Original Research Article

Assessing the Knowledge and Risk of Type 2 Diabetes Mellitus Among University Students

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ABSTRACT

Type 2 Diabetes mellitus is one of the concerning worldwide non-communicable diseases commonly affecting people ages 40 years old and above. Recent data shows that prevalence of T2DM in adolescent and young adults is increasing. This study aimed to assess the DM-related knowledge among undergraduates, to determine the relationship of sociodemographic factors and DM-related knowledge with DM risk score, and to assess the predictors of DM risk score. A cross-sectional survey was conducted among undergraduates at a public university in Selangor, Malaysia. The questionnaire was divided into two main sections, with section one focusing on demographic data and DM risk assessment using Modified Asian Finnish Diabetes Risk (ModAsian FIDSRISC) Score, and section two focusing on DM-related knowledge. Using convenient sampling method, undergraduates who are ≥ 18 years old and currently pursuing bachelor's degree of study were included in the study. Undergraduates who were unable to give consent, has been diagnosed with diabetes and pursuing study other than bachelor's degree were excluded. Pearson-Chi Square test and binary logistic regression analysis were used with significant study of $p<0.005$. A total of 462 students from various faculties contributed to the study. The mean score of DM-related knowledge obtained from the students was 10.99 ± 4.992 with the majority level of knowledge were found to be moderate (53.2%). Most of students had low risk of DM (61.3%) and only 0.2% had high risk of DM. There were significant relationships between the risk of DM with having relative(s) with DM ($p < 0.001$, OR = 0.065) and DM-related knowledge ($p = 0.029$, OR = 1.074). This study showed that students with higher DM risk was associated with good DM-related knowledge, which might contribute to delay prevention and treatment. These results highlight the importance of targeted educational intervention within university curricula to increase the awareness regarding DM among young adults, the future generation of our country.

Keywords: Type 2 diabetes mellitus, Knowledge, Risk score, Associated factors, University students

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1.0 Introduction

Type 2 diabetes mellitus (T2DM) is one of the concerning non-communicable diseases affecting 463 million people worldwide in 2019, a figure that is expected to rise to 700 million in 2045 (1). T2DM has been known for its complications such as cardiovascular diseases, chronic kidney diseases, eye diseases, and infectious diseases. These complications have resulted to increase health care economic burden and increase morbidity and mortality of the patient. It has been reported that the healthcare expenditure for T2DM medical care accounts for at least US$760 billion across the western world (1) whereby the cost increase with the complications of the disease. For example, the treatment cost in 12-month care diabetes patient in Ireland ranging from €798 to €21 926 depending on the existing complications, with the least amount of expenditure accounts for stable diabetes patient without complication and the highest expenditure accounts for diabetes with myocardial infarction (2).

The T2DM commonly prevalent among middle-aged and older people, and is rarely seen in adolescent and young adults (3). However, the incidence of early onset of T2DM has become increasingly common in young people. In the US for example, a substantial increase in the incidence of T2DM had been reported with 4.8% annual increase among adolescents aged 10-19 years old from 2002-2010 to 2011-2015 (4). In Malaysia, approximately 3.9 million adolescents age 18 years and above had raised blood glucose level in 2019 (5). This prevalence had shown increment from 11.2% and 13.4% in 2011 and 2015, respectively (6, 7). T2DM has less dramatic symptoms compared to T1DM, it often goes undiagnosed until severe complications have already developed (8, 9). Although the rising prevalence of diabetes mellitus (DM) among older adults is well known, the growing number of young people with T2DM is a more recent development and is of particular concern (10). Earlier onset of DM results in longer exposure towards the disease and consequently greater tendency for long-term complications (10, 11).

Similar to older adults, the incidence of T2DM in young adult is driven by several risk factors commonly obesity, physical inactivity and poor dietary lifestyle (10, 12, 13). The rising prevalence in the younger age group has been linked to lifestyle factors such as unhealthy eating habits and insufficient exercise, stress from exams and ongoing evaluation, smoking, and drinking, which are common among college-age groups, and non-modifiable risk factors, which include a family history of DM (14). Lifestyle intervention such as changes in dietary intake, increased physical activity and weight loss can delay the onset of T2DM in individuals with pre-DM and reduces the incidences of DM complications and DM-related mortality (15). The Da Qing Diabetes Prevention Study found that intervention with diet and exercise results in an overall 51% reduction in DM incidence in participants after a 6-year intervention (15). The lifestyle modification intervention can also significantly reduce the cardiovascular disease (CVD) events by 26%, microvascular complications by 35%, cardiovascular deaths by 33%, and all-cause mortality by 26%, leading to an increase in median survival by 4.82 years and a mean increase in life expectancy by 1.44 years (15).

Due to less dramatic symptoms present in T2DM compared to type 1 diabetes mellitus, the T2DM is often undiagnosed until severe complications have already developed (8, 9). Early diagnosis therefore is important for early management and to prevent complications from developing. Commonly, the diagnosis of T2DM are performed through relatively inexpensive testing of blood glucose to determine its level (16). However, this method resulted to overlooking of many individuals at risk of developing T2DM due to solely relying on the impaired glucose tolerance (IGT) and/or impaired fasting glucose (IFG) whereby

many people with normal glucose tolerance were reported to develop T2DM (17). Predictive models have been developed which incorporating risk factors of T2DM to identify people who have increased risk of T2DM (18, 19). In this young population, early screening of T2DM therefore can be done by using risk assessment tool to assess the risk of developing T2DM as early as possible. Several risk assessment tools have been developed such as Finnish Diabetes Risk Score (FINDRISC), Australian type 2 diabetes risk assessment tool (AUSDRISK) and American Diabetes Association risk test which serve as non-invasive methods, categorise the diabetes risk score into low risk, slightly elevated risk, moderate risk and high risk.

These risk assessment tools are suitable to assess the diabetes risk among adolescent and young adult such as undergraduate students who are less likely to visit healthcare setting for no particular reason due to occupied schedule. A study conducted in a university in Jordan using FINDRISC for example showed that the students had low risk (66.9%), slightly elevated risk (26.2%), moderate risk (5.2%) and high risk (2.8%) of T2DM respectively (20). In contrast, a cross sectional study conducted in Saudi Arabia showed that more than half of the university students had high risk of developing T2DM (21). These findings were associated with several factors that affect the risk of diabetes mellitus among the university students particularly, showing that the result had significant relationship with the demographic factors such as age, body mass index and gender. Other factors include lifestyle behaviors such as unhealthy eating habit due to stress for examination and assessment, and non-modifiable risk such as having family history of DM.

In addition, knowledge is the foundation for good health-related practises. Young people such as university students should be equipped with knowledge regarding DM considering that it is one of the common and fastest growing non-communicable disease worldwide to help promote awareness to their surrounding especially to people who have a lower level of formal education. It has been demonstrated that DM-related knowledge among university students were insufficient maybe because of the underestimation of young people with regards to their risk of developing T2DM (22). The increasing trend of T2DM in young population warrants additional studies to explore the impact of early disease prevention strategy such as the use of non-invasive screening by using validated diabetes risk score. In addition, it has been demonstrated by many studies that DM-related knowledge among university students were insufficient (22). Thus, it is essential to identify the possible DM-related knowledge gaps among the university students so that appropriate educational interventions can be devised to enhance students' knowledge on DM and its management. Therefore, the aims of this study are to assess the DM-related knowledge among university students, to determine the relationship of sociodemographic and DM-related knowledge with DM risk score, and to assess the predictors of DM risk score.

2.0 Materials and methods

2.1 Study design, participants, and setting

A cross-sectional study was conducted between March and September 2023 in UiTM Puncak Alam Campus. Undergraduate students who were 18 years old and above and pursuing bachelor's degree of study were included. The exclusion criteria include: 1) students who are unable to provide informed consent; 2) students who are pregnant or breastfeeding; 3) students who had been diagnosed with T1DM, T2DM, or GDM; 4) repeaters, and 5) non bachelor's degree students. The participants were approached based on convenient sampling method.

The sample size was calculated using 2004 Raosoft Inc. with population of 17,801 students pursuing bachelor's degree 2022/2023 according to the Data Analytic and Statistic Unit, University Transformation Section of UiTM. A minimum of 452 participants were needed using Confidence Interval 95%, population data 50% and consideration of 20% of data missing and drop out.

2.2 Ethical approval

This study was subjected to ethical approval of UiTM before proceed to data collection. Informed consent was obtained from the participants to allow their accountability in answering the questionnaire.

2.3 Data collection

A validated questionnaire was used by adopting the existing questionnaire known as Diabetes Knowledge Questionaire-24 (DKQ-24) and adapting it with addition of Modified Asian FINDRISC (ModAsian FINDRISC) tool and demographic data of participants. DKQ-24 was developed in 1983 initially consist of 64 items before it was reduced to 24 items in 1994. The questionnaire is widely used by clinicians and researchers to assess the knowledge of DM among participants (23, 24). The ModAsian FINDRISC tool is used in this study due to its incorporation of cut-off values of BMI and waist circumferences for Asian population (25, 26).

Section 1 consist of 22 items which include demographic data of the participants and ModAsian FINDRISC tool, a modified version of its original tool in assessing the risk of developing DM in the next 10 years without the need of laboratory testing. This tool calculates the score of the participant by utilising the data of BMI, waist circumferences, antihypertensive medications, family history of DM, dietary lifestyle and physical activity to assess the DM risk. In Section 2, an adopted questionnaire was utilised known as Diabetes Knowledge Questionaire-24 (DKQ-24) consisting of 24 items to assess the knowledge and management of DM among the participants.

2.4 Scoring of the questionnaire

DM risk score in Section 1 was determined based on the sums of the score from the components in the ModAsian FINDRISC tool. A score of <7 points indicate low risk, 7-11 points indicate slightly elevated risk, 12-14 indicate moderate risk, 15-20 points indicate hight risk, and >20 points indicate very high risk. For the assessment of knowledge and management of DM in Section 2, responses are checked against an answer key and scored as correct or incorrect. Total scores range from 0 to 24. The correct answer of each item was given one point and wrong answer was given zero point. The total score ranged from 0-24 was categorised into poor (0-8), moderate (9-16), and good (17-24).

2.5 Data analysis

IBM *SPSS28.0* statistical package was used to analyse the data. Descriptive analysis was conducted whereby categorical data was reported as percentage and frequency, continuous data was reported as mean ± standard deviation or median (interquartile range) depending on data distribution. Inferential statistic using Pearson Chi-square test were used to determine the relationship between sociodemographic factors and DM-related knowledge with DM risk level whereby binary logistic regression analysis was used to determine the predictor of DM risk score. P-value<0.05 was considered as significant.

3.0 Results

A total of 465 students participated the survey. Then, three students were excluded from the data analysis due to ineligible criteria of which has been diagnosed as DM. Figure 1 showed the flowchart of participant recruitment.

3.1 Demographic data

Of 462 respondents, majority were Malay (n =445, 96.3%), female (n = 373, 80.7%) with a mean age of 22.41 ± 1.60 years. More than two thirds of respondents were from non-healthcare related fields (n = 298, 64.5%) and the remaining were from healthcare-related fields (n = 164, 35.5%). Majority of the respondents were in the second- (n = 161, 34.8%) and third-year (n = 152, 32.9%) of studies. Only 44 (9.5%) reported having friend(s) with DM. Most of the respondents had a cumulative grade point average (CGPA) more than 3.00 (n = 409, 88.6%). A total of 15 (3.1%) respondents reported to have chronic illness with asthma being the most prevalent (n = 6, 1.3%). Table 1 showed the summary of the sociodemographic data of the participants.

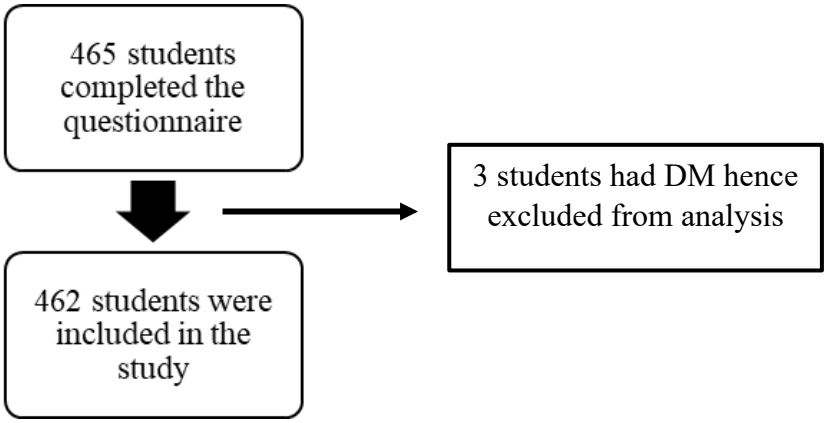

Figure 1: Flowchart of participant recruitment

Table 1: Sociodemographic data of participants

Variables		n (%)
Gender	Male	89 (19.3%)
	Female	373 (80.7%)
Age (years), mean ± SD	22.41 ± 1.603	
Age (years)	≤ 21	127 (27.5%)
	22 - 24	302 (65.4%)
	≥ 25	33 (7.1%)
Ethnicity	Malay	445 (96.3%)
	Other Bumiputeras	17 (3.7%)
Faculty	Faculty of Business Management	117 (25.3%)
	Faculty of Hotel and Tourism Management	42 (9.1%)
	Faculty of Health Sciences	56 (12.1%)
	Faculty of Pharmacy	108 (23.4%)
	Faculty of Education	49 (10.6%)
	Faculty of Accountancy	66 (14.3%)
	Faculty of Art and Design	11 (2.4%)
	Faculty of Architecture, Planning and Surveying	13 (2.8%)
Year of study	Year 1	61 (13.2%)
	Year 2	161 (34.8%)
	Year 3	152 (32.9%)
	Year 4	88 (19.0%)
Academic performance (CGPA)	3.50 - 4.00	204 (44.2%)
	3.00 - 3.49	205 (44.4%)

	2.50 - 2.99	46 (10.0%)
	< 2.50	7 (1.5%)
History of chronic disease(s) other than diabetes mellitus	Allergic rhinitis	2 (0.4%)
	Asthma	6 (1.3%)
	Atrial septal defect	1 (0.2%)
	Bone disease	1 (0.2%)
	Bronchitis	1 (0.2%)
	Epilepsy	1 (0.2%)
	Polycystic ovarian syndrome	1 (0.2%)
	Psoriasis	1 (0.2%)
	Systemic lupus erythematosus (Nephritis)	1 (0.2%)
	No	447 (96.8%)
Have friend(s) with diabetes mellitus	Yes	44 (9.5%)
	No	418 (90.5%)

3.2 DM-related knowledge

The mean total DM-related knowledge score was 10.99 ± 4.992 with 13.6% participants reported to have good DM-related knowledge level whilst more than half had moderate knowledge level, account for 53.2%. Of all the questionnaire, majority of the participants (n = 372, 80.5%) could answer correctly on the item "The way I prepare my food is as important as the foods that I eat" and did not answer correctly on the item "A person with diabetes mellitus should cleanse a cut with iodine and alcohol" which accounted for 3.7%.

In the cause domain, the majority of participants know that DM is caused by a lack of effectiveness of endogenous insulin and a family history of DM, with both factors accounting for 71.2% (n=329). Less than 25% (n=116) of the participants know that DM is caused by sugar consumption, excessive food intake, and the kidneys' failure to keep sugar out of the urine. However, 80.5% (n=372) know that blood sugar usually increases in untreated DM, accounting for the highest correct answer in the symptom domain. Other items in the symptom domain, such as high fasting blood sugar levels and the signs and symptoms of high and low blood sugar levels were answered correctly by 49.1% (n=227), 21.2% (n=98), and 26.8% (n=124), respectively.

For the management domain, more than half of the participants answered correctly regarding the importance of food preparation (82.5%, n=381), medication and lifestyle modification (71.6%, n=331), and wound care (63%, n=291). In contrast, only 3.7% (n=381) could answer correctly about how a diabetes patient should cleanse a cut. In the complication domain, most participants correctly identified that DM causes poor blood circulation (74%, n=342), slow healing mechanisms (73.6%, n=340), and kidney impairment (67.5%, n=312).

In the general knowledge domain, 62.5% (n=290) could correctly identify the main types of diabetes. Only 35% (n=165) know that diabetes cannot be cured. For the item on diagnosis or screening, only 29.4% (n=136) could answer correctly regarding the best test to check for diabetes. Table 2 shows the percentage of participants who had correct answer for each item in the questionnaire.

Table 2: Percentage of participants who had correct answer for each of the item

No.	Domain	Item	Answer Key	Correct response
1.	Cause	Eating too much sugar and other sweet foods is the cause of diabetes mellitus.	No	25 (5.4%)
2.	Cause	The usual cause of diabetes mellitus is the lack of effective insulin in the body.	Yes	329 (71.2%)
3.	Cause	Diabetes mellitus is caused by the failure of the kidneys to keep sugar out of the urine.	No	107 (23.3%)
4.	General knowledge	Kidneys produce insulin.	No	201 (43.5%)
5.	Symptom	In untreated diabetes mellitus, the amount of sugar in the blood usually increases.	Yes	372 (80.5%)
6.	Cause	If I have diabetes mellitus, my children have a higher risk of getting diabetes mellitus.	Yes	329 (71.2%)
7.	General knowledge	Diabetes mellitus can be cured.	No	165 (35.7%)
8.	Symptom	A fasting blood sugar level of 11.1 mmol/L is too high.	Yes	227 (49.1%)
9.	Diagnosis / screening	The best way to check for diabetes mellitus is with a urine test.	No	136 (29.4%)
10.	Management	Regular exercise will increase the need for insulin or other diabetic medication.	No	148 (32%)
11.	General knowledge	There are two main types of diabetes mellitus: Type 1 (insulin-dependent) and Type 2 (non-insulin-dependent).	Yes	290 (62.8%)
12.	Cause	Insulin reaction is caused by too much food.	No	105 (22.7%)
13.	Management	Medication is more important than diet and exercise to control diabetes mellitus.	No	331 (71.6%)
14.	Complication	Diabetes mellitus often causes poor blood circulation.	Yes	204 (44.2%)

15.	Complication	Cuts and abrasions on people with diabetes mellitus heal more slowly.	Yes	342 (74%)
16.	Management	People with diabetes mellitus should take extra care when cutting their toenails.	Yes	291 (63.0%)
17.	Management	A person with diabetes mellitus should cleanse a cut with iodine and alcohol.	No	17 (3.7%)
18.	Management	The way I prepare my food is as important as the foods I eat.	Yes	381 (82.5%)
19.	Complication	Diabetes mellitus can damage the kidneys.	Yes	340 (73.6%)
20.	Complication	Diabetes mellitus can cause loss of feelings in hands, fingers, and feet.	Yes	312 (67.5%)
21.	Symptom	Shaking and sweating are signs of high blood sugar.	No	98 (21.2%)
22.	Symptom	Frequent urination and thirst are signs of low blood sugar.	No	124 (26.8%)
23.	Management	Tight elastic hose or socks are not bad for a person with diabetes mellitus.	No	131 (28.4%)
24.	Management	A diabetic diet consists mostly of special foods.	No	72 (15.6%)
		Total score	**Mean (SD)**	10.99 (± 4.99)

3.4 DM Risk

The mean for ModAsian FINDRISC score was of 5.75 ± 3.278. Majority of the students were at low-risk category of DM (61.3%) whilst only 1 (0.2%) participant was found to have a high risk of DM. Table 3 showed the DM risk of participants. Pearson's chi-square test was performed to determine factors affecting DM risk score. Significant association was observed between DM risk score with having relative(s) with DM ($p < 0.001$) and DM-related knowledge ($p < 0.001$), as showed in Table 3. Based on binary logistic regression, level of DM-related knowledge contributes to the biggest predictor of developing DM (OR:1.074) followed by having relative with DM (OR:0.065), as showed in Table 4.

Table 3: Factors associated with DM risk score

	Low risk (n = 283)	**Slightly elevated to high risk (n = 179)**	**χ2**	**p-value**
Gender				
Male	57 (64.0%)	32 (36.0%)	0.361	0.548
Female	226 (60.6%)	147 (39.4%)		
Age (years)				
≤ 21	80 (63.0%)	47 (37.0%)	1.495	0.474

22 - 24	186 (61.6%)	116 (38.4%)		
≥ 25	17 (51.5%)	16 (48.5%)		
Faculty				
Clinical-related fields	93 (56.7%)	71 (43.3%)	2.216	0.137
Non-clinical-related fields	190 (63.8%)	108 (36.2%)		
Year of study				
Year 1	41 (67.2%)	20 (32.8%)	2.542	0.468
Year 2	94 (58.4%)	67 (41.6%)		
Year 3	90 (59.2%)	62 (40.8%)		
Year 4	58 (65.9%)	30 (34.1%)		
Academic performance (CGPA)				
≥ 3.00	247 (60.4%)	162 (39.6%)	1.122	0.289
< 3.00	36 (67.9%)	17 (32.1%)		
Relative(s) with DM				
Yes	101 (38.7%)	160 (61.3%)	128.628	< 0.001*
No	182 (90.5%)	19 (9.5%)		
Friend(s) with DM				
Yes	23 (52.3%)	21 (47.7%)	1.653	0.198
No	260 (62.2%)	158 (37.8%)		
DM-related knowledge				
Poor	112 (73.2)	41 (26.8)	16.647	< 0.001*
Moderate	142 (57.7)	104 (42.3)		
Good	29 (46.0)	34 (54.0)		

**Significant association with p<0.05*

Table 4: Result of binary logistic regression on factors determining DM risk

Variable		Slightly elevated to high risk	
		OR (95% CI)	*P*-value
Gender		0.980 (0.537-1.787)	0.946
Age		1.093 (0.939-1.273)	0.252
Faculty		0.716 (0.388-1.324)	0.287
Years of study	Year 1		ref.
	Year 2	1.612 (0.745-3.488)	0.225
	Year 3	1.251 (0.557-2.811)	0.587
	Year 4	0.523 (0.207-1.319)	0.170
Academic performance (CGPA)		1.364 (0.650-2.863)	0.411
Relative(s) with DM		0.065 (0.037-0.112)	<0.001*
Friend(s) with DM		0.729 (0.339-1.567)	0.418
DM-related knowledge		1.074 (1.007-1.145)	0.029*

**Significant association with p<0.05*

4.0 Discussion

This study aimed to assess students' knowledge on DM and its management, to determine relationship of sociodemographic and DM-related knowledge with risk of DM, and to determine the predictors of DM risk score. Our findings showed that majority of the students had moderate level of DM-related knowledge (53.2%) and around one third had poor level of knowledge (33.1%). Only 13.6% of the students obtained a good level of DM-related knowledge. This finding is consistent with a previous study conducted in the same campus among Health Sciences students by using DKQ-24 which found that majority of students had moderate level

of DM-related knowledge (58.5%) (19). However, the percentage of students with a good level of DM-related knowledge were higher in the previous study (36.8%) compared to this study (13.6%). This might be due to the study being conducted among health sciences students who could have better knowledge exposure about DM. Notably in this study, more than two thirds of respondents were from non-clinical related courses (64.5%) and hence a lower percentage of good knowledge level was obtained.

In general, the knowledge of students on certain causes, symptoms, screening, management and complication of diabetes were still poor. Based on the cause domain for example, only 5.4% of students know that eating too much sugary food can cause DM. In the symptom domain, 21.2% of participants had correct response for "Shaking and sweating are signs of high blood sugar", 26.8% for "Frequent urination and thirst are signs of low blood sugar" and 49.1% for "A fasting blood sugar level of 11.1 mmol/L is too high". Lack of awareness regarding DM among students is worrying because they are prone to consume sugary foods especially when they are in stress due to assignments and examination. Lifestyle factor such as unhealthy eating behaviour has been linked with the rising prevalence of DM in this younger population (27). Unable to recognise the alarming symptoms of DM can lead to treatment delay and worsening the condition of disease.

Other knowledge gap is found in management of DM diabetic wound care. While most of the participants know that diabetic patient should take extra care for wound involving toenails, but only 3.7% know how to cleanse a cut for diabetic patient. They were also unable to relate the complication of slow healing mechanism with the poor blood circulation. This finding consistent with a study assessing the knowledge of diabetic care among university students showing the knowledge score in participants with diabetes were higher than non-diabetes participants (28). Information regarding diabetes wound care is of paramount for diabetic patient to prevent infection and amputation. Nevertheless, educational program and awareness of diabetes should be enhanced at university level specifically related to cause, symptoms and complications of diabetes.

Our study revealed that majority of the students were in the low-risk category of developing DM (61.3%). This finding aligns with several previous studies conducted in similar sample. For example, a study among students at Universiti Kebangsaan Malaysia using FINDRISC tool found that more than two third (70.3%) was at low risk of developing DM (29). Another study using FINDRISC tool conducted among students at Hashemite University, Jordan also found that more than two third of the students (66.9%) had low risk of developing DM (30). However, majority of Malaysian students attending the course of Public Health and community Medicine at Tanta Faculty of Medicine in Egypt using AUDRISK tool had moderate DM risk (55.0%) (31). This may be due to different tools used and the AUDRISK tool incorporated gender ethnicity/country of birth and smoking status which may contribute to higher score.

It is important to note that 4.7% of respondents were at high risk of developing DM. If left unaddressed, this could result in the development of T2DM. The current data showed that the percentage of modifiable risk factors were almost half. 43.9% were either overweight or obese, 48.3% were abdominally obese, 46.8% were not physically active for at least 30 minutes daily and 35.3% were not consuming vegetables, fruits or berries daily. It is troubling to found that 0.9% of the students had hypertension. In another study conducted in Jordan, 23.2% were either overweight or obese, 27.3% were abdominally obese, 42.6% were not physically active regularly (30). *Al-Shudifat et al.* (2002) (19) used a higher cut off point for BMI and WC for male. Unmodifiable risk factor includes family history of DM (n = 261, 56.5%). A study conducted in Jordan revealed higher percentage of family history of DM with 28.4% reported first-

degree relative(s) with DM and 49.9% reported second-degree relative(s) with DM (30).

The Pearson chi-square test indicated that there was a significant association between having relative(s) with DM and DM-related knowledge with DM risk score ($p < 0.001$). The regression analysis performed showed that among the assessed sociodemographic factors, only having relative(s) with DM and DM-related knowledge were significant predictors of students' DM risk score. The negative B value of having relative(s) with DM indicates that the presence of family history of DM results in less likelihood to report slightly elevated to high risk of DM. Meanwhile, the positive B value of DM-related knowledge indicates that the higher DM-related knowledge score, the more likely to report slightly elevated to high risk of DM. The odds ratio of having relative(s) with DM was 0.065 which was less than 1 indicating that having relative(s) with DM, the less likely to have slightly elevated to high risk of DM. The odds ratio of DM-related knowledge was 1.074 which was more than 1 indicating that the higher DM-related knowledge score, the more likely to have slightly elevated to high risk of DM. Similarly, a study in Rural West Virginia Counties found that family history was a significant predictor of DM risk score (32). This finding might be due to increased exposure to patients with DM and its detrimental consequences thus, avoidance of lifestyle that can result in increased risk of DM such as unhealthy diet and physical inactivity.

It is surprising to observed that the students were more likely to have increased risk of DM with better DM-related knowledge. CANRISK tool incorporated level of education which gave higher score to individuals with lower level of education because it is thought that individuals with higher level of education would have better knowledge thus, lower risk of DM. However, this proves to be not true in our study. Perhaps, having risk of DM had driven the students to seek knowledge regarding DM and had better exposure compared to students with low risk of DM.

4.1 Future study

This study highlights the importance of educating the students on DM risk factors and ways to reduce DM incidence among young adults. The findings of our study present opportunity for collaboration between health service, university and student organisations to implement educational programs to address modifiable risk factors of DM and ways to lead a healthier lifestyle.

Future research could delve deeper into knowledge of students on healthy lifestyle and the effectiveness of interventions in reducing DM risk over time. In conclusion, our study shed light on DM risk among university students with emphasis on the need for early intervention and health promotion efforts. By addressing the modifiable risk factors and improving knowledge on healthy lifestyle, we can contribute to a healthier future population and potentially mitigate DM burden.

4.2 Limitations of study

The cross-sectional design did not allow for causal inference. In addition, responses were self-reported which could have a recall or social desirability bias. There is also the possibility that response bias was present, and respondents could have selected responses at random without reading the questions. However, the large sample size minimises such outliers. The sample size and demographic representation might influence the generalisability of the findings Furthermore, there is a lack of follow-up and biochemical profile of the respondents were not assessed. As with all surveys, definitions and items can be open to interpretation.

5.0 Conclusion

Several key findings were identified from this study. First, the overall DM-related knowledge was found to be moderate, indicating both strength and gaps in DM-related knowledge. The identified knowledge gaps, specifically in areas

related to cause of DM, symptoms of DM and management of patients with DM specifically lifestyle, wound management and the use of tight clothing, underscore the need for targeted educational interventions. It is clear that students' lack of knowledge regarding symptoms of DM and management of patients with DM need to be addressed through informative programmes and innovative educational strategies at the university level. Second, majority of the students were at low risk of DM. However, better DM-related knowledge was found in students with higher risk of DM, indicating they only seeking the knowledge after having the risk. This highlights the need for proactive interventions to address students' knowledge on modifiable risk factors of DM which include sedentary lifestyle, unhealthy diets and obesity to prevent DM and for early management. Addressing knowledge on the risk of DM and healthy lifestyle at this early stage can reduce the potential burden of DM-related complications and establish positive habits in the long run. The study underscores the importance of tailored health promotion strategies to reduce DM incidence within the university environment. Lastly, having relative(s) with DM places students at lower risk of DM and higher DM-related knowledge score places students at higher risk of DM. By addressing the modifiable risk factors and improving knowledge on healthy lifestyle, we can contribute to a healthier future population and potentially mitigate DM burden. This emphasises the need for early intervention and health promotion efforts among university students. Moving forward, this study prompts further investigation into the effectiveness of educational intervention on improving DM-related knowledge among university students. In conclusion, this study contributes to the growing body of literature on DM. By addressing the identified knowledge gaps and modifiable risk factors, a culture of informed decision-making can be made. By doing so, students can be more empowered in making decision about healthy living choices that can prevent or delay T2DM as well as gaining a long-term positive impact to their well-being.

Authorship contribution statement

NWZ: Methodology, Formal analysis, Writing – review & editing, supervision **NANK**: Methodology, Data analysis, Visualization, Writing – original draft **WYY**: Methodology, Data analysis, Visualization, Writing, supervision **NIAH**: Methodology, Data analysis, supervision **NFDI**: Visualization, Resources, Writing – review & editing, Draft corrections.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose and no funding was received from any external organisations, grants, or institution for the research conducted.

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