes – the only education given is done in the physician's office when there is an opportunity or obvious need.[43,44] People who are not educated may find it difficult to understand the pathophysiology of the disease as well as its management. Furthermore, ethnic differences in beliefs about diabetes and related management behaviours might inform initial disease conceptualisation, which might interfere with later understanding and acceptance of biomedical explanations.

Gaps in knowledge and implications for research

All the empirical studies reviewed in this paper addressing self-management of diabetes in Africa from 2000 to 2015 were accessed from Medline and CINAHL. They focus on compliance to medical advice, which is only one aspect of self-management.[21] No study among those reviewed focused on partnership or collaboration between patients and healthcare professionals and none examined experiences of persons living with diabetes in Africa. Jackson et al observed that most persons living with diabetes in Nigeria rely on healthcare professionals to make decisions, set goals, and give instructions on what to do while they try to comply with the instructions.[45] Diabetes self-management requires cognitive, emotional, and behavioural skills to handle the complex decision making and self- management tasks involved in disease management.[46] The compliance model implied in the studies reviewed for this paper aligns with the medical prescriptive approach to care which evaluates the success of patients in managing their diabetes by their ability to adhere to a prescribed therapeutic regimen. This traditional compliance model does not enforce shared decision making or the independent thinking needed in diabetes self-management.[47] Diabetes self-management requires complex decision making to balance and maintain glycaemia; these decisions are made outside the physician's office and have a direct impact on disease outcomes. Therefore, the ability to make informed, healthy, and independent decisions and choices is paramount to successful self-management, and this cannot be achieved by simply adhering to a set of instructions.

The medical prescriptive approach to disease management has been judged ineffective in the management of chronic diseases.[18,19,48,49] A new model in which there is a partnership between healthcare professionals and persons with diabetes has been proposed for better disease outcomes.[18,19] In the partnering relationship, healthcare professionals provide self-management support that goes beyond providing information and includes helping patients to develop problem-solving skills, improve self-efficacy, and support application of knowledge in real-life situations.[50] Self-management support is a crucial aspect of diabetes management which must be provided at diagnosis and on a continuing basis.[51,52] The partnership and patient empowerment that result from this will help to increase the capacity of patients to think critically and make independent, informed decisions in their daily disease management for a better outcome.[53]

In addition, no study among those reviewed explored the experiences of individuals living with diabetes in Africa and how people with diabetes adjust and integrate diabetes self-management into their daily lives. Kneck and colleagues[54] argued that successful integration is necessary for achieving balance as well as adequate self-management, while control and decision making by others (healthcare professionals) objectifies the illness (diabetes) and keep patients at the compliance level.

The idea of victim blaming shown in many studies on diabetes self-management in Africa will not provide a solution as people can only make an informed and healthy decision regarding their disease management when they are empowered through education and skills training. In view of the lack of understanding of diabetes and poor knowledge of self-management practices recorded in almost all the studies reviewed,[43,44] in addition to a lack of a national self-management education/support programme in many African countries, research should focus on examining the nature of partnership between people living with diabetes and healthcare professionals, as well as looking for ways to provide self-management support. Research should also be conducted to explore the experiences of people living with diabetes in Africa. Such studies will help to shed light on how contextual factors such as cultural beliefs, values, and practices influence the understanding and management of diabetes; as well as reveal possible reasons for poor glycaemic control and poor self-management.

Conclusions

Diabetes is a chronic disease with dire physical, social, and psychological implications. Being a life-long disease with the need for lifestyle modifications, self-management is regarded as the foundation of its management. Major components of self-management include medical management, a partnership with healthcare professionals, and adjusting to life with chronic disease. Most of the research studies carried out in Africa focused on the medical prescriptive approach (medical management) to self-management. A look at the two other components of self-management would shed light on the reasons for the poor self-management of diabetes and poor glycaemic control prevalent in many African countries.

Author declaration

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Prevalence, risk factors and awareness of hyperglycaemia in Mafia Island, Tanzania

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Abstract

Type 2 diabetes is of increasing prevalence and importance in Africa. We have surveyed a total of 570 adults in the Mafia Archipelago in Tanzania. Data were collected through questionnaires, anthropometric measurements, blood pressure, and random blood glucose measurements. Twenty seven percent (27%) of the participants were aged between 41 and 50 years and the male:female ratio was 1.05:1.00. Most (53%) of the participants had primary level education, while 28% had no formal education. Moderately elevated random blood glucose (RBG) was seen in 6.7% of the participants (10.0–20.0 mmol/l), while 2.5% had a severely elevated RBG (>20.0 mmol/l). In addition, a further 1.0% had known diabetes, but with a normal (<10.0 mmol/l) RBG. This gives a total prevalence of type 2 diabetes of 10.2%. This was significantly associated with increasing age, higher body mass index (BMI), and a family history of diabetes. We conclude that there is a high prevalence of diabetes in this area of Tanzania. Many patients were unaware of the diagnosis and/or had significant hyperglycaemia. There is an urgent need for raised awareness and greater availability of screening and treatment.

Introduction

Diabetes mellitus is now a rapidly emerging condition across the globe, and contributes to high morbidity and mortality due to the serious complications it is known to have. Type 2 diabetes is a complex disorder characterised by increased resistance to insulin or impaired secretion of insulin. The strongest known risk factors include obesity, physical inactivity, unhealthy diet, and a family history of diabetes.[1–4] This is an under-prioritised disease, especially in low-income countries.[5] The 2010 International Diabetes Federation Atlas found that only four African countries possessed data, which is crucial for planning and implementation of prevention and control of diabetes.

The prevalence of type 2 diabetes is rising rapidly, particularly in the developing world. The prevalence is higher in men than in women, and particularly high in those over 65 years old.[6] Surveys conducted in 75 Oriental communities showed prevalence rates of 14–20%.[7] The prevalence of diabetes in Africa ranges from 2.5% in Seychelles to 16.0% in the Democratic Republic of Congo.[8,9] A 1984 study in Tanzania showed a diabetes prevalence of 1.6%,[10] but it is likely to be much higher now. We have therefore undertaken a prevalence study in the Mafia District of Tanzania.

Methods

A cross-sectional study was carried out in Mafia Island, Tanzania from 13 to 16 October 2011. The population of the Mafia District is 40 801.[11] The economy is based on fishing and subsistence agriculture. Mafia's infrastructure is limited: it has electricity only in the district capital and in Utende. The vast majority of Mafia's population is extremely poor.[12]

An Eye and Medical Camp was held at a primary school compound in which questionnaires were completed by medical students, medical personnel, and research assistants. Measurements were done by medical students and medical personnel only. Using a questionnaire in Kiswahili, information was collected on demographics, smoking habits, alcohol consumption, family history of diabetes and hypertension, and personal medical history (only a diagnosis made by a doctor was considered) including drug treatment. Treatment was defined by the use of oral antidiabetic agents. Diabetes was considered to be controlled if the random blood glucose (RBG) was less than 10.0 mmol/l among those receiving medication.

Anthropometric measurements (weight and height) were taken, and body mass index (BMI) calculated. Weight was taken using a regular weighing machine after removal of shoes and excess weight in pockets, while height was taken using a measuring board resting on the wall. Weight was calculated to the nearest 0.5 kg and height to the nearest 1 cm. RBG measurements were taken using an Acucheck metre after swabbing the finger of the client and puncturing with a sterile disposable lancet. Data were entered and processed in SPSS version 17.

Permission to conduct the study was obtained from the School of Medicine at Muhimbili University of Health

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and Allied Sciences. In addition, permission was sought from responsible authorities in Mafia Island.

A normal RBG was defined as 3.5–10.0 mmol/l, elevated RBG was 10.1–20.0 mmol/l, and severely elevated was >20.1 mmol/l. Patients were assigned as underweight, normal weight, overweight, obese and morbidly obese with BMI values of <18.5, 18.5–25.0, 25.1–30.0, 30.1–40.0, and >40.1 kg/m² respectively.

Results

A total of 570 participants were enrolled, of whom 30 (5.3%) were known to have diabetes. Of these 30 participants, 24 (80%) were on oral antidiabetic medication (six had an RBG <10.0 mmol/l, 10 had an RBG of 10.1–20.0 mmol/l, and eight had an RBG >20.1 mmol/l). This pattern of glycaemia was not dissimilar to the six with known diabetes who were on no medication (p=0.343).

Among the total 570 participants, 518 (90.8%) had a normal (<10.0 mmol/l) RBG, 38 (6.7%) had an elevated (10.1–20.0 mmol/l) RBG, and 14 (2.5%) had a severely elevated (>30.1 mmol/l) RBG. Thus, a total of 52 (9.2%) had levels of RBG compatible with a diagnosis of diabetes. Adding to this figure, the six with known diabetes who had a RBG <10.0 mmol/l, this gives a total prevalence of 58/570 or 10.2%.

Table 1 shows details of gender, age, educational status, family history of diabetes, BMI, smoking, and alco-

hol consumption, all stratified by normal, elevated and severely elevated RBG levels. Higher RBG levels were associated with higher age, positive family history, and raised BMI (all p<0.05).

Discussion

In our screening programme of a large number of individuals, 6.7% had an elevated RBG (10.1 –20.0 mmol/l), and 2.5% a severely elevated RBG (>20.0 mmol/l) – a total of 9.2%. In addition, a further 1.0% were known to have diabetes, but had a normal RBG on screening.

	Normal RBG <10.0 mmol/l (n=518)	Elevated RBG 10.1–20.0 mmol/l (n=38)	Severely elevated >20.1 mmol/l (n=14)	Significance
Gender Male Female	252 (90%) 266 (92%)	20 (7%) 18 (6%)	8 (3%) 6 (2%)	p=0.743
Age <40 years 40–50 years >50 years	196 146 (95%) 176	6 8 (5%) 24	2 0 (0%) 12	p<0.05
Educational status No formal Primary Secondary College	148 272 86 12	8 22 8 0	4 10 0 0	p=0.448
Family history Yes No Don't know	104 76 338	14 10 14	10 0 4	p<0.05
Awareness of diabetes Yes No Don't know	6 24 488	14 2 22	10 0 4	p<0.05
BMI Underweight Normal Overweight Obese Morbidly obese	24 (92%) 240 (94%) 154 (87%) 96 (92%) 4 (50%)	2 (8%) 8 (3%) 18 (10%) 6 (6%) 4 (50%)	0 (0%) 6 (2%) 6 (3%) 2 (2%) 0 (0%)	p<0.05
Smoking Yes No	46 (100%) 472 (90%)	0 (0%) 38 (7%)	0 (0%) 14 (2%)	p=0.081
Alcohol Yes No	32 (89%) 486 (91%)	2 (5.5%) 36 (6.7%)	2 (5.5%) 12 (2.2%)	p=0.451

Table 1. Details of patients stratified by random blood glucose (RBG)

This makes a very high total of 10.2% with likely type 2 diabetes; much higher than previous local estimates.

Hyperglycaemia was associated with increased age and this was statistically significant (p<0.05). It was also significantly associated with increased BMI (p<0.05). There was positive correlation with a family history of diabetes (p<0.05). Sedentary lifestyle, poor diet, and low level of awareness may be contributing factors for this, although level of education was not statistically significant (p=0.448) in this study. There was no significant relationship between glycaemia and smoking or alcohol use (p=0.451), or with gender (p=0.743).

Out of the 30 participants who were aware of having diabetes, only six (20%) had a controlled RBG. Fourteen (47%) had an RBG of 10.1–20.0 mmol/l, while 10 (33%) had an RBG of more than 20.0 mmol/l. In addition, 24 (80%) out of the 30 known diabetic patients were taking oral antidiabetic agents, while the remaining 6 were not. Although this was not statistically significant (p=0.343), this suggests poor control, which may be due to numerous factors including lack of follow-up, low level of education (particularly health education), and non-compliance with oral agents.

In this survey in Mafia Island, 10.2% had diabetes, much of which was not known. This is alarming and therefore there is a need to raise awareness and availability of screening, treatment and follow-up. This study can also act as a baseline for more studies to be undertaken and more evidence to be gathered.

From the prediction of the rise in non-communicable diseases (NCDs), to the actual prevalence rates, poor awareness and poor control, together with the lack of priority given to NCDs, there is a clear message: 'The best time to put emphasis was yesterday, the next best is today'. Health education is of the utmost importance; it should be initiated by health professionals using whatever means possible. This can only be envisioned if priority is given to NCDs by governments and necessary funds are allocated.

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Author declaration

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Keto-acidosis at diagnosis of type 1 diabetes in children and adolescents in Lagos, South-West Nigeria: the pattern over 10 years

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Abstract

Diabetic ketoacidosis (DKA) is the most serious complication in newly diagnosed cases of type 1 diabetes. We have determined the frequency of DKA at diagnosis in children with type 1 diabetes in Lagos University Teaching Hospital over a 10-year period, and have compared rates for the earlier and later years of the study period. This was a retrospective review of the case records of all the patients diagnosed with type 1 diabetes over a 10-year period from 2005 to 2015. Fifty-six (56) patients (26 males; 30 females), were seen with a mean age at diagnosis of 9.7±3.9 years. Thirty-one (31) patients (55%) presented with DKA at diagnosis. The mean age at diagnosis of the patients with DKA (8.7±3.4) was lower that of the patients without DKA (11.0±4.0, p=0.021). The median duration of symptoms before presentation in the DKA group was lower than the non-DKA group (three vs four weeks, p=0.002). Patients aged 5.0–10.9 years constituted more than half (58%) of the patients presenting with DKA. The younger age group has a greater tendency to present with DKA (p=0.004). The rate of DKA was higher in the Yoruba than the Ibo ethnic groups (p=0.007). The frequency of DKA at diagnosis in the latter years (47.4%) reduced by a quarter from the rate of 72% in the earlier years (p=0.076). We conclude that the rate of DKA at diagnosis is still unacceptably high, although has shown a slight reduction in more recent years.

Introduction

Type 1 diabetes is increasing in incidence worldwide at a rate of 2–5% per year, and approximately 200 children are diagnosed with new-onset type 1 diabetes every day.[1]

The clinical presentation of type 1 diabetes can be acute or insidious. It is generally easy to diagnose based on a history of polyuria, polydipsia, polyphagia, weight loss, and generalised body weakness, together with simple bedside tests such as urine dipsticks and glucose test strips.[2] Diabetic ketoacidosis (DKA) is the most serious complication in newly diagnosed cases of type 1 diabetes and also the leading cause of death in these children.[3] Early insulin replacement prevents DKA, thus the presence and severity of DKA is largely a consequence of delay in diagnosis and initiation of insulin therapy.[4]

There is wide geographic variation in the frequency of DKA at onset of diabetes.[5,6] This ranges from 13 to 70% in Europe and North America and up to 80% in the United Arab Emirates.[5,6] African studies have documented rates of DKA at initial diagnosis in type 1 diabetes as low as 33%,[7,8] while the majority of other centres reported higher rates approaching as high as 88%.[9–16]

Diabetic ketoacidosis is associated with significant morbidity and mortality in the paediatric population.[5,17,18] Cerebral injury is the major cause of morbidity and mortality in children and cerebral oedema accounts for 60–90% of all deaths from DKA.[5,17,18] Other complications include hypercoagulability leading to stroke and deep vein thrombosis, rhabdomyolysis, pulmonary and gastrointestinal complications, and long-term memory dysfunction.[5,18]

The subspecialty of paediatric endocrinology is developing in Nigeria with the creation of the African Paediatric Endocrinology Training Centres, first in Nairobi, Kenya (2008) and later Lagos, Nigeria (2012), resulting in the creation of an awareness of the importance of early detection of symptoms of paediatric endocrine disease, especially diabetes. Hence, this study sought to determine the frequency of DKA at diagnosis in children presenting with type 1 diabetes in Lagos University Teaching Hospital over a 10-year period, and also to compare the frequency of DKA at diagnosis between the earlier five-year period (before the effective development of the subspecialty of paediatric endocrinology) and the latter five-year period. The aim was to

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	All patients (n=56)	DKA (n=31)	Non- DKA (n=25)	Significance
Male	26 (46%)	16	10	p=0.386
Female	30 (54%)	15	15	
Socioeconomic status				
High	9 (16%)	5	4	
Middle	24 (43%)	16	8	p=0.279
Low	23 (41%)	10	13	
Age at presentation (years)				
Mean±SD	9.7±3.9	8.7±3.4	11.0±4.0	p=0.021*
Median	10	9	11	
Duration of symptoms (weeks)				
Mean±SD	5.4±4.6	3.4±0.9	7.1±5.8	
Median	4.0	3.0	4.0	p=0.002*
HbA1C at presentation (%)				
Mean±SD	12.1±1.9	12.0±1.7	12.2±2.1	
Median	12.0	12.0	13.5	p=0.728
*Significant (p<0.05).				

Table 1. Socio-demographic and clinical characteristics of the patients

Age group	All patients (n=56)	DKA (n=31)	Non-DKA (n=25)
0–4.9 years	9 (16%)	6 (19%)	3 (12%)
5–10.9 years	23 (41%)	18 (58%)	5 (20%)
11–14.9 years	18 (32%)	6 (19%)	12 (48%)
≥15 years	6 (1%3)	1 (4%)	5 (20%)
Total	56 (100%)	31 (100%)	25 (100%)

Table 2. Patients' age group at presentation

provide information on any possible impact of awareness programmes or the need to increase the intensity of awareness-creation programmes.

Patients and methods

This was a retrospective study in which data were extracted from the case records of all the patients diagnosed with type 1 diabetes at the Lagos University Teaching Hospital from 1 October 2005 to 30 September 2015. Socio-demographic information such as age at presentation and presenting symptoms (especially whether symptoms of DKA was present or not) were extracted. Other relevant information such as duration of symptoms before presentation, investigation results, complications, family history of diabetes, and management were also extracted. The socio-economic status of the patient was determined by modifying the Oyedeji[19] classification based on the educational attainments and occupations of parents or their substitutes. DKA was defined as 'symptoms of ketoacidosis in combination with biochemical param-

eters of hyperglycaemia (blood glucose >11 mmol/l), serum bicarbonate <15 mmol/l, and ketonuria', in accordance with International Society for Pediatric and Adolescent Diabetes (ISPAD) and European Society for Paediatric Endocrinology/Lawson Wilkins Pediatric Endocrine Society Consensus guidelines.[5,17]

The Health Research and Ethics Committee of Lagos University Teaching Hospital approved the study and waived the requirement for informed consent. Data extracted were collated on a Microsoft 2010 excel sheet and analysed with SPSS version 20. Univariate analysis was carried out for all major variables of interest. Continuous variables were tested for skewness of distribution. Normally distributed variables are presented as means (±SD) while skewed data were summarised using median with minimum and maximum values (range). Chi-square analysis was used to compare differences between proportions while Student's t-test was used to compare differences between means. Fisher's exact test was used to determine statistical significance when small numbers of patients were involved in analysis. A p value of <0.05 was considered statistically significant.

Results

There were 59 registered patients with new type 1 diabetes during the study period; three had incomplete data and were withdrawn, leaving 56 patients. They comprised 26 males and 30 females (M:F ratio 1.0:1.1). Other demographic information is shown in Table 1. There was no significant difference between the DKA and non-DKA groups in terms of socioeconomic status, and gender distribution or glycated haemoglobin (HbA1c) at presentation. The DKA group, however, were younger (8.7±3.4 vs 11.0±4.0 years, p=0.021), and had a shorter duration of symptoms at presentation (3.4±0.9 vs 7.1±5.8 weeks, p=0.002).

Table 2 shows the age distribution of the group as a whole, and those presenting with and without DKA. It can be seen that the younger age group had a higher tendency to present in DKA, which was statistically significant (Fisher's exact test p=0.004).

The various ethnic distributions of the patients are shown in Figure 1. The Yoruba tribe, which is the predominant tribe in the study population constituted almost

40% of the patients followed by the Ibo tribe. The other tribes were also represented to a lesser degree as shown in the figure. In comparing DKA versus non-DKA presentation in the two major ethnic groups represented, the patients from the Yoruba tribe had a higher tendency to present in DKA (68% vs 32%) than the Ibo tribe in whom only one quarter presented in DKA (25% vs 75%). This was statistically significant (Chi-square p=0.007).

Table 3 compares characteristics of patients presenting in the first five years of the study (1t October 2010 to 30 September 2010) and the second five years (1 October 2010 to 30 September 2015). There was no significant difference in gender distribution, age at presentation, duration of symptoms or HbA1c at presentation. However, there was a significant reduction in those presenting in DKA: 72% in the first five years, compared with 47% in the second five years (p=0.076).

	Earlier 5 years (n=18)	Later 5 years (n=38)	Significance
Male Female	7 (39%) 11 (61%)	19 (50%) 19 (50%)	p=0.436
Age at presentation (years) (mean±SD)	10.5±4.4	9.3±3.6	p=0.278
Duration of symptoms (weeks) (mean±SD)	6.7±5.4	4.5±4.0	p=0.115
HbA1C at presentation (%)(mean±SD)	12.7±1.7	11.8±1.9	p=0.106
Mode of presentation DKA Non-DKA	13 (72%) 5 (28%)	18 (47%) 20 (53%)	p=0.076

Table 3. Comparison between the earlier 5-year period (1 October 2005 to 30 September 2010) and later five-year period (1 October 2010 to 30 September 2015)

Discussion

The prevalence of DKA at diagnosis in the children with diabetes observed in the index study was 55%. This is lower than rates of between 62 and 82% reported in other studies from different regions of the country (such as Port Harcourt, Sokoto, Abakiliki, Jos, and Benin) 9–13 and other parts of Africa.[15,16] However, this rate was also lower than those reported from some Nigerian studies,[7,8] and many other countries such as Congo,[14] Kuwait,[20] Iran,[21] New Zealand,[22] USA,[23] and Finland.[24] The differing rates of DKA at diagnosis of type 1 diabetes may be associated with many factors. An inverse relationship between background incidence of diabetes and occurrence of ketoacidosis at diagnosis has been documented.[4,6] Other factors include predominant age of the study population, presence or absence of family history of diabetes, and family socioeconomic status.[4] In addition to being a reflection of a delayed diagnosis and treatment, DKA at diagnosis has also been opined as possibly signifying an aggressive form of diabetes.[25]
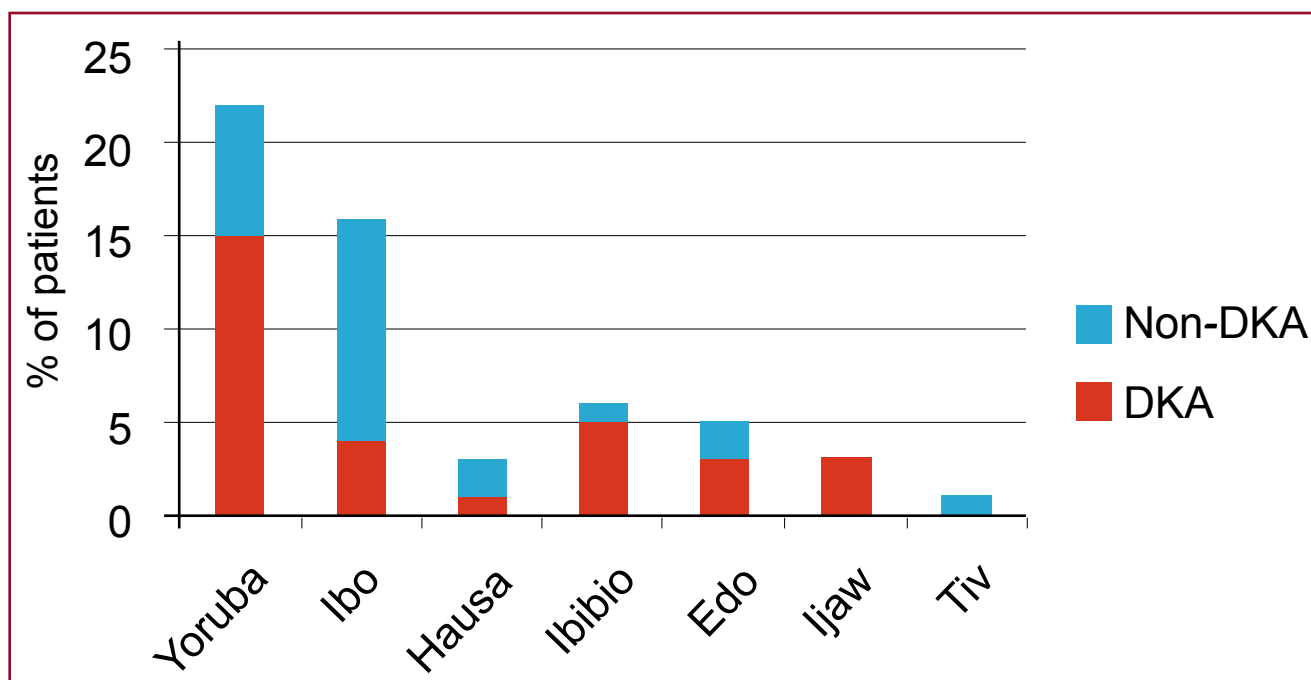

Figure 1. Ethnicity of the patients with modes of presentation (DKA versus non-DKA)

The overall mean age at diagnosis of our patients was lower than the age reported in other centres from the country, which had led some previous studies to conclude that type 1 diabetes presents at a later age in Nigeria.[7,13] While that may be a possibility, other factors such as missed diagnosis, and possibly death before diagnosis16 may be contributing to the younger age group not being picked up, patients may also not be able to express their symptoms, and also many health facilities in the country do not have the ability to routinely test for blood glucose.[26] However, the mean age in this study is slightly lower than other studies from South Africa[15] and Iran[21] respectively.

In comparing the mean age at diagnosis between the DKA and non-DKA groups, this was significantly lower in the children presenting with DKA, as has been documented by other authors.[15,21] Furthermore, it was noted that the younger age groups were more likely to present in DKA as has been noted in many other studies.[4,5,15,22] Contributing factors may include difficulty in recognising polyuria in toddlers who still wear nappies and failure of the younger age group to verbalise complaints to their care givers. However, this trend is changing for the better in some populations like Finland, as a result of intensified awareness campaigns leading to earlier diagnosis with milder metabolic decompensation in very young children.[24]

The mean duration of symptoms before presentation was significantly shorter in children who presented in DKA than those who did not. Similar findings have been reported from previous studies from Nigeria, South Africa, Iran, and Kuwait.[13,15,20,21] It has been postulated that this may be related to an aggressive and fulminant form of type 1 diabetes.[5,21,25]

With regards to ethnicity, there was a significant difference in the rates of presentation in DKA between the two tribes who are the major inhabitants in the geopolitical zone where the index study was conducted. Other studies have equally shown ethnicity to affect presentation in DKA.[22,27] Factors that may account for these findings include sociocultural issues that may in turn affect health-seeking behaviour[28] and genetic predisposition to DKA at diagnosis.[4,25] Ethnicity has also been shown to affect rates of DKA at diagnosis, even when socioeconomic status and access to health insurance were similar in the patients.[22,27]

In comparing changes over time, despite not being statistically significant, the rate of DKA in the index study reduced by one quarter in the latter five years compared with the earlier five years of the study period. This slight reduction may be due to the creation of more awareness by the availability of more trained personnel in Lagos. This is similar to the finding by a northern Finland study over a period of 20 years, comparing an earlier 10-year period (1982–1991) and a later 10-year period.[24] In contrast, in a previous Nigerian study,13 the rate of DKA at diagnosis (82% vs 73%, p>0.005) did not change significantly over an earlier eight-year period (1996–2003) and a later 8-year period (2004–2011). A lack of further significant reduction over 15 years (1999–2013) was also documented by Jeffries et al[22] in Auckland after an initial reduction over the period 1988–1996 from 68% to 42%, which suggested that factors beyond 'awareness' may be important contributors to the risk of DKA at diagnosis. Therefore, in addition to creating more awareness, future studies and strategies aimed at reducing the rate of DKA at diagnosis of type 1 diabetes should address other factors that may be contributing to children still presenting in DKA at diagnosis.

In the present study only 16% of the patients belonged to the high socioeconomic class. Even though there was no significant difference with regards to presenting with or without DKA at diagnosis, this has great implications for the care patients receive. Health insurance services are still very rudimentary in Nigeria and in many instances do not cater for chronic illnesses. Children with DKA often require prolonged hospitalisation or intensive care, imposing a great economic burden on families and health services in general.[22,29]

One limitation of this study is its retrospective nature. Future studies are needed to elucidate other factors, such as genetics, that may contribute to DKA at diagnosis in patients with type 1 diabetes. In conclusion, the rate of DKA at diagnosis of type 1 diabetes in our study is still unacceptably high, but shows a slight reduction over a period of 10 years. The younger age group is more prone to this form of presentation. It is imperative that awareness campaigns targeted at the populace on the symptoms of the disease, and also to health workers for prompt diagnosis and appropriate treatment, should be intensified to prevent DKA at presentation of type 1 diabetes and its attendant complications.

Author declaration

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Mortality among type 2 diabetic in-patients in a Nigerian tertiary hospital

J E Ojobi, G Odoh, E Aniekwensi, and J Dunga

Abstract

This report sets out to highlight the current status of diabetes-related mortality in north-central Nigeria and compare the results with other reports. We undertook a retrospective descriptive hospital-based study to determine the cause of death of type 2 diabetic patients over a 5-year period (2009–2013) at Federal Medical Centre, Makurdi, Nigeria. Approval for the study was obtained from the Ethics Committee of the institution. Relevant data (gender, age, occupation, blood pressur, and glycaemic control, co-morbid conditions and cause of death) were extracted from the case files of deceased patients and the hospital death register. There were 903 type 2 diabetic patients made up of 490 males (54%) and 413 females (46%), with a gender ratio of 1.2:1. Mean age was 54±16 years (mean±SD) years with a range of 36–82 years. Seventy-eight (78) patients (8.6% of type 2 diabetic admissions) died within the study period, made up of 37 males (47% of mortality) and 41 females (53% of mortality) respectively. The age range 60–69 years had the highest mortality. The most common causes of death were hyperglycaemic crises (38%), septicaemia (18%), diabetic ulcers (15%), and a variety of other causes (29%). We conclude that diabetes is still associated with an unacceptable in-patient high mortality burden.

Introduction

Diabetes mellitus now constitutes the highest morbidity and mortality of all chronic non-communicable diseases (NCDs) in Africa.[1] In Nigeria, diabetes accounts for 3–15% of medical admissions in most health facilities.[2] People living with type 2 diabetes are more vulnerable to various forms of both short- and long-term complications, which often lead to their premature death.[3] Approximately 5.1 million people aged between 20 and 79 years died

from diabetes in 2013, accounting for 8.4% of global all-cause mortality among people in these age groups. This estimated number of deaths is similar in magnitude to the combined deaths from several infectious diseases that are major public health priorities, and is equivalent to one death every six seconds. Close to half (48%) of deaths due to diabetes are in people under the age of 60 years.[4] Routine sources of health statistics consistently under-estimate the burden of mortality from diabetes, largely because diabetes is often omitted from death certificates as the cause of death.[4] While there has been a documented decline in mortality from some NCDs in some countries,[5] no such decline has been reported for diabetes.[4] This study aimed to highlight the prevalence and pattern of diabetic mortality in a tertiary health facility in north-central Nigeria.

Patients and methods

This was a retrospective, descriptive hospital-based study to determine the cause of death of patients with type 2 diabetes over a five-year period (2009–2013) at Federal Medical Centre, a 400-bed tertiary referral centre in Makurdi, Benue State, Nigeria. Benue State is located in the north-central region of Nigeria. Benue shares boundaries with five other states, namely Nasarawa to the north, Taraba to the east, Cross River to the south, Enugu to the south-west, and Kogi to the west. The state shares a common boundary with the republic of Cameroon on its south-east border. The 2006 national census put the state's population at 4 210 244, (2 164 058 males and 2 055 186 females).[6] Approval for the study was obtained from the Ethics Committee of the institution. Relevant data (gender, age, occupation, blood pressure and glycaemic control, co-morbid conditions, and cause of death) were extracted from the case files of deceased patients and the hospital death register. Uncontrolled blood pressure (BP) and blood glucose were taken as BP>130/80 mmHg, and fasting blood glucose (FBG)>7.0 mmol/l, or a random blood glucose (RBG)>11.0 mmol/l measured at different times.

Results

Socio-demographic characteristics of subjects. A total of 9101 patients were admitted into the medical wards in the five years this study lasted: 940 (9.7%) were individuals living with diabetes; 903 had type 2 diabetes (96%), while 37 (4%) had type 1 diabetes. This study focused

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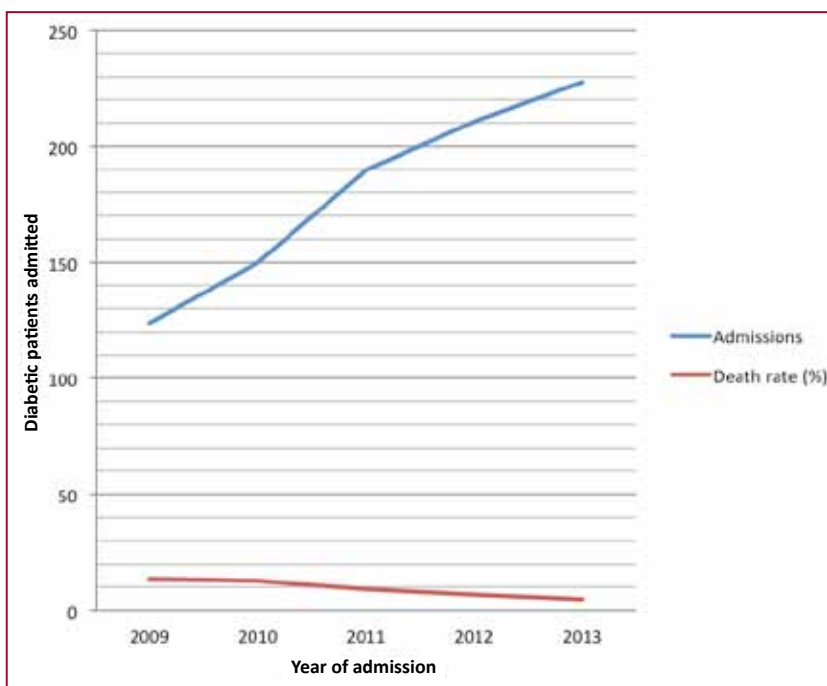
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Figure 1. Temporal pattern of mortality in type 2 diabetics (2009–2013)

Age range (y)	30–39	40–49	50–59	60–69	70–79	80–89	Total
Study year							
2009	0	0	4	7	2	4	**17**
2010	0	0	4	10	2	3	**19**
2011	0	3	6	3	4	1	**17**
2012	0	4	2	2	1	5	**14**
2013	1	1	2	3	3	1	**11**
Total	**1**	**8**	**18**	**25**	**12**	**14**	**78**

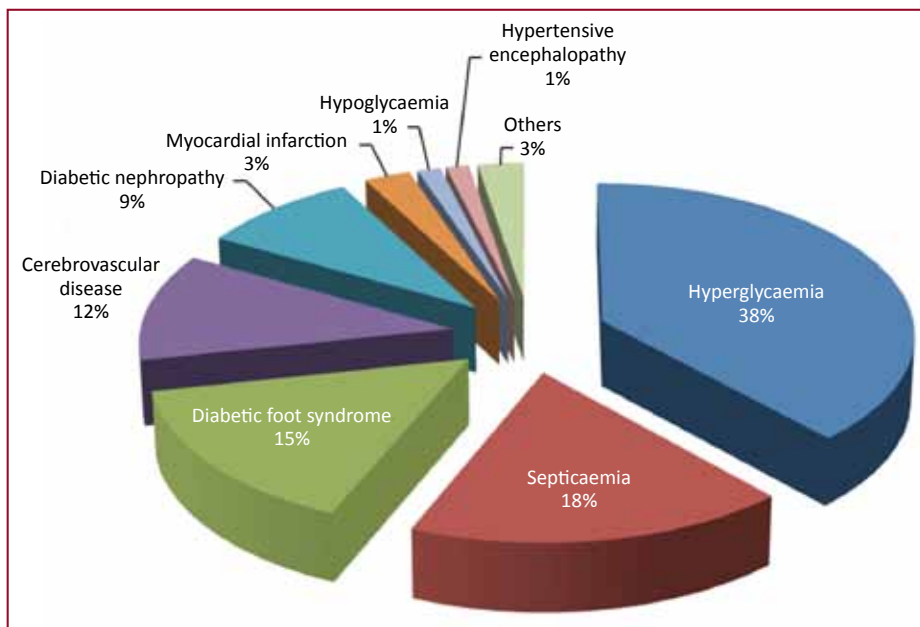*Table 1. Mortality pattern in each age range*

Figure 2. Pie chart depicting distribution of mortality of T2DM (2009–2013)

on individuals with type 2 diabetes only. Of these, 490 (54%) were male and 413 (46%) were female, giving a gender ratio of 1.2:1.0. The mean age was 54±16 years with a range of 36–82 years. The temporal breakdown of type 2 diabetes mortality for the period of study is shown in Figure 1.

Mortality. Seventy-eight patients (9% of type 2 diabetes patients admitted) died within the study period, made up of 37 males (47%) and 41 females (53%). The age range 60–69 years had the highest mortality (25 patients in five years), followed by the age range 50–59 years (18 patients in five years). This is depicted in Table 1.

Distribution of mortality. The most common causes of death included hyperglycaemic crises especially those complicated by septicaemia, cerebrovascular accidents, diabetic foot ulcers, diabetic nephropathy/end-stage renal disease, myocardial infarction, and a diverse array of illnesses which are grouped together for the sake of convenience under the heading 'others' (e.g. concomitant advanced AIDS, etc). The relative contributions of each cause of mortality are as outlined in Figure 2.

Discussion

People living with type 2 diabetes are more vulnerable to various forms of both short- and long-term complications, which often lead to morbidity and premature death.[3] One-tenth (10%) of all the admissions within the five years this study lasted were individuals living with diabetes. The overwhelming majority (96%) had type 2 diabetes, the predominant type of the disease regionally and globally.[7] There was a slight male preponderance, similar to observations from other researchers in developing countries where males appear to access medical facilities more than females.[2,3,8,9] The mean age was 54 years with an age range of 36–82 years.

Overall, mortality among individuals with type 2 diabetes progressively reduced from 13.7% to 4.8% even in the face of an increasing number of patient admissions (124 to 228). The total mortality for the period of study was 78 patients (19.4%). Males constituted 37 patients (9.2% of total mortality) and females 41 patients (10.2% of total mortality). The combined case fa-

tality rate observed in this study was higher than those from earlier reports.[2,9,10,11] It was, however, lower than the 28.7% reported by Chijioke[3] in 2010 from Ilorin. In contrast to our report, females had lower mortaility rates than males in these other series.[2,3,9,11]

The age group 60–69 years recorded the highest number of deaths (25 patients in five years, i.e. 32% of total type 2 diabetes mortality). This was followed by the age group 50–59 years which accounted for 18 deaths in five years (23% of mortality). In the age range 40–49 years, there were eight deaths (10% mortality). Young individuals (less than 60 years) made up more than one third (35%) of mortality for the five years examined. However, this percentage was still at variance with the 48% deaths (out of over five million) in people younger than 60 that were attributed to complications associated with diabetes in 2013.[4]

Hyperglycaemia was the most common single contributory factor for death in 38% of cases. Diabetic ketoacidosis (DKA) and non-ketotic hyperosmolar states (HHS) were the two principal hyperglycaemic crises recorded. DKA accounted for 20% of all mortality. It is a common factor in most studies that audited mortality among individuals living with diabetes.[2,3,9] HHS was recorded as the cause of death in 9% of mortality cases in this study, but could be as high as 30% in some series[9] and as common as 'three out of five' in another study.[13]

Up to 18% of study subjects succumbed to a septicaemic process. Septicaemia was the second most common cause of death in this study. Most cases of hyperglycaemia were precipitated by septicaemia. In a related study, Adekanle et al[14] reported that 70% of those that died presented with an infective process (e.g. urinary tract infection, diabetic foot disease, chest infection, or unidentified source). In their study, fever and signs of infection were significantly associated with in-hospital death.

Diabetic foot syndrome accounted for 15% of mortality. Diabetic foot ulcers are a leading cause of non-traumatic amputation and contribute significantly to diabetic morbidity and mortality.[15,16] Often, the accompanying ulcer was complicated by infection. It is unfortunate as a cause of mortality because the ulcers were, in the majority of cases, preventable.[15] Also, with adequate attention at an early stage, these foot disorders could be contained thereby averting amputation and the unnecessarily high cost of prolonged hospital stay, the prolonged time spent on wound care, and the cost of other consumables and drugs.[16–18] The contribution of diabetic foot ulcers to mortality is variable, ranging from 9% in a report from south-south Nigeria[18] to 30% in another report from western Nigeria.[11]

Cerebrovascular accident (CVA) was responsible for 11% of mortality in our study. Diabetes is a risk factor for cerebrovascular disease, and in coexistence with other risk factors like hypertension, dyslipidaemia, obesity, and the negroid race may significantly increase the risk of CVA.[18] Up to 50% of mortality in diabetic patients with hypertension was from stroke, and stroke is independently a poor prognostic index for mortality.[14,19] In their study on short-term case fatality rates and associated factors among in-patients, Chen et al showed that stroke was a significant risk factor for 28-day case fatality, and associated with both types of hyperglycaemic emergencies mentioned above.[20]

Diabetic nephropathy complicated by uraemia led to the death of seven patitens over the five-year period (i.e. 9% of mortality). The prevalence of this leading cause of end-stage renal failure in Nigeria varies but has been steadily rising.[21–23] Diabetic nephropathy is characterised by persistent albuminuria, elevated blood pressure, and a progressive decline in renal function leading to end-stage renal disease. In addition, these patients have a high risk of cardiovascular disease which further increases with deteriorating renal function.[24] The excess mortality is due to cardiovascular disease and it has been suggested that the presence of albuminuria is a marker of generalised vascular dysfuction leading to increased atherosclerosis and subsequent cardiovascular events.[25]

Documented hypoglycaemia is an important cause of death in any diabetes mortality audit. This is related to the action of drugs and regimens employed in the treatment of diabetes. Hypoglycaemia caused the death of one patient in this study: an 80-year old female being treated for diabetic nephropathy and sepsis. The incidence of hypoglycaemia varies across institutions.[3,11,15] A similar study in the same geopolitical setting observed that up to 12% of mortality in a 10-year period was due to hypoglycaemia.[3] In a decade-long retrospective study from south-south Nigeria, Unachukwu et al recorded a 10% mortality from hypoglycaemia.[15] However, the former utilised the World Health Organization (WHO) criteria[7] of 1999, while the latter (as well as this study) employed the American Diabetes Association (ADA) 2011 guidelines.[26] A report from south-west Nigeria also recorded one death from hypoglycaemia.[11] However, this study was prospective, lasted for a year, and employed the WHO criteria[7] of 1999.

Our study is limited by the fact that hospital-based studies may not be a true reflection of the actual magnitude of diabetes-related mortality in the community, but it has the potential of providing information on the current trends in morbidity and mortality patterns of disease.

In conclusion, there was a progressive reduction in year-by-year fatality rate, but diabetes is still associated with an unacceptably high mortality burden in Nigeria. In this study, the male gender, diabetes-related emergencies (DKA, HHS, and sepsis), diabetic foot ulcers, and cerebrovascular disease gave poorer outcomes. Most of these deaths were preventable with primary intervention, emphasising that knowledge about the disease and encouraging early utilisation of health facilities including referral to secondary and tertiary centres is of vital importance. Expansion of the National Health Insurance scheme to include diabetes would go a long way in this regard.

Original Article

Author declaration
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Prevalence of overweight and obesity among secondary school adolescents in an urban area of Lagos, Nigeria

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Abstract

Obesity is a major public health problem in the world with increasing prevalence among children and adolescents. The current study was a descriptive cross-sectional study involving 1100 students attending public and private secondary schools in Lagos. Calculations of body mass index (BMI) were performed, and 513 males and 587 females aged between 10 and 19 years were studied. Prevalence rates of overweight and obesity were 5.8% and 1.7% respectively; females had higher prevalence rates than males. Prevalence rates of overweight and obesity in private schools were higher than in public schools.

Introduction

Obesity is a major public health problem in the world and a significant contributor to ill health.[1] It is a global problem that affects more than 300 million people worldwide.[2] Obesity results from an imbalance between food intake and energy output leading to excessive fat accumulation.[3]

Obesity hitherto seen predominantly in developed countries is now a potential health problem in developing countries.[4,5] Prevalence rates are as high as 21–24% for overweight and 16–18% for obesity among adolescents in the USA.[6,7] In India, prevalence rates of 14% and 11% for overweight and obesity respectively have been documented,[8] while values reported in Nigerian adolescents are in the range of 3.3% for overweight and 1.4–4.2% for obesity.[9,10]

Obesity is a risk factor for type 2 diabetes mellitus, hyperlipidaemia, renal disease, hypertension, other cardiovascular diseases, and certain cancers,[11,12] all of which reduce life expectancy.[13] Comparisons among various weight-for-height indices have led to the selection of body mass index (BMI) as a useful measure of obesity.[14] The aim of the present study was to determine the prevalence of overweight and obesity among adolescents attending secondary schools in a local council development area (LCDA) of Lagos State, Nigeria, using BMI centiles.

Methods

The study was a descriptive, cross-sectional study, conducted in registered secondary schools located within Onigbongbo LCDA of Lagos State. Subjects were aged 10–19 years. Schools were grouped by stratified random sampling into private and public schools, and the sample size was distributed according to the ratio of adolescents in private and public schools. Four public and two private secondary schools were selected by random probability sampling. Students and parents gave consent, and ethical clearance was obtained from the Health Ethics and Research Committee of the Lagos State University Teaching Hospital.

Medical personnel who served as research assistants were trained in the measurement of weight and height, to reduce inter-observer and intra-observer errors. Height was measured to the nearest 0.1cm using a Prestige stadiometer. The subjects wore no shoes, and had their heels and backs against the height meter, with their heads in the Frankfurt plane.[15] Weight was measured to the nearest 0.1 kg with a Prestige spring scale tested and calibrated against a set of standard weights. BMI was computed as weight in kilogrammes divided by the square of height in metres. BMI percentiles were computed according to Centers for Disease Control (CDC) formulae.[16] Overweight was taken as a BMI equal to or greater than the 85th percentile for age and sex, and obesity was taken as a BMI equal to or greater than the 95th percentile for age and sex.[17]

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 20. Height, weight, and BMI values were expressed as means (±SD). Tests of association between categorical variables such as gender and type of school were carried out using Pearson's Chi square. Student's t-test was used for comparison of mean values, and p<0.05 was considered significant.

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	Type of school		Total
	Private n=247	**Public n=853**	
Gender			
Male	112 (45.3%)	401 (47.0%)	513 (46.7%)
Female	135 (54.7%)	452 (53.0%)	587 (53.3%)
Total	247 (22.5%)	853 (77.5%)	1100 (100.0%)
Age group (years)			
Early adolescence (10–13)	112 (45.3%)	314 (36.8%)	426 (38.7%)
Mid adolescence (14–16)	126 (51.0%)	381 (44.7%)	507 (46.1%)
Late adolescence (17–19)	9 (3.6%)	158 (18.5%)	167 (15.2%)
Mean weight (kg)	50.4±12.2	47.4±11.3	48.04±11.57
Mean height (cm)	158.6±10.4	156.3±10.4	156.83±10.44
Mean BMI (kg/m^2)	19.8±3.6	19.2±3.4	19.33±3.43
BMI percentile			
<85	215 (87.0%)	802 (94.0%)	1017 (92.5%)
85–94	23 (9.3%)	41 (4.8%)	64 (5.8%)
≥95	9 (3.6%)	10 (1.2%)	19 (1.7%)

Table 1. Demographic characteristics of adolescents studied

Results

The study subjects numbered 1100, comprising 513 males and 587 females giving a male to female ratio of 0.9:1.0; 853 (78%) adolescents attended public schools while 247 (22%) attended private schools. Table 1 shows the demographic characteristics of the adolescents studied.

The prevalence of overweight was 5.8%, and obesity 1.7%, using age- and sex-related criteria specified by the Centers for Disease Control (CDC).[17] Among adolescents who attended public schools, prevalence rates of overweight and obesity were 4.8% and 1.2% respectively, while corresponding values among adolescents who attended private schools were 9.3% and 3.6% respectively (p<0.01).

The mean weight, height, and BMI of males were 46.3±11.3 kg, 158.0±2 cm, and 18.3±2.5 kg/m^2 respectively; while corresponding female values were 49.5±11.6 kg, 155.8±8.5 cm, and 20.2±3.8 kg/m^2 respectively. Females were significantly heavier than males (p<0.001), while males were significantly taller than females (p=0.001).

In males, the prevalence of overweight and obesity was 2.1% and 0.4% respectively, and in females 9.1% and 2.9% respectively (p<0.001). Prevalence rates of overweight in early, mid and late adolescence were 6.4%, 6.1% and 2.5% respectively, while prevalence rates of obesity were 1.6%, 1.9% and 1.9% respectively (p=0.504).

Discussion

The overall prevalence rates of overweight and obesity in the present study are similar to those reported in previous studies in Nigeria,[9,10] but lower than results reported in the USA and other developed countries.[6,7] The present findings also differ from an Indian report.[8] This disparity may be attributed to different factors, including socio-demographic and economic variables.

Higher BMI values in females could be explained by higher levels of oestrogen which encourage fat deposition, and the higher probability of males being more involved in physical exercise.[18] Higher prevalence rates of overweight in lower adolescent ages may be due to increase in gonadotropin secretion which occurs at this time, stimulating oestrogen production and resulting in fat deposition.[18]

Overweight was twice as prevalent and obesity was three times as prevalent in private schools compared with public schools. This supports the general belief that privileged adolescents with greater access to wider food choices are more likely to attend private schools. Health education is needed to encourage lifestyle changes among those affected.[19]

Further research is needed to consider the socio-cultural, behavioural factors, and sexual maturity rating that may be predictors of overweight and obesity. Prevention of obesity should begin in childhood as the prevalence is highest in early adolescence.

Author declaration

Competing interests: none.
Any ethical issues involving humans or animals: none.
If required, was informed consent given: yes.

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Guidance to Authors

The Editors welcome articles on diabetes, and the management of diabetic diseases, from all health professionals, medical and non-medical. The philosophy of the journal is to reflect as much as possible the multi-disciplinary nature of diabetic care. The *African Journal of Diabetes Medicine* seeks to fulfil a role in continuing medical education and, therefore, welcomes in particular review articles which provide practical updates on the management of diabetic patients. Original research studies will constitute an important minority of the articles published. In assessing the suitability of research papers for publication, the Editors will favour those contributions which will provide readers with information of practical use in their day-to-day practice. Advice and assistance will, wherever possible, be provided to potential authors on the scope of their research or method of presenting papers.

Manuscripts

Review articles

These are particularly welcome as we receive relatively few. They can be on any aspect of diabetes, though preferably of general interest to our readers. Review articles do not need an abstract, and should be no more than 2500 words long (excluding references). A reasonable number of figures and/or tables can be used.

Original articles

These should be research-based articles, divided in a standard way into abstract (unstructured), introduction, methods, results and discussion. In length they should be no more than 2000 words (excluding references) with no more than three tables or figures, and 30 references.

Short reports/case reports

These should be up to 800 words long (excluding references), have one table or figure only, and up to 10 references. The sub-divisions of the report should be the same as for original articles, but the abstract should be very brief – usually two or three sentences.

Letters, news and notes, editorials etc.

We welcome news items, conference reports, letters to the editor, etc. We normally write editorials 'in house', but if you think you have a useful editorial to offer, we'd be glad to see it.

Illustrations

These must be supplied as jpeg, tiff or PDF files, in CMYK format with a resolution of at least 300 d.p.i.

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