





BMJ Open Recognition of diabetes and sociodemographic predictors: results of a cross-sectional nationwide population-based survey in Singapore

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ABSTRACT

Objective To assess recognition of diabetes among a nationally representative multiethnic sample of Singapore's general public. Also, to explore the sociodemographic predictors associated with the ability to correctly recognise diabetes.

Design and setting This was a cross-sectional vignette-based survey. Respondents were instructed to read the vignette, then answer the open-ended question, 'What do you think the person in the vignette is suffering from?'

Participants A sample of 2895 household residents aged 18 years and above, of which 436 were persons with diabetes.

Results 82.7% could correctly recognise diabetes in the vignette. Overall, recognition was significantly higher among respondents aged 35–49 years (OR 1.85, 95% CI 1.15 to 2.98), 50–64 years (OR 2.06, 95% CI 1.19 to 3.56), ethnic Malays (OR 1.39, 95% CI 1.02 to 1.89) and persons with diabetes (OR 2.64, 95% CI 1.38 to 5.08). By contrast, male (OR 0.64, 95% CI 0.46 to 0.90), ethnic Others (OR 0.59, 95% CI 0.37 to 0.93) and the unemployed (OR 0.48, 95% CI 0.25 to 0.92) were significantly associated with poor recognition of diabetes.

Conclusion Overall public recognition of diabetes was high, but the significant gaps in knowledge in certain demographic groups were of concern. Public health interventions aimed at preventing and controlling diabetes should continue to target all members of the population with accurate and appropriate information. Ongoing efforts of diabetes awareness and screening programmes need to be improved, particularly for young adults, males and the unemployed.

INTRODUCTION

Diabetes mellitus is a prevalent chronic condition which results in substantial target organ disease and significant complications including blindness, kidney failure, stroke and coronary heart disease. In 2017, it was estimated that there were 451 million adults (8.5%) worldwide with diabetes, with an associated cost of US\$850 billion comprising direct and indirect medical costs as well as

Strengths and limitations of this study

- This is the first study to explore recognition of diabetes in a representative sample of the general adult population in Singapore.
- Vignettes were developed in consultation with clinicians and people with diabetes.
- Use of a vignette-based design and structured questionnaire ensures reproducibility of the study.
- People who were hospitalised, institutionalised or uncontactable during the period of the study were excluded from the survey.
- The vignette might have facilitated diabetes identification by clearly describing persons with prototypical symptoms and functional changes, which may be different from real-life scenarios.

informal care.^{1,2} There is a growing diabetes epidemic in the Asia-Pacific region with more than 50% of people with diabetes being undiagnosed.^{2–4} To date, the International Diabetes Federation has estimated that Asia accounts for 60% of the world's diabetic population.³ In Singapore, as in many developed countries, diabetes is a major public health concern.⁵ The cost of diabetes per patient was found to be US\$1575.6, which was higher than the costs reported in other Asian countries.⁶ In 2017, diabetes became the seventh leading cause of morbidity and premature death in Singapore.⁷ An epidemiological study of the resident general population, found the prevalence of diabetes to be approximately 11.3% (one in nine) in those aged 18 years and above with higher rates among men than women.⁸ The national health survey data also revealed that 51.4% of individuals in Singapore were unaware that they had diabetes.

Diabetes literacy is herein defined as the knowledge and beliefs regarding diabetes

mellitus that aid recognition, management or prevention of this physical disease. This is adapted from 'mental health literacy', a term by Jorm⁹ with widespread usage that refers to 'knowledge and beliefs about mental disorders which aid recognition, management or prevention'. Poor knowledge of the signs and symptoms of diabetes may be a particularly important barrier to help-seeking behaviour for this chronic disease. Failure to recognise signs and symptoms associated with diabetes could lead to delays in timely medical attention.¹⁰ Accurate recognition and labelling of the disease are paramount to the prevention of diabetes to facilitate early and appropriate help-seeking to improve long-term health outcomes.

Recent qualitative studies exploring health literacy in diabetes in Asian cultures found that culture shaped understanding and experiences of health literacy.^{11–13} There are significant ethnic differences in how physical health conditions are recognised and labelled. For example, in a study with ethnic Chinese, the researcher found that a majority held on to cultural beliefs that ageing or a 'weak body' was the cause for diabetes.¹⁴ Much of the available literature tends to focus on the knowledge of patients with diabetes. Few reports are available on evaluating diabetes literacy in the general population, even though diabetes is increasingly becoming a major threat to global public health. A general population study of Australian adult residents found that only 14%–29% of the population were able to correctly recognise diabetes symptoms and warning signs.¹⁵ In the UK, 59.4% of the public were able to correctly identify diabetes symptoms and deemed to have adequate awareness of the disease.¹⁶ On the other hand, research conducted in Sri Lanka reported that 77% of the general public surveyed could correctly recognise diabetes.¹⁷ In Singapore, the only local study evaluating general public's knowledge of diabetes reported that about 60% were able to recognise the symptoms and complications of the disease.¹⁸ However, recent literature remains sparse and studies were often with smaller samples and the findings are not a valid representation of the overall population of the country.

Singapore is a multicultural, multiethnic and multilingual country where the major ethnic groups of Chinese, Malays and Indians still maintain somewhat separate cultural identities. The population of Singapore comprises about 5.9 million people, of which 3.9 million are Singapore citizens or permanent residents. The resident population comprises four main ethnic groups—Chinese (74.3%), Malay (13.3%), Indian (9.1%) and Others (3.3%).¹⁹ Therefore, Singapore is an ideal location to study diabetes literacy among the multiethnic Asian population. The purpose of this population-based diabetes literacy study was to specifically evaluate the proportion of the Singapore public who are able to recognise diabetes correctly and the factors associated with it, in a nationally representative multiethnic sample. The results of the study may have strategic implications for the reduction of ethnic or socioeconomic disparities

in diabetes detection, and better inform future health promotion campaigns.

METHODS

Setting and study design

This nationwide cross-sectional study of the Singapore population includes citizens and permanent residents aged 18 and above, belonging to the four major ethnic groups, who were literate in English, Chinese, Malay or Tamil and living in Singapore at the time of survey. All residents who were uncontactable due to incomplete or incorrect addresses and those living outside of the country were excluded from the study. The overall response rate of the study was 66.2%. Written informed consent was obtained from all respondents 21 years of age and above, as well as from parents or guardians of those aged 18–20 years.

Sample size calculation and sampling

Statistical power calculations for binary proportions post-adjusted for design effects determined sample sizes for the population prevalence estimate, as well as for subgroup (age and ethnicity) estimates, with an overall precision of 2.5%.²⁰ Using 20% as a prevalence estimate based on previously reported prevalence rates of diabetes knowledge in Singapore,¹⁸ a total sample size of 3000 was estimated to be adequate to determine the general knowledge of diabetes in the population. The margin of error for the overall prevalence estimate was found to be 2.5%, while that of the subgroups by age and ethnicity ranged from 4.5% to 5%. The relative standard error (SE) was found to be substantially below the acceptable range (<30%), ranging from 2.1% to 4.2%. Further details of the sampling strategy and processes are published elsewhere.²⁰

The sampling frame was an administrative database of all residents in Singapore from which the sample was derived. A disproportionate stratified sampling design was used in the study to randomly select a probability sample, based on 12 strata according to ethnicity (Chinese, Indian, Malay) and age groups (18–34, 35–49, 50–64, 65 and above). The study oversampled those of Malay and Indian ethnicities, as well as residents aged 65 and above in order to ensure sufficient sample size and to improve the reliability of parameter estimates for these population subgroups.

Data collection

Data were collected in face-to-face interviews by trained interviewers, using the computer assisted personal interviews on handheld tablets. For quality assurance, at least 10% of the completed interviews were validated through face-to-face and telephone follow-up.

Questionnaire

A structured questionnaire was used to obtain sociodemographic information including age, gender, ethnicity,

marital status, personal income, educational and employment status, and self-reported diagnosis of diabetes. The study was introduced as an investigation of Singapore residents' knowledge, attitudes and practices of a 'chronic physical condition'. This was done so as to not influence respondents' responses to the vignette presented at the beginning of the interview. The actual disease of interest, diabetes, was only revealed after the vignette section.

Vignette adaptation

Respondents were presented with a hypothetical vignette describing a person with diabetes mellitus. The vignette was developed and refined by the researchers in consultation with experienced clinicians specialising in diabetes care. The vignette length was approximately 110–120 words and described classic and common symptoms of the disease. Presented in English, Chinese, Malay or Tamil, the vignette was phrased with simple laymen's terms. Further incorporating elements of the local context such as descriptions of the character's background and home functioning, facilitated the development of a vignette storyline that was natural and relatable.^{21 22} The vignette also described a person of the same gender and ethnicity as the respondent. For instance, a Chinese male participant was presented a vignette about Mr Tan (see online supplemental appendix A). Respondents were asked what they thought the person described in the vignette was suffering from and to name the condition associated with the vignette description (free response). They were asked to base their considerations on the available information only. The response was coded as correct if the participant was able to correctly label the condition. In cases where the response was a near approximation of the correct answer, three of the investigators including the first author (AP, KR and MS) would come to a consensus on how that response should be coded.

Vignette translation and cognitive testing

The translation procedure undertaken was aimed at achieving conceptual equivalence using an adapted four-step process from WHO: (1) forward translation: the vignette and follow-up questions were translated into the three local languages—Chinese, Malay and Tamil using a professional translating firm, (2) expert panel review: which involved a critical evaluation of expert panel recommendations on issues identified with translations (3) pre-testing and cognitive interviews (CI): further CI were undertaken, with 25 respondents from diverse age groups, ethnicity, gender, and socioeconomic (or education attainment) status. Trained CI systematically probed respondents on what they thought the vignette was about, what came to their mind when they were presented a particular phrase or term and were asked how they decided on their response. Words or expressions that were not easily understood, or deemed offensive or unacceptable were highlighted to interviewers, and where alternative words or expressions existed, respondents were asked which of the alternatives better conformed to their usual

language. (4) The development of final translations was achieved after minor changes based on the information gathered from the CI.

Statistical analyses

The survey sample was weighted by age and ethnicity to match the Singapore resident population so that the results could be generalised. Weighted mean and SE of the mean were calculated for continuous variables, and frequencies and percentages for categorical variables. Descriptive statistics were performed to establish the prevalence of diabetes literacy as well as to describe sociodemographic characteristics of the study sample. Univariate analyses (t-test or χ^2 test) was used to investigate differences among age groups (18–34=1; 35–49=2; 50–64=3; 65 and above=4), gender (female=1; male=2), ethnicity (Chinese=1; Malay=2; Indian=3; Others=4), education (degree and above=1; primary and below=2; secondary=3; preuniversity/junior college=4; vocational institute/ITE=5; diploma=6), employment (employed=1; economically inactive*=2; unemployed=3), income (in SGD) (below 2000=1; 2000–5999=2; 6000 and above=3) and diabetes diagnosis (no=1; yes=2). Categories coded as 1 were set as the reference category for all variables. A logistic regression analysis using survey weights to account for complex survey design was conducted to determine the sociodemographic variables significantly associated with correct recognition of diabetes. The level of statistical significance was set at $p < 0.05$ using two-sided tests.

Patient and public involvement

Cognitive testing of survey questionnaires involved diabetic patients and members of the public to improve the quality of the questionnaire and to adapt it for local population use. Patients and/or the public were not involved in the recruitment, conduct, reporting and dissemination plans of this research.

RESULTS

The demographics of this study population are shown in [table 1](#). The survey data include 2895 respondents. The mean age of respondents was 45.8 years and 51.6% of the respondents were female. Majority (75.8%) were Chinese, 12.7% were Malays, 8.6% were Indians and 2.9% were from the ethnic group, Others. For education level, 29.5% of the respondents were university graduates, 20.3% of the respondents had completed secondary education and 20.4% had primary education or less.

[Figure 1](#) presents the percentage of respondents endorsing each category with respect to recognition of the vignette. In total, 82.7% (n=2418) of the respondents from the general population correctly identified the disease from the vignette, of which 89.9% (n=2036) did not have a diabetes diagnosis. While, 0.7% (n=23) were found to have partly correct recognition (eg, mislabelling and referring to diabetes as 'high blood sugar'). The 23 responses were as such, included under 'correct

Table 1 Sample characteristics (n=2895)

	N	Weighted	Non-diabetic (n=2459)		Diabetic (n=436)	
			N	Weighted	N	Weighted
Age group						
18–34	823	29.90%	817	32.70%	6	1.80%
35–49	719	28.20%	670	29.80%	49	12.30%
50–64	774	26.80%	591	24.50%	183	49.10%
65 and above	579	15.10%	381	13.00%	198	36.90%
Gender						
Female	1474	51.60%	1258	52.20%	216	44.90%
Male	1421	48.50%	1201	47.80%	220	55.20%
Ethnicity						
Chinese	796	75.80%	731	76.90%	65	64.90%
Malay	974	12.70%	811	12.10%	163	18.70%
Indian	918	8.60%	725	7.90%	193	15.10%
Others	207	2.90%	192	3.00%	15	1.40%
Education						
Primary and below	637	20.40%	456	18.30%	181	40.80%
Secondary school	684	20.30%	552	19.70%	132	26.60%
Pre-university/junior college	126	4.80%	112	5.00%	14	2.30%
Vocational institute/ITE	267	6.60%	241	6.80%	26	5.20%
Diploma	479	18.50%	442	19.00%	37	12.80%
Degree and above	702	29.50%	656	31.20%	46	12.50%
Marital status						
Married/cohabiting	1860	61.70%	1531	60.00%	329	78.10%
Single	731	29.20%	704	31.70%	27	4.70%
Divorced/separated	154	5.00%	131	5.00%	23	4.90%
Widowed	149	4.10%	92	3.30%	57	12.30%
Employment						
Employed	1933	70.50%	1731	72.40%	202	51.10%
Economically inactive*	829	25.40%	617	23.70%	212	41.80%
Unemployed	133	4.10%	111	3.80%	22	7.10%
Monthly income (in SGD)						
Below S\$2000	1455	45.30%	1155	43.30%	300	65.00%
S\$2000–S\$3999	698	23.90%	627	24.60%	71	17.30%
S\$4000–S\$5999	318	12.80%	295	13.20%	23	8.30%
S\$6000–S\$9999	183	7.80%	167	8.20%	16	4.00%
S\$10 000 and above	117	5.70%	104	5.90%	13	3.30%
Undisclosed	124	4.50%	111	4.70%	13	2.10%

Frequencies and percentages may not tally to 100% due to missing data.

*Economically inactive includes retired, homemaker, student and the physically disabled.

ITE, Institute of Technical Education.

recognition' in regression analysis. About 7.7% (n=220) incorrectly recognised the condition as other medical problems, 2.9% (n=75) incorrectly recognised the condition as ageing, 1.0% (n=33) of the respondents mislabelled the disease as a non-medical problem, and 4.9%

(n=126) did not provide answers, responding with 'don't know' or 'not sure'.

Online supplemental appendix B presents the weighted percentages of sociodemographic factors of respondents with incorrect recognition of diabetes. Among the 454

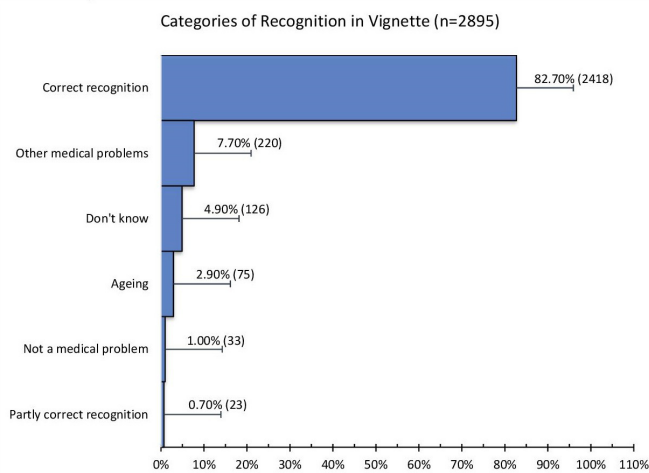


Figure 1 Weighted percentages of respondents by categories of recognition of diabetes. Error bar represents SE.

respondents who incorrectly recognised diabetes, the majority were male (56.1%, n=262), aged 18–34 years (40.4%, n=172), married (54.4%, n=253) and an equal proportion of them had primary education and below (22.8%, n=119) or had attained a university degree and above (22.8%, n=86); and about 4.3% (n=31) of the respondents diagnosed with diabetes, were unable to recognise the disease (see figure 2).

Sociodemographic factors associated with correct recognition

Logistic regression modelling was used to determine the significant correlates of the recognition of diabetes. Table 2 reveals that individuals of Malay ethnicity (OR 1.39, 95% CI 1.02 to 1.89; p=0.04) had higher odds of correct recognition for diabetes than the Chinese. Compared with individuals of ages 18–34 years, the recognition of diabetes was significantly higher among the age groups of 35–49 years (OR 1.85; 95% CI 1.15 to 2.98; p=0.01) and 50–64 years (OR 2.06; 95% CI 1.19 to 3.56;

Table 2 Sociodemographic correlates of correct recognition of diabetes

	OR	95% CI	P value
Age group			
18–34	Ref		
35–49	1.85	1.15 to 2.98	0.01
50–64	2.06	1.19 to 3.56	0.01
65 and above	1.45	0.76 to 2.75	0.26
Gender			
Female	Ref		
Male	0.64	0.46 to 0.9	0.01
Ethnicity			
Chinese	Ref		
Malay	1.39	1.02 to 1.89	0.04
Indian	1.24	0.92 to 1.68	0.15
Others	0.59	0.37 to 0.93	0.02
Education			
Primary and below	0.58	0.31 to 1.11	0.1
Secondary	0.75	0.43 to 1.32	0.32
Pre-university/junior college	0.79	0.36 to 1.71	0.54
Vocational institute/ITE	0.48	0.26 to 0.89	0.02
Diploma	0.91	0.54 to 1.53	0.73
Degree and above	Ref		
Marital status			
Married/cohabiting	Ref		
Single	1.04	0.67 to 1.6	0.87
Divorced/separated	0.93	0.45 to 1.92	0.85
Widowed	0.85	0.4 to 1.8	0.67
Employment			
Employed	Ref		
Economically inactive*	1.07	0.69 to 1.66	0.77
Unemployed	0.48	0.25 to 0.92	0.03
Monthly income (in SGD)			
Below S\$2000	Ref		
S\$2000–S\$3999	1.21	0.78 to 1.88	0.39
S\$4000–S\$5999	1.22	0.66 to 2.28	0.53
S\$6000–S\$9999	1.5	0.68 to 3.3	0.32
S\$10000 and above	1.25	0.51 to 3.06	0.62
No income	0.98	0.53 to 1.81	0.95
Diabetes status			
No	Ref		
Yes	2.64	1.38 to 5.08	0.004

*Economically inactive includes retired, homemaker, student and the physically disabled.
ITE, Institute of Technical Education.

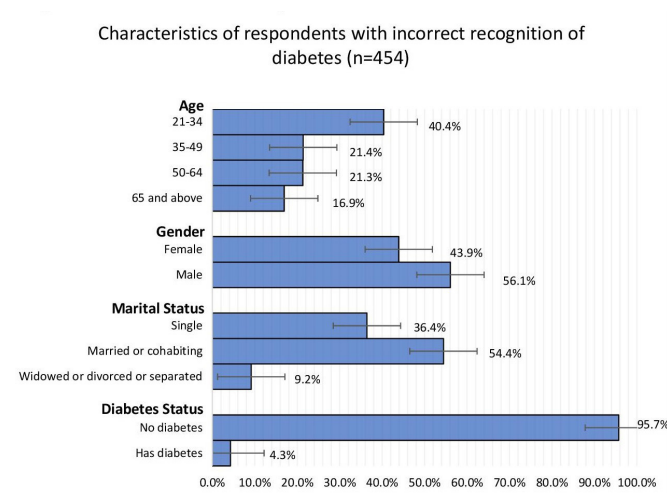


Figure 2 Weighted percentages of respondents by sociodemographic factors for incorrect recognition of diabetes. Error bar represents SE.

p=0.01). Individuals who were diagnosed with diabetes were nearly three times as likely to correctly recognise the condition as those who did not have diabetes (OR 2.64; 95% CI 1.38 to 5.08; p<0.01).



However, we found that male gender (OR 0.64; 95% CI 0.46 to 0.90; $p < 0.01$) and those from the Others ethnic category (OR 0.59; 95% CI 0.37 to 0.93; $p < 0.01$), had significantly lower odds of recognition for diabetes. Those who were unemployed (OR 0.48; 95% CI 0.25 to 0.92; $p = 0.03$) also had lower odds of correct recognition compared with those who were employed.

DISCUSSION

This was the first extensive study of diabetes literacy in Singapore to evaluate recognition by using a vignette. The study also identified significant sociodemographic characteristics associated with the correct recognition of diabetes mellitus. This study serves as a baseline measure of diabetes knowledge in Singapore's general population, and will play an important role to inform future health policies and initiatives as part of ongoing national efforts to tackle diabetes.

Overall, the findings of this study suggest that the general adult population in Singapore has a relatively high rate (82.7%) of diabetes recognition. Our results present a striking contrast with other research¹⁶ and correct recognition was much higher than previously found in local studies, where only about 60% of the general population were able to recognise symptoms and complications of diabetes.¹⁸ In a vignette-based study by Vimalanathan and Furnham,²³ which explored health literacy of different types of diseases, diabetes had a correct recognition rate of 46% among the British adults. Diabetes literacy in our study, in this regard, was considerably higher. The high percentage of recognising diabetes in the general public may be a positive reflection of the recent concerted national efforts and developments surrounding diabetes awareness in the country, which has led to a slew of measures including public health campaigns ('War on Diabetes'), education initiatives and the portrayal of diabetes-related problems and complications in local mass media.²⁴ However, some individuals though aware of this disease, may struggle to label it in proper medical terms. This was reflected in our results, with a proportion of answers observed to be 'partly correct recognition', wherein diabetes was labelled in non-technical, colloquial language (eg, 'high blood sugar'). Another interesting finding includes some individuals interpreting the symptoms depicted in the vignette as the presence of other medical conditions. This was reflected in our analysis with 7.7% of the respondents ascribing it to health problems other than diabetes. For example, symptoms of 'feeling thirsty' were construed to be a condition of 'dehydration'. This suggests people may be using their general health knowledge to answer, rather than having specific knowledge about diabetes. While we can appreciate that recognising symptoms as any other physical health condition (not diabetes) might still prove helpful in prompting individuals to seek professional care, ascribing the symptoms to a less serious condition can lead to significant delays in seeking proper and effective treatment. Furthermore,

this points out a gap in the public knowledge of diabetes which must be addressed in order to better differentiate its symptoms and treatments, from other health problems. The signs and symptoms of diabetes may have been overlooked because of the slow and chronic progression of the disease; unlike many other physical conditions, the consequences of diabetes may not be manifested immediately.²⁵

The current study identified a number of sociodemographic factors significantly associated with correct recognition, including age, gender, ethnicity, as well as personal experience with diabetes. Recognition varied by age group, where young individuals (18–34 years) recognised diabetes most poorly, whereas those aged between 35 and 49 years and those aged between 50 and 64 years were significantly better at correctly recognising diabetes. We surmise that these findings may have been a result of several factors. First, the average age of onset of diabetes is about 45 years.⁵ Comparably, the average age of respondents in our study was 45 years and a substantial proportion of adults with self-reported diabetes were from the age groups of 35–49 and 50–64, who may have recognised and had experience in dealing with similar problems to those described in the vignette. Unlike mental illnesses which may present with an early onset in younger people,²⁶ chronic physical diseases are known to be largely present and of greater concern in older individuals.²⁷ Perhaps the young adults in this study, were less likely to have directly or indirectly encountered diabetes. This theory is consistent with the local national health report⁸ which suggests young adults in Singapore were less likely to have attended health screenings for chronic disease and were less likely to seek frequent treatment or follow-up consultations for diabetes than individuals from older age groups. Therefore, it is not surprising that the knowledge and ability to correctly recognise signs and symptoms of diabetes among young adults was poorer than those of older ages. These findings add to the importance of rethinking the diabetes public education efforts in Singapore. There may be a need for different educational strategies, focusing on specific symptoms of the disease, and a consideration of how the content is communicated so as to better target young adults given recognition of diabetes was poorest among them.

This study also observed a significant difference between the ability of males and females to recognise the physical disease. Consistent with the body of literature which reports better rates of diabetes recognition among females than males,^{6 28} our study found that males were specifically less able to recognise diabetes. Gender differences in both mental and physical health literacy have previously been explained by greater self-awareness and higher sensitivity to symptoms of illnesses among women compared with men.^{29 30} This gender disparity has also been associated with health behaviour paradigms such that, men are less likely to seek professional help for their health problems,^{31–33} which could contribute to men's health gap in terms of disease knowledge and

recognition. Therefore, there is a crucial need for policy and health promotion programmes to target males who have a higher burden of the disease, with diabetes education strategies and materials designed to suit their needs and characteristics.

In this study, we found a relationship between ethnicity and recognition of diabetes. That is, ethnic Malays were more likely to identify it correctly, and those from the ethnic group, Others, were less likely to correctly recognise diabetes compared with Chinese. It is possible that respondents who are ethnic Malay, were disproportionately living with diabetes compared with the Chinese majority³⁴ or more likely to have direct contact with other individuals living with the disease. It can also be reasoned that the national diabetes education campaign since 2016, meant to engage ethnic Malays through community programmes and initiatives, may have been successful.³⁵ This emphasises utility in encouraging community involvement to support diabetes education by engaging racial/religious community groups in several small-scale activities. On the other hand, individuals from the Others ethnic group demonstrated poor recognition of diabetes, which could be due to the attribution of the symptoms to causes other than the disease. This is unfortunate because recognition of early symptoms can help to get diabetes under control immediately and prevent long-term complications. Content analysis of incorrect responses showed that there was a general tendency to consider symptoms described in the vignette as 'not a medical problem' or misinterpreting symptoms as 'ageing' or 'other medical problems'. However, we are unable to offer any definite explanation for this phenomenon just as has been observed in other research.³⁶ Future studies to elucidate underlying reasons for ethnic differences is warranted.

Employment status was another significant predictor of diabetes knowledge. Compared with those employed, unemployed individuals were found to be less likely to correctly recognise diabetes in our study. The majority of diabetes cases occur among working adults.³⁷ Research has linked diabetes to physical disability in adults worldwide,^{38 39} resulting in increased sick days for employees and increased costs for employers.⁴⁰ Thus, workplace screening and health talks for diabetes may have led to greater awareness and better recognition among those who are employed. In Singapore, health talks and routine health screenings including comprehensive blood tests offered to employees have become increasingly commonplace.⁴¹ There may be easier affordability to use healthcare services among residents who are gainfully employed compared with their unemployed peers. This is consistent with a recent national survey which found that participation in health screenings rose in tandem with income.⁸

It was not unexpected that persons with diabetes had significantly better recognition of the disease than the healthy population in our study. Patients with diabetes would have a deeper personal understanding of symptoms and chronic complications of diabetes when compared with the healthy population given their own experience

and the education imparted as part of the management of diabetes.

Strengths and limitations

There were some limitations in our study. The vignette format might have facilitated diabetes identification by clearly describing persons with prototypical symptoms and functional changes. Recognition may be poorer in real life, because one might not notice the slow changes and ignore, minimise, or misattribute symptoms to other causes. The recognition rate found here may not apply to non-typical presentations of diabetes.⁴² Moreover, the study did not include those who had language difficulties, and those who were institutionalised, hospitalised or uncontactable during the survey period. The survey was also a part of a larger study aimed at exploring the knowledge differences between those with and without diabetes in the general population, which may have introduced heterogeneity and the results could have hence overestimated diabetes recognition in the population. Nevertheless, the current study has its strengths in that it was a nationwide study with a representative sample who were surveyed ensuring high quality of the data collected. Additionally, the vignette was developed with inputs from experienced clinicians who are experts in the field and further cognitive testing was undertaken before use. Also, the study instruments were translated into the three major local languages ensuring inclusivity.

CONCLUSION

Given the high prevalence rate of diabetes in high-income countries including Singapore, it is imperative that educational campaigns target all members of the population with accurate and appropriate information. In order to do this, it is important to establish the population's baseline knowledge and ability to recognise the signs and symptoms of diabetes. This study therefore set out to obtain up-to-date data, which future strategies and national programmes could potentially deploy. Our findings can inform strategic plans to address the growing diabetes epidemic. To prevent diabetes, reduce its economic burden, and improve the quality of life for those with diabetes or at risk of diabetes, public health messages and healthcare system interventions should target specifically, young adults, males and the unemployed with poor knowledge of diabetes and efforts should be made to screen the populations at risk. This should include the development of suitable strategies to communicate more effectively with a deeper understanding of the needs and competencies of the specific demographic. We must additionally acknowledge that often there may be patients with early diabetes with no symptoms. Thus, public health strategies should be directed towards increasing awareness of risk factors such as age, overweight, genetics and gestational diabetes. Research to develop effective ground-up community initiatives to apply diabetes education and screening programmes more widely should be supported to circumvent delays in diagnosis and treatment for persons with diabetes.

Contributors KR led the analysis plan and interpretation of findings and prepared the manuscript. He is guarantor. MS and AP were actively involved in the analysis, interpretation and manuscript content. MS, SAC, ESL and CFS were involved in the conceptualisation of the study. JHL conducted the analysis and assisted in interpretation of findings and manuscript content. FDSK and PW provided significant intellectual inputs into the manuscript.

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Competing interests None declared.

Patient consent for publication Not applicable.

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