

Diabetes mellitus in Rhodesia: a comparative study

A. C. B. WICKS
M.B., CH.B., M.R.C.P.

J. J. JONES
PH.D., M.R.C.S.

Godfrey Huggins School of Medicine, Salisbury, Rhodesia

Summary

Diabetes mellitus in the African is compared with the disease in Western populations, where secondary diabetes is uncommon, and primary diabetes is often familial, and can usually be classified as growth-onset and insulin-dependent, or as maturity-onset and insulin-resistant, and particularly liable to vascular complications.

In contrast, amongst 107 newly diagnosed African patients admitted consecutively to Harare Hospital during a 1-year period, five patients had diabetic relatives, and in thirty-four patients, diabetes was clearly secondary to pancreatic and hepatic disease. A high proportion (72%) of the remaining maturity-onset patients were found to be insulin-dependent, so that their diabetes may also have been secondary to pancreatic disease. Vascular complications seldom occurred.

After standardizing this population for sex and age, the modal age for onset of diabetes remained earlier than in Britain. Male patients were underweight and female patients overweight compared with healthy contrast groups. The proportion of diabetic patients in skilled occupations, living in urban areas, and with large numbers of children was no greater than for age-matched non-diabetic hospital inpatients.

Introduction

Although secondary diabetes is rare in Western populations, the primary or idiopathic disease is becoming more common. Most patients with primary disease can be classified as growth-onset and insulin-dependent (Type 1) or maturity-onset and insulin-resistant (Type 2) (Himsworth, 1936; Lawrence, 1951). Amongst African patients, two further types of primary diabetes have been described: J type, first recognized in Jamaica, in young, thin insulin-resistant patients (Hugh-Jones, 1955), and the very similar K type of Uganda, which is associated with episodes of hypoglycaemia (Shaper, 1958).

Diabetes mellitus in the Rhodesian African is described in comparison with other African populations, and also with the characteristic disease now prevalent in Europe and North America. Laboratory investigations, including hormone secretion, have already been reported (Wicks and Jones, 1973);

patients with secondary diabetes will be described separately.

Patients and methods

In 1971, 4028 patients (including 107 newly diagnosed diabetics) were admitted to the medical wards of Harare Hospital. Nine diabetic patients died soon after admission; the remaining ninety-eight were studied in detail. All met the British Diabetic Association's diagnostic criteria (Fitz Gerald and Keen, 1964). Each patient was examined for complications and associated diseases by A. C. B. Wicks; a consultant ophthalmologist examined each patient for retinopathy, and the abdomen was X-rayed to detect pancreatic calcification.

The heights and weights of the maturity-onset patients were compared with two healthy contrast groups matched for age and sex. The men were compared with office and factory workers and the women with a group of nurses and nursing assistants. The proportion of diabetic patients in skilled or semi-skilled occupations, living in urban areas and with large numbers of children were compared with age- and sex-matched groups of non-diabetic inpatients.

The median of each group is followed by the tenth and ninetieth percentiles; the significance of the difference between groups was tested by Wilcoxon's method for ranked data, and the significance of the difference between proportions was calculated from the χ^2 distribution.

Results

Fourteen of the 107 patients were admitted in diabetic coma: ten were ketotic and four were not ketosed. Three of the non-ketosed patients were hyperosmotic (blood sugar 14.8, 10.0 and 9.4 g/l respectively), and one possibly had lactic acidosis (plasma bicarbonate 12.6 mEq/l). All ketotic patients were men, four were growth-onset and six were maturity-onset; four died and the others were found to be insulin-dependent. All hyperosmotic patients had maturity-onset diabetes, one died and the others were found to be insulin-independent. The non-ketotic patient with acidosis had maturity-onset, insulin-dependent diabetes. Another four maturity-onset patients died from cerebral haemor-

TABLE 1. Sex and age distribution in primary and secondary diabetic patients

Group	Number	Male percentage	Age
Total diabetics	107	54	45 (18-59)
Died	9	78	50 (9-68)
Primary	64	45	43 (14-55)
Secondary	34	68	48 (25-65)
Steatorrhoea	20	65	41 (28-65)
Cirrhosis*	12	83	50 (25-65)
Other†	2	0	20 and 45

* Including three with steatorrhoea.

† Acromegaly and Cushing's syndrome.

rhage, hepatic failure, renal failure, and hypoglycaemia respectively.

Table 1 shows that in 32% of the surviving patients, diabetes was secondary to pancreatic or hepatic disease; this group of diabetic patients contained a significantly higher proportion of men ($P < 0.03$). The primary diabetic patients are classified as growth-onset and insulin-dependent, as maturity-onset and insulin-resistant or as maturity-onset and insulin-dependent (Table 2). The first two groups closely resemble typical diabetic patients in the developed countries. Growth-onset diabetes was more common in men: they were often underweight and liable to develop ketonuria and ketosis; their serum growth hormone concentration was high, but they secreted little insulin; they were normotensive and the disease had a rapid onset. Typical maturity-onset diabetes was more common in women: they

were often obese and hypertensive; most of them had a normal or excessive insulin secretion; they were never ketosed, seldom ketonuric and their symptoms developed slowly. The third group of patients was unusual: they were maturity-onset but insulin-dependent, and they showed the following significant differences from typical maturity-onset, insulin-resistant patients: they included a higher proportion of men; more of them were underweight; more had a low secretion of insulin and a high fasting blood glucose concentration; more drank alcohol.

Although 23% of primary diabetic patients had no typical symptoms of the disease, burning upper abdominal pain radiating to the back (in 30%) and pain in the limbs and joints (in 25%) were comparatively common.

Surprisingly few of the maturity-onset diabetic patients showed the usual neurological (9%) and vascular (retinopathy in 8%) complication of diabetes. Sepsis was also uncommon (13%) and only two patients had active pulmonary tuberculosis.

When compared with the healthy contrast groups, male maturity-onset primary diabetic patients were found to be significantly taller (median height 173 cm compared with 165 cm, $P < 0.02$) and relatively lighter [86% of desirable weight for height (Diem and Lentner, 1970) compared with 102%, $P < 0.05$] than healthy office and factory workers. By contrast, female maturity-onset primary diabetic patients were significantly more obese (132% of desirable weight compared with 107%, $P < 0.001$) than healthy nurses and nursing assistants.

TABLE 2. Clinical and laboratory investigations in the three groups of diabetic patients. Median is followed by the tenth and ninetieth percentiles

Group	Growth-onset G	Maturity-onset dependent on insulin D	Maturity-onset independent I
Number	14	36	14
Percentage total	22	56	22
Age (years)	15 (7-29)	45 (34-54)	50 (30-69)
Male percentage	64	53	7 (a)
Weight percentage of desirable	89 (54-120)	103 (67-166)	110 (92-172)
Percentage > 120% of desirable weight	0 (b)	33	36
Percentage < 85% of desirable weight	36	22	0 (c)
Duration of symptoms (days)	21 (1 to nil) (d)	56 (14 to nil)	56 (21 to nil)
Ketonuria percentage	78 (e)	44	29
Ketosis percentage	21	8	0
Low insulin secretion percentage	87	68	27 (f)
Fasting growth hormone ng/ml	18 (4-30) (g)	1 (0-7)	1 (0-2)
Fasting blood glucose g/l	2.75 (1.75-5.25)	2.95 (1.27-4.20)	1.95 (0.92-3.50) (h)
Diastolic pressure mmHg	75 (60-100)	86 (72-110)	102 (75-160)
Percentage with diastolic pressure > 100 mmHg	0 (i)	22	36
Drinking alcohol percentage	29	75 (j)	43
Serum iron mg/l	0.68 (0.40-2.20)	0.73 (0.54-1.40)	0.92 (0.60-1.57)
Percentage with serum cholesterol > 2.5 g/l	45	42	50

a = $P < 0.01$, against D and G; b = $P < 0.05$, against D and I; c = $P < 0.05$, against G and D; d = $P < 0.02$, against D and I; e = $P < 0.05$, against D and I; f = $P < 0.05$, against G and D; g = $P < 0.05$, against D and I; h = $P < 0.05$, against G and D; i = $P < 0.05$, against D and I; j = $P < 0.05$, against G and I.

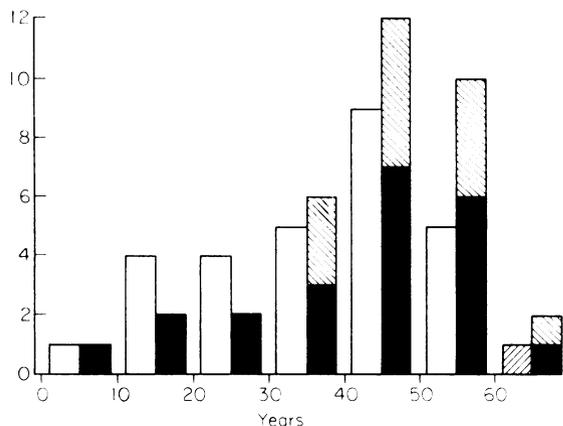


FIG. 1. The age and sex distribution of newly diagnosed primary diabetic patients admitted to Harare Hospital in 1971. Insulin-dependent male patients are shown as open bars and insulin-dependent female patients as closed bars. The insulin-independent female patients are cross-hatched above the closed bars. The only male patient in the over 60-year-old group was also insulin-independent and is also shown cross-hatched. The ordinate shows the number of patients in each group.

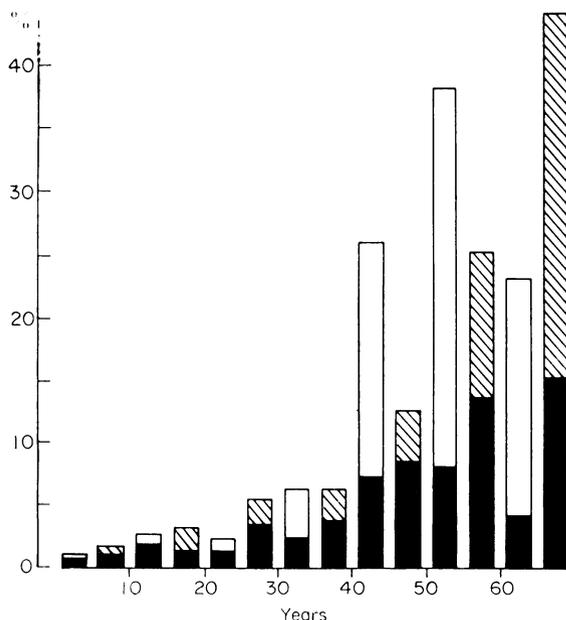


FIG. 2. The standardized age distribution of newly diagnosed primary diabetic patients admitted to Harare Hospital compared with newly diagnosed diabetic patients at King's College Hospital (Oakley *et al.*, 1968). Female Harare Hospital patients are shown in open bars and the female King's College Hospital patients as cross-hatched bars. The corresponding male patients are shown as closed bars in the corresponding column. The ordinate shows the percentage of the total number of patients in each age group.

Compared with the general population, a high proportion (69% of the male, 40% of the female) of primary diabetic patients were living in urban areas and were in skilled or semi-skilled occupations (62% of men) but these proportions were no higher than in contrast groups of non-diabetic hospital inpatients. Maturity-onset primary diabetic women had significantly fewer children than female non-diabetic inpatients ($P < 0.04$). Only one of the eleven patients who knew the birth weights of their children, had a child of over 4.5 kg and only five patients had diabetic relatives.

The ages of newly diagnosed primary diabetic patients are shown in Fig. 1. In Fig. 2 the age distribution has been standardized to match the population in Greater London (Registrar General, 1963; Rhodesia Census, 1969) and the distribution is compared with a recent study at King's College Hospital (Oakley, Pyke and Taylor, 1968). Below the age of 40 years the standardized age and sex distributions in the two populations are very similar, but the modal age of the newly diagnosed African primary maturity-onset patients is decidedly earlier.

Discussion

A high proportion of diabetes in Rhodesian Africans is undoubtedly secondary to pancreatic and hepatic disease. Diabetes may also be secondary to pancreatic damage in the group of maturity-onset patients who are also insulin-dependent. None of them showed pancreatic calcification, steatorrhoea (faecal fat over 6 g/day), or a typical history of abdominal pain; but low insulin secretion (Joffe *et al.*, 1969; Anderson *et al.*, 1970) and low body weight (Karam *et al.*, 1965) are characteristic of pancreatic deficiency in maturity-onset diabetes. Alternatively, the low insulin secretion, typical of healthy Rhodesian Africans (Wapnick *et al.*, 1972) and probably associated with a diet based on unrefined carbohydrate (maize meal), may explain why so many maturity-onset diabetic patients have inadequate insulin secretion and are consequently insulin-dependent.

Only three diabetic patients continued to eat a traditional African diet based on maize meal; the others had modified their diet to include sugar, bread, jam and butter. Diabetic patients from rural areas ate significantly more sugar than age-matched non-diabetic inpatients (Wicks, Castle and Gelfand, 1973). Cohen *et al.* (1960) found a high incidence of diabetes in Yemeni Jews who had moved to Israel, while in the Yemen, diabetes was virtually unknown. A careful dietary history indicated that the only difference in the diets between the two countries was that the consumption of refined sugar was much higher in Israel. Cleave, Campbell and Painter (1969) claim that a developing population must eat refined

carbohydrates for 20 years before diabetes becomes common. This could account for the small number of typical maturity-onset, insulin-independent diabetics in this group of African patients.

In comparison with Europe, the general African population has a very high proportion of children, which explains why juvenile-onset patients form 22% of the total (Fig. 1). In Fig. 2, the age distribution has been standardized to match Greater London and the proportion of patients in each age group below 40 years is shown to be very similar to a recent study at King's College Hospital (Oakley *et al.*, 1968). In spite of standardization, the modal age for the development of diabetes in Rhodesian maturity-onset patients was earlier than in London.

Although a high proportion of diabetic patients came from urban areas and from upper social and economic classes, the proportions were no greater than for non-diabetic inpatients, and presumably corresponded to the general population using Harare Hospital. Male maturity-onset diabetic patients were underweight, but the female patients were found to be significantly more obese than an age-matched, healthy contrast group. In South Africa, female diabetic patients also tend to be more obese than male patients (Seftel, Keeley and Walker, 1963; Jackson, 1972). Parity is very high in the African (median five children) but not higher in diabetics than in age-matched non-diabetic inpatients. Compared with Britain (Pyke, 1956; Fitz Gerald *et al.*, 1961), parity does not seem to be such an important consideration in the development of diabetes. Krikler (1969) in a retrospective survey in Rhodesia discovered a surprisingly high incidence of diabetes in Sephardic Jews when compared with other European and Asian ethnic groups. He postulated that the prevalence of consanguinity practised by this group was aetiologically more important than either their Jewish descent or environmental factors.

In agreement with Campbell (1960) we find that in southern Africa, sub-groups J (Hugh-Jones, 1955) and K (Shaper, 1958) are not applicable to the African diabetic patient; only two of the growth-onset patients were not ketonuric; neither of them was insulin resistant. Half of the patients with primary diabetes were ketonuric on admission; nine of them were in ketotic coma.

In the Rhodesian African population, vascular complications of diabetes are very uncommon. In the last 5 years, there have been over 100,000 admissions to Harare Hospital; only nine patients had myocardial infarction: not one of them was diabetic. The recent onset of diabetes in most patients probably explains the lack of vascular complications, and if Szanto and Yudkin (1969) are correct, they may also be protected by their insulinopenia.

At present, typical maturity-onset, insulin-resistant

diabetes is a rare disease in the Rhodesian African. In the last 10 years there has been little increase in the general prevalence of the disease, and not more than a threefold increase in newly diagnosed diabetic patients admitted to Harare Hospital, Salisbury (Wicks *et al.*, 1973), and to Mpilo Hospital, Bulawayo (Rachman, 1972). As the present tendency for the African to move to urban areas and to adopt a more Western style of life and diet continues, insulin-resistant diabetes in Rhodesia will become more common. Already, in Cape Town, diabetes has become equally common in the European and African populations (Marine *et al.*, 1969; Jackson, 1972) and the vascular complications of the disease are now being reported from Johannesburg (Seftel, Kew and Bersohn, 1970).

Acknowledgments

We particularly wish to thank Dr J. I. Forbes for his most valuable help and encouragement, and Mr D. S. Peacock for his ophthalmic opinion. We also thank Dr J. I. Forbes, Professor M. Gelfand, Dr E. Taube, Mr D. R. Barley and the Secretary for Health, Rhodesia, for access to patients and records in Harare Hospital, and Mrs D. Woods for expert secretarial assistance.

This work forms part of A. C. B. Wick's M.D. Thesis to be submitted to the University of Birmingham.

References

- ANDERSON, M.F., DAVISON, S.H.H., DICK, A.P., HALES, C.N. & OWENS, J. (1970) Plasma insulin in pancreatic disease. *Gut*, **11**, 524.
- CAMPBELL, G.D. (1960) Insulin-independent young diabetics in Natal. *British Medical Journal*, **2**, 537.
- CLEAVE, T.L., CAMPBELL, G.D. & PAINTER, N.S. (1969) *Diabetes, Coronary Thrombosis, and the Saccharine Disease*. Second edition, p. 48. John Wright: Bristol.
- COHEN, A.M., BAVLY, S. & POZNANSKI, R. (1961) Change of diet of Yemenite Jews in relation to diabetes and ischaemic heart disease. *Lancet*, **ii**, 1399.
- DIEM, K. & LENTNER, C. (1970) *Scientific Tables*. Seventh edition, p. 712. Documenta Geigy: Basle.
- FITZ GERALD, M.G. & KEEN, H. (1964) Diagnostic classification of diabetes. *British Medical Journal*, **1**, 1568.
- FITZ GERALD, M.G., MALINS, J.M., O'SULLIVAN, D.J. & WALL, M. (1961) The effect of sex and parity on the incidence of diabetes mellitus. *Quarterly Journal of Medicine*, **30**, 57.
- HIMSWORTH, H.P. (1936) Diabetes mellitus. Its differentiation into insulin-sensitive and insulin-insensitive types. *Lancet*, **i**, 127.
- HUGH-JONES, P. (1955) Diabetes in Jamaica. *Lancet*, **ii**, 891.
- JACKSON, W.P.U. (1972) Diabetes and related variables among the five main racial groups in South Africa: comparison from population studies. *Postgraduate Medical Journal*, **48**, 391.
- JOFFE, B.I., BANK, S., JACKSON, W.P.U., VINIK, A.I. & KELLER, P. (1969) Effect of intravenous tolbutamide on serum insulin levels in pancreatic diabetes. *Diabetes*, **18**, 499.
- KARAM, J.M., GRODSKY, G.M., PAVLATOS, F.C. & FORSHAM, P.H. (1965) Critical factors in excessive serum-insulin response to glucose. Obesity in maturity onset diabetes and growth hormone in acromegaly. *Lancet*, **i**, 286.
- KRIKLER, D.M. (1969) Diabetes in Rhodesian Sephardic Jews. *South African Medical Journal*, **43**, 931.

- LAWRENCE, R.D. (1951) Types of human diabetes. *British Medical Journal*, **1**, 373.
- MARINE, N., VINIK, A.I., EDELSTEIN, I. & JACKSON, W.P.U. (1969) Diabetes, hyperglycemia and glycosuria among Indians, Malays and Africans (Bantu) in Cape Town South Africa. *Diabetes*, **18**, 840.
- OAKLEY, W.G., PYKE, D.A. & TAYLOR, K.W. (1968) *Clinical Diabetes and its Biochemical Basis*. First edition, p. 240. Blackwell Scientific Publications: Oxford.
- PYKE, D.A. (1956) Parity and the incidence of diabetes. *Lancet*, **i**, 818.
- RACHMAN, I. (1972) Personal communication.
- REGISTRAR GENERAL'S STATISTICS REVIEW OF ENGLAND AND WALES (1963) Part II, Civil Tables, H.M.S.O., London.
- RHODESIA CENSUS OF POPULATION (1969) Central Statistical Office, Salisbury, Rhodesia.
- SEFTEL, H.C., KEELEY, K.J. & WALKER, A.R.P. (1963) Studies on glycosuria and diabetes in non-white populations of the Transvaal. Part I. Africans. *South African Medical Journal*, **37**, 1213.
- SEFTEL, H.C., KEW, M.C. & BERSOHN, I. (1970) Myocardial infarction in Johannesburg Bantu. *South African Medical Journal*, **44**, 8.
- SHAPER, A.G. (1958) The pattern of diabetes in Africans in Uganda. *Proceedings of the International Diabetes Federation*, Third Congress, Dusseldorf, 664.
- SZANTO, S. & YUDKIN, J. (1969) The effect of dietary sucrose on blood lipids, serum insulin, platelet adhesiveness and body weight in human volunteers. *Postgraduate Medical Journal*, **45**, 602.
- WAPNICK, S., WICKS, A.C.B., KANENGGONI, E. & JONES, J.J. (1972) Can diet be responsible for the initial lesion in diabetes? *Lancet*, **ii**, 300.
- WICKS, A.C.B., CASTLE, W.M. & GELFAND, M. (1973) The effect of time on the prevalence of diabetes in the urban African. *Diabetes*, **22**, 733.
- WICKS, A.C.B. & JONES, J.J. (1973) Insulinopenic diabetes in Africa. *British Medical Journal*, **1**, 773.