Socioedemographic determinants of glycaemic control in young diabetic patients in peninsular Malaysia

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Received 26 April 1999; received in revised form 27 July 1999; accepted 20 August 1999

Abstract

Recent studies have shown that good glycaemic control can prevent the development of diabetic complications in type 1 and type 2 diabetes. We wished to observe the glycaemic control in patients from different centres in Peninsular Malaysia and the factors that determine it. We recruited 926 patients with diabetes diagnosed before age 40 years from seven different centres, with proportionate representation from the three main ethnic groups. Clinical history and physical examination were done and blood taken for HbA1c and fasting glucose. The overall glycaemic control was poor with geometric mean HbA1c of 8.6% whilst 61.1% of the patients had HbA1c greater than 8%. Glycaemic control in patients with type 2 diabetes varied between various centres and ethnic groups, with the best control obtained in Chinese patients. Significant predictors of HbA1c in both type 1 and type 2 diabetes include access to nurse educators, ethnic background and WHR. In type 2 diabetes, use of insulin was a significant predictor, while in type 1 diabetes, household income was a significant predictor. Socioeconomic status did not have a significant effect in type 2 diabetes. There were no significant differences in the glycaemic control in patients with different educational status. In conclusion, glycaemic control in big hospitals in Malaysia was poor, and was closely related to the availability of diabetes care facilities and ethnic group, rather than socioeconomic status. © 2000 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Diabetic control; Socioeconomic factors; Diabetes care facilities; Malaysia

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1. Introduction

Malaysia is a rapidly developing country with increasing urbanization and adoption of a more western lifestyle. This is reflected by the increase in the prevalence of diabetes in Malaysia from 1 to 2% in the 1960s [1], 3.9% in 1984 [2] to between 4.5 and 10% in the 1990's [3,4]. The second national mortality and morbidity study conducted by the Ministry of Health in 1996 showed that the prevalence of diabetes in Malaysia has increased to 8.3% [5] and confirmed other reports from Malaysia and Singapore [6,7]. Type 2 diabetes accounts for almost 95% of the diabetic population. Increasingly, more type 2 diabetes patients are diagnosed at a younger age compared to western countries [8].

Control of hyperglycemia can reduce the incidence of acute diabetic complications and long-term end-stage microvascular complications in both type 1 and type 2 diabetes [9–11]. There are indications that high blood glucose is implicated in the pathogenesis of coronary heart disease and is a risk factor for mortality in patients with diabetes [12–14]. Further, poor glycaemic control is associated with increased costs of medical care for patients with diabetes [15].

There are very few diabetes centres or diabetes specialists in Malaysia. The facilities for specialised diabetes care vary between States, with concentration in urban centres within the Klang Valley [16]. The number of trained personnel for diabetes is also concentrated in a few teaching hospitals. In addition, there are three ethnic groups in Malaysia, and these are genetically and culturally distinct. These three ethnic groups have different prevalence of diabetes and other cardiovascular risk factors such as obesity and dyslipidaemia [7,17]. Traditionally, the Malays are farmers, the Chinese are involved in business and the Indians mainly work in the estates, but these are changing with urbanization.

This study was carried out to assess the level of glycaemic control in patients who were diagnosed to have diabetes before the age of 40, from different centres throughout Malaysia, with different ethnic backgrounds, economic factors and educational opportunities. The aim was to examine determinants of glycaemic control in these patients, including relation to sociodemographic factors and facilities for diabetes care such as access to trained personnel.

2. Materials and methods

A total of 926 patients, all of whom had diabetes diagnosed before the age of 40 years, were recruited from seven centres throughout Peninsular Malaysia. The two main teaching hospitals in the largest urban area of Klang Valley, Universiti Kebangsaan Malaysia (Hospital UKM) and Universiti Malaya (Hospital UM) contributed 250 patients (27%) and 241 patients (26%), respectively. The Hospital Sultanah Aminah (Hospital JB) from the southern state of Johor contributed 218 patients (23.5%) while the two main hospitals in the northeastern state of Kelantan, Universiti Sains Malaysia (Hospital USM) and Hospital Kota Baru (Hospital KB) contributed 77 patients (8.3%) and 68 patients (7.3%), respectively. Two other peripheral hospitals in the central state of Melaka (Hospital Melaka) and the northern state of Penang (Hospital Penang) contributed 43 patients (4.6%) and 29 patients, respectively (3.1%). The three main ethnic groups in the country were each well represented with the Malays making up 45.5% (421 patients), and the Chinese and Indians each making up 27.2% (252 patients) and 27.3% (253 patients), respectively. The Indians were slightly over-represented in the sample probably due to the higher prevalence of diabetes in Indians [5]. Informed written consent was obtained from the patient or the parents, prior to the study. The study protocol was approved by the Ethics Committees of the various centres. Most patients were born after the Independence of the country in 1957 and, as a result, were exposed to better facilities and opportunities including better health care and education.

Consecutive patients who attended the diabetic and medical outpatient clinics at the above centres from June 1997 to June 1998 and fulfilled the age entry criteria were invited to participate in the trial. All patients who were invited agreed to participate and were representative of the popula-
tion attending the hospital concerned. They were asked to attend the various centres on a particular day after an overnight fast. Clinical history and physical examination specifically looked at the type of diabetes, mode of treatment, diabetic complications, educational status, and household income. Based on the clinical features, the clinical type of diabetes was recorded for each patient. Type 1 diabetes was defined on the basis of acute symptoms associated with heavy ketonuria (>3+) or ketoacidosis at diagnosis, or continuous treatment with insulin within one year of diagnosis [18]. Household income was expressed as total monthly family income divided by the number of persons in the family. Weight and height were measured with the subject in light clothing and without shoes and the body mass index (BMI) was calculated. Waist circumference was taken as the minimum circumference between the umbilicus and xiphoid process. Hip circumference was taken as the maximum circumference around the buttocks and symphysis pubis. The waist-to-hip ratio (WHR) was then calculated [19]. According to the recent Malaysian Consensus for management of type 2 diabetes, a healthy WHR for a female is <0.85 and that for a male is <0.95 [20]. Blood samples were taken for HbA$_1c$ and fasting glucose.

Glycaemic control was assessed by HbA$_1c$, calculated from the total glycated hemoglobin level determined using Abbott IMX (Abbott Laboratories, USA), where inter-assay CVs at 4.6, 7.9 and 12.4% were 4.1, 6.7 and 6.5%, respectively. The normal range of the assay is less than 6%. The current Malaysian Practice Guidelines for type 2 diabetes define ideal glycaemic control as HbA$_1c$ within 1.5% of the upper limit normal of assay and poor control as HbA$_1c$ greater than 2% above the upper limit of normal [20]. Blood glucose was measured using a glucose reflectance meter (Glucometer 4, Bayer Diagnostics, Germany). The brand of meter was previously evaluated in 90 specimens and the correlation coefficient between meter readings and laboratory values (measured on a Beckman glucose oxidase system) was 0.98 (95% C.I. 0.97–0.99).

Data was analyzed using the Minitab Statistical Software (version 12, Minitab Inc.). HbA$_1c$ was logarithmically transformed due to skewed distributions. Other variables such as BMI, WHR, age and duration of diabetes were normally distributed. The primary analysis of the study used analysis of covariance (ANCOVA) conducted on log$_e$(HbA$_1c$). The model included main effects of centres, ethnic groups, gender, educational status, household income and mode of treatment in type 2 diabetes. Covariates included BMI, WHR, age, age at diagnosis and duration of diabetes. The effect of centres was broken down to three main types of diabetes care facilities namely access to diabetologists, dietitians or nurse educators to determine if these have independent significant effects on log$_e$(HbA$_1c$). Household income was entered into the model as a categorical variable to avoid the assumption of a linear relationship between household income and log$_e$(HbA$_1c$). Since different Regions vary in the cost of living, patients from each centre were categorised into 4 quartiles based on the household income of the patients recruited from that centre. These patients were classified as Group 1, which comprised patients from the lowest quartile of household income to Group 4, which comprised the highest quartile of household income. One-way ANOVA was used to analyse differences between groups and group comparisons used Tukey’s method. Multiple regression analysis was used to assess the significance of the various factors on the variance of log$_e$(HbA$_1c$). Variables which had significant effect and were included in the regression analysis were ethnic groups (coded using 2 dummy variables E1 and E2, where Malays were coded E1 = 1, E2 = 0, Chinese were coded E1 = 0, E2 = 1, and Indians were coded E1 = 1, E2 = 0), access to diabetologist and biochemistry lab (‘no’ coded as 0, ‘yes’ coded as 1), access to dedicated dietitian (‘no’ coded as 0, ‘yes’ coded as 1), access to dedicated nurse educator (‘no’ coded as 0, ‘yes’ coded as 1), gender (males coded as 1, females coded as 2), household income group (coded using three dummy variables, H1, H2 and H3 where Group 1 was coded H1 = 0, H2 = 0, H3 = 0, Group 2 by H1 = 1, H2 = 0, H3 = 0, Group 3 by H1 = 0, H2 = 1, H3 = 0 and Group 4 by H1 = 0, H2 = 0, H3 = 1) and treatment with insulin in subjects with type 2 diabetes (‘no’ coded as 0, ‘yes’
coded as 1). Values were expressed as mean (± SEM) or geometric mean (95% CI) where appropriate.

3. Results

Of the 926 patients, 329 patients (35.5%) were classified as type 1 diabetes, while 597 patients (64.5%) were classified as type 2 diabetes. Of the type 2 patients, 167 (28.0%) required insulin. Male patients made up 47.8% (443 patients) while female patients comprised 52.2% (483 patients).

3.1. Overall glycaemic control

The overall glycaemic control of young diabetics in Malaysia, as assessed by HbA1c, was poor with geometric mean HbA1c of 8.6% (95% CI 6.1–11.2%). The majority of patients (61.1% or 551 patients) had HbA1c greater than 8% (i.e. 2% above the normal range and the level at which the American Diabetes Association recommends intensification of therapy to improve glycaemic control). Only 28.8% of the patients (260 patients) had HbA1c below 7.5% (i.e. within 1.5% of the normal range). Glycaemic control was better in type 2 diabetes (geometric mean HbA1c of 8.5% (95% CI 6.1–11.0%) compared with type 1 diabetes (geometric mean HbA1c 8.9% (95% CI 6.3–11.4%), (t = 2.07, P = 0.04).

3.2. Glycaemic control in type 2 diabetes

The mean age at diagnosis of diabetes in adults with type 2 diabetes was 30.8 years, and the mean duration of diabetes since diagnosis was 8.6 years. The racial/ethnic distribution was 50.6% Malays, 27% Indians, and 22.4% Chinese and this ethnic distribution is similar to the general population. Glycaemic control in type 2 diabetes was poor (geometric mean HbAlc of 8.5% (95% CI 6.1–11.0%). The majority of type 2 diabetes patients (60.5%) have HbA1c greater than 8.0%. Less than a third (30.5%) of the patients are in the acceptable range of HbA1c less than 7.5%.

In type 2 diabetes, the factors with significant effects on loge HbA1c were centres (F = 4.49, P < 0.001), ethnic groups (F = 3.74, P = 0.02) and mode of treatment (F = 14.4, P < 0.001). When the effect of centre was broken down, only access to nurse educators had a significant effect (F = 11.6, P = 0.001) on loge HbA1c. WHR was the only covariate that had a significant effect (F = 12.8, P < 0.001) on loge HbA1c. One-way ANOVA showed that glycaemic control varied significantly between centres (F = 5.6, P < 0.0001) (Table 1). The best control was obtained in Hospital Melaka and Hospital UM. Poor glycaemic control was obtained at the two centres on the East Coast, Hospital Melaka and Hospital UM, and also at Hospital UKM and Hospital JB. Comparisons between centres showed significant differences between Hospital UM and Hospital UKM (95% CI of difference in geometric means: 1.0–1.2%), Hospital JB (95% CI of difference in geometric means: 1.0–1.2%), Hospital KB (95% CI of difference in geometric means: 1.0–1.3%) and Hospital USM (95% CI of difference in geometric means: 1.0–1.3%), and between Hospital Melaka compared with Hospital KB (95% CI of difference in geometric means: 1.0–1.4%) and Hospital USM (95% CI of difference in geometric means: 1.0–1.4%) (Table 1). There was also a significant difference between the ethnic groups (F = 7.82, P < 0.0001). The best control was obtained in Chinese patients compared with Malay patients (95% CI of difference in geometric means: 1.0–1.2%) (Table 2). There was also a significant difference between different modes of treatment. Better control was obtained when insulin was not used (geometric mean 8.4% (95% CI 5.9–10.9%) versus 8.9% (95% CI 6.3–11.5%), F = 7.1, P = 0.008). There was no difference between the sexes, educational status of the patients or household income group.

Multiple linear regression analysis resulted in the equation:

\[
\log_e(HbA_{1c}) = 1.71 + 0.52*\text{WHR}
\]

\[
-0.12*(\text{Access to educator}) - 0.057*\text{E2}
\]

\[
+ 0.089*\text{Treatment}
\]
Table 1
Sociodemographic features of patients with type 2 diabetes according to centres/hospitals

<table>
<thead>
<tr>
<th>Hospitals/centres</th>
<th>Geometric mean (95%CI) HbA1c (%)</th>
<th>Ethnic groups (% of pts)</th>
<th>Treatment (% of patients)</th>
<th>Median household income (RM/month/person)</th>
<th>Mean WHR</th>
<th>Mean BMI (Kg/m²)</th>
<th>Mean Age at diagnosis (years)</th>
<th>Mean age (years)</th>
<th>Mean duration (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chinese</td>
<td>Indian</td>
<td>Malay</td>
<td>OHA</td>
<td>Ins</td>
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<tr>
<td>Hospital UKM (n = 115)</td>
<td>8.8 (6.2–11.3)</td>
<td>17.4</td>
<td>32.2</td>
<td>50.4</td>
<td>67.0</td>
<td>33.0</td>
<td>RM233.00</td>
<td>0.88</td>
<td>25.5</td>
</tr>
<tr>
<td>Hospital Penang (n = 23)</td>
<td>8.2 (5.8–10.5)</td>
<td>21.7</td>
<td>52.2</td>
<td>26.1</td>
<td>95.6</td>
<td>4.3</td>
<td>RM150.00</td>
<td>0.90</td>
<td>25.5</td>
</tr>
<tr>
<td>Hospital KB (n = 56)</td>
<td>9.2 (6.7–11.6)</td>
<td>8.9</td>
<td>3.6</td>
<td>87.5</td>
<td>91.1</td>
<td>8.9</td>
<td>RM133.50</td>
<td>0.90</td>
<td>26.3</td>
</tr>
<tr>
<td>Hospital USM (n = 63)</td>
<td>9.0 (6.6–11.5)</td>
<td>16.0</td>
<td>6.3</td>
<td>77.7</td>
<td>68.2</td>
<td>31.7</td>
<td>RM175.00</td>
<td>0.88</td>
<td>24.4</td>
</tr>
<tr>
<td>Hospital JB (n = 155)</td>
<td>8.8 (6.3–11.3)</td>
<td>16.8</td>
<td>27.7</td>
<td>55.5</td>
<td>85.8</td>
<td>14.2</td>
<td>RM250.00</td>
<td>0.88</td>
<td>27.6</td>
</tr>
<tr>
<td>Hospital Melaka (n = 27)</td>
<td>7.6 (5.2–10.1)</td>
<td>59.3</td>
<td>11.1</td>
<td>29.6</td>
<td>85.2</td>
<td>14.8</td>
<td>RM286.00</td>
<td>0.88</td>
<td>26.1</td>
</tr>
<tr>
<td>Hospital UM (n = 158)</td>
<td>8.0 (5.5–10.4)</td>
<td>32.9</td>
<td>38.0</td>
<td>29.1</td>
<td>51.3</td>
<td>48.7</td>
<td>RM417.00</td>
<td>0.88</td>
<td>25.8</td>
</tr>
<tr>
<td>Overall</td>
<td>8.5 (6.1–11.0)</td>
<td>22.4</td>
<td>27.0</td>
<td>50.6</td>
<td>72.0</td>
<td>28.0</td>
<td>RM250.00</td>
<td>0.88</td>
<td>26.1</td>
</tr>
<tr>
<td>Ethnic group</td>
<td>Geometric mean (95%CI) HbA₁₀ (%)</td>
<td>Treatment (% of pts)</td>
<td>Median household income (RM/month/person)</td>
<td>Mean WHR (Kg/m²)</td>
<td>Mean BMI</td>
<td>Mean age at diagnosis (years)</td>
<td>Mean age (years)</td>
<td>Mean duration (years)</td>
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<tr>
<td>Chinese</td>
<td>8.0 (5.6-10.4)</td>
<td>64.9</td>
<td>35.1</td>
<td>RM350</td>
<td>0.88</td>
<td>26.7</td>
<td>31.2</td>
<td>38.9</td>
<td>7.3</td>
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<td>(n = 134)</td>
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<tr>
<td>Indian</td>
<td>8.5 (6.0-11.0)</td>
<td>69.6</td>
<td>30.4</td>
<td>RM240</td>
<td>0.88</td>
<td>25.3</td>
<td>29.7</td>
<td>40.7</td>
<td>10.8</td>
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<tr>
<td>(n = 161)</td>
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<tr>
<td>Malay</td>
<td>8.8 (6.3-11.3)</td>
<td>76.5</td>
<td>23.5</td>
<td>RM225</td>
<td>0.89</td>
<td>25.6</td>
<td>31.0</td>
<td>40.2</td>
<td>9.1</td>
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<td>(n = 302)</td>
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</tbody>
</table>
The majority of patients (62.3%) had Hba1c greater than 8.0%, while only 25.8% had Hba1c less than 7.5%. In type 1 diabetes, the factors with significant effects on loge Hba1c were access to nurse educators (F = 4.3, P = 0.04), ethnic groups (F = 3.8, P = 0.02), and household income category (F = 2.84, P = 0.04). WHR was the only covariate that had a significant effect (F = 9.4, P = 0.002) on loge Hba1c. One-way ANOVA showed that glycaemic control in type I diabetes varied significantly in different centres (F = 5.7, P < 0.0001). The best control was obtained at Hospital UM and Hba1c was significantly lower in Hospital UM when compared with Hospital KB (95% CI of difference in geometric means: 1.1–1.9), Hospital JB (95% CI of difference in geometric means: 1.0–1.3) and Hospital UKM (95% CI of difference in geometric means: 1.0–1.3). The worst control was obtained in Hospital KB and Hba1c was significantly higher in Hospital KB when compared with Hospital Melaka (95% CI of difference in geometric means: 1.1–2.0), and Hospital Penang (95% CI of difference in geometric means: 1.0–2.2) (Table 3).

Multiple linear regression analysis resulted in the following equation:

\[
\log_e(Hba1c) = 1.76 + 0.633* \text{WHR} - 0.12*(\text{Access to educator}) + 0.071* \text{E1} - 0.093* \text{H1} - 0.099* \text{H2} - 0.16* \text{H3}
\]

(R² = 15.4%, F = 7.8, P < 0.0001), P values for the coefficients were P < 0.001 for Educator access and H3, P = 0.04 for E1, P = 0.005 for WHR and P = 0.02 for H1 and H2.

Glycaemic control was also significantly different between the various ethnic groups (F = 13.0, P < 0.0001). The best control was obtained in Chinese patients. Hba1c in Chinese patients was significantly lower when compared with Indian (95%CI for difference in geometric means 1.1–1.3%) or Malay (95%CI for difference in geometric means 1.0–1.2%) patients (Table 4). There were no differences between the sexes or educational status of patients.

The ethnic distribution was significantly different between the centres (χ² = 68.39, DF = 12, P < 0.0001) (Table 3). In Hospital UM, there were proportionately more Chinese patients, in
Table 3
Sociodemographic features of patients with type 1 diabetes according to centres/hospitals

<table>
<thead>
<tr>
<th>Centre</th>
<th>Geometric mean (95%CI) HbA₁c (%)</th>
<th>Ethnic groups (% of pts)</th>
<th>Median income (RM/month/person)</th>
<th>Mean WHR</th>
<th>Mean BMI (kg/m²)</th>
<th>Mean age at diagnosis (years)</th>
<th>Mean age (years)</th>
<th>Mean duration (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital UKM</td>
<td>9.2 (6.7-11.7)</td>
<td>37.0</td>
<td>34.1</td>
<td>28.9</td>
<td>RM241.50</td>
<td>0.83</td>
<td>20.2</td>
<td>14.6</td>
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<td>(n = 135)</td>
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<tr>
<td>Hospital Penang</td>
<td>7.7 (5.4-10.0)</td>
<td>66.7</td>
<td>16.7</td>
<td>16.7</td>
<td>RM212.50</td>
<td>0.82</td>
<td>24.1</td>
<td>23.5</td>
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<td>(n = 6)</td>
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<tr>
<td>Hospital KB</td>
<td>11.8 (9.3-14.2)</td>
<td>7.1</td>
<td>92.9</td>
<td></td>
<td>RM74.00</td>
<td>0.82</td>
<td>24.9</td>
<td>24.6</td>
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<td>(n = 12)</td>
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<tr>
<td>Hospital USM</td>
<td>8.7 (6.0-11.3)</td>
<td>7.1</td>
<td>30.2</td>
<td>47.6</td>
<td>RM177.00</td>
<td>0.85</td>
<td>22.3</td>
<td>24.6</td>
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<td>(n = 14)</td>
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<tr>
<td>Hospital JB</td>
<td>9.3 (6.7-11.9)</td>
<td>22.2</td>
<td>30.2</td>
<td>47.6</td>
<td>RM167.00</td>
<td>0.82</td>
<td>20.9</td>
<td>16.9</td>
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<tr>
<td>(n = 63)</td>
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<tr>
<td>Hospital Melaka</td>
<td>8.1 (5.6-10.6)</td>
<td>62.5</td>
<td>37.5</td>
<td></td>
<td>RM216.50</td>
<td>0.82</td>
<td>21.7</td>
<td>19.8</td>
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<td>(n = 16)</td>
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<tr>
<td>Hosp UM</td>
<td>8.0 (5.5-10.5)</td>
<td>47.0</td>
<td>31.3</td>
<td>21.7</td>
<td>RM333.00</td>
<td>0.83</td>
<td>23.2</td>
<td>22.8</td>
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<td>(n = 83)</td>
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</tr>
<tr>
<td>Overall</td>
<td>8.9 (6.3-11.4)</td>
<td>35.8</td>
<td>28.0</td>
<td>36.2</td>
<td></td>
<td>0.83</td>
<td>21.4</td>
<td>18.4</td>
</tr>
</tbody>
</table>
Table 4
Sociodemographic features of patients with type 1 diabetes according to ethnic group

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Geometric mean HbA1c (%)</th>
<th>Median household income (RM/month/person)</th>
<th>Mean WHR</th>
<th>Mean BMI (Kg/m²)</th>
<th>Mean age at diagnosis (years)</th>
<th>Mean age (years)</th>
<th>Mean duration (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese</td>
<td>8.1 (5.6–10.6)</td>
<td>300</td>
<td>0.81</td>
<td>21.3</td>
<td>17.5</td>
<td>26.1</td>
<td>8.6</td>
</tr>
<tr>
<td>(n = 118)</td>
<td></td>
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<tr>
<td>Indian</td>
<td>9.6 (7.1–12.1)</td>
<td>200</td>
<td>0.84</td>
<td>21.1</td>
<td>18.9</td>
<td>25.9</td>
<td>6.7</td>
</tr>
<tr>
<td>(n = 92)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Malay</td>
<td>9.1 (6.6–11.7)</td>
<td>220</td>
<td>0.83</td>
<td>21.7</td>
<td>18.9</td>
<td>25.4</td>
<td>6.5</td>
</tr>
<tr>
<td>(n = 119)</td>
<td></td>
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</tr>
<tr>
<td>Overall</td>
<td>8.9 (6.3–11.4)</td>
<td></td>
<td>0.83</td>
<td>21.4</td>
<td>18.4</td>
<td>25.8</td>
<td>7.3</td>
</tr>
</tbody>
</table>


contrast to the East Coast centres of Hospital USM and Hospital KB where Malay patients were predominant. The household income was also significantly different \((H = 37.6, P < 0.0001)\) with the highest median income in Hospital UM (RM333/month/person), while the lowest was found in Hospital JB (RM167/month/person) and Hospital KB (RM74/month/person). There were significant differences in the BMI of patients \((F = 4.5, P < 0.0001)\). Patients from Hospital UM had significantly higher BMI compared with patients from Hospital UKM (95\% CI for difference in means: 1.2–4.8 kg m\(^{-2}\)) and Hospital JB (95\% CI for difference in means: 0.1–4.4 kg m\(^{-2}\)). There was no significant difference in the WHR \((P = 0.58)\).

As for type 2 diabetes, there were also significant differences in the demographic features of the ethnic groups. The household income was highest in Chinese (median RM300/month/person) and lowest in Indians (median RM200/month/person) \((H = 7.1, P = 0.03)\). However, when the household income was stratified according to quartiles, there was no difference in the proportion of the various household income groups among the ethnic groups. Similarly, there were significant differences in the WHR \((F = 6.0, P = 0.003)\) with Chinese patients having significantly lower WHR compared with Indians (95\% CI for difference in means: 0.01–0.06) (Table 4).

4. Discussion

The present study looked at glycaemic control 926 young patients with diabetes at various hospitals and centres in peninsular Malaysia in 1997–98. To obtain a clearer picture of the standard of care and glycaemic control of diabetes, the study was carried out at centres/hospitals at various regions of the country with different ethnic mixes and socioeconomic and educational status, and also with different facilities for diabetes care.

The present study found that the glycaemic control of diabetes throughout Peninsular Malaysia was poor, similar to that found in a previous smaller study in Malaysia [21]. The proportion of patients with \(\text{HbA}_{1c}\) greater than 8.0\% is very high (61.1\%) compared with 37.1\% found in the Third National Health and Nutrition Examination Survey (NHANES III) [22], 44\% in type 2 patients in Italy [23] and 56\% of patients in Finland [24]. To resolve the various confounding factors that could determine the glycaemic control as assessed by \(\text{HbA}_{1c}\), we did an analysis of covariance with all the factors and covariates, and this showed that the main factors determining the \(\text{HbA}_{1c}\) were access to nurse educators, ethnic group and WHR in both type 1 and type 2 diabetes. In addition, treatment with insulin was an important factor in type 2 diabetes while in type 1 diabetes, household income was a significant factor. The other factors considered in the analysis such as gender and educational status did not have a significant effect on glycaemic control. The other covariates such as age, age at diagnosis, duration of diabetes and BMI were not significant determinants of glycaemic control.

Our data suggest that availability of diabetes care facilities was an important determinant of glycaemic control. However, the type of facilities available was also important. Access to a diabetes educator was a major independent determinant of glycaemic control, and more important than access to a diabetologist or medical nutritionist, which did not feature in the analysis. There were only two centres that had access to nurse educators, i.e. Hospital UM and Hospital Melaka, and these two centres had the best glycaemic control, whereas Hospital USM with three diabetologists and no nurse educators had the worst control. It is likely that because of the shortage of diabetologists, too little time was spent with each patient while nurse educators were able to spend more time with patients, thus providing a better service as shown by others [25,26]. Further evidence of the critical importance of the educational process is provided by the widely diverse results achieved by the same type of intervention in different hands. Thus Hadden and colleagues [27] obtained considerably more weight loss with an apparently identical diet to those used by the UK Prospective Diabetes Study group [28].

Ethnicity was an important independent determinant of glycaemic control in both types of diabetes, independent of the socioeconomic status. This may explain in part the good control
obtained in Hospital UM and Hospital Melaka where there were proportionately more Chinese patients. The reason for this observation remains uncertain. The prevalence of diabetes is lowest in Chinese [2,7,17]. In the age group 30–69 years, the prevalence of diabetes was 18.0% in Asian Indians, 14.1% in Malays and 11.2% in Chinese subjects while the calculated insulin resistance in the general population was highest in Indians and lowest in Chinese [7]. It is possible that the factors that protect the Chinese from diabetes, either genetic or cultural or both, also contributed to the better glycaemic control. In type 1 diabetes, being Indian resulted in poorer glycaemic control, and this effect was independent of socioeconomic status. It is possible that insulin resistance which is higher in Indians, contributed to the poorer glycaemic control [7].

WHR, not BMI, was an important determinant of control in both type 1 and type 2 diabetes. BMI is closely associated with total body fat mass, while WHR is a simple estimation of abdominally distributed fat mass [29]. Intra-abdominal fat is the main fat store responsible for insulin resistance [30]. Thus WHR was a significant determinant of glycaemic control in these young diabetic subjects. This has also been previously reported in type 2 diabetic patients [31,32].

Patients on insulin were more likely to have poor glycaemic control, independent of the centres and ethnicity. It is likely that insulin was introduced in patients who were poorly controlled due to secondary pancreatic failure, and thus use of insulin was a result of poor control, rather than the cause. Similar observations were made in other studies [22].

Socioeconomic status as measured by household income or educational status was not an important determinant of glycaemic control in type 2 diabetes. The lack of association of glycaemic control with socioeconomic status was also found in a Michigan community study of whites [33] and a South Carolina study of blacks and whites [34] in which poor glycaemic control was not associated with educational level. In San Antonio, Texas, low socioeconomic status was not predictive of greater levels of hyperglycemia or retinopathy in either non-Hispanic whites or Mexican Americans [35]. The finding that socioeconomic status is not associated with poor glycaemic control is in marked contrast to relationships in non-diabetic patients, where socioeconomic status is often an important factor in morbidity.

In contrast to type 2 diabetes, household income was an important determinant of glycaemic control in type 1 diabetes and this confirms previous studies in type 1 diabetes [36,37]. Fewer financial resources may force the patients to place less emphasis on both preventative care and quality medical services. In contrast to Western countries, there is no National Health Insurance in Malaysia, and the cost of meters and strips are not subsidised. As a result, it is expensive for a patient with type 1 diabetes to do home monitoring. Type 2 patients, especially those on diet alone or oral hypoglycaemics, may still be able to maintain good control without having to monitor their glucose regularly.

In contrast to previous studies [38], we did not find any effect of educational status on the glycaemic control. Many of our patients may not have had the opportunity for tertiary education but have been able to find work with a respectable income.

Age was not an important determinant of glycaemic control, in contrast to other previous findings in type 1 diabetic patients [36,39]. Diabetic patients who were more mature, and perceived themselves to have control over their lives, maintained better glycaemic control [40]. In our study, although glycaemic control was negatively correlated with age, this effect disappeared when other factors were included in the analysis.

In conclusion, diabetes control in most big hospitals in Malaysia was poor in 1997–98, and was closely linked to the availability of facilities and ethnicity. The importance of access to a nurse educator was well demonstrated in Kelantan State, where there was no nurse educator available. Thus, both a teaching hospital (Hospital USM) with adequate number of diabetologists, and a general hospital (Hospital KB) with only one physician interested in diabetes had equally poor glycaemic control. Ethnicity was an important independent predictor of glycaemic control in
both type of diabetes. This observation warrants further study. In view of the possible political implications, this problem of inequality of diabetes control should be considered in future planning for health care delivery in this country.

Acknowledgements

This study was supported by a research grant 06-02-02-0056 from the Ministry of Science, Technology and Environment, Malaysia. The authors wish to thank all the Medical Laboratory Technologists who were involved in this nation-wide study for their assistance.

References


