PUBLIC HEALTH RESEARCH

Undiagnosed Type 2 Diabetes Mellitus and Its Risk Factors among Malaysians: Findings of a Nationwide Study

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ABSTRACT

Received 29 December 2015
Accepted 11 March 2016

Introduction The prevalence of Type 2 diabetes mellitus (T2DM) is increasing worldwide and many of these affected individuals remain unidentified. Undiagnosed T2DM may impose substantial public health implications because these individuals remain untreated and at risk for complications. The objective of this study was to determine the national prevalence of undiagnosed T2DM and to identify the associated risk factors.

Methods A nationwide cross-sectional study was conducted involving 17,783 respondents. Two-stage stratified sampling design was used to select a representative sample of the Malaysian adult population. Structured validated questionnaires with face to face interviews were used to obtain data. Respondents, who claimed that they were not having diabetes, were then asked to perform a fasting blood glucose finger-prick test by Accutrend GC machine.

Results The prevalence of undiagnosed T2DM was 8.9% (n=1587). The highest percentage of undiagnosed T2DM was found among males (10.2%), 55-59 years old (13.4%), highest education attainers of primary school (11.1%), Indians (10.3%), married (10.3%), working (8.9%) and living in the urban areas (9.2%). Multivariate analyses showed that factors associated with undiagnosed T2DM were gender, age group, ethnicity, marital status, obesity and hypertension.

Conclusion This study found an increasing trend of undiagnosed T2DM in Malaysia compared to 2006. This finding is alarming as risk factors associated with undiagnosed diabetes were related to most of the socio-demographic factors studied. Therefore, early diabetic screening is crucial especially among adults aged 30 and above to prevent more serious complications of this disease.

Keywords Malaysia - undiagnosed - type 2 DM, prevalence of diabetes, risk factor.

INTRODUCTION

Globally, diabetes is known as one of the most common non-communicable diseases. There is substantial evidence that this disease has become an epidemic in many low and middle-income countries as well as being the fourth or fifth leading cause of death in most high-income countries.[1] Untreated diabetes can cause significant morbidity and mortality due to microvascular (retinopathy, neuropathy and nephropathy) and macrovascular (heart attack, stroke and peripheral vascular disease) complications.[2]

Worldwide, the number of people with diabetes in 1995 was estimated to be 135 million; in the year 2000, it was 154 million and it is expected to affect 300 million people in the year 2025, with the main increase being in the developing countries.[3] Malaysia is a developing country and the World Health Organisation (WHO) has estimated that in the year 2030, Malaysia would have a total of 2.48 million people with diabetes.[4] According to the First National and Morbidity Survey (NHMS) in 1986, the prevalence of DM was 6.3%. This figure increased in NHMS II to 8.3% in 19965. NHMS III (2006) reported that the prevalence of DM also increased to 11.6 %.[6] International Diabetes Federation estimated that globally as many as 183 million people, or half of those who have diabetes, are unaware of their condition. Most of them have type 2 diabetes.[7]

It has been reported that the number of people with type 2 diabetes mellitus is increasing worldwide and many of these individuals remain unidentified.[8] Based on the data and information gathered by the National Health Morbidity Survey (NHMS) for the Malaysian population aged ≥30 years, which was conducted every 10 years [9,10,11] the prevalence of undiagnosed diabetes (or newly diagnosed) has also increased, from 1.8% in 1996 to 5.4% in 2006. Undiagnosed type 2 diabetes and impaired glucose regulation are reported to have substantial clinical importance.[12] Undiagnosed diabetes may also impose substantial public health implications because these subjects remain untreated and at risk for complications.[13] Hence, this study was undertaken to determine the national prevalence of undiagnosed DM and to identify risk factors that are associated with it.

METHODS

Secondary data from the National Health and Morbidity Survey (NHMS) 2011 were used for this study. The NHMS 2011 is a household survey conducted by the Institute for Public Health, Ministry of Health Malaysia in the year 2011. NHMS 2011 employed a multi-stage stratified sampling design proportionate to the population size throughout all state in Malaysia. NHMS covered both urban and rural areas for every state in Malaysia. The target population was all non-institutionalized individuals residing in Malaysia for at least 2 weeks prior to data collection. To ensure national representativeness, a two stage stratified sampling design was used. A total of 794 Enumeration Blocks (EB) were selected from the total EBs in Malaysia, where 484 and 310 EBs was randomly selected from urban and rural areas respectively. Twelve living quarters (LQ) were randomly selected from each selected EB and all households within the selected LQs and all members in the households were surveyed.[14]

Respondents were interviewed on socio-demographic and health status using a bi-lingual questionnaire which has been designed, pre-tested and validated before data collection. Clinical anthropometric and biochemistry tests were performed based on the modules. Overall, 7,522 LQs were successfully visited and 28,650 individuals were interviewed with a response rate of 88.2% and 93.0% respectively. This survey involved structured questionnaires that covered general household, socio-demographic, and specific health problems. Included in the protocol also were blood glucose level and blood pressure measurements. All measurements were conducted by trained nurses and researchers. The participants signed informed consent forms before the questionnaires were administered. Ethical approval from the Medical Research Ethics Committee of Ministry of Health was obtained to conduct the study.

This study was carried out on all respondents aged 18 years old and above by questionnaire measurement of finger-pricked fasting blood glucose method using the Accutrend GC machine. Only respondents who claimed to be non-diabetics were tested for their glucose level. For the purpose of this study, a respondent was classified as having "undiagnosed diabetes" when the respondent was not known to have diabetes and had a fasting capillary blood glucose (FBG) of 6.1mmol/L after finger pricking.

Systolic and diastolic blood pressures were measured using Omron Digital Automatic Blood Pressure Monitor Model HEM-907. Two readings were taken for both diastolic and systolic blood pressure, with a gap of 15 minutes. The average was used as recorded blood pressure values. Respondents were considered hypertensive if their average reading was ≥140 mmHg for systolic and/or ≥90 mmHg for diastolic blood pressure 17, or were on blood pressure lowering drugs, or were self reported to be hypertensive.

The respondent's height was measured in centimeters using Seca 206 Bodymeter. Weight was measured in kilograms using a digital weighing machine (TANITA HD-319). Body Mass Index (BMI) was calculated using weight and high of the respondents. Respondents with BMI of 30.0 kg/m2 or more were classified as obese.

Physical activity level was assessed using the International Physical Activity Questionnaire (IPAQ) - short form. Respondent was classified as physically active if his combination of vigorous-intensity, moderate-intensity and walking activities achieved a minimum of 600 MET-minutes/week.

A respondent who is still smoking during the interview was classified as a smoker.

Statistical Analysis

Data were analyzed by using SPSS Version 16. Categorical variables were presented as frequencies and percentages. Meanwhile, continuous variables were presented as means with 95% confidence interval (CI) and standard deviations (SD). Pearson's chi-square test was used in order to determine the association between categorical variables. Finally, multivariate analysis was performed by using binary logistic regression and result of logistic regression was expressed as odds ratio and 95% CI. A two sided p value of less than <0.05 was considered as statistically significant.

RESULTS

Socio-demographic characteristics of the study respondents.

Total number of responded to the diabetes questionnaire was 17,782 with 53.3% was female and 52.6% of respondent were 40 years and above. Almost 60.0% of respondents were from urban area. Majority of the respondents were Malays (56.9%), followed by Chinese (19.3%). More than 60.0% of respondents comprised of secondary and tertiary education attainers. Almost 70.0% of respondents were married and more than 60.0% of them were working (Table 1).

Table 1 Socio-demographic characteristics of the respondents.

Socio-demographic characteristic		N	%
Gender			
	Male	8309	46.7
	Female	9473	53.3
Age (mean, sd) : 42.1, 15.99			
Age Group			
	18 – 19	763	4.3
	20 – 24	2044	11.5
	25 – 29	2048	11.5
	30 – 34	1839	10.3
	35 – 39	1751	9.8
	40 – 44	1793	10.1
	45 – 49	1757	9.9
	50 – 54	1645	9.3
	55 – 59	1434	8.1
	60 – 64	978	5.5
	65 – 69	661	3.7
	70 – 74	528	3.0
	75 & Above	541	3.0
Residence			
	Urban	10354	58.2
	Rural	7428	41.8
Ethnic group			
	Malays	10112	56.9
	Chinese	3437	19.3
	Indians	1425	8.0
	Other Bumiputeras	1714	9.6
	Others	1094	6.2
Educational Level			
	No Formal Education	1418	8.1
	Primary Education	4276	24.4
	Secondary Education	8089	46.1
	Tertiary Education	3761	21.4
Marital Status			
	Single	4124	23.2
	Married	12214	68.7
	Widow/widower/divorcee	1440	8.1

Occupation status		11050	62.2
	Working	6725	37.8
	Not working		

Prevalence of undiagnosed diabetes mellitus in Malaysia.

The prevalence of undiagnosed diabetes mellitus in this study was 8.9%. There were significance differences by gender, age group, ethnic group, educational level, marital status, smoking, obesity status and hypertensive status. (Table 2).

Table 2 Prevalence of Undiagnosed Diabetes Mellitus

Socio-demographic characteristic		Undiagnosed diabetes mellitus		P value
		N	%	
National		1587	8.9	
Gender				
	Male	846	10.2	<0.001*
	Female	741	7.8	
Age (mean, sd) : 47.6, 14.60				
Age Group				<0.001*
	18 – 19	20	2.6	
	20 – 24	77	3.8	
	25 – 29	98	4.8	
	30 – 34	131	7.1	
	35 – 39	130	7.8	
	40 – 44	191	10.7	
	45 – 49	220	12.5	
	50 – 54	200	12.2	
	55 – 59	192	13.4	
	60 – 64	127	13.0	
	65 – 69	85	12.9	
	70 – 74	53	10.0	
	75 & Above	57	10.5	
Residence				0.263
	Urban	903	9.2	
	Rural	684	8.7	
Ethnic group				<0.001*
	Malays	983	9.7	
	Chinese	257	7.5	
	Indians	147	10.3	
	Other Bumiputeras	118	6.9	
	Others	82	7.5	
Educational Level				<0.001*
	No Formal Education	149	10.5	
	Primary Education	476	11.1	
	Secondary Education	682	8.4	
	Tertiary Education	266	7.1	
Marital Status				<0.001*
	Single	182	4.4	
	Married	1246	10.3	
	Widow/widower/divorcee	149	10.3	
Occupation status				0.999
	Working	987	8.9	
	Not working	600	8.9	
Smoking Status				0.022*
	Smoker	395	9.8	
	Non-smoker	1190	8.7	
Physical Activity				0.901
	Active	1014	8.9	

	Inactive	562	8.9	
Obesity				<0.001*
	Obese	327	12.1	
	Non-obese	1201	8.7	
Blood Pressure status				<0.001*
	Hypertension	820	12.4	
	Non Hypertension	766	6.9	

*Notes: *p,0.05 was considered statistically significant*

Factors associated with Undiagnosed Diabetes Mellitus in Malaysia.

Multivariate analysis (logistic regression) was performed for significant variables found in univariate analysis (Table 2). Table 3 showed the adjusted Odd Ratio (aOR) of the associated factors for undiagnosed diabetes mellitus.Significant associations were found in gender males (aOR 1.36 95% P<0.001), age (aOR 1.017 95% P<0.001), ethnic group (Chinese aOR 0.70 95% P<0.001, other Bumiputra aOR 0.70 95% P<0.001), married (aOR 1.63 95% P<0.001), obese (aOR 1.32 95% P<0.001) and hypertensive status (aOR 1.38 95% P<0.001). No significant association was found in educational levels, and smoking status.

Table 3 Factors associated with Undiagnosed Diabetes Mellitus (using Logistic Regression)

	OR (95% CI)	P value	aOR (95% CI)	P value
Gender				
Female	1.00		1.00	
Male	1.34	<0.001*	1.36	<0.001*
Age	1.023	<0.001*	1.017	<0.001*
Ethnic group				
Malays	1.00		1.00	
Chinese	0.75	<0.001*	0.70	<0.001*
Indians	1.07	0.480	1.05	0.612
Other Bumiputeras	0.69	<0.001*	0.70	<0.001*
Others	0.75	0.017*	0.89	0.343
Educational Level				
No Formal Education	1.00		1.00	
Primary Education	1.07	0.515	1.04	0.737
Secondary Education	0.78	0.011*	1.03	0.837
Tertiary Education	0.65	<0.001*	0.96	0.742
Marital Status				
Single	1.00		1.00	
Married	2.48	<0.001*	1.63	<0.001*
Widow/widower/divorcee	2.50	<0.001*	1.33	0.050
Smoking Status				
Smoker	1.15	0.022*	1.06	0.456
Non-smoker	1.00		1.00	
Obesity				
Obese	1.44	<0.001*	1.32	<0.001*
Non-obese	1.00		1.00	
Blood Pressure status				
Hypertension	1.93	<0.001*	1.38	<0.001*
Non Hypertension	1.00		1.00	

*Notes: *p,0.05 was considered statistically significant*

DISCUSSION

The National Health and Morbidity Survey (2011) showed that the prevalence of undiagnosed DM in Malaysia was 8.9%. The prevalence of undiagnosed diabetes in this study was higher than that found in NHMS 2006 (5.4%). The present study recorded a relatively higher level of undiagnosed DM compared to that reported by Yoseph et. al, 201315 in Ethiopia (4.7%).[16] Undiagnosed DM was also reported as 4.8% in India and 5.9% in Qatar.[12] Possible factor that contributed to the increase in the prevalence of

undiagnosed diabetes is due to unawareness of the diabetes symptoms at the early phase of diabetes.[17] Further, overloaded of patients in the governments' primary health care clinics, posed difficulty and hinders Malaysians from performing diabetes screening.[6] Higher prevalence of undiagnosed diabetes (11.1%) was found in a rural area in Tamil Naidu by Raja et al in 2014.[13] The findings in this study could partly be due to lack of health awareness among the population to undergo health screening at an early stage. Furthermore this trend could be, it is related with rapid culture and social changes, ageing population, increasing urbanization, dietary changes, reduction in physical activity and other unhealthy lifestyles and behavioural patterns. Differing European countries dictated varying degrees in the prevalence of undiagnosed diabetes. UK highlighted a prevalence of 2.0% undiagnosed diabetes among their adult population, [18] while USA has shown a fairly constant prevalence of undiagnosed diabetes (11.0%) for the past two decades.[19] This suggested the success of USA's programs focusing on the awareness and knowledge on diabetes and risk factors in US and its approaches in detecting diabetes among the population.[19]

Based on the results in Table 3, the likelihood of a person having undiagnosed DM increases dramatically with age (aOR=1.017 per year older, 2% increase in the odds for every year). The age-specific prevalence increased progressively with increasing age from the 15-59 year old age group but lowers in the older age group of 60-75 years and above. This finding is similar to the findings in Kashmir[20] and also in Qatar[12] where there was a higher occurrence of undiagnosed DM with increasing age. The mechanisms of age-related glucose intolerance include decreased insulin sensitivity and decreased β- cellfunction.[21]

For gender, the prevalence of undiagnosed DM was significantly higher among males compared to females. The result in table 3 showed that males were 1.36 times more likely to have undiagnosed DM compared to females. The male predominance in the occurrence of undiagnosed DM was similar to the result disclosed by Bando et al, 2008 in Japan[22] and Megerssa et al, 2013 in Ethiopia.[23] Basically, the health behaviours and beliefs among males are implicated in the health differences between males and females. It is well documented that males are reticent about accessing healthcare services [24-25] and are less likely to visit their general practitioners (GP) when they are ill.[26-27]

Based on the marital status, the prevalence of undiagnosed DM for married and divorced/ widowed respondents was significantly higher compared to single respondents. The present study showed that those who were married were 1.63 times more likely to have undiagnosed DM compared to those who were single. Some findings suggest that single, divorced and widowed statuses increase the risk of developing DM.[28] Busy to managing the careers and lives among married couples may cause a lack of opportunity and awareness for prevention.

Analysis showed association between ethnicity and undiagnosed DM. The highest prevalence of undiagnosed DM was observed in Indians, followed by Malays and lastly among Chinese. This finding is similar to the result disclosed by NHMS III in 2006 which showed that Indians had the highest prevalence of undiagnosed diabetes compared to other races. This may be due to differences in lifestyle, dietary intake and genetic inheritance for these three ethnicities. The lowest prevalence of undiagnosed diabetes was shown among the Chinese ethnicity. We suggested that they have more access to the health care facilities; hence diabetes cases were diagnosed early and resulted in a lower prevalence of undiagnosed diabetes.

The result shows that the prevalence rate of undiagnosed DM for current smokers was significantly higher compared to non-smokers. A finding in Qatar by Bener et al. also dictated a similar condition whereby it was found that smoking habit was a major contributor to DM. However, the present study showed that smoking status was not associated with undiagnosed DM. A study by Raghupathy et al. in India also reported lack of association between smoking and undiagnosed DM21. There was no association in this study may be due by small participation of smaller propotion of smoker in the study.[28]

Regarding to the prevalence of undiagnosed DM and obesity, the results showed a higher prevalence rate of undiagnosed DM in obese respondents compared to non-obese respondents and the finding was found to be significantly associated. The current study revealed that obese people were 1.32 times more likely to have undiagnosed DM. Studies by Wee et al, 2008 in US30, Gregg et al, 2004 in US31 and Ahmad et al, 2011 in Kashmir[20] also reported the association of obesity or high BMI status with undiagnosed DM. According to Wee et al, 2008 in US30, one reason for the high prevalence of undiagnosed DM among obese respondents might be due to the disproportionate number of normal-weight adults identified with Type 1 diabetes, which often produces symptoms earlier in the disease course. Delayed diagnosis of diabetes among the overweight and obese adults who are at higher risk of type 2 diabetes may reflect delays in experiencing, recognizing, and presenting symptoms of diabetes in a timely manner. However, competing health concerns, social

stigma, and health system bias may also contribute to this phenomenon.[32]

The results showed a higher prevalence rate of undiagnosed DM in hypertensive respondents and there was a significant association between hypertensive status and undiagnosed DM. This finding is in accordance with the findings in Indonesia.[33] The current study also revealed that respondents who had hypertension were 1.38 times more likely to have undiagnosed DM. This indicates that screening for DM should also be targeted to hypertensive patients in Malaysia.[22] Apart from the increase prevalence of undiagnosed diabetes in Malaysia, future studies have to be undertaken to determine why Malaysians do not screen themselves regularly for diabetes and level of awareness towards diabetes and other non-communicable diseases.

There are several limitations in this study. First, the data were obtained were from secondary data of NHMS 2011 therefore there is limited information obtained regarding the risk factors of undiagnosed DM in Malaysia. Second, there is limited availability in the number of studies on undiagnosed DM, to be compared with our findings in this study.

CONCLUSION

The prevalence of undiagnosed T2DM among Malaysians was significantly associated with gender, age, ethnicity, marital status, obesity and blood pressure. Large numbers of people were unaware of their diabetic status. Early diabetic screening is crucial, especially among adults aged 30 years and above to prevent more serious complications of this disease.

ACKNOWLEDGEMENT

We would like to thank the Director-General of Health Malaysia, for his kind support and granting permission to publish this study.

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