

ORIGINAL ARTICLE

Determinants of Diabetes Knowledge among Patients with Type 2 Diabetes Mellitus in a Malaysian Primary Care Setting: A Cross-sectional study at Kangar Health Clinic.

Tan Zhen Sheng¹, Aina Nabila Basri¹, Faiqah Nabilah Noorhaidi¹, Nurulaishah Mohammad¹, Soo Pei Pei^{2*}, Ng Yit Han³

¹Pharmacy Unit, Kangar Health Clinic, Kangar, Perlis, Ministry of Health, Malaysia.

²Pharmaceutical Services Division, Perlis State Health Department, Ministry of Health Malaysia.

³Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia.

Corresponding Author

Soo Pei Pei

Pharmaceutical Services Division, Perlis State Health Department, Jalan Raja Syed Alwi, 01000 Kangar, Perlis, Malaysia.

Email: soo_pei@moh.gov.my

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Abstract

Introduction: Type 2 Diabetes Mellitus (T2DM) requires ongoing self-management to reduce the risk of complications, with patient knowledge playing a pivotal role in making informed decisions about diet, medication adherence, and lifestyle modifications. A better understanding of diabetes enables patients to manage their condition effectively and prevent complications. **Objectives:** This study aimed to assess the level of diabetes knowledge and its associated factors among T2DM patients at Kangar Health Clinic, Perlis. **Methods:** A cross-sectional study was conducted at Kangar Health Clinic. Participants were eligible for inclusion if they were aged 18 years or older and had been diagnosed with T2DM. A self-administered questionnaire comprising 35 items, which included sociodemographic information, diabetes-related characteristics, and the validated Malay-translated Simplified Diabetes Knowledge Test (DKT), was used for data collection. Multiple linear regression was performed to identify factors associated with diabetes knowledge. **Results:** A total of 298 participants were included, with a mean age of 64.0 years (SD = 10.6). The majority were male (62.4%) and Malay (91.3%). Most respondents (69.8%) demonstrated a poor level of knowledge. After multivariable analysis, higher knowledge was significantly associated with being female ($p = 0.003$), being married ($p = 0.020$), and having higher education levels ($p < 0.05$). Additionally, having hypertension ($p = 0.004$) or dyslipidemia ($p = 0.001$), and being a former smoker ($p = 0.015$) were associated with higher scores, while current smokers were associated with significantly lower knowledge ($p = 0.003$). **Conclusion:** Participants demonstrated poor level of diabetes knowledge. Tailored educational interventions targeting males, individuals with lower education levels, and current smokers are recommended to improve self-management and health outcomes.

Keywords: Diabetes knowledge, health literacy, patient education, self-management, type 2 diabetes mellitus,



Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels due to insulin resistance, inadequate insulin secretion, and both. Type 2 Diabetes Mellitus (T2DM) is the most prevalent form of diabetes, accounting for approximately 90% of diabetes cases worldwide. According to the International Diabetes Federation (IDF) Diabetes Atlas 2021, approximately 537 million adults worldwide (10.5% of the global adult population) have diabetes, and this number is projected to rise to 783 million by 2045 [1]. In Malaysia, the National Health and Morbidity Survey (NHMS) 2023 reported that diabetes is the most prevalent non-communicable disease, affecting 15.6% of the adult population, equivalent to one in six adults [2]. The overall prevalence of diabetes has increased from 11.2% in 2011 to 15.6% in 2023, peaking at 18.3% in 2019 [3]. Notably, diabetes prevalence is higher in rural areas than in urban areas, with significant regional variations. Perak recorded the highest prevalence (21.7%), followed by Pahang (21.5%) and Perlis (20.6%). Like many other chronic non-communicable diseases, T2DM is often asymptomatic in its early stages, making it difficult for individuals to detect the condition without regular screening. However, if left uncontrolled, diabetes can lead to serious long-term complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy, which can significantly impact a patient's quality of life and increase healthcare costs [4]. Effective diabetes management requires not only medical intervention but also a strong foundation of patient knowledge regarding the disease, its risk factors, complications, and self-care practices. Patients themselves play a crucial role in ensuring the effectiveness of their diabetes management [5]. Essential components of self-care include dietary regulation, physical activity, blood glucose monitoring, foot care, and medication adherence. Studies have shown that improved self-management skills are associated with better health outcomes and a reduced incidence of complications, particularly in the early stages of the disease [6].

Patient knowledge about diabetes is a key determinant of effective disease management and prevention of complications. Research has consistently shown that individuals with greater diabetes knowledge are more likely to adopt healthier lifestyle habits, adhere to prescribed medications, and regularly monitor their blood glucose levels, all of which contribute to better disease control [7]. However, knowledge levels among diabetes patients vary widely and are influenced by multiple factors, including education level, healthcare access, socioeconomic status, and cultural beliefs [8]. Patients with limited knowledge may struggle with self-care and disease management, increasing their risk of developing severe complications. Understanding these knowledge gaps is essential to designing targeted educational interventions that can empower patients to take an active role in managing their condition and improving their overall health outcomes.

In Malaysia, despite ongoing efforts to promote diabetes awareness through public health campaigns, patient education programs, and nationwide healthcare initiatives, significant knowledge gaps persist among individuals living with T2DM [9,10]. Limited awareness and inadequate understanding of the disease can contribute to poor self-management behaviors, resulting in uncontrolled blood glucose levels and increased risks of complications. The escalating prevalence of diabetes, coupled with these persistent knowledge gaps, underscores the urgent need for comprehensive educational strategies aimed at improving patient awareness and self-care practices. To develop effective interventions, it is essential to first assess the level of diabetes knowledge among T2DM patients and determine the factors that influence their understanding of the disease. However, no study has yet examined the determinants of diabetes knowledge specifically among T2DM patients attending Kangar Health Clinic.

Kangar Health Clinic is one of the primary healthcare facilities in Perlis that provides medical services to a large number of diabetes

patients. Evaluating the knowledge levels of T2DM patients attending this clinic can provide valuable insights into their awareness and educational needs. By identifying key factors associated with diabetes knowledge, healthcare providers can develop targeted educational programs to improve patient understanding and enhance diabetes management strategies. This study aims to assess the level of diabetes knowledge among T2DM patients at Kangar Health Clinic and identify the factors associated with knowledge levels. The findings of this study will contribute to evidence-based recommendations for improving diabetes education and self-management support, ultimately leading to better glycemic control, reduced complications, and improved health outcomes among patients.

Methodology

A cross-sectional study was conducted among patients attending Kangar Health Clinic in Perlis from November to December 2024. The study population comprised individuals diagnosed with T2DM who were followed up at Kangar Health Clinic. Participants were eligible for inclusion if they were 18 years or older and had been diagnosed with T2DM. This study was registered with the National Medical Research Registry (NMRR) and received ethical approval from the Medical Research Ethics Committee (MREC). Before data collection, approval was obtained from the Kangar District Health Officer.

The required sample size was determined using the Raosoft sample size calculator, with an accepted margin of error of 5%, a 95% confidence level, a population size of approximately 1,300, and a response distribution of 50%. Based on these parameters, the calculated sample size was 297 participants. Participants were recruited using a convenience sampling method until the required sample size was achieved. Data collection involved scheduled appointments at the clinic, where eligible participants received a detailed explanation of the study objectives and

procedures. Participants were allowed to ask questions before providing informed consent. Only those who consented received a printed questionnaire.

The questionnaire, available in Malay, consisted of three sections. The first section collected sociodemographic information, including age, gender, race, marital status, occupation, household income, and education level. The second section assessed diabetes-related characteristics, including medical history (underlying diseases), medication history, smoking status, family history of diabetes, and duration of diabetes. The most recent HbA1c level was obtained from the patient's medical record. The final section evaluated diabetes knowledge using a validated Malay-translated version of the Simplified Diabetes Knowledge Test (DKT) [11]. The questionnaire covered topics such as general knowledge of diabetes, lifestyle modifications, dietary management, HbA1c, as well as prevention and screening related to diabetes. HbA1c controlled was defined as $\leq 7\%$, in accordance with the Malaysian Clinical Practice Guidelines for Type 2 Diabetes Mellitus (6th edition) [12]. The questionnaire was piloted among a small group of patients ($n=10$) to ensure clarity, relevance, and appropriateness of the questions before the main data collection.

Permission to use the questionnaire had been obtained from the original author. The 20-item questionnaire provided three response options: "True," "False," and "Don't Know," to facilitate understanding. Each correct response was assigned one point, while incorrect or unsure responses received zero. A higher cumulative score indicated greater knowledge of diabetes. Knowledge levels were then categorized based on Bloom's cut-off: Poor ($<60\%$), Moderate (60–79%), and Good (80–100%) [13]. This categorization was chosen because Bloom's cut-off is widely used in knowledge assessment studies, including those employing the 20-item DKT, and provides a standardized way to interpret knowledge levels. Participants took approximately 30 minutes to complete the

questionnaire. All complete questionnaires were systematically collected, and participant responses remained anonymous.

The descriptive analysis employed measures of central tendency and dispersion, such as mean with standard deviation or median with interquartile range, to present numerical variables. Categorical variables were summarised using frequency and percentage. The bivariate analysis utilised independent t-tests or the Mann-Whitney U test, followed by Pearson's correlation or Spearman ranked correlation analysis, to investigate the relationship between all independent variables and the knowledge of T2DM among participants. Subsequently, multiple linear regression was deployed to determine the factors associated with the knowledge level. Besides, the variance inflation factor (VIF) was calculated to detect potential multicollinearity between the included independent factors in the regression model. A VIF less than 5 suggests no multicollinearity issue. All VIF values were <2, indicating no multicollinearity. All factors with a p-value less than 0.05 in the multiple regression were considered significant at the 95% level. All data analyses were carried out using JAMOVI version 2.6.24.0.

Results

Sociodemographic characteristics of T2DM patients

A total of 298 patients with T2DM participated in the study. Detailed sociodemographic data are presented in Table 1. The study population primarily comprised older adults, with a mean age of 64.0 years (SD =10.6). The cohort was predominantly male (62.4%) and of Malay ethnicity (91.3%). Socioeconomic characteristics revealed that the majority were married (74.5%) and had a low household income (66.8% earning <RM 2499). Educational attainment was concentrated at the primary (35.6%) and secondary (35.6%) levels, with a notable 13.4%

reporting no formal education. The largest occupational group was unemployed (40.3%).

The mean BMI was 27.0 (SD=4.9), indicating that many participants were overweight or obese. Regarding smoking status, 56.0% had never smoked, while 41.3% were current smokers, and 2.7% had quit smoking. Additionally, 42.6% reported having a family history of T2DM.

Medical History and Clinical Profiles

Participants' medical and clinical characteristics are summarized in Table 2. Comorbidities were highly prevalent in this cohort. Hypertension was the most common, affecting 66.1% of respondents, while 33.6% had dyslipidemia and 12.1% had kidney disease. Regarding the disease itself, the majority of patients (64.4%) had been diagnosed with T2DM for 5 to 10 years. Treatment primarily consisted of oral hypoglycaemic agents, used either alone (52.0%) or in combination with insulin (43.3%). The mean HbA1c level was 7.1% (SD=1.5). A majority of participants (69.5%) had controlled HbA1c levels ($\leq 7\%$), whereas 30.5% had uncontrolled diabetes (HbA1c $> 7\%$).

Knowledge of T2DM

The study found that the majority of respondents (69.8%) had poor knowledge level, while 26.8% had a moderate level and only 3.4% had a good knowledge level (Table 3). The mean knowledge score was 9.3 (SD=3.4). The study revealed varying levels of understanding across different aspects of diabetes management (Table 4). The highest correct response rate was for the statement that a healthy diet for diabetes is suitable for most people (66.1%), while regular exercise helping to lower high blood pressure was also well recognized (64.1%). However, significant misconceptions were noted, particularly regarding the impact of fruit juice on blood sugar (38.9% correct), the role of low-sugar soft drinks in treating hypoglycaemia (34.9% correct), and the relationship between lung disease and diabetes (34.9% correct). Moreover, only 25.8% correctly identified the need for more

frequent blood sugar monitoring during illness, and a similar percentage understood that high blood sugar is not caused by excessive insulin intake.

Relationships of sociodemographic and clinical variables with knowledge on T2DM

Our univariable analysis (Table 5) identified multiple factors significantly associated with better diabetes knowledge. These included female gender, married status, government employment, higher income, higher education, non-smoking status, a family history of T2DM, and the presence of comorbidities such as hypertension, dyslipidemia, or kidney disease. Race, however, showed no significant association with knowledge ($p=0.888$). In addition to these findings, a correlation analysis (Figure 1) revealed significant relationships between T2DM knowledge, age, and BMI. Knowledge was found to be weakly and negatively correlated with age ($r=-0.244$, $p<0.001$), suggesting that older participants tended to have lower knowledge scores. Conversely, knowledge had a weak positive correlation with BMI ($r=0.293$, $p<0.001$). A weak negative correlation was also observed between age and BMI ($r=-0.304$, $p<0.001$).

The multivariable analysis in Table 6 identifies several significant factors associated with knowledge of T2DM. Among demographic factors, males had significantly lower knowledge scores compared to females (Adjusted B=-1.25, 95% CI: -2.09, -0.42, $p=0.003$). Marital status also played a role, with married individuals demonstrating higher knowledge levels than those who were single (Adjusted B=1.38, 95% CI: 0.22, 2.54, $p<0.001$). Education level was another key determinant, with individuals possessing primary, secondary, or diploma-level education showing significantly better knowledge compared to those with no formal education.

Lifestyle factors also influenced knowledge, as former smokers exhibited significantly higher scores than non-smokers (Adjusted B=2.39, 95% CI: 0.46, 4.31, $p=0.015$), whereas current smokers had lower scores (Adjusted B=-1.28, 95%

CI: -2.13, -0.43, $p=0.003$). Among clinical factors, individuals with hypertension (Adjusted B=1.04, 95% CI: 0.34, 1.75, $p=0.004$) and dyslipidemia (Adjusted B=1.38, 95% CI: 0.55, 2.21, $p=0.001$) had significantly higher knowledge scores. In contrast, kidney disease and a family history of T2DM were not significantly associated with knowledge. Additionally, BMI showed a weak but significant positive association with knowledge (Adjusted B=0.08, 95% CI: 0.02, 0.14, $p=0.016$). The final reduced model, which retained only significant variables, explained 46.3% of the variance in knowledge scores ($R^2=0.463$), indicating that these factors play a major role in determining T2DM knowledge.

Discussion

This study highlights substantial gaps in diabetes knowledge, emphasizing the urgent need for targeted educational interventions to enhance self-management behaviors and glycaemic control. The predominance of poor knowledge levels, with only a small proportion of participants achieving high scores, mirrors findings from several local studies conducted in diverse primary care settings [8,14]. These results align with previous research demonstrating that diabetes knowledge varies across patient populations and is influenced by sociodemographic and clinical factors [14]. Insufficient knowledge about diabetes remains a pressing concern, as it contributes to inadequate self-care practices, suboptimal glycaemic control, and an increased risk of complications [6]. Bridging these knowledge gaps is therefore crucial for promoting effective diabetes management and reducing the burden of long-term complications.

Our findings indicate a weak positive association between BMI and diabetes knowledge. This relationship should be interpreted cautiously, as higher BMI is generally a risk factor rather than a marker of greater knowledge. One possible explanation is that individuals with higher BMI may have more frequent healthcare visits or

greater exposure to medical counselling, which could enhance their awareness of diabetes and related complications [15]. Additionally, such patients may be more likely to receive referrals to dietitians for weight management, diabetes prevention, or glycaemic control strategies, including carbohydrate counting and meal planning [16]. However, this association may also reflect confounding factors, such as differences in healthcare access, rather than a direct causal relationship. Gender differences were also evident, with males exhibiting poorer knowledge compared to females. This disparity may be attributed to the tendency of women to be more proactive in seeking health information, their higher healthcare utilization rates, and their role as primary caregivers, which often involves learning about chronic disease management [17]. Marital status emerged as another significant factor, with married individuals exhibiting better diabetes knowledge. Spouses often remind and encourage one another about medication adherence, dietary restrictions, and clinic appointments. This mutual support may enhance health awareness, prompt timely medical consultations, and reinforce effective diabetes-management practices [18]. Additionally, education level played a crucial role, as individuals with formal education demonstrated significantly better knowledge than those with no formal education. Higher education levels are associated with improved health literacy, better comprehension of medical advice, and increased access to health-related information, which collectively enhance diabetes knowledge and self-care capabilities. Health literacy, as a component of education, plays a central role in enabling patients to understand and apply diabetes-related information effectively, thereby supporting better disease management and outcomes. These findings align with previous studies that emphasize the role of education in improving disease awareness and adherence to recommended self-care practices [5]. Although family history of T2DM was associated with higher knowledge scores in univariable analysis,

this effect was attenuated after adjusting for education and comorbidities, suggesting that these factors may mediate the relationship between family history and diabetes knowledge. Our study also revealed that smoking status influenced diabetes knowledge. Former smokers demonstrated better understanding compared to current smokers, likely due to exposure to health education during smoking cessation programs. These programs may have provided them with valuable information about diabetes prevention and management, thereby enhancing their knowledge [19]. Conversely, current smokers had poorer knowledge, possibly due to lower engagement with healthcare services and a lack of participation in preventive health measures. Furthermore, individuals with hypertension and dyslipidemia exhibited better knowledge of diabetes, likely because these conditions necessitate regular medical follow-ups, during which they receive information on diabetes management [20]. This suggests that patients with comorbidities may benefit from continuous reinforcement of health education in clinical settings.

Implications for Diabetes Education and Management

Despite ongoing national diabetes awareness campaigns, our findings indicate persistent knowledge gaps among T2DM patients in Malaysia. The results underscore the need for more structured, accessible, and patient-centered education programs. Health literacy initiatives should be tailored to patients' sociodemographic backgrounds, utilizing simple language, visual aids, and culturally relevant materials to enhance comprehension and retention. Education delivery could include group sessions, one-on-one counselling, involvement of family members, and digital tools such as mobile applications or online modules. Healthcare professionals should integrate routine patient education into clinical practice, emphasizing key aspects of diabetes management such as dietary modifications,

medication adherence, blood glucose monitoring, and early recognition of complications. Peer support groups, digital health tools, and community-based interventions could also play a vital role in improving diabetes knowledge and self-care behaviours.

Strengths and Limitations

This study has several strengths, including its relatively large sample size, which enhances the generalizability of the findings to other primary healthcare settings in Malaysia. Furthermore, the use of a validated diabetes knowledge questionnaire ensures the reliability of the results. However, several limitations should be acknowledged. First, the cross-sectional design precludes causal inferences between knowledge levels and clinical outcomes, meaning that observed associations cannot determine directionality or temporal relationships. Second, convenience sampling method was employed, which may introduce selection bias, as participants who were more proactive about their health may have been more likely to participate. Although efforts were made to recruit participants across all clinic days and shifts to minimize this bias, individuals who were more proactive about their health may have been overrepresented. Third, the self-administered nature of the knowledge test may introduce social desirability or acquiescence bias. Despite the inclusion of a "Don't Know" option, some participants may have guessed the correct answer rather than admitting uncertainty, potentially overestimating true knowledge levels. Fourth, this study was conducted at a single primary care clinic in Kangar, Perlis. Given the unique demographic composition of the study population—predominantly Malay (91.3%) and rural—the findings may not be generalizable to other regions in Malaysia with different ethnic distributions, urban settings, or varying healthcare access. Fifth, while education level was assessed, health literacy—a distinct construct that encompasses the ability to obtain, understand, and apply health

information—was not directly measured. Education level serves only as a proxy, and future studies should incorporate validated health literacy instruments to better understand its role in diabetes knowledge. Finally, the high prevalence of current smokers (41.3%) in this cohort warrants caution, as this may reflect local characteristics rather than being representative of broader T2DM populations. Despite these limitations, the study provides valuable insights into diabetes knowledge gaps and their determinants in a Malaysian primary care setting, informing targeted educational interventions.

Conclusion

This study identified significant gaps in diabetes knowledge among T2DM patients in Kangar Health Clinic. These findings highlight the urgent need for educational interventions specifically tailored to at-risk groups, particularly for males, individuals with lower education levels, and current smokers. We recommend that healthcare providers integrate brief education modules into routine clinic visits and involve family members, especially for married patients, to reinforce learning and support self-management. Future research should consider longitudinal studies to evaluate the effectiveness of structured educational programs on knowledge retention, self-management behaviours, and long-term clinical outcomes.

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Conflict of interest

All authors declared that no conflict of interest may arise from this research.

Ethics

The Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH) has provided ethical approval for this study (NMRR ID-24-02716-QUQ).

Authors' contributions

SPP, TZS, ANB, FN, NM and NYH came out with the study design. SPP, TZS, ANB, FN and NM performed the literature search and data collection SPP and NYH were involved in the statistical analysis and manuscript preparation. All authors agreed and approved the manuscript for publication.

Table 1. Sociodemographic T2DM patients at Kangar Health Clinic (n=298)

Characteristics	Mean (SD)	n (%)
Age	64.0 (10.6)	
Gender		
Male		186 (62.4)
Female		112 (37.6)
Race		
Malay		272 (91.3)
Chinese		12 (4.0)
Indian		14 (4.7)
Marital		
Single		21 (7.0)
Married		222 (74.5)
Divorced		21 (7.0)
Windowed		34 (11.4)
Occupation		
Unemployed		120 (40.3)
Government sector		25 (8.4)
Private sector/Self		102 (34.2)
Retiree		51 (17.1)
Household income		
< RM2499		199 (66.8)
RM 2499 – RM 4849		81 (27.2)
RM 4850 – RM 10959		15 (5.0)
> RM 10960		3 (1.0)
Education level		
No formal education		40 (13.4)
Primary		106 (35.6)
Secondary		106 (35.6)
Form six/Diploma		37 (12.4)
Bachelor		9 (3.0)
BMI	27.0 (4.9)	
Smoking status		
No		167 (56.0)
Quit		8 (2.7)
Yes		123 (41.3)
Family history of T2DM		
No		171 (57.4)
Yes		127 (42.6)

SD = Standard deviation, n = Frequency, % = Percentage.

Table 2. Medical history and clinical profiles of respondents (n=298)

Characteristics	Mean (SD)	n (%)
Hypertension		
No		101 (33.9)
Yes		197 (66.1)
Dyslipidemia		
No		198 (66.4)
Yes		100 (33.6)
Kidney disease		
No		262 (87.9)
Yes		36 (12.1)
Other diseases (n=2)		
IHD		1 (50.0)
Prostate		1 (50.0)
Duration of diabetes (years)		
< 5		62 (20.8)
5-10		192 (64.4)
> 10		44 (14.8)
T2DM medications		
Insulin		14 (4.7)
Tablet		155 (52.0)
Combination of both		129 (43.3)
HbA1c level	7.1 (1.5)	
HbA1c status		
Uncontrolled (> 7 %)		91 (30.5)
Controlled (≤ 7%)		207 (69.5)

SD = Standard deviation, n = Frequency.

Table 3. Distribution of respondents by total correct answers and mean knowledge score (n=298)

Knowledge	n (%)	Mean (SD)
Knowledge score		9.3 (3.4)
Knowledge level (%)		
Poor (<60)	208 (69.8)	
Moderate (60 – 79)	80 (26.8)	
Good (80 – 100)	10 (3.4)	

The knowledge groups were categorised according to the Bloom's cut-off.

Table 4. Diabetes Knowledge among patients at Kangar Health Clinic (n=298)

No.	Item	Correct n (%)	Incorrect n (%)
Q1	Diabetic diet - <i>Pemakanan diabetes adalah diet yang sihat untuk kebanyakan orang</i>	197 (66.1)	131 (33.9)
Q2	Glycosylated haemoglobin - <i>Glikosilat hemoglobin (HbA1c) adalah ujian untuk mengukur purata kadar gula dalam darah sepanjang tempoh seminggu yang lepas</i>	134 (45.0)	164 (55.0)
Q3	Carbohydrate content - <i>Semangkuk nasi putih mempunyai kandungan karbohidrat yang lebih tinggi berbanding sekeping roti putih</i>	155 (52.0)	143 (48.0)
Q4	Fat content - <i>Jus oren mempunyai lebih banyak kandungan lemak berbanding susu rendah lemak</i>	66 (22.1)	232 (77.9)
Q5	Urine and blood tests - <i>Pemeriksaan air kencing dan pemeriksaan darah adalah sama baik untuk mengukur kadar gula dalam darah</i>	164 (55.0)	134 (45.0)
Q6	Unsweetened juice - <i>Jus buah-buahan tanpa gula boleh meningkatkan kadar gula dalam darah</i>	116 (38.9)	182 (61.1)
Q7	Diet soda for hypoglycemia - <i>Satu tin minuman bergas kurang gula boleh digunakan untuk merawat kadar gula rendah di dalam darah</i>	104 (34.9)	194 (65.1)
Q8	Olive oil - <i>Menggunakan minyak zaitun dalam masakan boleh mengurangkan kadar kolesterol dalam darah</i>	155 (52.0)	143 (48.0)
Q9	Exercise and blood pressure - <i>Senaman secara kerap boleh membantu mengurangkan tekanan darah yang tinggi</i>	191 (64.1)	107 (35.9)
Q10	Exercise and glucose - <i>Bagi pesakit yang baik kawalan gulanya, senaman tidak memberi kesan terhadap kadar gula dalam darah</i>	110 (36.9)	188 (63.1)
Q11	Infection causing high glucose - <i>Jangkitan kuman berkemungkinan menyebabkan peningkatan kadar gula di dalam darah</i>	125 (41.9)	173 (58.1)
Q12	Diabetic foot - <i>Memakai kasut yang bersaiz besar dari kebiasaan boleh mengelakkan ulser kaki</i>	137 (46.0)	161 (54.0)
Q13	Low fat diet - <i>Makanan rendah lemak mengurangkan risiko masalah jantung</i>	179 (60)	119 (40)
Q14	Numbness and tingling - <i>Rasa kebas dan sesemut merupakan gejala penyakit saraf</i>	179 (60)	119 (40)
Q15	Diabetes and lung problems - <i>Masalah paru-paru kebiasaannya dikaitkan dengan penyakit kencing manis</i>	104 (34.9)	194 (65.1)
Q16	Flu - <i>Sekiranya anda sakit selsema, anda patut memeriksa kadar gula dengan lebih kerap</i>	77 (25.8)	221 (74.2)
Q17	Follow ups can detect complications - <i>Pemeriksaan kesihatan secara berkala boleh membantu untuk mengesan tanda-tanda awal komplikasi kencing manis</i>	185 (62.1)	113 (37.9)
Q18	Follow ups can avoid complications - <i>Menghadiri temujanji kencing manis anda akan mengelakkan anda dari mendapat komplikasi kencing manis</i>	182 (61.1)	116 (38.9)
Q19	Insulin - <i>Kadar gula yang tinggi di dalam darah mungkin disebabkan oleh pengambilan insulin yang terlalu banyak</i>	77 (25.8)	221 (74.2)
Q20	Insulin morning and hypoglycaemia - <i>Jika anda mengambil insulin pada waktu pagi dan tidak bersarapan, kadar gula di dalam darah anda akan berkurangan (hipoglicemia)</i>	128 (43.0)	170 (57.0)

n = Frequency

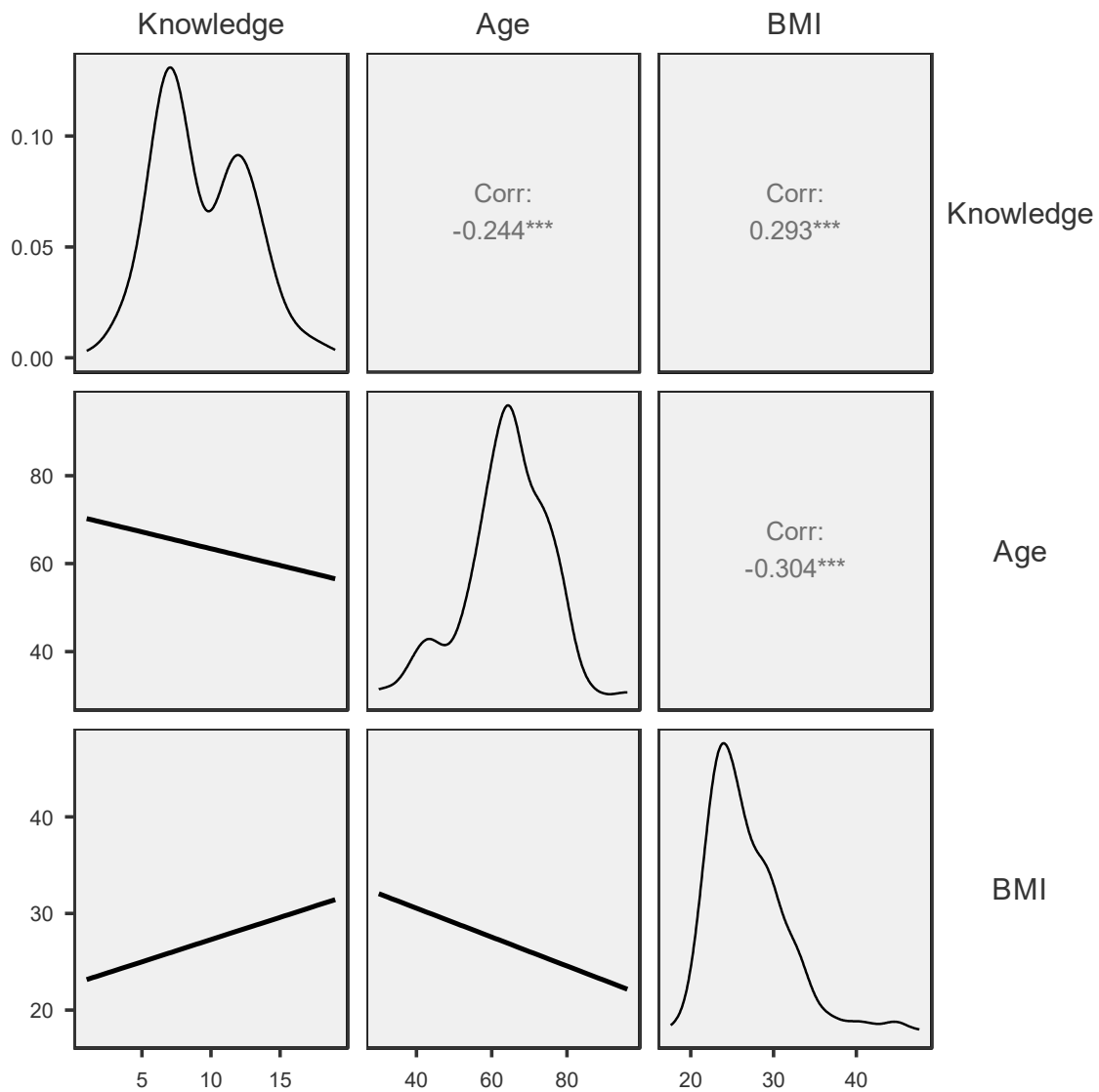


Figure 1. Correlation between age and BMI with knowledge of T2DM (n=298)

Table 5. Relationships of sociodemographic and clinical variables with knowledge on T2DM (n=298)

Variables	Knowledge on T2DM Mean (SD)	Test statistics (df)	p-value
Gender		-7.90 (296) ¹	< 0.001
Male	8.2 (3.1)		
Female	11.1 (3.0)		
Race		0.12 (2,295) ²	0.888
Malay	9.3 (3.4)		
Chinese	9.4 (2.8)		
Indian	8.9 (4.0)		
Marital		16.4 (3,47.2) ²	< 0.001
Single	7.7 (3.1)		
Married	9.8 (3.3)		
Divorced	6.0 (2.3)		
Windowed	9.2 (3.4)		
Occupation		6.66 (3,294) ²	< 0.001
Jobless	9.7 (3.2)		
Government sector	10.0 (2.8)		
Private sector/Self	8.1 (3.2)		
Retiree	9.7 (3.2)		
Household income		4.39 (3,294) ²	0.005
< RM2499	9.0 (3.4)		
RM 2499 – RM 4849	9.5 (3.2)		
RM 4850 – RM 10959	11.1 (3.3)		
> RM 10960	14.3 (3.1)		
Education level		31.5 (4, 49.3) ²	< 0.001
No formal education	6.9 (1.5)		
Primary	8.3 (3.1)		
Secondary	10.2 (3.6)		
Form six/Diploma	11.5 (2.5)		
Bachelor	11.2 (3.5)		
Smoking status		79.0 (2, 24.1) ²	< 0.001
No	10.6 (3.2)		
Quit	12.5 (1.2)		
Yes	7.3 (2.6)		
Family history of T2DM		4.89 (296) ¹	< 0.001
No			
Yes	8.5 (3.4)		
	10.3 (3.1)		

SD = Standard deviation, df = Degree of freedom, ¹ = t-test, ² = One-way ANOVA.

Table 5. Continued

Variables	Knowledge on T2DM Mean (SD)	Test statistics (df)	p-value
Hypertension		-4.08 (244) ¹	< 0.001
No	8.3 (2.8)		
Yes	9.8 (3.5)		
Dyslipidemia		-3.99 (296) ¹	< 0.001
No	8.7 (3.3)		
Yes	10.3 (3.4)		
Kidney disease		8.28 (85.8) ¹	< 0.001
No	9.6 (3.4)		
Yes	6.8 (1.6)		

SD = Standard deviation, df = Degree of freedom, ¹ = t-test.

Table 6. Factors associated with knowledge on T2DM (n=298)

Factors	Saturated model		Reduced model	
	Adjusted B (95% CI)	p-value	Adjusted B (95% CI)	p-value
Age	-0.02 (-0.06, 0.01)	0.232	-	-
BMI	0.07 (-0.001, 0.13)	0.056	0.08 (0.02, 0.14)	0.016
Gender				
Female (Ref)				
Male	-1.31 (-2.17, -0.46)	0.003	-1.25 (-2.09, -0.42)	0.003
Marital		< 0.001		< 0.001
Single (Ref)				
Married	1.40 (0.23, 2.56)	0.019	1.38 (0.22, 2.54)	0.020
Divorced	-1.18 (-2.17, 0.40)	0.142	-1.28 (-2.83, 0.27)	0.105
Windowed	0.66 (-0.79, 2.28)	0.371	0.82 (-0.60, 2.24)	0.258
Occupation		0.166	-	-
Government (Ref)				
Unemployed	0.94 (-0.39, 2.28)	0.165		
Private/Self	0.70 (-0.59, 1.99)	0.284		
Retiree	1.53 (0.12, 2.91)	0.034		
Household income		0.047		0.057
< RM2499 (Ref)				
RM 2499 – RM 4849	0.37 (-0.39, 1.13)	0.339	0.30, (-0.44, 1.05)	0.421
RM 4850 – RM 10959	0.20 (-1.49, 1.89)	0.817	0.14 (-1.41, 1.78)	0.871
> RM 10960	4.39 (1.25, 7.52)	0.006	4.28 (1.15, 7.40)	0.008
Education level		0.059		0.011
No (Ref)				
Primary	0.99 (0.02, 1.96)	0.046	1.09 (0.14, 2.04)	0.025
Secondary	1.66 (0.57, 2.76)	0.003	1.83 (0.82, 2.85)	< 0.001
Form6/Diploma	1.47 (-0.02, 2.97)	0.054	1.88 (0.50, 3.26)	0.008
Bachelor	1.93 (-0.49, 4.35)	0.117	2.12 (-0.16, 4.40)	0.068
Smoking status		< 0.001		< 0.001
No (Ref)				
Quit	2.28 (0.35, 4.21)	0.021	2.39 (0.46, 4.31)	0.015
Yes	-1.13 (-2.02, -0.25)	0.012	-1.28 (-2.13, -0.43)	0.003
Family history of T2DM			-	-
No (Ref)				
Yes	0.40 (-0.25, 1.05)	0.224		
Hypertension				
No (Ref)				
Yes	1.23 (0.31, 2.14)	0.009	1.04 (0.34, 1.75)	0.004
Dyslipidemia				
No (Ref)				
Yes	1.38 (0.55, 2.21)	0.001	1.38 (0.55, 2.21)	0.001
Kidney disease			-	-
No (Ref)				
Yes	0.44 (-0.82, 1.70)	0.491		
R-squared	0.478		0.463	

B = Regression coefficient, CI = Confidence interval, Ref = Reference group.

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