A Window on the Current Status of Diabetes Mellitus in Singapore – The Diabcare – Singapore 1998 Study

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ABSTRACT

The Diabcare-Singapore project was carried out in 22 clinics (general hospitals, GH and primary healthcare centres, PHC) to provide an overview of diabetes management and metabolic control status. Data from 1697 diabetic patients were collected on paper forms and analysed centrally. Type 2 diabetes mellitus patients constituted 91.4% and type 1 patients constituted 8.1% of population. The proportion of type 1 patients was greater in GH (18.1%) vs PHC (3.4%). The mean age (± SD) was 58.1 ± 14.4 years and mean duration of diabetes was 10.1 ± 7.5 years. Mean body mass index (BMI) was 25.1 ± 4.4 kg/m^2 and more than half (53%) of patients were overweight (BMI >25 kg/m^2). Mean HbA_{1c} and FBG levels were 8.0 (1.9% and 9.1 ± 3.1 mmol/l. A total of 51% of patients had HbA_{1c} (1% above the Upper Limits of Normal (ULN). Fasting blood glucose (FBG) was >7.8 mmol/l in 61% of patients. The majority (70%) had satisfactory levels of fasting lipids (triglycerides, total cholesterol and HDL-cholesterol). Only 19.7% practised home blood glucose self-monitoring, while 99% reported receiving some diabetes education. Sixteen percent of patients had abnormal levels of protein (>500 mg/24h) in the urine, 3% had elevated serum creatinine levels and 36% had microalbuminuria. Retinopathy (12%), cataract (16%) and neuropathy (12%) were commonly reported diabetic complications. The data revealed suboptimal glycaemic control in about half of patients studied.

Keywords: diabetes mellitus, Singapore, demographic profile, HbA_{1c}, metabolic control

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INTRODUCTION

According to the 1998 National Health Survey, diabetes mellitus now affects 9.0% of Singaporeans aged 18 - 69 years. Associated with the disease are complications such as arteriosclerosis, hyperlipidemia, hypertension, ischemic heart disease and cerebrovascular accidents, retinopathy with potential loss of vision, nephropathy leading to renal failure, peripheral neuropathy with risk of foot complications. The Diabetes Control and Complications Trial (DCCT)[1] and the United Kingdom Prospective Diabetes Study (UKPDS)[2,3] along with other studies have shown that with good glycaemic control, the development of diabetic complications can be delayed or prevented. The quality of diabetes management would therefore be expected to impact on the rate of complications in Singapore versus duration of diabetes.

Fundamental to any diabetes management programme is the establishment of a reliable baseline status of the disease. The Diabcare-Singapore Study was part of the "Diabcare-Asia" project, a collaborative study between Novo Nordisk Asia Pacific Centre (NNAPC) and 12 participating Asian countries working through national diabetes associations. A pilot study involving 26,514 patients in six countries has been reported by Cockram[4]. In addition, a few individual country reports (Malaysia[5] and India[6]) are also available. The Diabcare-Asia project is similar to the "DIABCARE" project established in Europe several years ago, and was designed to provide large-scale, simple yet standardised information about patient characteristics and care received by patients from numerous centres. The objectives of the study were to describe as well as to investigate the relationship between diabetes control, diabetes management and complications status in the diabetes population of each participating country. It was also the aim of this study to provide a means of measuring the quality of diabetes management. This paper represents the metabolic control outcome data set for the Diabcare-Singapore 1998 survey. The study outcome of Singapore patients was compared to that of the Asian[4] basket instead of individual countries as each country has its own limitations on the ground.

METHODS

The overall design of the study was a cross-sectional snapshot survey of existing diabetes care providers,

utilising retrospective data collection. No attempt was made to influence the patient care practices in the individual centres.

Study Population

The study was carried out in 22 diabetes clinics between 1 March 1998 and 30 April 1998. Diabetes clinics were defined as medical care facilities (primary health care and restructured hospitals diabetes clinics) that managed more than 100 diabetic patients per month and the diabetes clinics were selected by the Diabcare-Asia Singapore working group. The study population included all patients registered in that centre for the management of diabetes for at least 12 months. The definition of diabetes type (type 1 and type 2) was carried out in individual centres based on individual doctor's clinical judgment, as in the overall Diabcare-Asia project.

The aim was to recruit approximately 100 patients from each participating centre from 1 March 1998 to 30 April 1998. In order to have a representative sample of patients, every one in X patients (X = total patients/required sample size) who visited the centre within the two months would be recruited, while a representative sampling of treating physicians at each centre was ensured by the main investigator of the centre, in consultation with the other members of the local working group.

Overall, primary health care contributed 67% of patients while general hospitals contributed 33% of patients.

Data Collection Method

This was a cross-sectional study and each centre contributed all the data that they had available for the patient. Data were obtained by interview and laboratory assessments, as well as clinical findings as they appeared in the patient's medical records. Data fields were left blank if no data were available. Data were recorded in the Diabcare-Asia Data Collection Forms provided for each patient. Data collected included information on patient demography, type of diabetes, frequency and nature of educational interventions received, cardiovascular risk factors (blood pressure, lipids, BMI, smoking history and drinking habits), glycaemic control (HbA_{1c} and FBG), monitoring of renal function (serum creatinine, micro-albuminuria, macro-albuminuria and proteinuria), eye and feet examination in the past 12 months, severe late complications, diabetes management and self-monitoring (blood and urine glucose).

The methods used to diagnose neuropathy varied among centres, ranging from a doctor's standard clinical examination to the use of monofilaments and biosthesiometers. A more detailed methodology was eschewed for reason of brevity of the data collection form, and lack of standardisation of methods. Similarly, the assessment of renal function was performed via a variety of methods, namely dipstick proteinuria, a 24-hour urinary excretion assay, presence of microalbuminuria and serum creatinine concentration.

Data Handling and Statistical Analysis

All data were entered into a Statistical Analysis System (SAS, Version 6.12, SAS Institute Inc., Cary, USA) by electronic scanning (TELEform Elite, version 5.2; Cardiff Software, San Marcos, USA) and a data validation was carried out by both the scanning software and the SAS system. All data were tabulated and descriptive statistical analyses were performed. Subgroupings were carried out according to type of diabetes clinics and duration of diabetes. Only data on metabolic control will be presented.

RESULTS

Patient Demographic Characteristics

A total of 2001 patients were recruited for the study from 22 clinics. However 304 (15%) patients were excluded from the statistical analysis due to missing data on basic patient information (such as diabetes duration) or any inconsistency between basic data fields. Thus, 1697 patients constituted the final study population, with 67% of patients from the primary health care clinics and 33% from the restructured hospital clinics.

The patient demographics and characteristics are summarised in Table I. As shown, the majority of patients (91%) recruited in the study were diagnosed as having type 2 diabetes and 8% of patients were classified as having type 1 diabetes. Male patients made up 48% while female patients comprised 52% of the sample. The overall mean age of patients was 58.1 ± 14.4 years with the majority (44.8%) of patients in the age group 55 - 70 years. Overall duration of diabetes was 10.1 ± 7.5 years and majority (44.7%) had 10 or more years of diabetes. Mean age at onset of diabetes was 47.4 ± 14.2 years.

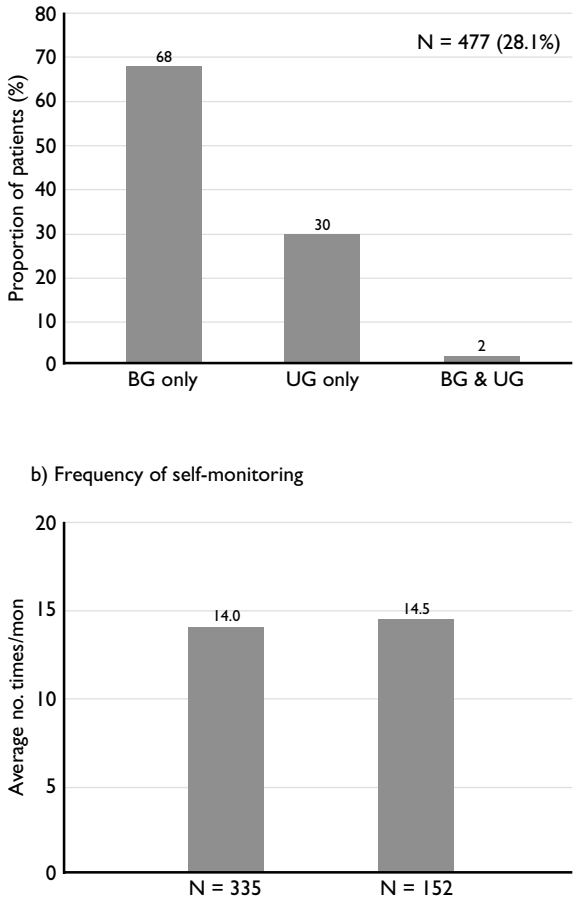
Overall, mean BMI was 25.1 ± 4.4 kg/m^2 and subgroup analysis showed that 22.6% and 21.8% respectively of patients were in the BMI subgroups 20 - 23 and 23 - 25 kg/m^2. About half (47% of patients) would have BMI >25 kg/m^2 (indicative of overweight according to the WHO classification). Based on the 1996 WHO classification criteria[7] for hypertension, the majority had normal blood pressure, while 23% had hypertension (indicated by blood pressure ≥140/90 mmHg and/or on hypertensive medication).

Table I. Patient Demographics.

Total no. of Patients	1697
Type of Diabetes	
N	1667
Type 1 (%)	8.2
Type 2 (%)	91.4
Others (%)	0.4
Sex	
N	1697
Male (%)	47.7
Female (%)	52.3
Age of Patients (years)	
N	1697
mean ± SD	58.1 ± 14.4
<15 (%)	1.2
15 - 30 (%)	3.4
30 - 40 (%)	4.7
40 - 45 (%)	5.6
45 - 55 (%)	20.0
55 - 70 (%)	44.8
≥70 (%)	20.2
Age at Onset of Diabetes (years)	
N	1630
mean ± SD	47.7 ± 14.2
<15 (%)	3.4
15 - 30 (%)	6.9
30 - 40 (%)	15.0
40 - 55 (%)	40.0
55 - 70 (%)	30.9
≥70 (%)	3.9
Duration of Diabetes (years)	
N	1630
mean ± SD	10.1 ± 7.5
1 - 3 (%)	11.2
3 - 5 (%)	14.3
5 - 7 (%)	14.6
7 - 10 (%)	15.2
≥10 (%)	44.7
BMI (kg/m²)	
N	1412
mean ± SD	25.1 ± 4.4
<20 (%)	8.4
20 - 23 (%)	22.6
23 - 25 (%)	21.8
25 - 27 (%)	18.6
27 - 30 (%)	16.1
30 - 35 (%)	10.4
≥35 (%)	2.2
Hypertension status	
N	1639
Normal (%)	77.2
*Hypertension (%)	22.8
Non-smoker	
%	91
Non alcohol drinker	
%	95

N - number of patients used in the analysis
* - Includes known hypertensives on treatment

Fig. 1 Glucose self-monitoring via blood glucose (BG), urine glucose (UG) or BG & UG.



The majority of patients were non-smokers (91%) and non-alcohol drinkers (95%).

Diabetes Educational Status

Data on diabetes education were hampered by reported confusion on whether the questions were taken to refer to diabetes education episodes over the last year or over the period since diagnosis of diabetes. We have taken the data to reflect information on those who were documented to have had diabetes education since diagnosis. Using this definition, 99% of patients reported receiving some diabetes education (healthy eating, hypoglycaemia, complications, risk factors, foot care and self-monitoring) (data not shown). However, only 9% of patients had more than five days of diabetes education (data not shown).

Glucose Self-Monitoring

Data on home self-monitoring were only available from 28% (n = 477) of patients. Of these 477 patients, the majority (68%) used home blood glucose monitoring, 30% practised urine glucose monitoring while 2%

practised both forms of glucose monitoring (Fig. 1a). Overall, 19.7% of patients practiced home blood glucose monitoring. The mean frequency of monitoring was 14 times per month in those on blood glucose monitoring, and 14.5 times per month in those on urine glucose monitoring (Fig. 1b).

Glycaemic Control

The overall mean HbA_{1c} value was 8.0 ± 1.9%, based on measurements from local centre laboratories. Although no centralised HbA_{1c} measurement was available, the majority of primary health care centres had been using a single laboratory, shared with one of the general hospital centres. In addition, most of the centres used the BIORAD Variant HPLC method and Bayer DCA 2000. The normal HbA_{1c} ranges reported by laboratories ranged from 4.6% - 6.4% in 15 centres, 4.5% - 6.5% in three centres, 4.6% - 6.3% in two centres, and <6.1% in three centres. Since there was slight variation in normal ranges for HbA_{1c} measurements, we expressed HbA_{1c} values according to percentage (≤1%, >1%, ≤2% and >2%) above the upper limit of normal range (ULN) to categorise quality of glycaemic control. As shown in Fig. 2a, about half of the patients (49%) had HbA_{1c} ≤1% above ULN (indicative of good glycemic control), 20% had >1, ≤2% above ULN (indicative of borderline glycemic control) and 32% had >2% above ULN (indicative of poor glycaemic control).

When the HbA_{1c} profiles are categorised according to the American Diabetes Association (ADA)[8], European (EU)[9] and Asia Pacific (AP)[10] guidelines (Fig. 2a), it is shown that 41% (according to ADA guidelines), 52% (according to EU guidelines) and 25% (according to AP) had poor glycaemic control.

The overall mean FBG level for patients was 9.1 ± 3.1 mmol/l. In the case of FBG profile, regardless of the guidelines used (ADA, EU or AP), the proportion of patients (61%) with FBG >7.8 mmol/l, indicative of poor glycaemic control, was the same (Fig. 2b).

Lipid Profile

Of all patients (n = 1403) for whom triglyceride (TG) assessment was available, the majority (73%) had TG <2.2 mmol/l (European target for good and borderline metabolic control). In addition, 82% of the patients had total cholesterol (TC) level <6.5 mmol/l and 88% had HDL >0.9 mmol/l, all of which indicated that majority of patients had satisfactory lipid control (Fig. 2c).

According to the Singapore Ministry of Health Clinical guidelines[11], TG and TC profiles were classified according to the following guidelines for good control: patients aged ≥45 years, TG ≤1.7 mmol/l, TC ≤4.5 mmol/l; patients aged <45 years, TG ≤2.3 mmol/l, TC ≤5.2 mmol/l. The proportion of patients aged ≥45 years with good control of TG and TC was 55% (n = 1203) and 13% (n = 1219) respectively. The proportion of patients aged <45 years with good control of TG and TC was 76% (n = 200) and 50% (n = 199) respectively. These figures do not

Fig. 2 Biochemical Parameters.

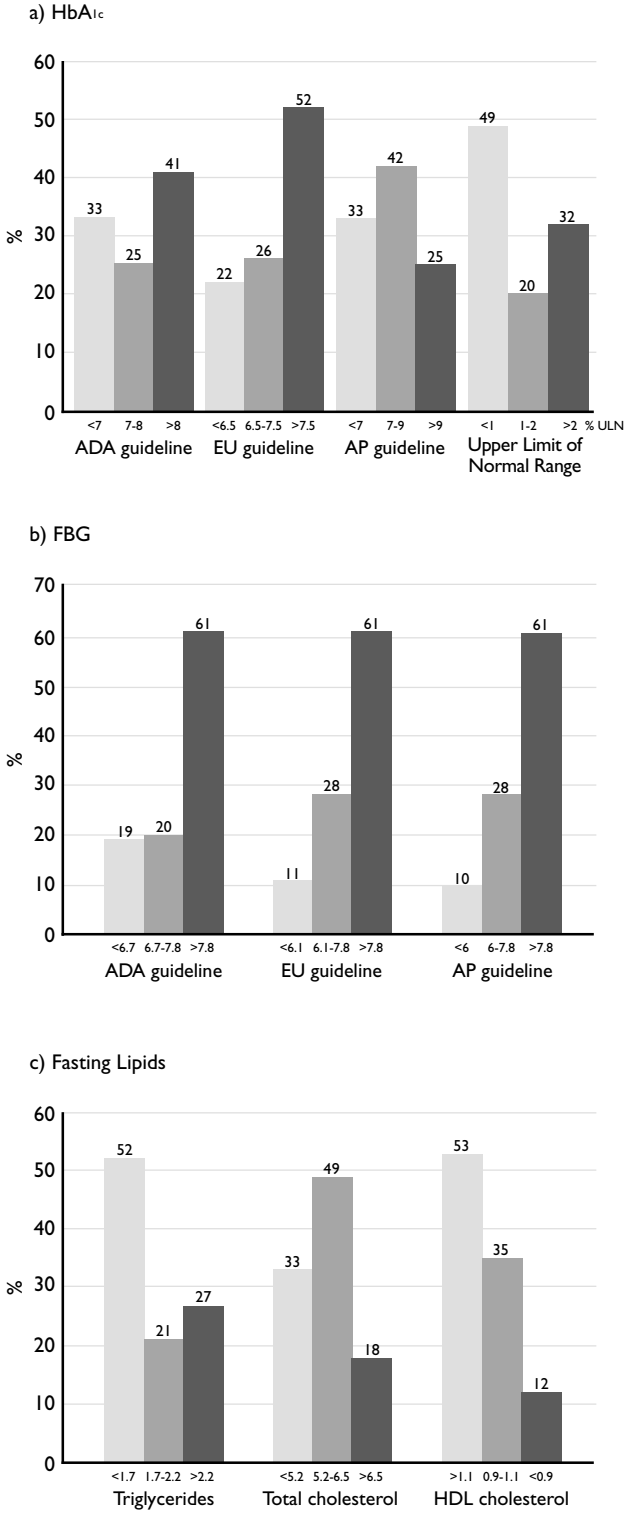


Table II. Status of Complications.

	N	Proportion of patients (%)
Renal Function		
Serum creatinine (>180 (mol/l)	1315	3
Urine microalbumin	174	
Normal (<20 mg/l)		61
Microalbuminuria (20 - 300 mg/l)		36
Macroalbuminuria (>300 mg/l)		3
Proteinuria (>500 mg/24 h)	1069	16
Eye complications		
Photocoagulation	1607	7
Cataract	1614	16
Retinopathy	1578	12
Advanced eye disease	1599	1
Feet complications		
Foot pulse	1525	0
Healed ulcer	1646	2
Acute ulcer/gangrene	1653	0
Neuropathy	1625	12
Severe late complications		
Legal blindness	1675	0
MI/CABG/angioplasty	1674	5
Cerebral stroke	1676	3
Renal failure	1677	0
Leg amputation	1676	1

MI/CABG/angioplasty - myocardial infarction/coronary artery bypass graft/angioplasty

N - number of patients used in the analysis

take into account presence or absence of coronary heart disease or number of other cardiovascular risk factors.

Diabetes Complications

The main modality used for screening renal function was through serum creatinine (77%) and assessment of proteinuria (63%). The use of urine micro-albuminuria for screening (10%) was less frequent compared to the above two methods (Table II). Of the 174 (10%) patients who had albumin excretion assessed, 36% were found to have micro-albuminuria, defined as urine albumin concentration between 20 mg/L and 300 mg/L, while 3% had macro-albuminuria (urine albumin concentration >300 mg/L). Of the patients tested for excreted protein level and serum creatinine level, 16% had excreted protein >500 mg/24 hours (proteinuria) and 3% had serum creatinine >180 µmol/l.

The presence of eye complications included history or evidence of retinal photocoagulation, retinopathy, cataract and advanced eye disease. The overall response rate was good with <5% of data unavailable. Of all the eye complications, cataract (16%) was the most commonly reported. Retinopathy was reported in 12% of patients, photocoagulation in 7% and advanced eye disease in 1% of patients (Table II). Since reports of photocoagulation and advanced eye disease were not counted as retinopathy, the prevalence of retinopathy was probably more than 12%.

Feet complication examination included screening for foot pulse, healed ulcer, acute ulcer/gangrene, neuropathy and amputation. The overall response rate was good with <8% of data unavailable. The frequency of reported feet complications was low and the most common complication was neuropathy (12%) (Table II).

The presence of severe late complications included legal blindness, myocardial infarction/coronary artery bypass graft/angioplasty (MI/CABG/angioplasty), stroke, renal failure and leg amputation. The overall response rate was good with only 1% of unavailable data. Like both eye and feet complications, the frequencies of reported severe late complications were low, in particular, legal blindness was not reported. The most frequently reported late complication was MI/CABG/angioplasty (5%) (Table II).

DISCUSSION

Within the past 20 years, a rising trend in prevalence of diabetes mellitus was observed in the adult population of Singapore, from 1.99%[12] in 1975 to 9.0%[13] in 1998, while the prevalence of IGT hovered around 14% in 1992 to 15% in 1998. According to the 1998 national health survey[13], diabetes mellitus was the sixth leading cause of deaths in 1997, accounting for 1.8% of all deaths. In the 1997 global estimate of type 2 diabetes mellitus by the World Health Organisation (WHO), Singapore was ranked amongst countries with a high prevalence of diabetes[14].

The objective of this Diabcare-Singapore study was to describe diabetes control, management and complication status in the Singapore diabetes population. Data from a cohort of diabetic patients with more than 12 months of diabetes management were collected. The centres participating in this study were randomly selected from the primary healthcare sectors and general hospital sector. This helped to ensure that the data collected were representative of the entire diabetes population and the different types of diabetes care facilities available. However, the limitation of this study is that many diabetic patients are cared for by private general practitioners and family physicians who are under-represented in this study. Although the proportion of patients classified as having type 1 diabetes appeared to be rather high

in this study, we felt that this was likely to reflect the fact that a third of the study population was drawn from restructured hospitals, which have traditionally been taking care of the bulk of type 1 patients, and the rest of the patients were drawn primarily from the government primary health care centres which provide subsidised insulin therapy. Another possibility was of course the misclassification of type 1 and type 2 patients. However, it was perceived as unlikely, given the fact that the restructured hospitals had a higher percentage of type 1 patients. Patients with poorer mobility as a result of lower limb problems, renal failure or more severe eye disease might arguably also have been less likely to see their doctors for diabetes care. This might account for the low reported rates of some severe late complications.

The demographic characteristics of diabetes patients in Singapore were rather comparable to those of diabetes patients in Asia[4] and Malaysia[5] where parallel studies showed mean age (58.3 ± 12.0 vs 56.4 ± 12.7 years respectively), mean BMI of 24.2 ± 5.5 kg/m^2 and 25.9 ± 6.0 kg/m^2 respectively and 95% of Asian and Malaysian patients with type 2 DM. The duration of diabetes was comparable between Singapore, Malaysian and Indian[6] patients (10.1 ± 7.5 vs 10.1 ± 7.1 vs 10.0 ± 6.9 years respectively) but was long compared to Asian patients (8.2 ± 6.7 years). The proportion of Singapore patients who were overweight (BMI >25 kg/m^2) was higher than Asian patients (36%) and Indian patients (39%) but lower than Malaysian patients (52%).

Of the 1697 patients surveyed, 1308 patients (77.1%) had data on HbA_{1c} measurement, indicating that the measurement was only lacking in 23% of the patients. This suggests that the use of glycated haemoglobin assessment appears to be fairly widespread in Singapore. About half (52%) of patients had HbA_{1c} >7.4% (>1% above the upper limit of normal range) and 61% had FBG >7.8 mmol/l. Hence both the HbA_{1c} and FBG data suggest that a substantial proportion of patients in Singapore had unsatisfactory glycemic control.

Another worrying process indicator was that only 28% of the patients reported any form of home glucose monitoring, and of these, only 68% practised home blood glucose monitoring. This was lower than what was reported in the NHANES III study[15], which indicates that 47% of American diabetes patients with HbA_{1c} ≥8% and 32% with HbA_{1c} <8% had their home blood glucose monitoring at least once daily. Thus, there is a need to make home glucose monitoring more available and also a need to educate our patients on the importance of home glucose monitoring, particularly, blood glucose monitoring.

The mean values of HbA_{1c} (8.0 ± 1.9%) and FBG (9.1 ± 3.1 mmol/l) of Singapore diabetic patients appeared to be lower compared to Asian patients[4] (HbA_{1c} of 8.5 ± 2.4% and FBG of 9.4 ± 3.9 mmol/l). A lower proportion (52%) of Singapore patients had unsatisfactory control (HbA_{1c} >1% above ULN ie >7.4%) compared to 61% of Asian patients (HbA_{1c} >7.5%). In addition, the data outcome on metabolic control indicated that at least 70% of diabetic patients in this study had satisfactory control (good or borderline levels) of fasting lipids. Recent published results from the largest and longest United Kingdom Prospective Diabetes Study (UKPDS)[2,3] had shown a continuous relationship between the risks of microvascular complications and glycaemia, such that for every percentage point decrease in HbA_{1c}, there was a 35% reduction in risk of complications.

Screening for appearance of abnormal levels of albumin in urine (microalbuminuria), was rarely performed in Singapore, as indicated by the availability of data in only 10% of the patients. Of these 10% of patients, nephropathy (microalbuminuria and macro-albuminuria) was seen in 39% of them. This inadequate assessment for microalbuminuria could be due to lack of facilities compared to a higher screening rate for proteinuria by urine test strip, which by current standards, was not a sensitive indicator for proteinuria. Low awareness and higher costs of microalbuminuria test strips may be another reason. Proteinuria >500 mg/day was reported by 16% of patients in this study, while 3% had serum creatinine >180 μmol/l, compared to 14% and 6% respectively in Asian patients[4]. Since microalbuminuria is a useful indicator for early manifestations of nephropathy and a marker of increased cardiovascular morbidity and mortality for diabetic patients[16]. Early screening for microalbuminuria is necessary for our patients.

Overall, the proportion of diabetes patients who had retinopathy in this study was at least 12% compared to 21.4% reported earlier by Thai et al[17]. In this study, the presence of retinopathy, history of photocoagulation and advanced eye disease was taken to be mutually exclusive by some clinics. However, since the presence of photocoagulation indicated that patients' previous treatment for retinopathy and advanced eye disease pointed to previous retinopathy, the prevalence of retinopathy was probably more than 12%. Neuropathy (12%) was the most common reported feet complications in this survey, compared to 39% reported in Asian diabetes patients[4] and 15.7% in an earlier Singaporean survey by Thai et al[17]. However, it should be noted that the response rate to foot complications among Asian patients was very low compared to the present study.

Since neuropathy increases the risk of other complications including amputations and foot ulcers[18,19], early detection and treatment of complications are clinically effective in preventing progression.

The present data present the status of diabetic control, management and complications in Singapore. Since the DCCT[20-22] and UKPDS[2,3] have shown that poor diabetic control over a long period of time contributes to chronic diabetic complications and demonstrated a relationship between blood glucose level and risk of diabetes complications, we should aim to maintain normoglycaemia as far as is safely possible.

In conclusion, the data from this stratified sample of patients (from primary care and hospital-based diabetes clinics in Singapore) showed that more than half of those studied were suboptimally controlled and their screening for microalbuminuria was infrequently done. The DCCT and UKPDS have shown that chronic poor diabetes control contributes to long-term diabetic complications and that near normal glycaemic control reduces and delays the onset of microvascular complications. These two major findings call for efforts at establishing and maintaining improved diabetes management with regards to control and screening for microalbuminuria. In addition, our study also suggests the importance of empowering the patients via greater availability of diabetes self-care skills, diabetes education and home glucose monitoring equipment. Adequate encouragement is needed to enable the patients to make continued efforts in achieving optimal glycaemic control. More resources to forge a better partnership between diabetes healthcare providers and patients in the area of awareness, comprehensive diabetes service and patient co-operation in therapy are highly recommended.

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REFERENCES

1. American Diabetes Association. Implications of the Diabetes Control and Complications Trial. Diabetes Care 1998; 21 Suppl 1:S88-S90.
2. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. (UKPDS 33). Lancet 1998; 352:837-53.
3. UK Prospective Diabetes Study Group. Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes. (UKPDS 34). Lancet 1998; 352: 854-65.
4. Cockram C. Diabetes management in Asia. International Diabetes Monitor 1999; April:11-6.
5. Mustaffa BE, Mohamad WB, Chan SP, Rokiah P, Mafauzy M, Kumari S, Chandran AA, Ong GKC, Jorgensen LN and Yeo JP. The current status of diabetes management in Malaysia. JAFES 1998; 16:1-13.
6. Kapur A, Jorgensen LN, Ramamoorthy S, Yeo JP, Pendsey S, Sahay BK, et al. Diabetes care in India - Current status. J Assoc Physicians India. In press.
7. WHO. Hypertension control: report of a WHO expert committee. WHO Technical Report Series 862, Geneva, World Health Organisation, 1996.
8. American Diabetes Association. Standards of medical care for patients with diabetes mellitus. Diabetes Care 1997; 20 Suppl 1: S5-S13.
9. A desktop guide for the management of non-insulin-dependent diabetes mellitus (NIDDM). A contribution to the implementation of the St. Vincent Declaration, 1993.
10. Non-insulin dependent diabetes mellitus (NIDDM) practical targets and treatments. Asia-Pacific NIDDM Policy Group, 1995.
11. Ministry of Health. Clinical practice guidelines - diabetes mellitus, 1999.
12. Cheah JS, Lui KF, Yeo PPB, Tan YT, Ng YK. Diabetes mellitus in Singapore, results of a country-wide population survey. In: Cheah JS ed. Proceedings of the 6th Asian and Oceania Congress of Endocrinology. 1978; 227-38.
13. Epidemiology and disease control department. In: National Health Survey 1998. Ministry of Health, 1999; 5-9.
14. Zimmet P, McCarty DJ and Courten MP. The global epidemiology of non-insulin-dependent diabetes mellitus and the metabolic syndrome. Diabetes Care 1997; 11:60-8.
15. Harris MI. Health care and health status and outcomes for patients with type 2 diabetes. Diabetes Care 2000; 6:754-8.
16. American diabetes association. Diabetic nephropathy. Diabetes Care 1998: 21 Suppl 1:S50-S53.
17. Thai AC, Yeo PPB, Lun KC, Hughes K, Ng WY, Lui KF, Cheah JS. Diabetes mellitus and its chronic complications in Singapore: an increasing healthcare problem. Ann Acad Med Singapore 1990; 19(4):517-23.
18. McNeely MJ, Boyko EJ, Ahroni JH, Stensel VL, Reiber GE, Smith DG. and Pecoraro RF. The independent contributions of diabetic neuropathy and vasculopathy in foot ulceration. How great are the risks? Diabetes Care 1995; 18:216-9.
19. Reiber GE, Pecoraro RE. and Koepsell TD. Risk factors for amputation in patients with diabetes mellitus. Ann Intern Med 1992; 117:97-105.
20. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Eng J Med 1993; 329:977-86.
21. The Diabetes Control and Complications Trial Research Group. Prevention of neuropathy: the effect of intensive diabetes therapy on the development and progression of neuropathy in the DCCT. Ann Intern Med 1995; 122:564-8.
22. The Diabetes Control and Complications Trial Research Group. Effect of intensive therapy on the development of diabetic nephropathy in the DCCT. Kidney Int 1995; 47:1703-20.