Prevalence of Diabetes in the Malaysian National Health Morbidity Survey III 2006

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SUMMARY

The Malaysian National Health Morbidity Survey III (NHMS III), conducted in 2006, was a cross-sectional household survey of the prevalence of chronic diseases, involving 34,539 respondents of age ≥ 18 years old, in all states of Malaysia. Data collection was by face-to-face interview. Those who self-professed not to be diabetics underwent finger-prick glucose test following at least 8 hours of fasting. The overall prevalence of diabetes mellitus (known and newly diagnosed) was 11.6%. The Indians had the highest prevalence of 19.9% followed by Malays 11.9% and Chinese 11.4%. The prevalence of people with known diabetes and newly diagnosed diabetes was 7.0% and 4.5% respectively. Impaired Fasting Glycaemia was found to be 4.2%. Majority (73.5%) of the patients used government healthcare facilities for their diabetic care. Usage of insulin alone or in combination was low at 7.2% of patients. Only 45.05% of known diabetics have ever had their eye examined. Amputees formed 4.3% of the patients with known diabetes while 3.4% had suffered a stroke event and 1.6% was on some form of renal replacement therapy.

KEY WORDS:
Prevalence, Diabetes, National health morbidity study, Malaysia

INTRODUCTION

Diabetes mellitus is a global health problem[1]. The number of people with diabetes is increasing. This is evidenced by findings from a series of global estimates of current and predicted future prevalence of diabetes [2,3,4] and the latest update in 2004[5]. This rising trend is due to many factors such as population growth, aging, urbanization and increasing prevalence of obesity and physical inactivity[5]. Based on the Diabetes Atlas[4], the highest number of people with diabetes would currently be in the European region with 48 million and Western Pacific Region with 43 million. However, by 2025, the greatest number of person with diabetes is expected to change to the South East Asia Region, with estimated prevalence of 13.5% and in number with some 145 million people. The importance of quantifying the prevalence of diabetes and the number of people affected by diabetes, i.e. burden of disease, both at present and future projections, is therefore important to allow rational planning and allocation of resources.

In the Malaysian Burden of Disease and Injury Study[6], it was estimated that for year 2000, there were 2,261 deaths attributed to diabetes (857 men and 1404 women). Although diabetes was not in the top 10 causes of highest Years of Life Lost (YLL) in men, the disease incurred a huge burden in terms of non-fatal disability, i.e. morbidity measured as Years Lived with Disability (YLD). Diabetes was ranked third at 34,750 years in the men. The scenario was worst for women; scoring higher for both indexes; 18,759 years for YLL and 37,631 years for YLD. This means, Malaysian women with diabetes die faster, and those who survived, had to endure more sufferings. The simple mathematical addition of YLL + YLD yielded yet another index; the Disability Adjusted Life Years (DALYs), is a composite measure of burden of premature mortality and non-fatal health outcome (morbidity). Based on DALYs, among the top 10 total burden of disease in Malaysia, diabetes was ranked 6th for men and 5th for women. Despite its lower ranking, diabetes probably contributed significantly to the causality of the higher ranking diseases with the exception of unipolar major depression [6].

The earliest diabetes studies carried out in Malaysia were in 1960[7] and in 1966[8]. The first National Health and Morbidity Survey (NHMS) in Malaysia was carried out in 1986 where prevalence of diabetes among adults of age ≥35 years old was found to 6.3%[9]. Ten years later, in NHMS II, the figure had increased by one third to 8.3% among adults of age ≥ 30 years old[10]. This shocking rise spurred the initiation of numerous national healthy lifestyle campaigns by the Ministry of Health Malaysia. A national steering committee was set up to improve the screening and management of diabetes in primary and secondary care clinics.

In 2006, the Ministry of Health Malaysia, once again took the task of conducting the third NHMS (NHMS III). Amongst the many objectives, the survey included determining the prevalence of known and newly diagnosed diabetes as well as impaired fasting glucose. It also sought to determine the types of treatment, specific complications rates and the health seeking behaviour of the diabetic population.

MATERIALS AND METHODS

This cross-sectional, population-based national survey was carried out between the months of April to the end of July

This article was accepted: 29 November 2010
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2006 involving 59,938 eligible adults of age ≥18 years old. Briefly, NHMS III utilized the sampling frame that is maintained by the Department of Statistics, Malaysia. Malaysia is divided into artificially created contiguous geographically areas called Enumeration Blocks (EBs). Each EB has on average about 100 living quarters (LQs). A 2-stage stratified random sampling proportionate to the population size was used to select the EBs and the LQs. At first stage, the sample unit was the EB, while at the second stage; the sample unit was the LQ. One LQ was estimated to house 4.4 individuals. All persons in the selected LQ were included in this survey. A total of 2,150 EBs and 17,251 LQs were randomly selected and of these, 1424 EBs and 726 EBs were from urban and rural areas respectively.

Face-to-face interviews using pre-coded questionnaires were conducted by trained survey teams. Where an interview was unsuccessful, for example, due to the absence of the respondent at the selected household, repeated visits were conducted. A household member was only classified as a non-responder after failure to answer any of the modules following at least three visits by the study team. Prior to the actual survey, a pilot study was carried out to test the questionnaires, testing the field logistic preparation, the scouting activities and the central monitoring and logistics support.

This survey was funded by the Ministry of Health Malaysia and ethical approval was obtained from the Malaysian Medical and Research Ethics Committee, Ministry of Health Malaysia.

Data Collection

Blood glucose level was only tested among those who self-professed to be non-diabetes and gave informed, written consent. Following a period of 8–10 hours of fasting, the finger-prick blood glucose measurement was performed by trained nurses using the Accutrend GC, (Roche Diagnostic) glucometer, whole blood calibrated. Respondents were informed of their results and those with abnormal results (≥ 6.1mmol/l) were referred to the nearest health care facility for further investigation. Respondents who were eligible for the glucose test but refused to be examined were classified as "refused to be examined".

Definition of Terms / Variables used

Normal Fasting Blood Glucose (FBG, fasting blood glucose < 5.6mmol/l), *Impaired Fasting Glucose* (IFG, fasting blood glucose between ≥5.6 and <6.1 mmol/l), Newly *diagnosed diabetes* (fasting blood glucose ≥ 6.1mmol/l) as defined by the WHO using capillary blood[11].

Currently on anti-diabetic treatment was defined as on regular anti-diabetic medication in the recent 4 weeks prior to date of interview.

Lower limb amputation was defined as amputation of toes, parts of the leg, above or below knee arising from diabetes.

Stroke was defined as paralysis/weakness of half or full body including those who have recovered all of which arise from diabetes.

Eye examination was defined as self-reporting of having been tested using any of these equipments, either slit lamp, fundus camera, direct ophthalmoscope or indirect ophthalmoscope (photographs of the equipment were shown to the respondent).

Modern treatment was defined as medication and treatment that was provided by medical doctors or health personnel, either in public or private hospitals or clinics.

Traditional treatment was defined as medication or treatment that was other than modern treatment such as homeopathy, massage, herbal therapy, acupuncture and others.

Place of treatment was defined as self-reporting of places where they obtained treatment at most times such as government hospitals/clinics, private hospitals/clinics, medicine shops, pharmacy and direct selling.

Statistical Analysis

A manual double entry system was utilized for data capture. Data was analysed using STATA version 10.0 and SPSS version 15.0. All analyses took into account the complex survey design and unequal selections of NHMS III. Findings are reported as the weighted estimates of the prevalence (mean value, confidence interval of the mean).

RESULTS

Diabetes mellitus

A total of 34,539 study subjects responded to the diabetes questionnaires, where a total of 31,943, who claimed that they were not diabetic underwent the finger-prick glucose test following at least 8 hours of fasting. The national prevalence of diabetes was 11.6% (95% CI: 11.2-12.0), where 4.5% (95% CI: 4.3-4.8) were those people with newly diagnosed with diabetes (Table I).

Diabetes was also detected in the younger age group, between the age of 18 years and less than 30 years old. The prevalence was 2.4%, out of which people with known diabetes was 0.4%, and people with newly diagnosed diabetes were 2.0%. IFG was 3.1% in this age group as compared to 4.7% in all people above 30 years old (Table I).

There was a general increasing trend in diabetes prevalence with age; from 2.0% in the 18-19 years old age group to a prevalence ranging between 20.8 to 26.2% among the 60-64 years olds (Figure 1).

Amongst the States, Negeri Sembilan, Malacca and Penang had the highest prevalence of diabetes at 15.3, 15.2 and 14.9% respectively (Figure 2). The prevalence was higher in the urban at 12.2% (95% CI: 11.6-12.7) compared to the rural areas at 10.6% (95% CI: 9.9-11.1).

No significant gender difference in the prevalence was observed; 11.9% (95% CI: 11.3-12.4) in the males versus 11.3% (10.8-11.8) in the females. As in NHMS II, the highest diabetes prevalence was found to be the Indians at 19.9% (18.3-21.5) followed by 11.9% (95% CI: 11.4-12.5) in the Malays and 11.4% (95% CI: 10.6-12.2) in the Chinese.

Prevalence of diabetes among other indigenous groups including the aborigines in Peninsula Malaysia and the Kadazan, Iban and Dayak of East Malaysia and other smaller ethnic minorities were 6% and 4.5% respectively.

By job category, the Senior Officials and Manager group showed the highest prevalence of 15.9% (95% CI: 12.9-18.9), followed by the housewives and the unemployed, 14.2% and 16.1% respectively (Table II).

Treatment Status of People with Known Diabetes

This survey also revealed that out of the 2180 (91.8%, 95% CI: 90.5-92.9) people with known diabetes who claimed to have taken medications for diabetes, only 93.1% of them were still taking medications at the time of the survey. Among people with known diabetes, only 84.3% were found to be on modern medications; 77.1% were on oral, 3.1% on insulin alone and 4.1% were treated with both oral and insulin (Table III). Compared to the Chinese and Indians, Malays (81.9%) and other indigenous groups (82.5%) were found to be the lowest among those who were on modern treatment. There was no gender difference but higher percentage of the urbanites (78%) was on modern treatment compared to those living in the rural areas (75.1%). The percentage of people with known diabetes who chose traditional or alternative methods either alone or along with modern medication for treating their disease was only 0.6%. Educational status, occupation and household income did not have influence on the percentage of people receiving modern medication.

As for utilisation of health care facilities, 73.5% of the people with known diabetes sought treatment from the government facilities versus 20.3% from private facilities. Self-treatment was also reported; 2.9% of the people with known diabetes claimed to obtain their medications from alternative or traditional, medicinal and direct selling. As expected, higher utilization of government facilities was by those living in the rural areas (79.1%) compared to the urbanites (70.8%) and by females (77.3%) compared to males (68.5%). In contrast, private facilities were utilized more by the males (23.6%) compared to females (17.8%) and the highest being the Chinese (32.1%) followed by the Indians (19.9%) and the Malays (17.2%). Based on income, government facilities were mostly used by those with household earning of RM2000/month (approximately USD570) and below, while private facilities catered for the higher income groups [Figure 3]. However, it was interesting to note that close to 60% of the higher income groups continued to use the government health facilities.

Diabetic Complications

Among the people with known diabetes, 4.3% reported to having had lower limb amputations, 3.4% had strokes and 1.6% were on dialysis or had kidney transplants due to diabetes (Table IV). The percentage of strokes was highest in the Chinese (5.5%), nearly twice of that in the Malays (2.9%). For dialysis or kidney transplants, the Chinese and Indians reported almost double the percentage seen amongst the Malays.

In this survey, only 45.0% (95% CI: 43.0-47.2) of the people with known diabetes reported to ever had eye examinations. The percentage was lowest among those younger than 30 years old, at 17.5% (95% CI: 8.0-34.2%). There was no significant gender and ethnic difference in the percentage of eye examination. Only one third of the people with known diabetes were examined as scheduled. Of those who had eye examinations, 32.9% (95% CI: 29.9-36.0) reported that their last eye examination was within last one year, 49.7% (95% CI: 46.5-52.9) had it done in the last one to 2 years and 17.4% (95% CI: 15.2-19.9) had it done more than 2 years ago. Significantly higher eye examinations were performed by the government healthcare facilities (50.6 %, 95% CI: 48.1-51.9) as compared to private healthcare facilities (40.3%, 95% CI: 35.7 - 45.0).

Impaired Fasting Glucose

The national prevalence for IFG was 4.2% (95% CI: 4.0-4.6) with high prevalence in Kuala Lumpur (6.1%, 95% CI: 4.8–7.5), Pulau Pinang (6.1%, 95% CI: 5.0-7.1) and Perak (5.0%, 95% CI: 4.0-6.0) (Figure 4). Prevalence of IFG was significantly higher among the urbanites 4.5% (95% CI: 4.2–4.9) compared to rural folks (3.8%) and in the males (5.2%, 95% CI: 4.8–5.6%) compared to the females (3.5%, 95% CI: 3.2–3.8%). By ethnicity, the Chinese (5.1%, 95% CI: 4.5–5.7%) and the Indians (5.2%, 95% CI: 4.3– 6.1) showed significantly higher prevalence of IFG than the Malays (4.0%, 95% CI: 3.6–4.3%).

DISCUSSION

The prevalence of diabetes (known and newly diagnosed) among Malaysian adults of age ≥18 years old has risen to 11.6%. With our diet rich in carbohydrates and fat, coupled with increasing urbanization and sedentary lifestyle, the rise is not unexpected. This figure however, could not be compared directly with the prevalence rate of 8.3% reported in the NHMS II in 1996[10]. The diagnosis of newly diagnosed diabetes in NHMS II was based on two hours post-glucose load (2-h plasma glucose) while NHMS III was based on finger-prick fasting glucose. As shown in the NHANES II study[12], about 75% of subjects with diagnostic 2-h plasma glucose level of ≥ 11.1mmol/l had fasting glucose values below 7.8 mmol/l, the level defined as diagnostic by the WHO[11]. Similarly, using the ADA criteria, between 32 to 72% of the population who were previously not diagnosed to be diabetic based on fasting plasma glucose of <7.0mmol/l had 2-h plasma glucose glucose of ≥11.1 mmol/l[13,14,15]. Hence the prevalence of newly diagnosed diabetes in NHMS III would have been higher if diagnosis was based on the 2-h plasma glucose cut-off.

In 1999, WHO reduced the threshold for fasting venous plasma glucose from 7.8mmol/l to 7.0mmol/l[11]. This was probably one of the reason for the higher rate of known diabetes reported in this study as compared to the two earlier national surveys. Similar increase in rates was also observed by Unwin *et al.*[16] who reported that upon changing from the threshold value for diabetes based on previous WHO criteria to the new ADA criteria, there was an increase in the prevalence from 4.8 to 7.1% in Caucasians, from 4.7 to 6.2% in people of Chinese origin and from 20.1 to 21.4% in people of South Asian origin.

Table I: Status of Diabetes Mellitus and Impaired Glucose Tolerance (IGT) / Fasting Glucose (IFG) (%) in Malaysia in the past 20 years

	1986 NHMS I	1996 NHMS II	2006 NHMS III	2006 NHMS III	2006 NHMS III
Age group (years)	≥ 35	≥ 30	≥ 18	≥18 - < 30	≥ 30
Diabetes Prevalence (%)	6.3	8.3	11.6	2.4	14.9
Known diabetes (%)	4.5	6.5	7.0	0.4	9.5
Newly diagnosed (%)	1.8	1.8	4.5	2.0	5.4
IGT / IFG (%)	*4.8	*4.3	#4.2	#3.1	#4.7

*based on IGT; #based on IFG.

Table II: National Prevalence Diabetes by Job Description in Malaysia

Job Category	Prevalence %	95% CI	
		Upper	Lower
Senior Officials & Managers	15.9	12.9	18.9
Professionals	10.0	8.7	11.3
Technical & Associates	12.1	10.8	13.5
Clerical Workers	8.7	7.4	10.0
Service Workers & Shops	10.7	9.8	11.5
Skilled Agricultural & Fishery	9.7	8.6	10.9
Crafts & Related Trade Workers	6.4	5.2	7.5
Machine Operators & Assemblers	11.7	10.2	13.2
Elementary Occupations	9.0	7.4	10.6
Housewives	14.2	13.3	15.0
Unemployed	16.1	14.8	17.4
Unclassified	6.7	5.4	7.9

Table III: Treatment Status of People with Known Diabetes in Malaysia

	Modern Treatment (%)				Traditional/ Alternative alone or along with modern treatment (%)
	Oral Medication Only	Insulin Only	Oral and Insulin	Overall	
NATIONAL	77.1	3.1	4.1	84.3	0.6
Malay	75.1	2.6	4.2	81.9	0.9
Chinese	83.9	1.9	2.8	88.6	0.2
Indians	78.0	5.0	5.8	88.8	*No obs
Other Indigenous	74.1	6.6	1.8	82.5	*No obs
Others	66.2	2.6	*No obs	68.8	*No obs
Male	76.4	3.4	3.7	83.5	1.1
Female	77.6	2.9	4.4	84.7	0.1
Urban	78.0	3.0	4.3	85.3	0.3
Rural	75.1	3.3	3.6	82.0	1.1

*No obs = no observation

Table IV: Percentage of People with Known Diabetes with Complications in Malaysia

	COMPLICATIONS (%)			
	n	Lower limb amputations	Strokes	Dialysis / Kidney transplants
National	394	4.3	3.4	1.6
Malay	180	4.1	2.9	1.2
Chinese	120	4.5	5.5	2.3
Indians	49	4.6	3.1	2.4
Other Indigenous	40	7.6	2.6	0.8
Others	5	*No obs	*No obs	*No obs

*No obs = no observation

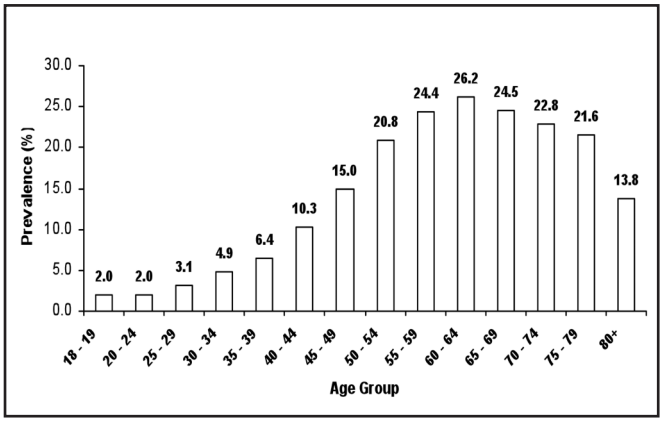

Fig. 1: National prevalence of Diabetes Mellitus by Age Group.

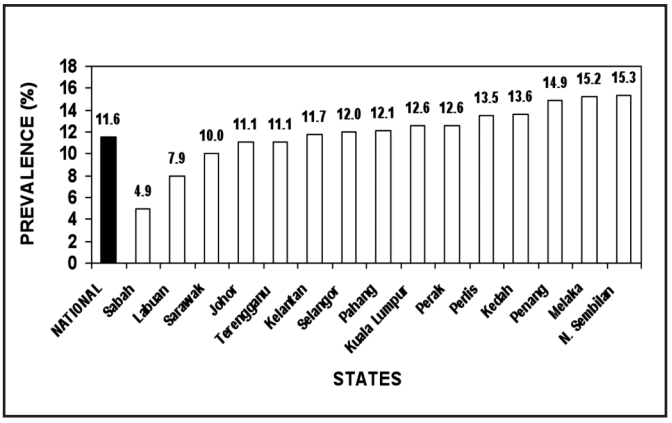

Fig. 2: Prevalence of Diabetes Mellitus in Malaysia (▪) and by states (□).

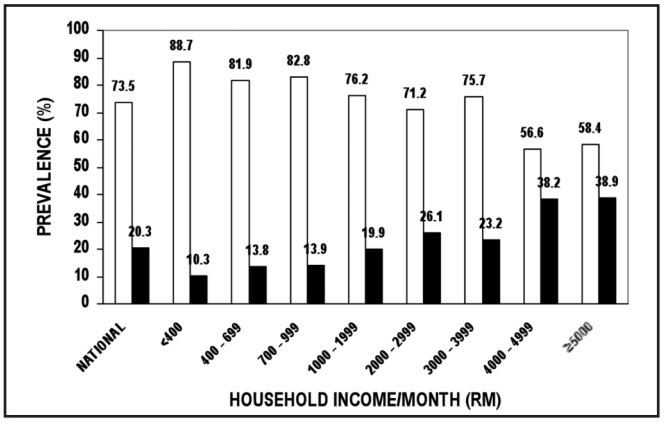

Fig. 3: Percentage of people with diabetes seeking treatment at Government hospitals and clinics (□) and at private hospitals and clinics (▪) by household income (RM).

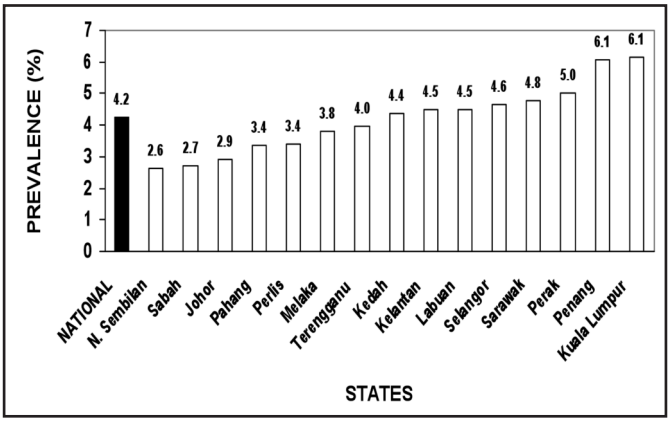

Fig. 4: Prevalence of Impaired Fasting Glucose (IFG) in Malaysia (▪) and by states (□).

It should also be noted that the age group studied in NHMS II was from 30 years old and above while in NHMS III, the age of eligible subjects was from 18 years old onwards. Nevertheless, the rise in prevalence was alarming in spite of taking into account the differences in methodology and definitions used. Prevalence of known and newly diagnosed diabetes among adults of ≥30 years old had risen from 8.3% in NHMS II to 14.9% in NHMS III. It is very likely that this 80% rise is associated with the increase in prevalence of obesity seen among our adult population over the last decade [17]. As shown by Amos *et al* [2], obesity in the U.S. population began to go up at a rapid rate in 1986, four years prior to the time when diabetes began to increase significantly.

The prevalence of diabetes in Malaysia is above average when compared to the estimation by the International Diabetes Federation (IDF) for all regions in the world[4]. As a matter of fact, NHMS III results have showed that Malaysia has already reached the projected prevalence for year 2025. The Ministry of Health had consistently organised annual healthy lifestyle campaigns with emphasis on early screening. Hence it would have been expected for the undiagnosed diabetes rate to be lower but the reverse occurred. Despite there are many clinics, both public and private which offer screening services, the prevalence of newly diagnosed diabetes had increased from 2.5% in NHMS II to 5.5% in NHMS III. One main reason for this failure could be accessibility to do screening especially in the public primary health centres which are always crowded and with limited resources. Another possible factor is the attitude of the Malaysian public; gain in knowledge but not resulting in behaviour change. People may know and understand the importance of screening but not actually taking the effort to do so.

In this survey, the national prevalence of IFG amongst Malaysians of ≥18 years old was found to be 4.2%. Both IFG and impaired glucose tolerance (IGT) are known to predict subsequent diabetes. However, there have been reports that there is significant ethnic difference in the prevalence of IGT and IFG. IGT was reported to be more common than IFG in Mauritius (36% versus 19%) [14], in the USA (39% versus 25%) [18], in the Canarian population (17.1% versus 8.8%)[19] and in Pima Indians (15% versus 5%)[20]. People with IGT have been shown to have higher risk of developing diabetes; reported to be 4.3% per year among ethnic Chinese in Singapore [21], 8.8% per year in Taiwan [22] and 11.2% per year in China[23]. On the other hand, a 5-year cumulative incidence of diabetes in the Pima Indians, showed that IFG had a similar positive

predictive value as IGT for predicting subsequent diabetes[20]. Thus, there is likely to be ethnic differences, warranting longitudinal studies in different ethnic groups to determine the significance of IFG and IGT as risk predictors of diabetes. This is the first time that NHMS has included the younger age group of between 18 and 30 years old. Alarmingly, the prevalence of diabetes was 2.4%, out of which people with newly diagnosed diabetes was 2.0%. Impaired fasting glucose was also high at 3.1%. People in this age would consider themselves to be free of disease and would not normally undergo screening for chronic diseases. This probably explains the relatively high percentage of newly diagnosed diabetes among them.

Indians continued to lead with a prevalence rate of 19.9% which was almost double that of other major races. Other studies have also shown this inherent risk in Indians [2, 24]. Interestingly, among the newly diagnosed diabetes and IFG, the difference in the prevalence rates among the ethnic groups was relatively small. One possible explanation for this is the postulation that there may be phenotypic differences in the rate of progression to diabetes [25].

Diabetes prevalence was higher among the urbanites compared to the rural population. This was to be expected as the lifestyles of urban folks tend to be minimal expenditure of energy and calorie-rich diets. For similar reasons, the "Senior Officials and Managers" had much higher diabetes prevalence than those in the "crafts and related trade". However, highest prevalence of known diabetes seen among the "unemployed" raised a concern as to whether the disease and its complications had made the person unproductive.

There was a striking difference in the diabetes prevalence between states; lowest being in the state of Sabah (4.9%) and highest in the state of Negeri Sembilan (15.3%). This finding needs to be investigated further taking into account the prevalence of obesity, the age groups, urban-rural ratio and ethnic composition of these states. Comparable with the general global trend[5], diabetes prevalence was found to be slightly higher in males (11.9%) than females (11.3%).

With regards to treatment, majority (73.5%) of the people with diabetes used government healthcare facilities. As expected, the higher income group in general and the Chinese as a race formed the biggest subpopulation that obtained treatment from the private sector. However, it needs to be highlighted that even among them, the majority still utilised public healthcare facilities. Chronic diseases incur large expenses over time; hence it would be logical to seek treatment in the government public facilities where health services are either provided free or at much discounted charges.

Majority of the patients were on oral medication (77%) and only a small percentage on insulin alone or in combination (7.2%). Despite the fact that most patients would eventually need insulin to reach the glycaemic target, the relatively low insulin usage reflects the continued unhealthy collusion between patients and their doctors to prolong a failing treatment regimen.

Surprisingly, only 0.6% of the population studied reported that they took traditional medicine for diabetes. This we suspect, was gross underreporting as in real clinical practice, patients are known to combine prescribed medications with alternative treatment including use of local herbs, chinese or ayuverdic medicine.

Amputees formed 4.3% of the patients with known diabetes. Lower limb amputations confer much morbidity and mortality. We believe amputation rate among patients with diabetes is a good reflection of the overall state of health care services. It is also disturbing to note that less than half of the people with known diabetes (45.0%) ever had any eye examination done and only one third were examined within one year from the time of the survey. This is clearly unsatisfactory as our clinical practise guidelines on management of diabetic retinopathy in type 2 diabetes clearly recommends eye examination at diagnosis and then annually. The percentage of eye examination was significantly lower for those treated at private healthcare facilities as compared to those who seek treatment at the government healthcare facilities. There may be many reasons for this observation; patients were not aware of the schedule or more likely, the lack of eye screening services due to inadequate trained staff and resources.

Chinese had the highest stroke prevalence rate at 5.5%. This is similar to other studies that showed relatively higher prevalence of cerebrovascular complications among the Chinese compared to the Caucasians[26]. The lower dialysis and kidney transplant rates recorded among the Malays may reflect the issue of accessibility to dialysis centres since a high percentage of them still live in the rural areas.

The inability to perform the do 2-h plasma glucose was a major limitation in this survey as a sub-group of the respondents with prandial hyperglycaemia would have been left out. Despite the limitation of not using venous plasma glucose, the high percentage of undiagnosed diabetes detected in particular among the younger age group is a cause of concern. Based on the estimated population in 2006, the absolute number of person 18 years old and above affected by diabetes in Malaysia would be therefore be 1,492,665.

There is an urgent need to re-evaluate the various programs and strategies that have been developed and implemented for the last 10 years. It must be realised that the overall management of diabetes is most effective when the limited resources are put in the primary prevention interventions. Mere public forums and television advertisements of healthy lifestyle would not stem the tide as shown in the last ten years. Having knowledge does not always translate to behaviour change. All stakeholders have a responsibility to overcome this problem. Though there are drugs available now to prevent or rather delay the onset of diabetes, it has been consistently shown that lifestyle modifications are the most effective intervention.

The survey has also highlighted the issue of provision of care which was found to be below expectations in terms of low insulin use, low fundus examination and high amputation rate. As clearly shown by the UK Prospective Study (UKPDS)

Group[27,28,29] and Steno-2 study[30], treating hyperglycaemia early could significantly reduced microvascular and macrovascular events in patients with type 2 diabetes. This means there is a need to screen for diabetes early and keep the affected ones in the normoglycaemic range for as long as possible in order to avoid the complications. The public and private health centres should have dedicated clinics with specially trained nurses and doctors. There should be periodic audit on outcomes of intervention at every clinic. There is also a strong need for a publicity blitz on the use of insulin therapy, perhaps a more personalised intervention to address the concerns of these patients. A more concerted effort with the involvement of multiple stakeholders (multiple ministries, local councils and non-government organisations) to enhance or induce change in the public behaviour to lead a healthier lifestyle is badly needed to arrest this epidemic.

Competing interests

Nothing to declare.

ACKNOWLEDGEMENT

This research for funded by the Ministry of Health Malaysia. The authors wish to thank the Director General of Health Malaysia for permission to publish this paper.

REFERENCES

1. King H and Rewers M. Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults. WHO Ad Hoc Diabetes Reporting Group. Diabetes Care 1993; 16: 157-77.
2. Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabetic Medicine; 1997; 14: S -S85.
3. King H, Aubert R, Herman W. Global burden of diabetes, 1995-2025. Prevalence, numerical estimates and projections. Diabetics Care 1998; 21: 1414-31.
4. International Diabetes Federation. Diabetes Atlas. Executive Summary, 2nd edn. Brussels: International Diabetes Federation, 2003.
5. Wild S, Roglic G, Green A, Sicree R and King H. Global Prevalence of Diabetes. Estimates for the year 2000 and projections for 2030. Diabetes Care. 2004; 27: 1047-53.
6. Faudzi AY, Nasir A, Gurpreet K, Vos T, Chalapati VP, Stephen B. Malaysia Burden of Disease Study. Institute for Public Health, Ministry of Health, Malaysia, 2004.
7. Pillay RP and Lim EH. Incidence of Diabetes Mellitus in Malaya. Medical Journal of Malaya 1960; 16: 242-4.
8. West KM and Kalbfleisch JM. Glucose tolerance, nutrition and diabetes in Uruguay, Venevuela, Malaya and East Pakistan. Diabetes 1966; 15: 9-18.
9. National Health Morbidity Survey 1986–1987. Diabetes Mellitus. Volume 4. Institute for Public Health, Ministry of Health, Malaysia.
10. National Health Morbidity Survey 1996. Diabetes. Volume 9. Institute for Public Health, Ministry of Health, Malaysia.
11. WHO/NCD/NCS/99.2. Definition, diagnosis and classification of Diabetes Mellitus and its complications. Part 1: Diagnosis and Classification of Diabetes Mellitus. Report of a WHO Consultation. Geneva: World Health Organization, 1999.
12. Harris MI, Hadden WC, Knowler WC, Bennett PH. Prevalence of diabetes and impaired glucose tolerance and plasma glucose levels in U.S. population aged 20–74 year. Diabetes 1987; 36: 523-34.
13. Barrett-Connor E, Ferrara A. Isolated post challenge hyperglycemia and the risk of fatal cardiovascular disease in older women and men: the Rancho Bernardo Study. Diabetes Care 1998; 21: 1236-39.
14. Shaw J, Zimmet P, de Courten M. Impaired fasting glucose or impaired glucose tolerance. What best predicts future diabetes in Mauritius? Diabetes Care 1999; 22: 399- 402.
15. The DECODE Study Group on behalf of the European Diabetes Epidemiology Group. Is fasting glucose sufficient to define diabetes? Epidemiological data from 20 European studies. Diabetologia 1999; 42: 647-54.
16. Unwin N, Alberti KGMM, Bhopal RS, Harland J, Watson W, White M. Comparison of the current WHO and new ADA criteria for the diagnosis of diabetes mellitus in three ethnic groups in the UK. Diabetic Med 1998; 15: 554-7.
17. Ismail MN, Chee SS, Nawawi H, Yusoff K, Lim TO, James WPT. Obesity in Malaysia. Obesity Reviews 2002; 3: 203-08.
18. Harris MI., Goldstein DE, Flegal KM, Little RR, Cowie CC, Wiedmeyer HM *et al*. Prevalence of diabetes, IFG and impaired glucose tolerance in U.S adults. The Third National Health and Nutrition Examination 1988-1994. Diabetes Care 1998; 21: 518-24.
19. De Pablos-Velasco PL, Martinez-Martin FJ, Rodriguez-Perez F, Ania BJ, Losada A, Betancor P. Prevalence and determinants of diabetes mellitus and glucose intolerance in a Canarian Caucasian population comparison of the 1997 ADA and the 1985 WHO criteria: The Guia Study. Diabetic Medicine 2001; 18: 235-41.
20. Gabir MM, Hanson RL, Dabelea D, Imperatore G, Roumain J, Bennett PH *et al*. The 1997 American Diabetes Association and 1999 World Health Organization criteria for hyperglycaemia in the diagnosis and prediction of diabetes. Diabetes Care 2000; 23: 1108-12.
21. Wong MH, Gu K, Heng D, Chew SK, Chew LS, Tai ES. The Singapore Impaired Tolerance Glucose Follow-up Study: Does the ticking clock go backward as well as forward? Diabetes Care 2003; 26: 3024-30.
22. Chou P, Li CL, Wu GS, Tsa ST. Progression to type 2 diabetes among high-risk groups in Kin-Chen, Kinmen: Exploring the natural history of type 2 diabetes. Diabetes Care 1998; 21:1183–87.
23. Pan XR., Li GW, Hu YH, Wang JX, Yang WY, An ZX, *et al*. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the Da Qing IGT and Diabetes Study. Diabetes Care 1997; 20: 537–44.
24. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das, AK, *et al*. High prevalence of diabetes and impaired glucose tolerance in Indian National Urban Diabetes Survey (NUDS). Diabetologia 2001; 44: 1094-01.
25. Meigs JB, Muller DC, Nathan DM, Blake DR, Andres R. The natural history of progression from normal glucose tolerance to the type 2 diabetes in the Baltimore Longitudinal study of aging. Diabetes 2003; 52: 1475-83.
26. Kay R, Won J, Kreel L, Wong HY, Teoh R and Nicholls MG. Stroke subtypes among Chinese living in Hong Kong. Neurology 1992; 42: 985-87.
27. 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.
28. Holman RR, Paul SK, bethel MA, Mathews Dr, Neil HAW. 10-year follow-up of intensive glucose control in Type 2 diabetes. N Engl J Med 2008; 359: 1577-89.
29. UK Prospective Diabetes Study (UKPDS) 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.
30. Gaede P, Vedel P, Larsen N, Jensen GVH, Parving HH, Pedersen O. Multifactorial intervention and cardiovascular disease in patients with Type 2 diabetes. N Engl J Med 2003; 348: 383-93.