ORIGINAL ARTICLE

Changing Prevalence of Diabetes Mellitus Amongst Rural Malays in Kuala Selangor over a 10-Year Period

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Summary

A cross-sectional study was carried out to determine the prevalence of diabetes mellitus and its relationship with age, physical activity, nutritional status and diet amongst rural Malays in Kuala Selangor. By simple random sampling 360 subjects were selected for the study. Besides guided questionnaires, subjects also underwent a 2 hours post prandial (2HPP) test to determine the diabetic status as recommended by WHO. The crude prevalence of diabetes mellitus was 14.6% which increases with age. The prevalence of diabetes adjusted for age was 12.2%. Physical activity status seemed to be a significant risk factor for diabetes. A greater proportion of diabetics was obese and their mean fat intake was higher than normal subjects ($p<0.05$). The prevalence of diabetes mellitus in this study was significantly higher compared with data from 1984 (3.9%), representing a marked increment of 212.8 per cent over a 10-year period.

Key Words: Prevalence of diabetes, Rural Malays, Risk factors, Ten-year period

Introduction

Diabetes mellitus is a chronic non communicable disease that is fast gaining public health importance in the world because of the magnitude of the problem as well its preventable undesirable side effects. Uncontrolled diabetes is associated with a number of complications and may result in blindness, kidney failure, hypertension and heart attack[1]. Over the past decades a number of studies have shown differences in the prevalence and incidence of non-insulin dependent diabetes mellitus (NIDDM) among various geographical regions as well as in different ethnic groups[2]. It is now generally accepted that the sociocultural transformation of certain ethnic groups, e.g., the adoption of a westernized lifestyle, increases the prevalence of diabetes[3,4].

There is an interaction of genetic and environmental risk factors[5] such as, physical activity and diet in the development of diabetes. In one study, the prevalence of diabetes among the urban population in Western Samoa was almost 3 times that in the rural (10.1% versus 3.6%). After controlling for differences in obesity and age, the prevalence was still two times higher in urban subjects[6]. A countrywide prevalence study carried out in Singapore in 1975 found that the prevalence of diabetes was 1.99%[7]. A second study done in 1985[8] reported a prevalence rate of 4.7%, representing a 135% rise over the 10-year period.

A community-based study of rural Malays in Kuala Selangor found the prevalence of diabetes to be 3.9%[9]. The most recent study done by Osman in Pahang and Kuala Lumpur showed that the crude prevalence of diabetes in a traditional Malay village was 2.8% and in the land development scheme was 6.7%, whereas urban Malays had a prevalence of

8.2%[10]. However it was difficult to make a comparison with previous study due to different geographical area and study design. Thus this study was conducted in the same area and the methodology used was similar as in the study done by Osman *et al* for the purpose of comparing the prevalence of NIDDM over a ten-year period.

Research Design and Methods

Sampling

The 1994 survey was performed in the same geographically defined areas as the 1984 survey. A cross sectional study was conducted in three villages with a predominantly Malay population, i.e. Kampung Asam Jawa, Kampung Api-Api and Kampung Pasir Tuntung in the Api-Api subdistrict of Kuala Selangor from November 1993 to January 1994. The target group included all individuals aged 15 years and above who resided in the abovementioned villages. A house-to-house census was completed in the month before the commencement of the survey to record the names of all eligible residents. Then by simple random sampling a sample size of 360 subjects were chosen. Elderly people who were incapacitated and/or suffering from dementia, those who were staying in the villages only during weekend and pregnant women were excluded from the study.

Survey procedure

A guided questionnaire was administered by one of the trained interviewers at the selected subject's house. Information on socio-economic status, family history of diabetes, physical activities and 24-hour dietary recall was collected. Both occupational and leisure activities were graded on separate three-level scales. For occupational activity the scale was as follows: 1) light physical activity, e.g., office work and housework; 2) moderate, e.g., tradework, mechanical farming; and 3) heavy, e.g., manual labour. Leisure activity was graded as 1) light, e.g., gardening; 2) moderate, e.g., games or aerobics sports 1-2 days per week; and 3) heavy, e.g., games or aerobic sports ≥ 3 days per week.

Subjects were informed to come to special survey clinics conveniently sited in their villages between 0730 and 1000 hrs after an overnight fast. After registration, capillary blood was collected by finger prick from all subjects and fasting blood glucose level was measured using Hemo-glucotest strips and Ames glucometer[11] as was done in the 1984 study. Fasting serum cholesterol levels were determined by the Reflotron analyzer method (Boehringer Mannheim). Fasting serum cholesterol < 5.2 mmol/L was considered as normal. Then all subjects except those taking oral hypoglycemic tablets and those with fasting blood sugar of less than 7.0 mmol/L, were given 75 g of glucose diluted in 250 ml of water and drunk over a period of ≤ 5 minutes. The 2-hour post prandial (2HPP) blood sugar was measured using similar method as described above.

Height was measured to the nearest 0.5 cm using microtoise tape. Weight was determined on a good quality portable scale (SECA) up to 0.5 kg accuracy with the subjects in light clothing and without shoes. The scale was calibrated daily with a standard weight of 5 kg. Body mass index (BMI) was calculated as kg/m^2. Blood pressure was measured by the researcher on the right arm of subjects who were seated and rested, using standard mercury sphygmomanometer and large adult-sized cuffs. Systolic blood pressure (sBP) was recorded at the level of appearance of sound and diastolic blood pressure (dBP) at the level of its disappearance (phase 5) to the nearest 5 mmHg. In this study hypertension was taken as systolic pressure of more than 140 mmHg and/or diastolic pressure equal or more than 90 mmHg.

Skinfold thickness was measured on the right side of the body using Herpenden skinfold calipers at four sites; 1) subscapular, i.e., just below the tip of the inferior angle of the scapula, at an angle of about 45° to the vertical; 2) triceps, i.e., over the mid-point of the muscle belly, mid-way between the olecranon and the tip of the acromion, with the upper arm hanging vertically; 3) biceps, i.e., over the mid-point of the muscle belly with the arm resting supinated; 4) supra iliac, i.e., just above the iliac crest at the midaxillary line. At these four sites, the skinfold was pinched up firmly between the thumb and forefinger and pulled away slightly from the underlying muscles before applying the calipers for the measurement. Estimation of body fat percentage from skinfold was calculated using Durnin's formula. Body fat of 20% or higher

for men and 30% or above for women were used as the cut off point for obesity respectively[12].

1984 procedure

Methods used in the 1984 survey have been described in detail elsewhere[9] and were very similar to those described above, with some exceptions. Normal weight was defined as ± 10% of ideal weight. Physical activity, dietary intake and skinfold thickness were not assessed.

Classification of glucose tolerance

This was based on World Health Organisation (WHO) criteria and modified for survey conditions. If subjects said they had diabetes and 1) reported current use of oral hypoglycemic tablets, or 2) had a 2-h glucose reading > 11.0 mM/l, they were classified as having known diabetes. Subjects not reporting diabetes and with a 2-h plasma glucose reading > 11.0 mmol/l was classified as having newly diagnosed diabetes. A 2-h plasma glucose concentration ≥ 7.0 but ≤ 11.0 mM/l indicated impaired glucose tolerance (IGT), and normal glucose tolerance (NGT) was defined by a fasting blood sugar < 7.0 mM/.

Statistical analysis

Data were analyzed using Epiinfo version 5.0 and SAS. Chi-square significance test was used for group or categorical data and Student's t test was used for continuous independent variables. The criterion for statistical significance was $p < 0.05$. For comparison, the prevalence of diabetes mellitus was age-standardized by the direct method using age-specific population in the 1984 survey as the standard population.

Results

Household and demographic characteristics

Of the 360 subjects interviewed, 260 had their blood tested and this gave an overall response rate of 72.2%. Almost all respondents' households (99.2%) had electricity and piped water supply and 78.3% had one or more motor vehicles. The mean respondents' income was RM460 per month. One hundred and forty eight (56.9%) of the respondents were women and the mean age was 46.5 ± 15.7 years, (42.5 ± 14.9 and 51.9 ± 15.3 years for women and men respectively).

1994 prevalence and risk factors

The overall crude prevalence rate of diabetes and IGT were 14.6% and 11.5% respectively (Fig. 1). The difference in the prevalence rate of diabetes between male (12.5%) and female (16.2%) was not significant. Of the 38 subjects who had diabetes, 39.5% were previously known diabetics and 60.5% were newly diagnosed diabetics, a ratio of 2:3.

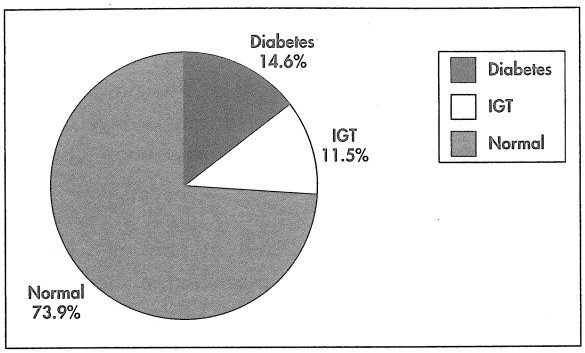

Fig. 1: Prevalence of diabetes and impaired glucose tolerance (IGT)

The prevalence of diabetes rose with age except in the youngest and oldest age groups (Fig. 2); the high prevalence in the 15-24 age group was probably due to small sample size, whereas the unusually low prevalence in the 65 years and above age group is more likely due to the fact that diabetics tend to have shorter life expectancy. The prevalence of diabetes was 5.9% in the below 40 years age group but markedly increased to 18.9% for those who were 40 years and above age ($p < 0.05$).

The prevalence of diabetes was highest in light activity group (18.4%) followed by 7.3% in moderate activity group and none in the heavy activity group (Table I). There was a significant difference in the mean of BMI between normal (24.7 ± 4.7 kg/m^2) and diabetics respondents (28.7 ± 4.7 kg/m^2). Of the diabetics, 63.2% were obese as compared to only 38.4% among normal subjects when they were classified according to body fat percentage ($p < 0.05$). Mean fat intake was found to be higher amongst diabetic (28.3 ± 6.2gm than normal; vs 23.7 ± 8.4 gm $p < 0.05$). There was no significant difference in other nutrient intake. It was interesting to note that mean

fasting cholesterol had an ascending trend according to glucose tolerance; from normal, to IGT, newly diagnosed diabetics and highest in known diabetics ($p > 0.05$) (Table II). The mean diastolic pressure of diabetics (88.6 ± 2.3 mmHg) was significantly higher than normal subjects (83.5 ± 2.3 mmHg).

Temporal trends

Changes between 1984 and 1994. For the same survey areas, a higher prevalence of NIDDM was observed in 1994 compared with 1984 in each age-group as clearly shown in Figure 3. The prevalence of a family history of diabetes among subjects with NIDDM was 15.3% in 1984 and has almost doubled in 1994 (28.9%).

There was no change observed in ratio of known case of diabetes and newly diagnosed diabetics, i.e., 2:3 over the 10-year period (Table III). Mean respondents age in 1984 and 1994 were 38.5 ± 16.5 and 46.6 ± 15.7 years respectively ($p < 0.05$). Using age-specific population in 1984 as the standard population, the age-standardized prevalence of diabetes

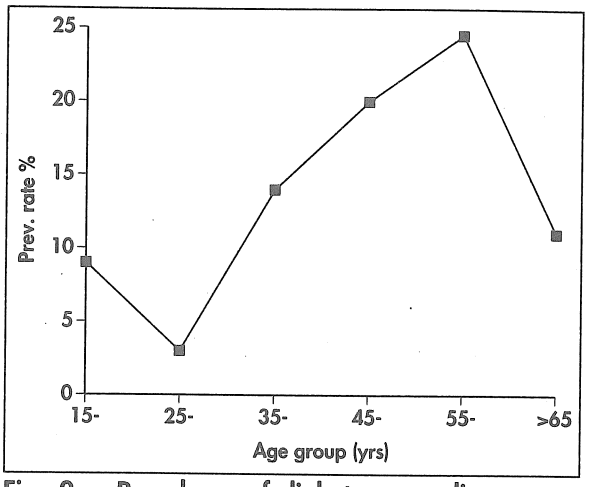

Fig. 2: Prevalence of diabetes according to age groups

in 1994 was 12.2% and it was significantly higher compared with 1984 (3.9%). The prevalence of NIDDM has increased dramatically (212.8%) over a ten-year period.

Table I
Prevalence of diabetes mellitus according to level of physical activity

Physical activity Status	No. examined	No. with diabetes	Prevalence rate (%)
Light activity	174	32	18.4
Moderate activity	82	6	7.3
Heavy activity	4	0	0.0

$X^2 = 6.17$ $df = 2$ $p < 0.05$

Table II
Mean fasting serum cholesterol by glucose tolerance status

Glucose tolerance Status	No. examined	Mean fasting cholesterol ± SD (mmol/L)
Normal	192	5.14 ± 1.09
IGT	30	5.24 ± 0.72
Newly diagnose diabetics	23	5.31 ± 1.11
Known diabetics	15	5.66 ± 1.45

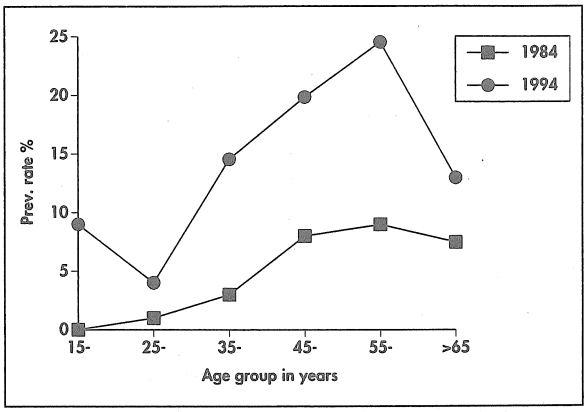

Fig. 3: Prevalence of NIDDM across age-groups in 1984 and 1994

Discussion

The prevalence of diabetes has increased substantially between 1984 and 1994 in the population of rural Malays in Kuala Selangor. This is the first study to demonstrate directly an increasing prevalence of NIDDM in a modernizing Malaysian population. The prevalence of diabetes amongst the Singapore Malay ethnic group was 2.4% in 1975 which jumped to 7.6% in 1985. This represent a 212.7% increment over a ten-year period[13]. Therefore the prevalence of diabetes has increased dramatically amongst Malays irrespective of whether they reside in Malaysia or Singapore. In the rural areas, as in Kuala Selangor, the effects of modernization, such as dietary changes, motor vehicles and mechanization of agricultural activities, are now being seen. Women in Kuala Selangor are predominantly leading sedentary lifestyles. Obesity was found to be a significant risk factor for diabetes in the present study. In muscular individuals, skinfold thickness measurement usually gives a better estimate of body fat (adipose tissue) than BMI. Body adiposity has been known to have a close relationship with the occurrence of hyperinsulinaemia in NIDDM subjects[14]. An association between physical activity and the occurrence of NIDDM has been shown in this study and others[15,16]. The mechanism of this association is suggested by studies that have shown improvements in glucose tolerance and increased insulin sensitivity associated with increased physical activity[17].

The prevalence of diabetes increased with age in this study, especially among those who are above 40 years old. Both the 1984 and the present studies showed that the ratio of previously diagnosed diabetics to newly diagnosed diabetics was 2:3. This implies that for every 2 known cases of diabetes there may be 3 more still undiagnosed diabetics in the community.

Like some population groups with a high prevalence of NIDDM[19], rural Malays in Kuala Selangor show a lower prevalence of IGT compared to NIDDM. We are still unable to exactly explain this phenomenon but probably most of the IGT cases already 'matured' into NIDDM, thus, resulting in increased prevalence of diabetes.

Mean fat intake amongst diabetics was significantly higher than normal subjects. This is probably one of the factors associated with very high prevalence of diabetes observed in this community. In addition, an increasing trend in mean fasting cholesterol was

Table III
Distribution of known case of diabetes and newly diagnosed diabetes in 1984 and 1994

	1984		1994	
	No. of diabetes	%	No. of diabetes	%
Known diabetics	8	40	15	39.5
Newly diagnosed diabetes	12	60	23	60.5
Total	20		38	

observed from normal subjects, IGT, newly diagnosed diabetes with the highest in known cases of diabetes. Mean diastolic blood pressure was also noted to be significantly higher in diabetics than normal subjects. The relationship between insulin resistance in NIDDM with hiperlipidaemia and hypertension has been suggested by many researchers[20,21] and known as insulin resistance syndrome or 'syndrome X'. More research needs to be done in order to establish the significance of this phenomenon especially in the management of diabetic patients.

NIDDM and its associated complications cause a considerable burden on populations, particularly those of developing nations like Malaysia where there are many demands on limited health budgets. Therefore it is imperative to implement preventive measures and institute screening programmes for diabetes among adults in this country. Although OGTT has better sensitivity and specificity than fasting plasma glucose in detection of undiagnosed NIDDM[18], it is more expensive and difficult to do on a mass scale. Therefore, for population screening FBS is probably the most suitable test to be used.

Conclusions

Although diabetes is a genetic disease, the expression of its phenotype is very much related to the presence of risk factors such as age, obesity, high fat intake and lack of physical activity. The factors mentioned are interrelated i.e., elderly people tend to be obese and less motivated to do physical activity. Longer life expectancy, increasing affluence, changing lifestyles and food habits mean that the non-communicable chronic diseases particularly diabetes mellitus which is age and nutrition related will become a significant public health problem in the health care system of Malaysia. The dramatic increments in the prevalence of diabetes provide a stark warning not only for Malaysia, but also for developing nations worldwide. Screening programmes should be made compulsory for those who are 40 years and above. This study also indicates the need to expand preventive programmes for NIDDM and related lifestyle diseases to rural areas as well.

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