Diabetes in tropical Africa: a prospective study, 1981-7

I. Characteristics of newly presenting patients in Dar es Salaam, Tanzania, 1981-7

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Abstract

***Objective*—To study the clinical characteristics of newly diagnosed diabetic patients in tropical Africa.**

***Design*—Prospective study of all newly diagnosed diabetic patients registered at a major urban hospital between 1 June 1981 and 31 May 1987.**

***Setting*—Muhimbili Medical Centre, Dar es Salaam, Tanzania.**

***Patients*—1250 Patients: 874 men, 376 women.**

***Results*—272 (21·8%) Patients had diabetes requiring insulin, 825 (66·0%) had diabetes not requiring insulin, and 153 (12·2%) had diabetes of uncertain type. Most patients (1103, 88·2%) presented with the classic symptoms of diabetes. The peak time of presentation of diabetic patients requiring insulin was at age 15 to 19 years. Male manual workers and peasant farmers with diabetes not requiring insulin presented at a significantly older age and had a lower body mass index than sedentary office workers. Forty six (18·1%) of the patients requiring insulin diabetes and 111 (14·4%) not requiring insulin had first degree relative with diabetes. Twenty seven per cent of patients were underweight (body mass index <20 kg/m^2) and 14·6% were obese (body mass index >30 kg/m^2). Hypertension was diagnosed in 211 (26·7%) of 791 patients not requiring insulin. Nine (3·3%) of those requiring insulin may have had the protein deficient type of diabetes related to malnutrition. The fibrocalculous variety of diabetes related to malnutrition was not observed.**

***Conclusions*—Newly presenting diabetic patients in Tanzania with diabetes requiring insulin are older at presentation than those in Britain; most diabetic patients present with diabetes not requiring insulin and a smaller proportion of Tanzanian patients are obese. Most have a lower socioeconomic state than diabetic patients in Britain. There are often delays in diagnosis in Tanzania, and there is a higher incidence of death shortly after presentation.**

Introduction

Diabetes was, until recently, considered rare in tropical Africa.[1,2] The prevalence of diabetes not requiring insulin in rural areas is lower than that reported in most other parts of the world,[3,4] but diabetic clinics are now found in many large hospitals in cities throughout Africa. In some hospitals diabetes accounts for 2-5% of all medical admissions.[5-7] The clinical characteristics of patients attending diabetic clinics have been described in several publications,[8-17] but apart from one prospective study of diabetic patients in hospital in Harare, Zimbabwe,[18] there have been no prospective studies describing the clinical features of all newly diagnosed diabetic patients seen in one locality over a prolonged period.

In 1981 a registry of all newly diagnosed diabetic inpatients and outpatients was opened at Muhimbili Medical Centre, Dar es Salaam. During a six year period from 1 June 1981 to 31 May 1987, 1250 new patients were registered. We describe the clinical characteristics of these patients.

Patients and methods

The United Republic of Tanzania has a population of 23 million. Its people, mainly of Bantu origin, belong to about 120 tribes. Dar es Salaam is the country's largest city and has a population of about 1·5 million. Muhimbili Medical Centre in Dar es Salaam is the country's largest hospital and a national referral hospital: most newly presenting African diabetic patients who seek non-traditional medical treatment are seen here. (Only a minority of affluent Africans seek diagnosis and treatment of their diabetes in private hospitals in the city.) In June 1981 a registry was opened in the centre to record the clinical characteristics of each newly presenting diabetic patient, irrespective of mode of presentation or type of diabetes. All registered patients were, as far as could be determined, of tropical African ethnic origin.

At presentation a questionnaire was completed for each patient in which the following information was recorded: age (actual or estimated), sex, occupation, date of presentation, duration of symptoms (weeks), educational background, smoking (current smoker or not), alcohol (at present taking alcohol or not), reason(s) for seeking medical attention, and family history of diabetes. Height and weight were measured in light clothing and without shoes. Body mass index was calculated (weight/height^2 (kg/m^2)). Those patients with body mass index <20 were regarded as underweight, those with a body mass index of 20-24·9 as of normal weight, 25-30 as overweight, and >30 as obese.

Blood pressure was measured with a mercury sphygmomanometer (hypertension was defined as blood pressure ≥160/95 mm Hg). Urine was tested for glucose and ketone bodies with either N-Multistix test strips (Ames, Slough, UK) or BM strips (Boehringer Mannheim). Ketone bodies were recorded as negative (nil or trace) or positive. Though most patients presented with polydipsia and polyuria, in all patients the diagnosis of diabetes was confirmed by measuring blood glucose concentrations according to the World Health Organisation's criteria.[19] Blood glucose was measured in the ward or outpatient clinic using a glucometer (Ames) or in the laboratory by a glucose analyser (Yellow Springs Instruments, Yellow Springs, Ohio, USA) or by the orthotoluidine method, or both.

Complete data could not be obtained from every patient because, for example, the patient died shortly after admission or failed to return to the outpatient clinic. Patients whose symptoms lasted more than 51 weeks were excluded from the analysis of duration of symptoms.

CLASSIFICATION OF DIABETES

The classification of diabetes as not requiring insulin

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or requiring insulin was based retrospectively on the patient's need for insulin to control symptoms of hyperglycaemia, weight loss, and persistent glycosuria. As insulin is expensive and often scarce most patients (excepting those under 20 years of age) were given a trial of oral hypoglycaemic drugs. C peptide concentrations were not measured, and islet cell antibodies were measured in only a limited number of patients. We therefore refer to patients treated with insulin as having diabetes requiring insulin. In some patients it was not possible to be certain about classification owing to death at time of admission, rapid default from the clinic, or failure to receive an adequate trial of oral hypoglycaemic drugs. Such patients were placed in an "uncertain" category. Also included in this category were three patients known to have pancreatic calcification and one with Cushing's syndrome. Two patients aged under 20 who presented with a long duration of symptoms, signs of malnutrition, and cataracts were classified as having diabetes requiring insulin.

Some of the patients classified as not requiring insulin either died on admission or were quickly lost to follow up. The diagnosis of diabetes not requiring insulin was considered likely on the basis of factors such as increased age, long duration of symptoms, obesity, absence of ketonuria, and diagnosis of diabetes during admission for other diseases. Severe diabetic ketoacidosis was defined according to criteria suggested by Alberti.[20]

COMPARISON POPULATION AND DATA ANALYSIS

The frequencies of several variables in the diabetic patients were compared with the frequencies of similar variables among 1456 randomly selected community members from two comparable areas of Dar es Salaam.

The statistical package for the social sciences (SPSS PC)[21] was used for data analysis. Statistical analysis included the χ^2 test and analysis of variance. As only random blood glucose values were obtained in most patients the blood glucose values were not analysed in relation to other variables.

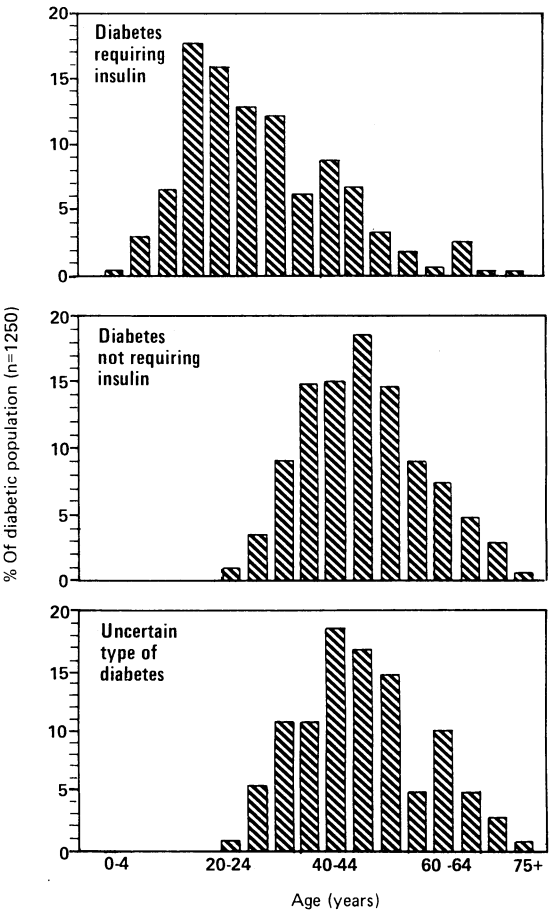
Results

Of the 1250 newly diagnosed patients, 272 (21·8%) had diabetes requiring insulin, 825 (66·0%) had diabetes not requiring insulin, and 153 (12·2%) had diabetes of uncertain type. There were 874 men and 376 women (ratio 2·3:1). The sex ratios among the patients with diabetes requiring insulin, not requiring insulin, and of uncertain type were 2·0:1, 2·4:1, and 2·8:1 respectively. Of 196 (15·7%) patients aged under 30, 153 (78·1%) had diabetes requiring insulin, 34 (17·3%) had diabetes not requiring insulin, and 9 (4·6%) had diabetes of uncertain type. Seven hundred and twelve (57·0%) patients were aged over 40.

The mean (SD) age of the patients requiring insulin was 29·4 (14·0) years, of the patients not requiring insulin 46·5 (11·1) years, and of the uncertain group 46·0 (12·0) years. The figure shows the age distribution of the patients.

Of the patients whose residence was known, 1081 (88·0%) lived in Dar es Salaam or its environs.

Occupation—Of the men, 273 (31·2%) were peasants or manual workers, 171 (19·6%) were non-manual workers such as students and teachers, 88 (10·1%) worked in offices but in non-sedentary jobs, 184 (21·1%) worked in offices in sedentary posts, and 51 (5·8%) were drivers. The occupational categories of the remaining 107 (12·2%) men were not easily definable or unknown. Nearly two thirds of the women were housewives. The occupational categories among men in the urban population did not differ significantly from those in the diabetic population. The mean (SD) age at diagnosis of diabetes in the 156 male peasant



Age distribution of patients with diabetes requiring insulin, diabetes not requiring insulin, and diabetes of uncertain type

farmers and manual workers with diabetes not requiring insulin was 50·8 (11·5) years; it was 42·5 (8·5) years in the 133 men with sedentary office jobs. Table I shows the relation between age at diagnosis of diabetes among manual workers and office workers.

Educational state—Four hundred and sixty seven (44·0%) of 1068 patients whose educational state was known were unable to read or write or had only attended adult literacy classes or received instruction on reading the Koran, compared with 335 (23%) in the comparison population. Three hundred and ninety three (37·0%) had completed primary education, and 208 (19·5%) had had post-primary education with a minimum of four years' secondary education, compared with 888 (61%) and 189 (13%) Dar es Salaam residents.

Family history of diabetes—Among 1158 patients who were asked about a family history of diabetes, 46 (18·1%) of 254 requiring insulin had a first degree relative with diabetes, compared with 111 (14·4%) and 10 (7·5%) of 771 not requiring insulin and 133 with uncertain type of diabetes respectively.

Mode of presentation—Of all the patients, 1103 (88·2%) presented with the classic symptoms of diabetes (polydipsia, polyuria, and weight loss). Complications were commonly present at the time of presentation, but the patient's request for medical attention was precipitated primarily by the onset of these symptoms. The complication that often brought the patient to hospital was infection, especially of the feet. Several patients presented with pulmonary tuberculosis or after a bad obstetric history. Of the 272 patients with diabetes requiring insulin, 62 (22·8%) presented with severe diabetic ketoacidosis.

Duration of symptoms—The median duration of classic symptoms in patients requiring insulin (4·0 weeks, range 1-36) was the same as that in those not requiring insulin (4·0 weeks, range 1-44).

TABLE I—*Age at diagnosis and body mass index of male manual workers (including peasant farmers) and sedentary office workers with diabetes not requiring insulin*

	Age (years)*				Body mass index (kg/m²)†				
	20-39	40-59	≥60	Total	<20	20-24·9	25-30	>30	Total
No (%) of manual workers	24 (15)	88 (56)	44 (28)	156	34 (26)	43 (33)	36 (27)	18 (14)	131
No (%) of office workers	49 (37)	76 (57)	8 (6)	133	4 (3)	46 (38)	48 (40)	22 (18)	120

*$p<0·001$, $\chi^2=32·74$. †$p<0·001$, $\chi^2=25·47$.

Seasonal distribution—During the six year study period a seasonal pattern in the presentation of patients with diabetes requiring insulin and with diabetes not requiring insulin was observed. The peak months of presentation were August to November.[22]

Alcohol—Significantly more diabetic men drank alcohol than men in the community population (378 (48%) *v* 208 (33%), $p<0·001$). No difference was observed among women (84 (25%) *v* 194 (23%), $p=0·15$).

Body mass index—Of 1069 patients in whom body mass index was calculated, 289 (27·0%) were underweight, 348 (32·6%) of normal weight, 276 (25·8%) overweight, and 156 (14·6%) obese (table II). The mean (SD) body mass index was 19·2 (3·4 kg/m²) in patients with diabetes requiring insulin, 25·9 (5·4) kg/m² in those with diabetes not requiring insulin, and 20·7 (5·5) kg/m² in those with diabetes of uncertain type. The mean body mass index in the peasant farmers and manual workers with diabetes not requiring insulin was 24·0 (5·3) kg/m² compared with 26·0 (4·7) kg/m² in sedentary office workers (table I).

Blood pressure—Of the 1186 patients with a satisfactory record of blood pressure, 211 (26·7%) of 791 patients not requiring insulin had hypertension compared with 10 (4·0%) of 250 patients requiring insulin. The mean (SD) systolic and diastolic blood pressures in the patients requiring insulin were 110 (18) mm Hg and 70 (14) mm Hg respectively, and 133 (24) mm Hg and 84 (15) mm Hg in the patients not requiring insulin. Both systolic and diastolic blood pressures were related to increasing age and body mass index.

Ketones—Ketones were found on presentation in the urine of 173 (67·8%) of 255 patients with diabetes requiring insulin, 186 (25·5%) of 729 patients not requiring insulin, and 52 (39·7%) of 131 patients with diabetes of uncertain type.

Outcome at presentation—Forty nine patients died in hospital at the time of presentation: 18 (6·6%) of the 272 patients requiring insulin, 17 (2·1%) of the 825 patients not requiring insulin, and 14 (9·2%) of the 153 in the uncertain category. Diabetic ketoacidosis was the most frequent cause of death in patients requiring insulin.

Diabetes related to malnutrition—Pancreatic calcification was found in three patients in a consecutive series of plain abdominal *x* ray films in 106 patients. As all three patients were aged over 30 and had a history of heavy alcohol intake no patient in this limited series was found to have the fibrocalculous type of diabetes related to malnutrition.[19] In addition, among the 272 patients with diabetes requiring insulin there were four patients who had all the criteria for diagnosis of the protein deficient type of diabetes related to malnutrition apart from age—that is all four patients were aged over 30 years.

TABLE II—*Body mass index of diabetic patients and comparison group in Dar es Salaam, Tanzania*

Body mass index (kg/m²)	No (%) of diabetic patients			
	Requiring insulin	Not requiring insulin	With uncertain type of diabetes	No (%) of urban group
<20	149 (64·5)	85 (11·7)	55 (50·0)	403 (27·7)
20-24·9	71 (30·7)	236 (32·4)	41 (37·3)	722 (49·6)
25-30·0	11 (4·8)	254 (34·9)	11 (10·0)	239 (16·4)
>30		153 (21·0)	3 (2·7)	92 (6·3)
Total	231 (21·6)	728 (68·1)	110 (10·3)	1456 (100·0)

Discussion

As recently as 1956 the occurrence of diabetes in native Africans in tropical Africa was questioned,[2] but today few major African hospitals are without a diabetic clinic. Diabetes has, therefore, emerged as an important medical problem in the past 30 years, although no one has yet shown a real increase in the incidence of the disease in defined populations over this period.[24]

The proportion of patients in this study requiring insulin for adequate control (21·8%) was similar to the 24% reported by Gatling *et al* in a study of all 846 diabetic patients registered with general practitioners in Poole, England.[25] It is likely that most patients in our uncertain category were normal weight and underweight patients with diabetes not requiring insulin, which would mean that the proportion of patients not requiring insulin was comparable in Poole (76%) and Dar es Salaam (78%). In contrast, surveys of West Indian diabetic populations in the United Kingdom have shown that only 4% have insulin dependent diabetes.[26,27]

As C peptide concentrations and islet cell antibodies were not measured in most patients we cannot classify our patients requiring insulin as type I or insulin dependent diabetic patients. Our classification was strict, however, and based, in almost all patients aged over 20, on whether or not symptoms could be controlled with oral hypoglycaemic drugs. About one fifth of patients under 30 were controlled with oral hypoglycaemic drugs alone. Similar rates of insulin use were reported by Omar and Asmal in a study of African diabetic patients aged under 35.[28] In contrast, only 1% of diabetic patients under 30 in Denmark could be controlled with drugs,[29] and among young Indian diabetic patients 58% had non-insulin dependent diabetes.[30] In most studies in Africa much higher rates of insulin use have generally been reported.[10,15,17] This may be related to selection of patients through clinics as patients requiring insulin are less likely to default from treatment. It is also possible that many patients are treated unnecessarily with insulin, a matter for concern in view of the common problem of the availability and expense of insulin.

Diabetes in Africa affects people of all ages. This study suggests that patients with diabetes requiring insulin tend to present at a later age in tropical than temperate countries and patients with diabetes not requiring insulin at an earlier age. The decline in the number of patients aged over 55 may reflect the population structure of developing countries, with many of those at risk of developing diabetes having already died. Among patients with diabetes requiring insulin the peak age at presentation was 15-19 years (for the entire population and those with ketonuria at presentation), in contrast to 10-14 years in developed countries. These differences may, in part, reflect underdiagnosis of diabetes in younger children in developing countries.[31]

At least twice as many men as women had diabetes. Most studies from tropical Africa (apart from South Africa[16,28]) have reported a similar preponderance of men. In community based studies in rural Tanzania a slight excess of men (1·6:1) was found among patients with diabetes not requiring insulin.[3] This ratio is similar to that reported in the current prospective study of patients with non-insulin dependent diabetes in the United Kingdom (1·5:1).[32]

Diabetes is often considered to be a disease that affects only the "urban bourgeois class" in developing countries. It is not uncommon among affluent overweight people, but most patients in this study were poor and over two fifths were illiterate or had received little education. The higher proportion of patients who had received minimal or no formal education compared with the general population is probably explained by the fact that 57% of the diabetic population were over the age of 40 compared with 27% in the urban population. It is of interest that the onset of diabetes was significantly later among peasants and manual workers with diabetes not requiring insulin than those with non-manual occupations, emphasising perhaps the protective role of physical activity.[33] Body mass index was also significantly lower in the peasants and manual workers compared with those in non-manual occupations. The distribution of body weight in our patients (15% were obese and 26% overweight) differed appreciably from that in rural populations, where obesity is rare,[3] and that in the control population but was less than would be expected in a Western diabetic population.[32]

Genetic influences obviously play a part in the aetiology of diabetes in Africa as in other populations. Most estimates of a positive family history of diabetes in African series of patients are likely to be underestimates as patients are often unfamiliar with diabetes and the exact cause of death in relatives.

All patients in our study were, as far as we could ascertain, of tropical African origin. It has been suggested that insulin dependent diabetes in black Americans may result from the admixture of northern European genes.[34] The coastal and other parts of Tanzania have had close contacts with Arabs over many centuries, but extensive genetic admixture with Europeans is unlikely.

Most patients presented with the classic symptoms of diabetes, but owing to lack of awareness of diabetes among both patients and medical workers many attended clinics several times before diabetes was diagnosed. A similar lack of awareness of the symptoms and signs of diabetic ketoacidosis was observed in another study in Dar es Salaam, even at the level of tertiary care.[31]

Hypertension was common among patients with diabetes not requiring insulin. Similar high rates have been reported in other studies in Africa.[12 35]

The presence of ketones in the urine at the time of diagnosis was not a reliable guide to the patient's long term need for insulin. Many patients, because of moderate or severe ketosis and acute onset of symptoms, were treated initially with insulin, but after a period of weeks or months insulin could safely be withdrawn and the patient given drugs or diet alone. A similar phenomenon has been described in Jamaican diabetic patients,[36] in patients in another town in Tanzania,[37] and in young Afro-American diabetic patients.[38]

Diabetes related to malnutrition has been the subject of recent extensive reviews.[39 40] The fibrocalculous variety, as described in Uganda[41] and Ibadan, Nigeria,[9] does not seem to occur in Tanzania. In patients with a calcified pancreas alcohol seems to be the main associated factor as is the case in Zimbabwe.[42] The existence of the protein deficient type of malnutrition related diabetes without pancreatic calcification is controversial, but in our study nine of the 272 patients with diabetes requiring insulin met the criteria of Ahuja for the diagnosis of protein deficient diabetes,[23] although this is not proof of its occurrence.

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