THE PREVALENCE AND CAUSES OF GLYCOSURIA IN 28,765 YOUNG MEN IN THE POPULATION IN SINGAPORE

By J. S. Cheah, B. Y. Tan and A. F. Wong

SYNOPSIS

In 28,765 young men of 17 years of age undergoing a medical examination for National Service, a postprandial urine specimen was tested for the presence of sugar with Clinistix (glucose-oxidase strip—Ames Co.). There were 23,163 Chinese (80.5%), 3,622 Malays (12.6%), 1,660 Indians (5.8%) and 320 Eurasians (1.1%).

In 141 glycosuria was found. All had an oral glucose tolerance test done. In 27 (17.3%) the glucose tolerance test was normal; in these Clinistix was regarded as having given a false positive. The prevalence of a false positive test with Clinistix was 27 in 28,765 (or 1: 1,065). Glycosuria was confirmed in 114 cases by the glucose tolerance test.

The prevalence of glycosuria was 114 in 28,765 (0.40%); its prevalence in Malays (0.44%) was approximately equal to that in Indians (0.42%), while it was slightly less common in Chinese (0.38%).

The most common cause of glycosuria was renal glycosuria (77 out of 114 cases or 67.5%). The prevalence of renal glycosuria was 77 in 28,765 or 0.27%; it was more common in Malays (0.36%) than in Chinese (0.25%) and Indians (0.24%).

Alimentary glycosuria (lag-storage, oxyhyperglycaemia) occurred in 21 out of 114 cases (18.4%). The prevalence of alimentary glycosuria in all ethnic groups was 0.073%; it was more common in Indians (0.121%) than in Chinese (0.075%) and Malays (0.028%).

Two cases of diabetes mellitus (previously unknown) was found in this survey (prevalence of 0.7 per 10,000). One was a Chinese while the other was an Eurasian. The prevalence of diabetes in this study is lower than in studies from other countries.

The mean height and weight of these with renal or alimentary glycosuria did not differ significantly from those with a normal glucose tolerance test. One of the diabetic was underweight while the other was overweight.

The prevalence and aetiology of glycosuria among the population in Singapore is unknown. In Singapore, male citizens, on reaching the age of 17 years, is required by law to undergo a routine medical examination to assess his fitness for National Service. Included in this examination is the detection of glycosuria. This paper describes the preliminary data of the prevalence and causes of glycosuria among young men of 17 years of age of various ethnic groups in the population.

MATERIALS AND METHODS

Clinistix (glucose-oxidase test strip—Ames Co.) was used to detect the presence of glucose in the urine. Clinistix was dipped into a freshly voided postprandial urine specimen and then waved in the air for 10 seconds: a blue discolouration indicated glycosuria.

An oral glucose tolerance test was performed in all those with glycosuria. An oral load of 50 Gms. of glucose was given after the fasting blood sugar was taken. The blood sugar was determined at ½ hourly interval for 2 hours. Urine was tested for the presence of sugar using Clinistix at the same interval.

The blood sugar was determined by the semi-micro method of Asatoor and King (1954) using capillary blood.

RESULTS

One hundred and forty-one cases were investigated for glycosuria. In 27 (17·3%) the glucose tolerance test was normal; in these the Clinistix was regarded to have recorded a false positive. The false positive rate with Clinistix was thus 27 in 28,765 (1 in 1,065).

Glycosuria occurred in 114 men out of 28,765 screened (0·40%). The prevalence of glycosuria

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among Chinese, Malay and Indian was 0·38%, 0·44% and 0·42% respectively. Glycosuria appeared to be more common in Eurasians (1·25%) but the number screened was much smaller (Table I).

TABLE I

PREVALENCE OF GLYCOSURIA IN YOUNG MEN AMONG THE ETHNIC GROUPS IN THE POPULATION

Ethnic Group	No. Screened	% of No. Screened	No. with Glycosuria	% with Glycosuria	Prevalence of Glycosuria per 1,000
Chinese	23,163	80·5	87	0·38	3·8
Malay	3,622	12·6	16	0·44	4·4
Indian	1,660	5·8	7	0·42	4·2
Eurasian	320	1·1	4	1·25	12·5
All Ethnic Groups	28,765	100·0	114	0·40	4·0

The following criteria were used in the interpretation of the glucose tolerance test: (*1*) normal—fasting and 2 hour blood sugar of 120 mg.% or less, maximum blood sugar of 180 mg.% or less and absence of sugar in all urine specimens; (*2*) diabetic—a 2 hour blood sugar of 140 mg.% or more (World Health Organisation expert committee No. 310, 1965); (*3*) renal glycosuria—normal blood sugar levels with presence of glycosuria (Lawrence, 1947) and (*4*) alimentary glycosuria (lag-storage curve, oxyhyperglycaemia)—normal fasting and 2 hour blood sugar levels but the maximum blood sugar exceeds 180 mg.% with the presence of glycosuria (McLean, 1922).

Diabetes mellitus occurred in 2 (a Chinese and Eurasian) out of 28,765 young men and formed 1·8% of those with glycosuria (Table II). Both had symptoms. Their glucose tolerance curves are shown in Fig. 1. There was no known diabetic in this survey; the prevalence of diabetes was 0·007%. There was no family history of diabetes in these 2 detected cases of diabetes mellitus.

Renal glycosuria was the commonest cause of glycosuria in young men—being found in 77 men (67·5%) of 114 with glycosuria (Table II). It appeared to be most common in Malay and least common in Indian (disregarding the Eurasian as the number was too small compared to the other ethnic groups). In Malay, renal glycosuria formed 81·5% of those with glycosuria and the prevalence was 3·6 per 1,000 of those screened; in Indians the corresponding figures are 57·2% and 2·4 per 1,000 screened respectively. The Chinese occupied an intermediate position (Table III). The glucose tolerance curves of those with renal glycosuria are shown in Fig. 1 and Table IV.

Alimentary glycosuria is the second most common cause of glycosuria in young man: it was found in 21 (18·4%) of 114 cases with glycosuria (Table II). The glucose tolerance curve of those with alimentary glycosuria is shown in Fig. 2. Among the 3 main ethnic groups, alimentary glycosuria was commonest in Indian and least common in Malay (Table V).

In 14 cases (12·3%), the glucose tolerance curves were classified as miscellaneous (Table II). In 9 cases their curves resembled those of renal glycosuria, but in 7 the 2 hour blood sugar level was higher than 120 mg.% but less than 140 mg.%

TABLE II

CAUSES OF GLYCOSURIA AMONG 114 YOUNG MEN

Cause of Glycosuria	No. of Cases				All Ethnic Groups	%
	Chinese	Malay	Indian	Eurasian		
Diabetes Mellitus	1	0	0	1	2	1·8
Renal Glycosuria (R.G.)	58	13	4	2	77	67·5
Alimentary Glycosuria (A.G.)	17	1	2	1	21	18·4
Miscellaneous Causes:						
R.G. with high 2 hour*	5	1	1	0	7	6·1
R.G. with high fasting†	2	0	0	0	2	1·8
A.G. with high 2 hour*	4	0	0	0	4	3·5
A.G. with high fasting†	0	1	0	0	1	0·9
ALL CAUSES	87	16	7	4	114	100·0

* > 120 < 140 mg.%

† > 120 mg.%

TABLE III

RENAL GLYCOSURIA AMONG YOUNG MEN OF VARIOUS ETHNIC GROUPS IN THE POPULATION

Ethnic Group	No. with Glycosuria	No. with Renal Glycosuria	% with Renal Glycosuria	No. Screened	Prevalence of Renal Glycosuria per 1,000
Chinese	87	58	66·7	23,163	2·5
Malay	16	13	81·5	3,622	3·6
Indian	7	4	57·2	1,660	2·4
Eurasian	4	2	50·0	320	6·3
All Ethnic Groups	114	77	67·5	28,765	2·7

TABLE V

ALIMENTARY GLYCOSURIA AMONG YOUNG MEN OR VARIOUS ETHNIC GROUPS IN THE POPULATION

Ethnic Group	No. with Glycosuria	No. with Alimentary Glycosuria	% with Alimentary Glycosuria	No. Screened	Prevalence of Alimentary Glycosuria per 1,000
Chinese	87	17	20·0	23,163	0·75
Malay	16	1	6·3	3,622	0·28
Indian	7	2	28·6	1,660	1·21
Eurasian	4	1	25·0	320	3·13
All Ethnic Group	114	21	18·4	28,765	0·73

while in the other 2 cases the fasting blood sugar was more than 120 mg.%. In 5 cases their glucose tolerance curves resembled alimentary glycosuria but in 4 cases the 2 hour blood sugar was more than 120 mg.% but less than 140 mg.% while in the remaining case the fasting blood sugar was more than 120 mg.%.

The height and weight of those with the various types of glycosuria are shown in Table VI. One of the diabetic was overweight while the other was underweight. The mean height and weight of those with renal glycosuria and alimentary glycosuria did not differ significantly from that of those with normal glucose tolerance tests.

DISCUSSION

Glycosuria is uncommon in the young as the renal threshold for glucose falls with increasing age (Fine, 1965; Butterfield, 1967). The prevalence of glycosuria in young men of 17 years of age in this survey is 0·4%; this compares with 3 to 5% in the general population (Oakley, Pyke and Taylor, 1968). Among 45,650 men, aged 18 to 45 years, examined prior to army indiction in Boston, glycosuria occurred in 0·8% (Blotner and Hyde, 1943). Glycosuria occurred in approximately similar frequency in Malays (0·44%) and Indians (0·42%) while it is slightly less common in Chinese (0·38%). In South Africa, the frequency of glycosuria among Indians and Africans is approximately equal (Jackson, Marine and Vinik, 1968).

Renal glycosuria is the commonest cause of glycosuria in this survey, accounting for 77 cases (67·5%). Sixty-five per cent of 800 cases of glycosuria in Army personnel investigated in London were due to renal glycosuria (Lawrence, 1947). Renal glycosuria occurs mainly in young men (Malins, 1968); thus its prevalence in our series

TABLE IV

THE MEAN AND STANDARD DEVIATION OF THE GLUCOSE TOLERANCE TEST IN NORMAL, RENAL GLYCOSURIA AND ALIMENTARY GLYCOSURIA

Glucose Tolerance Test		Capillary Blood Sugar in mg.%				
		Fasting	½ Hour	1 Hour	1½ Hours	2 Hours
Normal (27 cases)	Mean ± S.D.*	80 ± 14	149 ± 15	137 ± 21	112 ± 14	76 ± 29
Renal Glycosuria (77 cases)	Mean ± S.D.	81 ± 19	141 ± 30	128 ± 25	101 ± 22	85 ± 19
Alimentary Glycosuria (21 cases)	Mean ± S.D.	98 ± 18	198 ± 33	187 ± 33	130 ± 20	89 ± 19

*Standard Deviation

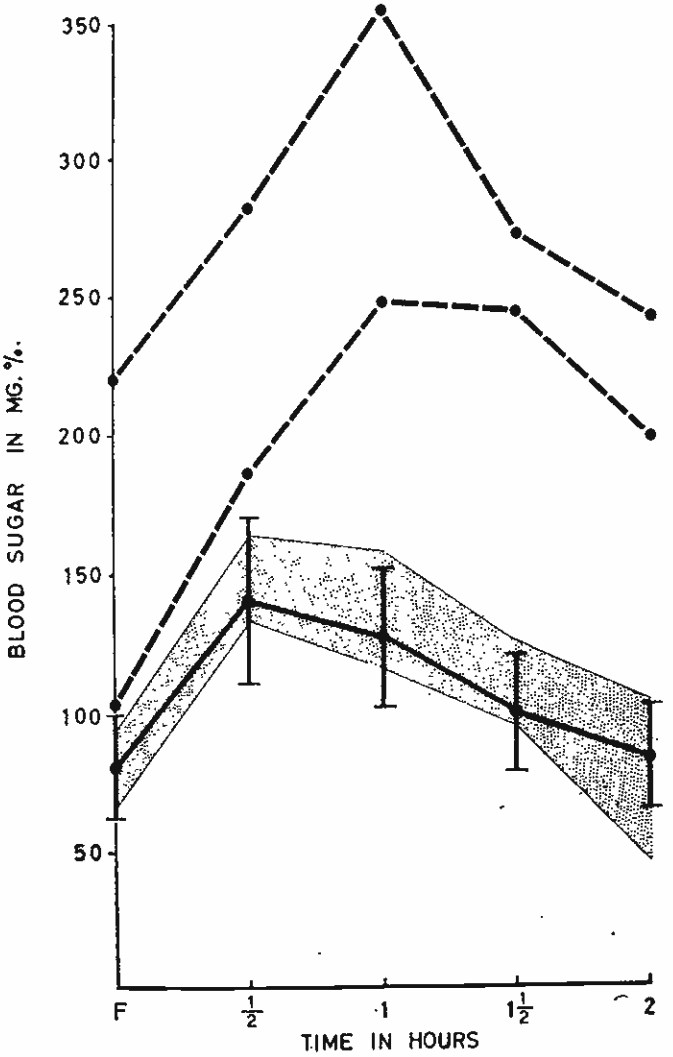

Fig. 1. The shaded area represents a standard deviation from mean in 27 men with normal glucose tolerance test. The upper 2 curves are diabetic (•————•). The mean (•————•) and a standard deviation from the mean of the 77 cases with renal glycosuria are also shown.

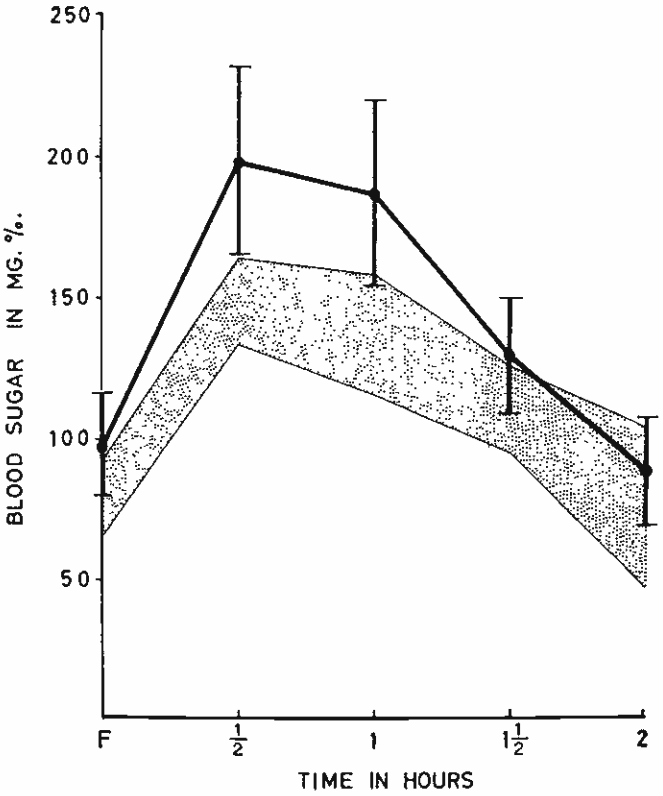

Fig. 2. The glucose tolerance test in alimentary glycosuria. The mean and a standard deviation (21 cases) at each point is shown. The shaded area represents a standard deviation from mean in 27 men with normal glucose tolerance.

TABLE VI

THE HEIGHT AND WEIGHT (MEAN AND STANDARD DEVIATION) OF YOUNG MEN WITH NORMAL, RENAL GLYCOSURIA, ALIMENTARY GLYCOSURIA AND DIABETIC GLUCOSE TOLERANCE TESTS

Glucose Tolerance Test		Height in Inches	Weight in Lbs.
Normal (27 cases)	Mean ± S.D.	64·4 ± 2·7	110·4 ± 11·0
Renal Glycosuria (77 cases)	Mean ± S.D.	65·6 ± 2·2	119·0 + 22·9
Alimentary Glycosuria (21 cases)	Mean ± S.D.	66·4 ± 2·4	118·3 ± 13·8
Diabetic	Case 1	62·5	89·0
	Case 2	65·0	164·0

(0·40%) is higher than that in the general population (0·2 to 0·3%; Malins, 1968; Brand *et al*, 1964). The prevalence of renal glycosuria is higher in Malays (0·36%) than in Chinese (0·25%) and Indians (0·24%). A Malay family from Kluang, Malaysia with renal glycosuria was reported by Chew (1969). Some cases of renal glycosuria are familial; it is a harmless condition and does not progress to diabetes mellitus (Joslin, 1959; Malins, 1968).

Alimentary glycosuria ("lag-storage"; oxyhyperglycaemia) is the second most common cause of glycosuria in this survey—these being 21 cases or 18·4% (Table II). It forms 7% of the 800 glycosurics among Army personnel reported by Lawrence (1947). In a diabetes detection survey in Sweden of the population about 10 years of age, 0·03% of the population was found to have alimentary glycosuria (Brandt *et al*, 1964). Its prevalence in this study is 0·07% (Table V); in the 3 main ethnic groups it is most common in Indians (0·12%) followed by Chinese (0·075%) and Malay (0·028%). A follow-up after 5 years of the cases with alimentary glycosuria in the Birmingham survey shows that the incidence of diabetes was 17 times that which would be expected in a normal population (Malins, 1968).

As expected, diabetes mellitus is rare in the young. Thus in this survey there were only 2 cases of diabetes (prevalence: 0·007% or 0·7 per 10,000). In the Swedish diabetic detection survey, the prevalence of diabetes in the age group 15 to 20 years is about 0·2% (Brandt *et al*, 1964). In Birmingham, the incidence of diabetes in men aged 15 to 19 years is 0·25% (Malins, 1968). Our low prevalence of diabetes is probably due to a relatively small number screened. One of our diabetic is a Chinese while the other is an Eurasian. In Malaya, West and Kalbfleish (1966) found that the prevalence of diabetes is highest in Chinese (4·7%), followed by Indians (4·2%) and lowest in Malays (1·8%). In Singapore, Ho (1959) had the impression that diabetes was more common in Indians than in Chinese.

The significance of the 14 cases with abnormal glucose tolerance classified as miscellaneous (Table II) is difficult to evaluate. Only a re-evaluation 5 to 10 years later can help to classify the fate of these cases. A follow-up of the Oxford diabetic survey 17 years later (O'Sullivan and Mahan, 1965) showed that a 2 hour postprandial blood sugar of less than 140 mg.% is not associated with an increased risk of diabetes.

The mean height and weight of these with renal glycosuria and alimentary glycosuria does not differ significantly from those with normal glucose tolerance test (Table VI). Blotner and Hyde (1943) reported that of 33 cases with renal glycosuria, 14 were of normal weight, 17 were underweight and 2 were overweight.

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NEW DIABETICS IN SINGAPORE

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SYNOPSIS

A clinical study was undertaken of new diabetics seen at a general medical unit in Singapore. Over a period of 12 months, there were seventy-five cases of which 38 (50.7%) were Chinese, 15 (20%) Malays and 22 (29.3%) Indians. Male patients were twice as common as female patients. The majority of patients (61.3%) were in the 5th and 6th decade and only 23 (30.7%) were obese. Oral sulphonylurea and dieting provided effective control in 80.6% of the patients, and only 9% of patients required insulin. Ketosis was present in only 6 cases and was easily controlled with appropriate treatment. Other clinical features are presented and discussed.

INTRODUCTION

Physicians who manage patients with diabetes mellitus in Singapore and Malaya have long had the impression that the clinical pattern of the disease they see bear many dissimilarities from that described in the familiar Western text-books. Thus Pillay and Lim (1960) found that more than 90% of their patients were above 30 years of age and Pallister (1951) believed that diabetes of the middle-aged or older man is the commoner type of the disease in Malaya. In the present communication, an attempt is made to characterise the local clinical pattern of this complex disease and to point out those features peculiar to our diabetic population.

MATERIAL AND METHOD

Newly-discovered diabetics seen at Medical Unit II, Department of Medicine, over a period of 12 months were studied. These patients were referred from Government outpatient clinics and private practitioners, and represent a reasonably random sample of new diabetics. New diabetics were chosen for this study because they yield, in addition, information on the occurrence of clinical diabetes and allow a strict assessment of response to treatment.

Diagnosis of diabetes mellitus was made on the basis of one or more of the following criteria: (*1*) fasting blood sugar in excess of 120 mg./100 ml.; (*2*) blood sugar, 2 hours after 50 gm. oral glucose, in excess of 140 mg./100 ml.; (*3*) random blood sugar in excess of 160 mg./100 ml. The following features were carefully looked for:—

1. Family history of diabetes.
2. Obesity. Body weight 10% or more in excess of standard values according to age, height and sex. The standard weights used are 5% below those for Western subjects; this is based on the finding by Kusunoki and Hirata (1960) for Japanese subjects.
3. Ischaemic heart disease. History of angina and/or myocardial infarction with ECG confirmation.
4. Peripheral vascular disease. The state of peripheral pulses, particularly the foot pulses.
5. Hypertension. Diastolic blood pressure in excess of the arbitrary figure of 90 mm.Hg.
6. Cerebrovascular disease. History and/or physical signs of "stroke".
7. Neuropathy. State of tendon jerks (particularly ankle jerks) and vibration sense.
8. Retinopathy. Features specific to diabetic retinopathy by ophthalmoscopy.
9. Nephropathy. Presence of casts and albuminuria.
10. Ketonuria.

Management of the disease was along conventional lines. In the absence of ketosis, appropriate dietary adjustment was instituted particularly to correct obesity if present, and an oral hypoglycaemic (sulphonylurea) added if necessary. Patients with ketosis were initially treated with insulin and when they were in the stable state, an attempt to change over to oral hypoglycaemic agents was made if the insulin requirement did not exceed 40 units. Criteria of control is absence or trace amount of sugar in pre-prandial urine at least twice a day.

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RESULTS

Over the period of 12 months, 75 new patients were seen, the racial composition of which is as follows: (Table I) Chinese 50·7%; Malays 20%; Indians 29·3%. Male patients were twice as common as female patients (Table I), the preponderance of male over female being particularly marked among Indian patients.

TABLE I

SEX AND RACE DISTRIBUTION OF PATIENTS

Race	Male	Female	Total
Chinese	30·7%* (23)	20% (15)	50·7% (38)
Malay	10·7% (8)	9·3% (7)	20% (15)
Indian	25·3% (19)	4% (3)	29·3% (22)
TOTAL	66·7% (50)	33·3% (25)	— —

*Percentage of total number of patient.
Figure within bracket denotes actual number of patients.

Age distribution of the patients is shown in Table II. Only 4 patients were younger than 30 years of age at the onset of clinical diabetes, while none were between 10 and 15 years of age. The majority (61·3%) were in the fifth and sixth decade. Seven patients (9·3%) were in the eighth decade.

Only five patients (6·7%) had a positive family history. The commonest presenting symptoms were polydipsia and polyuria (33%). Skin infection occurred in 22·7%, while infection elsewhere (lung and urinary tract) was found in only 6·7% of the patients. General debility was a presenting feature in 16% and cataract in 12%. In one third of the cases, diagnosis was discovered either at routine medical examination or when the patients presented with unrelated clinical problems. Three patients presented in ketoacidosis and four in hyperglycaemic hyperosmolar coma.

Ketonuria was present in only 6 (9%) patients and only 3 of these developed clinical ketoacidosis. In all the 6 patients, there was evidence of infection at the time of ketonuria. With subsidence of infection ketonuria was easily eliminated in all cases with appropriate treatment.

The occurrence of obesity, ischaemic heart disease, peripheral vascular disease, neuropathy and retinopathy and their comparison with those in a Western clinic (Oakley, Pyke and Taylor, 1968) are shown in Table III. Cerebrovascular insufficiency was present in 7 patients (9·3%) and hypertension in 14 patients (18·7%). Only one patient had nephropathy, as shown by the presence of significant proteinuria.

The response to treatment is shown in Table IV. Eight patients did not stay under surveillance sufficiently long to be assessed. Of the rest, 54 (80·6%) were adequately controlled with diet and a sulphonylurea. Dieting alone was sufficient for 6 patients (9%). One patient required the combination of a sulphonylurea (chlorpropamide) and a biguanide (metformin) for control. Only 6 patients (9%) required insulin and the average daily requirement was 55·3 units. Of the six patients who had significant ketonuria only two required to be maintained on insulin and all of them did not exhibit undue liability to ketosis.

TABLE II

AGE AT ONSET OF CLINICAL DIABETES

Race	10-15	16-29	30-39	40-49	50-59	60-69	70+
Chinese	—	4%* (3)	1·3% (1)	9·3% (7)	17·3% (13)	10·7% (8)	8% (6)
Malay	—	—	2·7% (2)	6·7% (5)	6·7% (5)	2·7% (2)	1·3% (1)
Indian	—	1·3% (1)	4% (3)	9·3% (7)	12% (9)	2·7% (2)	—
TOTAL	—	5·3% (4)	8% (6)	25·3% (19)%	36% (27)	16% (12)	9·3% (7)

*Percentage of total number of patients.
Figure within bracket denotes actual number of patients.

TABLE III

PREVALENCE (IN PERCENTAGE) OF CERTAIN ASSOCIATED FEATURES OF DIABETES MELLITUS AMONG NEW PATIENTS— A COMPARISON WITH DATA FROM A WESTERN CLINIC*

	Obesity	Ischaemic Heart Disease	Peripheral Vascular Disease†	Peripheral Neuropathy	Retinopathy
Patients in present study	30·7	9·4	0	25·3	8·0
Patients at a Western clinic (at time of diagnosis)	50·0	4·5	11	14·0	6·4

*Oakley *et al* (1968).

†In patients over 50 years of age.

TABLE IV

PATTERN OF RESPONSE TO TREATMENT

	Diet Alone	Diet Plus Sulphonylurea	Diet Plus Sulphonylurea and Biguanide	Diet Plus Insulin
No. of patients	6	54	1	6
Percentage	9%	80·6%	1·5%	9%

DISCUSSION

The materials used in this study might be regarded as a random sample of new diabetics presenting for treatment, excepting an unknown proportion who sought treatment with traditional Chinese medicine. The random nature of our materials is based on the fact that these patients were referred to us, by turn, from the Government outpatient clinics for assessment. An unknown proportion presented themselves first to private practitioners who probably would refer to us only those patients that are problematical, a further element of bias being thus introduced into the present series. However, even if the validity of randomness can be questioned, comparison of this hospital experience with those from foreign clinics reveals several interesting features worthy of comment.

The racial distribution of the patients does not reflect the racial composition of Singapore. The disproportionately high incidence of Indian diabetics is consistent with the result of the survey of West and Kalbfleisch (1964) in Malaya. Even in South Africa, Campbell (1960) has assessed that diabetes is 8 times as common in Indian as in the African, and Wood (1960) found an 8·8% incidence of diabetes among Indians over the age of 30 years. It is not known to what extent the preference for treatment with traditional Chinese medicine contributes to the comparatively small proportion of Chinese patients in this series.

The high incidence of the disease in the older age groups (fifth and sixth decade) is in common with that seen among the diabetic population reported elsewhere (Wada *et al*, 1964; Pyke, 1968). It is noteworthy that only 10 patients were less than 40 years of age, and 4 less than 30 years of age. No patient between 10 and 15 years of age was seen; the scarcity of incidence of the disease in this age group is keeping with the finding of Pyke (1968) among new patients at a Western clinic. Patients less than 10 years of age were not seen at our clinic (being referred to Paediatricians) and are not included in this series, but they are rare (Wells, 1960) as is the experience of Western (Pyke, 1968) and Japanese (Wada *et al*, 1964) clinics.

The preponderance of male patients over female patients (two to one) is in contrast to the finding in a Western series (Fitzgerald *et al*, 1961) where the female to male ratio among 5,441 new diabetics was 3:2. However, it is claimed that more recently, in Britain (Pyke, 1968) men seem actually to have outnumbered women among newly-diagnosed diabetics in the forties and fifties and that the female preponderance has appeared only after this age. The data for Japanese patients (Wada *et al*, 1964) also showed male preponderance.

The incidence of obesity of 30·7% is markedly lower than that of a Western series which reported the presence of obesity in about 50% of maturity-onset diabetes (Pyke, 1968). On the other hand, the incidence of obesity among Japanese diabetics (Satoshi and Kunizo, 1957; Wada *et al*, 1964) is of the same order as the incidence of the present study.

Only 5 patients (6·7%) gave a history of diabetes among their blood relatives. This low incidence is in contrast to 15% found among Japanese patients (Wada *et al*, 1964) and 38% among British diabetics (Pyke, 1968). On the other hand, Kobayashi *et al* (1959) found a positive family history in only 7·6% of their patients in Japan. This vast difference, even among patients of one racial group, cannot be readily explained. The low incidence, as is seen in our series, can perhaps be attributed partly to the large number of undiagnosed diabetics in the population.

The local pattern of "complications" of diabetes shows some interesting differences from the Western pattern. The apparently higher incidence of ischaemic heart disease and peripheral neuropathy at the time of diagnosis is in contrast to the absence of peripheral vascular disease at this stage of the disease. Nephropathy was practically not seen in these patients, as is the experience of others with new diabetics. The prognostic significance of the different pattern remains to be defined.

The very striking feature of our patients is the low incidence of significant ketosis (9%) in comparison with 43% of reported by Freeman (1958). However, reports from eight Japanese clinics indicate that 2 to 11% of all their diabetic patients had ketonuria before treatment (Sasaki *et al*, 1938). Half of our ketotic patients were in frank ketoacidosis. Only 2 of the 6 patients finally required insulin for control of diabetes and none showed persisting ketosis. Freeman (1958) found that 94% of patients with ketonuria required insulin. Although only 9% of our present series require insulin for control, the average dose of 55·3 units per day is probably higher than that of Western patients (Wells, 1958).

Four patients included in this series presented with extreme hyperglycaemia and hyperosmolality without ketosis (Lim, 1970). Three of them survived with treatment and two were subsequently found to have clinical, and one, latent diabetes. The patient who succumbed gave no clear-cut history of diabetes mellitus.

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