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ASSOCIATION BETWEEN KNOWLEDGE STATUS, DIET QUALITY, ANTHROPOMETRY AND RISK OF DIABETES MELLITUS AMONG YOUNG ADULTS

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Background: According to the World Health Organization (WHO), diabetes is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It has become a global health threat, particularly among young adults. **Methods:** This study aimed to determine the association between knowledge status, diet quality, anthropometry, and the risk of diabetes mellitus among young adults at Universiti Sultan Zainal Abidin (UniSZA). A cross-sectional study was conducted among 150 university students. Data on sociodemographics, knowledge status, and diet quality were collected using validated questionnaires, while anthropometric measurements were taken face-to-face. The Finnish Diabetes Risk Score (FINDRISC) was used to assess the 10-year risk of developing type 2 diabetes. **Results:** showed a significant association ($p < 0.05$) between anthropometric indices and diabetes risk. Among underweight individuals, 97% were at moderate risk and 3% at low risk. In the normal-weight group, 74.1% were at moderate risk and 25.9% at low risk. The risk increased markedly with higher BMI, with 100% of those in obesity class III categorized as high risk. A strong relationship was also observed between waist circumference and diabetes risk: 45.5% of individuals with central obesity were at high risk, while none were in the low-risk group. **Conclusion:** assessing diabetes risk among young adults is crucial for early prevention. Enhancing awareness and promoting healthy dietary habits are essential strategies. Implementing targeted educational and health promotion programs in universities may effectively reduce diabetes risk among young adults

Key words : Anthropometry, Diabetes, Diet Quality, Knowledge Status, Young adult

INTRODUCTION

According to the World Health Organization (WHO), diabetes is defined as a chronic metabolic disorder characterized by high blood sugar levels (hyperglycemia) resulting from defects in insulin secretion, insulin action, or both. Diabetes has emerged as a worldwide pandemic and poses a significant threat to global health. With a 68.3% increase, the prevalence of diabetes increased from 11.2% in 2011 to 18.3% in 2019. A national survey report states that 3.6 million persons in Malaysia who were 18 years of age or older had diabetes in 2019; 49% of these cases went undiagnosed. With a 31.3% incidence of diabetes, 7 million persons in Malaysia who are 18 years of age or older are predicted to have the disease by 2025, representing significant public health concerns. (Akthar et al, 2020). A growing concern is the rising number of young people with type 2 diabetes, which increases their lifetime risk of high blood sugar and related long-term complications, leading to early illness and reduced quality of life.

Diet quality is considered as the main modifiable risk factor for diabetes among young adults. Plant-based diets (PBD) and low dietary sugar intake are considered as several examples of healthful eating patterns and are recommended for the young adult population with diabetes mellitus.

A more recent and significant problem is the growing number of young individuals with type 2 diabetes mellitus. An earlier onset increases the lifetime risk of hyperglycemia and as a result, increases the likelihood of long-term problems resulting in early morbidity and a low quality of life. The students' nutrition knowledge would correlate positively with their attitudes towards food and nutrition which has a high impact on risk of diabetes among young adults. Besides that, family health history plays an important role as both genetic marker and an indicator of the complex interactions between behavioral and shared environmental variables. The fact that a person has a family history of diabetes cannot be changed, but it can be used as an effective tool in public health to help prevent disease. Only a few studies, mostly among Asian people, have studied the traits of young adults with and without a family history of diabetes.

The results they obtained were also inconsistent. The healthy diet was considerably more common among young adults with a family history of diabetes. When compared to people without a family history of diabetes, they still had a much lower level of physical activity (Tam et al.). Furthermore, it was found that calorie intake and regular exercise did not differ significantly based on a family history of diabetes (Moon et al). Consequently, additional research is needed to verify these findings, especially among young adults, who typically range in age from 18 to 29.

These findings support the need for more research on adherence to healthy eating knowledge about diabetes, as well as their corresponding factors, in among young adults with diabetes in order to better explain non-adherence and drive the development of treatments to promote adherence. (Liese et al.,2020). Therefore, the purpose of this study is to determine the association between the diet quality, knowledge status, anthropometry and other factors that can influence the risk of diabetes among the young adult population. Other than that, the knowledge status toward diabetes will contribute to how the participants in Terengganu practice to change their dietary pattern to lead a healthy lifestyle. As observed in this study on the young diabetes trial, the patients are amenable to reversal by rigorous lifestyle management. (Srivastava V,2020). In order to achieve this target, the information regarding associated risk factors that can cause diabetes among young adults should be ruled out.

The outcome of this study will provide information regarding the importance of lifestyle management in order to reduce the risk of diabetes among young adults. Therefore, more studies should be done to determine the associated factor of diabetes among Malaysian young adult population. Through this research, we can identify the risk factors that influence the risk of diabetes among the young adult population in the local university (UNISZA) in Terengganu. The elements in each individual might be different in terms of their dietary intake, anthropometric measurement, family history of diabetes and lifestyle management.

METHOD

Study Participants

The study design that was used in this study is a cross-sectional study. This study was conducted from 01 March 2024 until 31 July 2024.This study was conducted in Universiti Sultan Zainal Abidin, Gong Badak Campus (UniSZA) in Kuala Nerus,

Terengganu. The purpose of recruiting respondents from UniSZA was to determine the association between knowledge status, diet quality, anthropometry and risk of diabetes which can be generalized as a population of young adults in Malaysia. The sampling method used to select a sample was convenient sampling. The recruiting process was done at universities' library, cafeteria and through social media where all the students were randomly asked and selected to join this study. This study was to recruit Malaysian young adults aged 18 to 30 years old who are studying in UniSZA Campus Gong Badak Terengganu, Malaysia. A total of 150 respondents participated to complete the questionnaire provided. The respondents' participation was voluntary, and prior consent was obtained.

Malaysian male and female young adults aged 18-30 years studying in Universiti Sultan Zainal Abidin who were able to read, write and communicate were considered eligable to participate and included in this study. Excluded from the study were participants not studying in Terengganu, pregnant, lactating women, have mental related and chronic problem, who were unable to understand read and write and taking diabetes medications.

Data Collection

This data collection was done face-to-face. The process of data collection was carried out from March to August 2024 for the first measurement followed by the second measurement of data collection. Participants requested to answer questionnaires form which has been designated in Malay. Time allocation for the survey is about 15 to 20 minutes. The method of data collection consists of different sections of the survey. Section A: Participant personal data entry; Participant background includes sex, age, course, academic year, smoking status, and ethnicity and family history; Section B: Simplified Diabetes knowledge status; It consist of 20 items and three response options: "true," "false," and "don't know." The last two items (19 and 20) will only be answered by the participants who are taking insulin. The simplified questionnaire focused on 5 five domains. The five domains were as follows: awareness items, lifestyle adjustment items, diet and monitoring things, general knowledge items, and preventative screening items. Section C: FINDRISC Test.

The questionnaire includes seven items, including age, a family history of diabetes in first- or second-degree relatives, a history of hypertension and use of hypertensive drugs, daily soft drink intake, physical activity, BMI, and WC. Each question includes a point system that provides points for different replies, with a total score ranging from 0 to15 points. Section D: Food frequency questionnaire. There are 165 items in the FFQ and divided into 14 groups of food. There are four options for the frequency of intake: daily, weekly, monthly, and not at all. Section E: The anthropometric measurement such as height, weight and waist circumference of participants also will be taken by the researcher using electronic weighing scale, portable stadiometer and SECA measuring tape respectively. Participants will remain anonymous when completing the survey to protect their identity and respect their privacy.

Statitical Analysis

The statistical analysis of data was performed using Statistical

Package for Social Science (SPSS) software for Windows, version 21.0. Data entry might be occur during data entry and respondent's error. After the data entered into the SPSS, they were checked. Data checking was important to ensure the accuracy of the entered data, identify any missing data and any outliers during the data entry. Before the descriptive statistical analysis was performed, the frequency distribution and boxplot were used to check the normality. The continuous data were described as Mean ± SD if normally distributed or median (interquartile range) if not normally distributed whereas for categorical variables, the data were reported as the number of frequency and percentage. Statistical significance of all tests was set at the level of $p \leq 0.05$ and each test was done according to the objectives of the study. The knowledge status, diet quality and anthropometry detail were tested using descriptive statistics t determine frequency. Meanwhile, Fisher's Exact Test was used to find the association between knowledge status, diet quality, anthropometry and risk of diabetes among young adults.

This study was supported by ethical approval obtained from the Universiti Sultan Zainal Abidin Human Research Ethics Committee (UHREC)(UniSZA/UHREC/2023/585.

RESULTS AND DISCUSSION

Sociodemographic Factors

The participants in the study were divided based on gender, and sociodemographic factors. Standard deviation was 1.226 shows that the participants' average age was 21. The age distribution of the male participants was as follows: 10 years old (10.7%), 20 years old (27.9%), 21 years old (30.0%), 22 years old (40.0%), 23 years old (20.0%), 24 years old (10.0%), and the distribution of the female participant's ages were 25 years old (0.7%). 19 years (33.6%), 20 years (20.0%), 21 years (4.3%), 22 years (2.9%), and 23years (0.7%). Among the male participants, the percentages of Malays (30.0%) and Indians (70.0%) were the highest. Among the female participants, there were 2 Chinese (1.4%), 18 Indians (12.9%), 118 Malays (84.3%), and two individuals from other ethnic groups (1.4%). In terms of religion, 3 Muslims (30.0%), 1 Christian (10.0%), and 6 people from other religions (60.0%) made up the male participants. Of the men, there were no Buddhists. There were 120 Muslims (85.7%), 2 Buddhists (1.4%), and 18 members of other religions (12.9%) among the female participants. None of the female participants said they were Christians.

Regarding marital status, 139 female participants (99.3%) and 1 female participant (0.7%) were married, whereas all male participants (100%) were unmarried. The scholarship data revealed that 4 male participants (40.0%) were receiving PTPTN, 3 were on JPA (30.0%), 2 had no scholarships (20.0%), and 1 had other scholarships (10.0%). Among the female participants, 50(35.7%) had no scholarships and 9(6.4%) were on other scholarships while 70 (50.0%),11(7.9%) were on PTPTN and JPA (7.9%) respectively. Based on chronic disease data, 3 (30%) male participants had hypertension. Additionally, 5 males reported other chronic diseases, making up 50.0% of the male population. None of the male participants had diabetes mellitus, heart disease, or cancer. On the other hand, 25 female participants had diabetes mellitus, which accounted for 17.9% of the female participants. Other than that, 23 females had hypertension (16.4%), 3

had heart disease (2.1%), and 1 had cancer (0.7%). Additionally, 45 (32.1%) females reported other chronic diseases. Interestingly, 2 male participants (20.0%) and 43 female participants (30.7%) reported no history of chronic diseases

Table 1. Sociodemographic Characteristics of the Participants

Sociodemographic	Male		Female	
	n	%	n	%
Age				
19	0	0	15	10.7
20	0	0	39	27.9
21	3	30	47	33.6
22	4	40	28	20
23	2	20	6	4.3
24	1	10	4	2.9
25	0	0	1	0.7
Ethnicity				
Malay	3	30	8	84.3
Chinese	0	0	2	1.4
Indian	7	70	18	12.9
Others	0	0	2	1.4
Religion				
Muslim	3	30	120	50
Buddhist	0	0	2	1.4
Christian	1	10	0	0
Others	6	60	1	12.9
Status				
Single	10	100	139	99.3
Maried	0	0	1	0.7
Scholarship				
PTPTN	4	40	70	50
JPA	3	30	11	7.9
None	2	20	50	35.7
Others	1	10	9	6.4
Faculty				
FSK	7	70	24	17.1
FUHA	1	10	14	10
FKI	0	0	37	26.4
FSSG	1	10	8	5.7
FPP	1	10	31	22.1
FRIT	0	0	2	1.4
FBK	0	0	17	12.1
FP	0	0	7	5
Chronic Diseases				
Diabetes Mellitus	0	0	25	17.9
Hypertension	3	30	23	16.4
Heart disease	0	0	3	2.1
Cancer	0	0	1	0.7
Others(more than 1 disease)	5	50	45	32.1
No history	2	20	43	30.7

Data are frequency (%)
Data were analyzed using descriptive statistic
Abbreviations: FSK (Fakulti Sains dan Kesihatan), FUHA (Fakulti Undang-undang dan Hubungan Antarabangsa), FKI (Fakulti Pengajian Kotemporari Islam), FSSG (Fakulti Sains Sosial Gunaan),

FPP (Fakulti Perniagaan dan Pengurusan), FRIT (Fakulti Reka Bentuk Inovatif dan Teknologi), FBK (Fakulti Bahasa dan Komunikasi) and FP (Fakulti Perubatan)

Table 2. Questions and Scores of Simplified Diabetes Knowledge Test

Question	Total, n (%)		
	True	False	Don't Know
Q1: Diabetic nutrition is a healthy diet for many people	47(31.3)	73(48.7)	30(20.0)
Q2: Glycosylated hemoglobin (HbA1c) is a test used for measuring the average of blood sugar levels over the past week.	64(42.7)	11(7.3)	75(50.0)
Q3: A bowl of white rice has a higher carbohydrate content compared to a piece of bread.	100(66.7)	40(26.7)	10(6.7)
Q4: Orange juice has a higher fat content than low-fat milk.	27(18.0)	86(57.3)	37(24.7)
Q5: Urine examination and blood examination are equally good for measuring blood sugar levels.	90(60.0)	30(20.0)	30(20.0)
Q6: Unsweetened fruit juice can increase blood sugar levels.	52(34.7)	75(50.0)	23(15.3)
Q7: A can of less-sugar-carbonated drinks can be used to treat low sugar levels in the blood.	31(20.7)	92(61.3)	27(18.0)
Q8: The use of olive oil in cooking can reduce the rate of high cholesterol	116(77.3)	8(5.3)	26(17.3)
Q9: Regular exercise can help reduce high blood pressure.	130(86.7)	6(4.0)	14(9.3)
Q10: For patients with good sugar control, exercise has no effect on blood sugar levels.	30(20.0)	83(55.3)	37(24.7)
Q11:Infection is likely to cause an increase in blood sugar levels	58(38.7)	24(16.0)	68(45.3)
Q12:Wearing shoes that are large and out of the ordinary can help avoid food ulcers	62(41.3)	43(28.7)	45(30.0)
Q13: Low fat foods reduce the risk of heart problems.	139(92.7)	4(2.7)	7(4.7)
Q14:Numbness and tingling are symptoms of neurological diseases.	-	-	-
Q15:Lung problems are commonly associated with diabetes.	31(20.7)	66(44.0)	53(35.3)
Q16: If you have cold, you should check your sugar Level more often.	20(13.3)	90(60.0)	40(26.7)
Q17: Regular health check-ups can help detect early signs of diabetes.	139(92.7)	3(2.0)	8(5.3)
Q18: Attending your diabetes appointment will prevent you from developing diabetes complications.	110(73.3)	23(15.3)	17(11.3)
Q19: High sugar levels in the blood may be caused by too much in insulin intake.	-	-	-
Q20: If you take insulin the morning and don't eat breakfast, your blood sugar level will decrease.	-	-	-

Data are frequency (%)

Table 3. Questions and Score of Diabetes Risk (FINDRISC) Test Among Young Adults

Question	Total , n (%)	
	Yes	No
Do your parents, siblings or relatives have diabetes?	79(52.7)	71(47.3)
Do you have a history of high blood pressure or blood pressure more than 140/90mmHG?	13(8.7)	137(91.3)
Are you taking any diabetes medication?	0(0)	150(100.0)
Do you take any supplement?	61(40.7)	89(59.3)
Are you taking part in any weight management programme	3(2.0)	147(98.0)
or Do you have any diseases or problems related to gastrointestinal	9(6.0)	141(94.0)
Are you on a prescribed medical diet?	17(11.3)	133(88.7)
Are you pregnant, breastfeeding or planning to get pregnant?	0(0)	150(100.0)
Are you on a diet?	35(23.3)	115(76.7)
Do you Ssmoke?	0(0)	150(100.0)

Table 4. Overall Knowledge Status about Diabetes Mellitus Among Students

Total Scores	Total, n(%)
Good knowledge	9(6.0)
Moderate knowledge	89(59.3)
Poor knowledge	52(34.7)

Data were analyzed using descriptive statistics
≥ 9 Good Knowledge
8-12 Moderate Knowledge

Table 5. Diet Components and Score of Dietary Intake Among Young Adults

Component (Score)	Total score, n(%)	
	More than 5	Less than5
Dairy Products	118(78.7)	32(21.3)
Sodium	59(39.3)	91(60.7)
Sugar Sweetened Beverages (SSB)	14(9.30)	36(90.7)

Data are frequency (%)
Data were analyzed using descriptive statistics

Table 6. Diet Quality Among Young Adults

Total Scores	Total, n(%)
Good Quality	34(22.7)
Moderate Quality	113(75.3)
Poor Quality	3(2.0)

Data are frequency (%)
Data were analyzed using descriptive statistics
>80% High Quality Diet
51%-80% Moderate Quality Diet

Table 7. Anthropometry Measurement BMI

Variable	Total, n(%)	Mean ±SD
Body mass index		
Underweight	33(22.0)	46.17(20.65)
Normal weight	85(56.7)	53.14(13.16)
Pre obesity	17(11.3)	64.72(9.25)
Obesity Class I	8(5.3)	89.00(9.33)
Obesity Class II	6(4.0)	99.92(10.75)
Obesity Class III	1(0.7)	90.00(-)
Waist circumference		
Central Obesity	11(7.3)	97.27(4.54)
Normal	139(92.7)	65.57(12.80)

Data are frequency (%)
Data were analyzed using descriptive statistics
Central obesity: More than102 cm for males and more than 88 cm for females
Data were analyzed using descriptive statistics

Association between Knowledge Status, Diet Quality and Anthropometry and Risk of Diabetes among Young Adults

The study examined the relationship between participants' diabetes knowledge and risk classification. The findings indicated that those with good knowledge were classified as low-risk (11.1%), moderate-risk (88.9%), and high-risk. Conversely, individuals with moderate knowledge were categorized as high-risk (3.4%), moderate-risk (77.5%), and low-risk (19.1%). Meanwhile, those with poor knowledge were classified as low-risk (21.2%), moderate-risk (69.2%), and high-risk (9.5%). Despite the disparities in knowledge levels, the statistical analysis yielded a p-value of 0.529, which exceeds the significance level of 0.05. This suggests that in this specific population, there is no statistically significant association between diabetes awareness and the probability of getting the condition. Therefore, although there are variations in risk classification based on knowledge levels, these results do not offer strong evidence to support a direct connection between knowledge of diabetes and the actual risk of developing diabetes among the participants in the study.

The research investigated the correlation between diet quality and the risk classification for diabetes among the participants. The results displayed varying distributions among different levels of diet quality: for those with good diet quality, 11.8% were labeled as low-risk, 76.5% as moderate-risk, and 11.8% as high-risk. In comparison, participants with moderate diet quality were categorized as 21.2% low-risk, 75.2% moderate-risk, and 3.5% high-risk. Conversely, individuals with poor diet quality were classified as 33.3% low-risk and 66.7% moderate-risk, with none falling into the high-risk category. Despite these disparities, the statistical analysis produced a p-value of 0.207, surpassing the significance threshold of 0.05. This suggests that the link between diet quality and diabetes risk in this sample is not statistically significant. Therefore, although there are noticeable differences in risk classification based on diet quality, the results do not offer strong evidence to back a direct connection between diet quality and the risk of developing diabetes among the participants. This implies that other factors beyond diet quality may also impact the risk of

diabetes in this population, prompting further exploration into comprehensive lifestyle and health factors.

The study looked at the association between each participant's anthropometry (waist circumference, BMI) and risk of diabetes . There were significant correlations found, with 97% of underweight people being categorized as being at moderate risk, 3% as being at low risk, and 0% as being at high risk.Those with a normal weight, on the other hand, showed a wide range of results, with the majority (74.1%) of them at moderate risk and 25.9% at low risk. When BMI increased into the obesity categories, there was a clear tendency towards higher risk levels; this was particularly evident for obesity class III, where 100.0% of the population was classified as high risk. This pattern unequivocally shows that there is a link between a rising BMI and a higher chance of getting diabetes. Similarly, waist circumference exhibited a strong correlation with the risk of diabetes; women with central obesity were predominantly at moderate risk (54.5%) or high risk (45.5%), while those with a normal waist circumference were primarily at moderate risk (76.7%), with a minority at low risk (22.5%) and very few at high risk (0.8%).

Table 8. Association Between Knowledge Status, Diet Quality, Anthropometry and Risk of Diabetes Mellitus Among Young Adults In Universiti Sultan Zainal Abidin

Variable	Total (n)	Risk of Diabetes				
		Low Risk	Moderate Risk	High Risk	x2	p-value
Knowledge status						
Good knowledge	9	1(11.1)	8(88.9)	0(0)	3 .850	0.529
Moderate knowledge	89	17(19.1)	69(77.5)	3(3.4)		
Poor knowledge	52	11(21.2)	36(69.2)	5(9.6)		
Diet Quality						
Good quality	34	4(11.8)	26(76.5)	4(11.8)	5.038	0.207
Moderate quality	113	24(21.2)	85(75.2)	4(3.5)		
Poor quality	3	1(33.3)	2(66.7)	0(0)		
BMI						
Underweight	33	1(3.0)	32(97.0)	0(0)	39.54	0.000
Normal weight	85	22(25.9)	63(74.7)	0(0)		
Obesity	32	6(18.8)	18(56.3)	8(25.0)		
Waist circumference						
Central obesity	11	0(0)	6(54.5)	5(45.5)	38.80	0.000
Normal	139	29(20.9)	107(77.0)	3(2.2)		

Fisher's Exact Test was used
Data are frequency (%)
p-value<0.05 indicates statistically significant

The statistical significance of waist circumference and BMI confirms that the analysis supported these associations, providing strong evidence of their influence on diabetes risk. These results highlight the importance of BMI and waist circumference as key indicators for evaluating diabetes risk in both clinical practice and public health settings. These findings further underscore the necessity for implementing targeted interventions aimed at managing body weight and reducing abdominal obesity. The analysis of the data indicates that there is no significant correlation between the

knowledge status and the risk of diabetes among young adults at UniSZA. This pattern is consistent with other research that suggests that young individuals with diabetes may be able to prevent diabetes and manage it more effectively if they have a better knowledge of the disease (Kumar et al., 2020).In addition, a study conducted among South Asian caretakers found differences in their understanding about diabetes that affected their quality of life. But it's important to remember that Koipuram et al.'s 2020 study showed no conclusive evidence of a link between diabetes risk and knowledge levels. Another study found that although there was no direct correlation between an adult's knowledge level and a lower risk of developing diabetes, it was related to improved self-management (Yazidi et al., 2022).

Studies conducted in Saudi Arabia, Ghana, and Ethiopia have revealed that people's understanding of diabetes plays a crucial role in shaping their behavior and management strategies, emphasizing the necessity of educational initiatives. In Saudi Arabia, for instance, individuals continued to consume sugary foods even though they were fully aware of the negative consequences of sugar, indicating a disparity between knowledge and actions. This finding is supported by research from Ghana and Ethiopia, which shows that better self-care behaviors, like exercise, diet, and blood sugar testing, are made possible by higher knowledge levels. The current study observed that having good knowledge is associated with better diabetes outcomes, which is consistent with findings in Pakistan and the United States where knowledge correlated with better HbA1c levels and self-care behaviors, even though it did not find knowledge significantly affecting risk factors like gender, income, or education level (Kumar et al., 2020).

Furthermore, 7% of participants in the latest survey did not know enough about diabetes, which is less than the 25% of participants in the US. The studies conducted on Pakistani communities have shown that people who have average or poor levels of education are more likely to experience difficulties managing their blood sugar. It's interesting to note that increasing knowledge does not always equate to increasing physical activity, improving glycaemic control, or lowering the chance of acquiring diabetes mellitus (Velázquez López et al., 2023).The tendency appears to be that a higher level of knowledge is associated with a lower risk of acquiring diabetes; however, the lack of statistical significance suggests that knowledge alone may not be sufficient. It is vital to conduct comprehensive, behavior-focused interventions in order to successfully minimize the risk of diabetes in young adults.

Based on the findings, young adults at UniSZA who have high-quality diets are less likely to develop the risk of diabetes. The statistical test produced no significant results, but the data trends point to some interesting patterns. A significant majority of young adults with good diet quality had a moderate risk of diabetes, with smaller percentages having low and high risk. The data indicates that although a healthy diet may not completely prevent diabetes, it does appear to maintain a balance where the majority of individuals are considered to be at moderate risk rather than high risk. Conversely, individuals with poor-quality diets had a higher percentage in the low-risk category; however, this may not be a reliable trend due to the small sample size (n=3). The majority

of participants, which are 113 individuals with a moderately high-quality diet were classified as being at moderate risk, while a significant number were at low risk and only few of them were at high risk.

According to earlier research, Siddiqui's study (Siddiqui et al., 2020) did not identify any statistically significant association between the diet quality and risk of diabetes. However, other research has demonstrated a negative correlation between the incidence of diabetes and diet quality. The primary discovery indicates that there is no consistent relationship between dietary sugar and young adult T2D risk factors, as evidenced by Xu et al. (2022). Likewise, other extensive cohort studies have not found any link between fructose-containing sugars and incident T2D, challenging the prevailing belief that sugar consumption raises the risk of T2D (MB et al., 2019).

A meta-analysis of 15 prospective cohort studies revealed no connection between total sugar and fructose intake with T2D, and a higher consumption of sucrose was linked to a reduced risk of T2D (Tsilas et al., 2017). Inconclusive findings regarding sugar intake and diabetes risk may differ from varying levels of sugar consumption and the potential for different sugars to have different metabolic effects. A distinction is made between different kinds of fruit juices: a meta-analysis confirmed that while 100% fruit juice has not shown any association in other research, sugar-sweetened fruit juice has been demonstrated to increase the risk of acquiring type 2 diabetes in some prospective studies. Moreover, because sugars are found in many poor foods and offer empty calories, they are often misreported.

A recently developed healthy diet score in a Shanghai, China study was found to be correlated with a lower risk of type 2 diabetes. Individuals with consistently high diet ratings were 26% less likely to develop type 2 diabetes than those with consistently low diet ratings. After controlling for relevant confounders, those who followed the dairy product pattern had a considerably decreased risk of developing diabetes compared to other dietary patterns, The quality of the dairy product pattern, which is defined by a balance of dietary groups, may help lower the incidence of diabetes in the population under research, according to the study. These results emphasize the need of taking into account dietary quality and particular dietary patterns, such the pattern of dairy products, in relation to lowering the incidence of diabetes, especially in areas with distinctive food cultures like northern China.

According to a recent study by Matsunaga et al. (2021), younger persons who consume excessive amounts of sodium are more likely to develop diabetes mellitus. Moreover, Esfandiar et al. (2022) found that consuming more sodium was linked to an increased risk whereas greater diet quality scores did not substantially lower the risk of type 2 diabetes, Additionally, Ym et al. (2021) found a link between high sodium intake and insulin resistance. The results indicate that the risk of diabetes may be influenced by a variety of factors in addition to diet quality, including genetic predisposition, physical activity, and lifestyle decisions. The absence of statistical significance suggests that more thorough study with larger sample sizes is needed to definitively establish the association between diet quality and diabetes risk.

The data provided indicates a strong link between anthropometric measurements and the likelihood of diabetes in young adults at UniSZA, for both BMI and waist circumference. When it comes to BMI, there is a noticeable trend where underweight individuals are mostly at moderate risk with very few at low risk and none at high risk. On the other hand, normal weight people have a more balanced distribution, with the majority at moderate risk and others at low risk. It's interesting to note that no participant with a normal weight was at high risk. A significant percentage of obese people displayed a distinct distribution, suggesting a clear correlation between a higher BMI and an increased risk of diabetes. These findings highlight how important it is to keep a healthy weight in order to lower your risk of developing diabetes.

Likewise, there exists a high correlation between the risk of diabetes and waist circumference, which is a marker of central obesity. The risk of diabetes was highest in those with central obesity; none were in the low-risk group, and most were in the moderate-risk group. On the other hand, most of the people with a normal waist circumference were categorized as being at moderate risk, and a sizable minority as being at low risk. These findings highlight the important role that central obesity plays in the development of diabetes as well as the significance of waist circumference in predicting diabetes risk.

According to the research carried out by Si-Xuan Li in 2023, it was discovered that there is an association between waist circumference, BMI, and the likelihood of developing type 2 diabetes, with waist circumference demonstrating a more significant association. According to Li et al. (2023), there was an increased risk of T2DM starting when central obesity and high BMI were combined. Eyitayo Omolara Owolabi et al. (2020) observed that central obesity, including normal-weight central obesity (NWCO), was widespread and linked to significant health hazards, although not directly associated with diabetes in individuals with a normal BMI. S T Zhang et al. (2022) determined that central obesity was more prevalent and substantially heightened the risk of T2DM compared to general obesity\

Additional studies have demonstrated that having a high BMI and WC in early adulthood can raise the chance of acquiring diabetes later in life even after controlling for other variables, (Nair et al., 2021). People who have a body mass index (BMI) of ≥30 kg/m² and a waist circumference (WC) of >88 cm for women or >102 cm for men are shown to be substantially more likely to develop diabetes. Another different study stated that young people who are overweight or obese have a significantly high chance of developing diabetes than people who have a normal or underweight BMI (Nagarathna et al., 2019). Mkumbuzi et al. discovered that a WC of ≥106 cm was linked to an elevated risk of type 2 diabetes and that obesity and overweight were significantly more common among young adults in South Africa. On the other hand, those with a normal WC had a much lower risk of type 2 diabetes compared to those who are having central obesity. The findings highlight the need for targeted interventions targeted at healthy weight control and management and reducing central obesity in order to lower the risk of diabetes among young adults at UniSZA. They also highlight the importance of considering both waist

circumference and BMI when evaluating the risk of diabetes\

CONCLUSIONS AND SUGGESTIONS

In this study, we investigated the association between knowledge status, diet quality, anthropometric measures, and the risk of diabetes among young adults in Universiti Sultan Zainal Abidin (UniSZA). The results showed that the risk of diabetes and knowledge status did not significantly correlate statistically. In this particular study, there was no statistically significant correlation found between the diet quality and the risk of diabetes. However, there is a statistically significant association between anthropometry and risk of diabetes. Waist circumference and body mass index (BMI) were found to be statistically significantly associated with the risk of diabetes. This highlights the significance of fat distribution and body weight in the onset of diabetes in young individuals.

This study has several notable strengths, particularly as the first to explore the relationship between knowledge status, dietary quality, and anthropometric risk factors for diabetes among young adults at UniSZA. It provides vital baseline data that can inform future research and targeted interventions to reduce diabetes risk in this group. The findings highlight important links between body weight, fat distribution, and diabetes risk, offering practical insights for preventing and managing diabetes in younger populations. These results have significant implications for improving health outcomes in this demographic.

This research faced several limitations that affected its conclusions. Firstly, only 150 participants were recruited instead of the intended 222, which may have reduced the statistical power and generalizability of the findings. The low enrollment rate was likely due to challenges in motivating individuals to complete the survey within the specified timeframe. Additionally, the results may not accurately reflect other populations, as the demographics, socioeconomic status, and educational backgrounds of UniSZA students could differ significantly from those of young adults in other settings. Time constraints and difficulties in participant recruitment also limited the diversity of the sample, potentially impacting the data collected.

To address these limitations, future research should aim to recruit larger and more diverse samples to enhance statistical power and generalizability. Expanding the participants from various universities or regions could provide a more comprehensive understanding of the factors influencing diabetes risk. Furthermore, incorporating objective data, such as medical records and physical examinations, alongside self-reported information can improve the accuracy and reliability of the results. Implementing these recommendations will help to address the gaps identified in the current study and contribute to a more thorough understanding of diabetes risk among young adults.

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