Darussalam Nutrition Journal, Mei 2025, 9(1):1-13 *P- ISSN 2579-8588*
DOI: 10.21111/dnj.v9i1.14323 *E-ISSN 2579-8618*

ASSOCIATION OF BODY MASS INDEX AND DIETARY COMPLIANCE ON GLYCEMIC CONTROL AMONG OUTPATIENTS WITH TYPE 2 DIABETES MELLITUS IN KUALA TERENGGANU

Nurul Husna binti Khoder[1], Sakinah binti Harith[1*], Indahtul Mufidah[2]

[1] School of Nutrition and Dietetics, Faculty of Health Sciences, Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300 Kuala Nerus, Terengganu, Malaysia
[2] Departement of Nutrition Science, Faculty of Health Sciences, Universitas Darussalam Gontor, Indonesia
* Corresponding author: sakinahharith@unisza.edu.my

ABSTRACT

Background*: Glycemic control is essential in managing Type 2 diabetes and preventing complications. Several factors, including sociodemographic characteristics, BMI, and dietary compliance, may influence glycemic outcomes. This study aimed to identify key factors associated with glycemic control among Type 2 diabetic outpatients in Kuala Terengganu.* ***Methods****: A retrospective study was conducted involving 134 outpatients from one clinic and one hospital, selected through purposive sampling. Data were collected via patient records and questionnaires. Glycemic control was assessed using HbA1c levels, with compliance measured based on self-reported dietary behavior.* ***Results:*** *Among all sociodemographic variables, only the type of treatment (diet and oral anti-diabetic drugs) showed a significant association with glycemic control (p = 0.013). Additionally, BMI was significantly associated with glycemic outcomes (p = 0.029), as poor glycemic control was more prevalent among overweight (84.2%) and obese (82.7%) individuals. No significant association was found between dietary compliance and glycemic control (p = 0.560), potentially due to reporting bias or inconsistent adherence.* ***Conclusion:*** *BMI and treatment type are significant factors influencing glycemic control in this population. Despite no observed link between dietary compliance and glycemic control, further studies with larger, more diverse samples are needed. Healthcare providers should focus on improving BMI and treatment awareness to enhance diabetes management.*

Keywords: Glycemic control, Type 2 diabetes, BMI, Dietary compliance, Sociodemographic factors, Kuala Terengganu

INTRODUCTION

Effective diabetes management requires careful monitoring of blood sugar levels alongside dietary and lifestyle modifications to maintain glycemic control (Okura *et al.*, 2018). A balanced diet, rich in essential micronutrients, is particularly beneficial for individuals with chronic conditions such as Type 2 diabetes. Anthropometric measures such as body mass index (BMI), waist circumference (WC), hip circumference (HC), and waist-to-height ratio (WHtR) are commonly used to assess the risk and progression of diabetes (Khader *et al.*, 2019). While following a professionally recommended diet can improve glycemic control, the impact of socio-demographic factors, dietary compliance, and BMI on managing diabetes remains underexplored. Understanding these relationships is crucial for developing effective, individualized diabetes care strategies.

In Kuala Terengganu, the prevalence of T2DM has been rising steadily, with many outpatients exhibiting suboptimal glycemic control (Awang *et al.*, 2022). Previous studies have highlighted the

importance of dietary adherence and BMI in managing diabetes, but the relationship between these factors and glycemic control remains inadequately explored, particularly within the local context of Kuala Terengganu. Understanding these associations can help inform clinical practice and guide targeted interventions to improve diabetes outcomes in this region.

However, the lack of research addressing these elements in the setting of Kuala Terengganu requires a more localised investigation. This study is aimed at addressing a research gap by providing valuable insights about socio-demographic, BMI and dietary compliance that can improve glycemic control and overall well-being in Type 2 diabetic outpatients in Kuala Terengganu.

METHOD

This retrospective study was conducted among outpatients with Type 2 diabetes mellitus (T2DM) attending a diabetes clinic in Kuala Terengganu. A total of 134 participants were recruited from the outpatient records over a six-month period, from January 2023 to June 2023. Eligible participants were individuals diagnosed with Type 2 diabetes by a healthcare professional, confirmed through blood tests indicating elevated blood glucose levels. Participants were required to be receiving diabetes care on an outpatient basis, attending regular outpatient appointments for diabetes check-ups. The study included adults aged 18 years and above who reside in Kuala Terengganu, ensuring the relevance of the study to the local population. Additionally, individuals had to express a willingness to participate in the study.

Participants were excluded if they had Type 1 diabetes or cognitive impairments that could affect their ability to provide informed consent, such as Alzheimer's disease or Parkinson's disease. Pregnant women were also excluded due to the potential impact of pregnancy on dietary habits and glycemic control. Furthermore, individuals who expressed unwillingness or were unable to participate in the study, as well as those living outside of Kuala Terengganu, were not included. Data collection utilized a structured questionnaire to gather socio-demographic information, which included 11 items such as age, gender, address, ethnicity (Malay, Chinese, Indian, other), phone number, marital status (single, married, divorced, widowed), religion (Muslim, Buddhist, Christian, other), occupation, and location.

Dietary compliance in this study was assessed using the Malay version of the Summary of Diabetes Self-Care Activities (SDSCA) questionnaire, a validated tool for evaluating self-care behaviors in diabetes. The dietary subscale included seven items that measured adherence to dietary recommendations over the past week. These items covered frequency of following a healthy eating plan, consumption of fruits and vegetables, avoiding high-fat foods (reverse scored), consuming recommended portions from each food group, evenly distributing carbohydrate intake, limiting sugar intake, and maintaining regular meal and snack times. Each item was scored based on the number of days (0–7) the behavior was followed in the past week.

An overall adherence score was calculated by averaging the responses across all seven items. A mean score of ≥ 5 days was considered good dietary adherence, while a score of < 5 days

indicated poor adherence. To supplement the questionnaire data, additional information on patients' dietary behaviors was gathered from medical records and health histories, including dietetic notes, food checklists, and 24-hour dietary recall assessments by healthcare professionals. This approach aimed to provide a more comprehensive understanding of patients' dietary practices and their compliance with nutritional guidelines in diabetes management.

BMI was calculated by dividing weight (kg) by height (m^2), using medical record data. Glycemic control was assessed by HbA1c levels. Body weight status was categorized into two groups: 1 for underweight and normal weight, and 0 for overweight and obese. HbA1c was classified as "Poor glycemic control" for HbA1c > 6.5%, and "Good glycemic control" for HbA1c ≤ 6.5%. These categories determined participants' glycemic control status.

The statistical analysis was conducted using SPSS version 21.0, with a significance level of $p \leq 0.05$. Descriptive statistics, including mean, standard deviation, and percentages, were used to describe the participants' socio-demographic characteristics. Fisher's Exact Test was used to analyze the associations between Body Mass Index (BMI) and glycemic control, as well as between dietary compliance and glycemic control, due to the categorical variables and small expected cell counts.

The University Sultan Zainal Abidin Human Research and Ethics Committee (UHREC) accepted this study and assigned a study protocol code (UniSZA/UHREC/2023/584) that should be used in all correspondence with the UHREC regarding this investigation. Only researchers have access to the data, which was kept private and not shared with any other parties.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of Participants

Table 1 presented the socio-demographic data of 134 respondents, consisting of 71 males (53.0%) and 63 females (47.0%), indicating an almost balanced gender distribution. In terms of age, the majority of respondents (67.2%) were aged 44 years and above, suggesting that diabetes was more prevalent among older individuals. All respondents were of Malay ethnicity, indicating that the study population was ethnically homogeneous. Most of the respondents were married (89.6%), which could have provided social support in managing a chronic illness such as diabetes.

Additionally, 61.2% of respondents were either retirees or housewives, suggesting that the majority were not actively employed, a factor closely related to their income levels. Over half of the respondents (56.7%) had a monthly income below RM1900, indicating a predominance of individuals from lower-middle economic backgrounds, which could have implications for healthcare access. In terms of disease duration, most respondents (73.9%) had been living with diabetes for more than five years, signifying a chronically affected population requiring long-term management.

This study examined the socio-demographic characteristics of outpatients with Type 2 diabetes in Kuala Terengganu, revealing a predominance of older adults, with 67.2% aged 54 and above, consistent

with the higher prevalence of diabetes in this age group (Akhtar et al., 2022). The participant population was ethnically homogeneous (100% Malay), allowing for a focused analysis of socio-demographic factors without cultural confounding. Most participants were married (91%), suggesting potential spousal support in diabetes management, although literature shows mixed outcomes related to marital status and health (Brown et al., 2017; Kposowa, Ezzat and Breault, 2021).

Educational attainment was relatively high, with 41% having completed secondary school, indicating good health literacy, which is crucial for diabetes management (Tan, Juliana and Sakinah, 2011). Employment status varied, with 43.3% working in government or private sectors, reflecting diverse economic backgrounds that could impact healthcare access (Chen et al., 2019). A significant portion of participants (70.1%) had diabetes for 6-10 years, indicating a need for ongoing management as longer duration increases the risk of complications (de Jong, Woodward and Peters, 2022). Most participants (85.1%) were on a combination of diet and oral medications, aligning with common treatment regimens (Shen et al., 2022).

Additionally, the prevalence of hypertension (46.3%) and other comorbidities underscores the necessity for integrated management strategies (Williams et al., 2015). With low smoking prevalence (5.2%) but high rates of physical inactivity (86.6%), these lifestyle factors highlight critical areas for intervention, as physical activity is essential for effective diabetes management (Harrington and Henson, 2021)

Table 1. Socio-Demographic Data of The Respondents

Socio-demographic characteristic	Male (n=71)	Female (n=63)	Total (n=134)
Age, n (%)			
18-29	2(2.8)	1(1.6)	3(2.2)
30-41	6(8.5)	8(12.7)	14(10.4)
42-53	17(23.9)	10(15.9)	27(20.1)
54 Above	46(64.8)	44(69.8)	90(67.2)
Ethnic, n (%)			
Malay	71(53)	63(247)	134(100)
Marital status, n (%)			
Married	65(91.5)	57(90.5)	122(91)
Single	4(5.6)	3(4.8)	7(5.2)
Widowed	2(2.8)	3(4.8)	5(3.7)
Educational Level, n (%)			
No formal educational	1(1.4)	3(4.8)	4(3.0)
Primary school	1(1.4)	43(68.3)	44(32.8)
Secondary school	53(74.6)	2(3.2)	55(41.0)
College/university	16(22.5)	15(23.8)	31(23.1)
Working Status, n (%)			
Government/private worker	37(52.1)	21(33.3)	58(43.3)
Pensioner	30(42.3)	17(27.0)	47(35.1)
Unemployed/Housewife	4(5.6)	25(39.7)	29(21.6)
Income, n (%)[1]			
< RM 2500	26(36.6)	43(68.3)	69(51.5)
RM2501-4850	29(40.8)	15(23.8)	44(32.8)
RM4851-RM10970	14(19.7)	5(7.9)	19(14.2)
RM10970 Above	2(2.8)	0(0)	2(1.5)

Socio-demographic characteristic	Male (n=71)	Female (n=63)	Total (n=134)
Duration of Diabetes (years), n (%)			
< 1	13(18.3)	11(17.5)	24(17.9)
1-5	2(2.8)	4(6.3)	9(4.5)
6-10	53(74.6)	41(65.1)	94(70.1)
> 10	3(4.2)	7(11.1)	10(7.5)
Type of Diabetes Treatment, n (%)			
Diet alone	9(12.7)	11(17.5)	20(14.9)
Diet and oral anti diabetic drugs	62(87.3)	52(82.5)	114(85.1)
Family History of Diabetes, n (%)			
Yes	17(23.9)	17(27.0)	34(25.4)
No	54(76.1)	46(73.0)	100(74.6)
Other Health Problems, n (%)			
CVD	1(1.4)	1(1.6)	2(1.5)
Hypertension	26(36.6)	36(57.1)	62(46.3)
Other disease	39(54.9)	19(30.2)	58(43.3)
No other disease	4(5.6)	7(11.1)	11(8.2)
Smoking, n (%)			
Yes	7(9.9)	0(0)	7(5.2)
Never	53(74.6)	63(100)	113(84.3)
Quit	11(15.5)	0(0)	11(10.4)
Physical activity, n (%)			
Yes	12(16.9)	6(90.5)	18(13.4)
None	59(83.1)	57(90.5)	116(86.6)
Frequency			
None	59(83.1)	57(90.5)	116(86.6)
1-2 per week	6(8.5)	3(4.8)	9(6.7)
3-4 per week	2(2.8)	1(1.6)	3(2.2)
Everyday	4(5.6)	2(3.2)	6(4.5)
Duration of physical activity, n (%)			
None	59(83.1)	57(90.5)	116(86.6)
0-30 min	6(8.5)	4(6.3)	10(7.5)
31-60 min	3(4.2)	0(0)	3(2.2)
>60 min	3(4.2)	2(3.2)	5(3.7)

[1]Classification is based on Household Income and Basic Amenities Survey Report 2019, Department of Statistics Malaysia

Association Between BMI Towards Glycemic Control

Based on the data in Table 5 obtained, of the 113 respondents classified as overweight, 88 individuals (77.9%) exhibited poor glycemic control, while 25 individuals (22.1%) had good control. Conversely, among the 21 respondents who were not overweight, 18 individuals (85.7%) showed poor glycemic control, and only 3 individuals (14.3%) had good control. Although descriptively the proportion of poor glycemic control appeared higher in the non-overweight group, statistical testing showed a p-value of 0.564. This indicated that there was no significant relationship between BMI status and glycemic control ($p > 0.05$). Moreover, the odds ratio (OR) was 0.587, suggesting that overweight individuals were 41.3% less likely to experience poor glycemic

control compared to their non-overweight counterparts, although this difference was not statistically significant.

These findings contradicted the general understanding in medical literature which stated that overweight and obesity were major risk factors for metabolic disorders and poor glycemic control. Obesity had been strongly associated with insulin resistance, elevated fasting glucose levels, and higher HbA1c levels (American Diabetes Association, 2023). However, several studies also identified the presence of the obesity paradox, a condition in which individuals who were overweight or obese experienced better clinical outcomes under certain circumstances, including in patients with type 2 diabetes. A prospective study by Hainer and Aldhoon-Hainerová (2013) reported that overweight patients sometimes exhibited better prognoses for cardiometabolic complications than those with normal body weight, potentially due to differences in fat distribution, metabolic status, or more intensive clinical management

These findings further underscore the complex relationship between BMI and glycemic control. While this study did not identify a statistically significant association between BMI status and glycemic control, existing literature suggests that higher BMI, particularly in overweight and obese individuals, is linked to increased insulin resistance, impairing the body's ability to manage blood glucose effectively (Rusli and Harith, 2020). Obesity-related factors, such as the production of pro-inflammatory cytokines and ectopic fat deposition, contribute to insulin resistance, exacerbating challenges in glycemic control (Kahn and Flier, 2000). This is further supported by studies highlighting the detrimental effect of excess weight on HbA1c levels, reinforcing the need for weight management in diabetes care (Ghani et al., 2021; Nugrahaeni et al., 2022)

Table 2. Association Between Body Mass Index (BMI) On Glycemic Control Among Outpatients With Type 2 Diabetes In Kuala Terengganu

Variable BMI	Glycemic Control		Total n (%)	p	OR
	Poor n (%)	Good n (%)			
Overweight	88(77,9)	25(22,1)	113(100)	0,564	0,587
Not Overweight	18(85,7)	3(14,3)	21(100)		

However, conflicting evidence from Deng et al. (2019) suggests that BMI may not always impact glycemic control outcomes, highlighting the complexity of this relationship and the need for further research. For instance, a cross-sectional study by Deng et al. (2019) found no significant association between BMI and glycemic control in patients with type 2 diabetes mellitus, indicating that factors beyond BMI may play a more critical role in managing blood glucose levels. Similarly, a study conducted in Indonesia reported no significant relationship between BMI and HbA1c levels among type 2 diabetes patients, suggesting that BMI alone may not be

a reliable predictor of glycemic control (Nugrahaeni et al., 2022). These discrepancies emphasize the importance of considering a multifactorial approach when assessing glycemic control, taking into account various physiological and lifestyle factors that may influence outcomes.

In conclusion, while higher BMI is generally associated with poorer glycemic control, as evidenced by several studies, the relationship is not universally consistent across all populations and settings. This inconsistency underscores the need for individualized patient assessments and the consideration of additional factors influencing glycemic control beyond BMI alone. Future research should aim to elucidate the underlying mechanisms and identify other contributing factors to develop more effective, personalized strategies for managing type 2 diabetes.

Moreover, the elevated prevalence of overweight and obesity observed in the current study population highlights the critical need for weight management strategies to improve glycemic outcomes and reduce diabetes-related complications such as cardiovascular disease, retinopathy, and neuropathy (American Heart Association, 2021; Eckel et al., 2011). These interventions should not only focus on dietary modification and physical activity but also consider culturally embedded lifestyle behaviors and urbanization-related changes, particularly in rapidly developing areas such as Kuala Terengganu (Ghani et al., 2021; Chan et al., 2010). Integrating culturally sensitive public health programs and individualized clinical management may enhance the effectiveness of diabetes prevention and treatment efforts in such communities.

This study revealed both encouraging and concerning trends in dietary compliance among outpatients with Type 2 diabetes in Kuala Terengganu. While participants showed strong compliance in avoiding high-fat foods (100% compliance, mean score 4.80 ± 2.05), adherence to consuming five or more servings of fruits and vegetables was alarmingly low, with only 5.2% meeting the guideline (mean score 2.10 ± 1.22). These findings align with previous research, such as Hiong et al., (2020), where poor compliance in fruit and vegetable intake was similarly reported. The low compliance may be attributed to factors like a lack of awareness about the importance of dietary fiber, economic constraints, and limited access to fruits and vegetables, particularly in lower-income groups (Hiong et al., 2020). Furthermore, the overall compliance rate was significantly low, with only 3.7% showing good adherence to dietary guidelines, indicating a pressing need for comprehensive dietary education and interventions targeted at improving dietary habits among this population.

This study found that among all socio-demographic characteristics examined, only the Type of diabetes treatment (diet and oral anti-diabetic drugs) had a significant association with glycemic control ($p = 0.013$). While the hypothesis suggested that factors such as Body Mass Index (BMI) and dietary compliance might also influence glycemic control, the data showed that treatment type played the most crucial role. This aligns with previous research, such as (Turner et al., (1999), which demonstrated that a combination of diet and oral medications significantly improves glycemic outcomes. Other socio-demographic factors, like gender and

age, showed no significant association with glycemic control, which is consistent with some studies (Sami et al., 2017). That found similar non-significant results for variables like gender and employment status.

This aligns with research suggesting that higher BMI, especially in overweight and obese individuals, is linked to increased insulin resistance, which impairs the body's ability to manage blood glucose effectively (Rusli and Harith, 2020). Obesity-related factors such as the production of pro-inflammatory cytokines and ectopic fat deposition contribute to insulin resistance, exacerbating glycemic control challenges (Kahn and Flier, 2000). This is further supported by studies , which highlight the detrimental effect of excess weight on HbA1c levels, reinforcing the need for weight management in diabetes care (Ghani et al., 2021; Nugrahaeni et al., 2022). However, conflicting evidence from Deng et al., (2019) suggests that BMI may not always impact glycemic control outcomes, highlighting the complexity of this relationship and the need for further research.

Association Between Overall Dietary Compliance Towards Glycemic Control

Based on the table 6, the analysis of the relationship between dietary compliance and glycemic control showed that among the 130 respondents who were non-compliant with dietary recommendations, 103 individuals (79.2%) had poor glycemic control, while 27 individuals (20.8%) achieved good control. In contrast, among the four respondents who were compliant with dietary guidelines, three individuals (75%) exhibited poor glycemic control, and only one individual (25%) had good control. The statistical test yielded a p-value of 1.00, indicating no significant association between dietary compliance and glycemic control ($p > 0.05$). Furthermore, the odds ratio (OR) was 1.27, suggesting that non-compliant individuals were 27% more likely to experience poor glycemic control compared to those who were compliant, although the difference was not statistically significant

Table 3. Association Between Overall Dietary Compliance On Glycemic Control Among Outpatients With Type 2 Diabetes In Kuala Terengganu

Overall Dietary compliance	**Glycemic Control**		**Total** n (%)	**p**	**OR**
	Poor n (%)	**Good** n (%)			
Not Compliance	103(79,2)	27(20,8)	130(100)	1,00	1,27
Compliance	3(75)	1(25)	4(100)		

These findings demonstrated that although dietary compliance is clinically important, it did not show a significant association with glycemic control in this study. This outcome might have been influenced by the very small sample size of the compliant group (n = 4), which weakened the statistical power and increased the risk of a type II error

.

A study conducted by Putri et al. (2021) in Indonesia found that dietary adherence among patients with type 2 diabetes was generally low and impacted HbA1c levels, though statistically significant associations were more apparent among those with long-term compliance. Similarly, research by Shamsi et al. (2020) in Pakistan reported that dietary compliance affected glycemic outcomes, but significance emerged only when reinforced by ongoing education and family support.

Research in Malaysia by Hiong et al. (2020) supported these findings, reporting poor compliance with fruit and vegetable intake and low overall dietary adherence, both contributing to suboptimal glycemic control. This highlighted the inadequacy of informational interventions alone and underscored the need for comprehensive and sustained approaches. Furthermore, as noted by Davies et al. (2018), glycemic control was influenced by multiple factors beyond diet, including physical activity, medication, social support, and psychological conditions.

Other factors, including medication adherence, physical activity, and stress, are likely to play a role in influencing glycemic control, suggesting that a multifaceted approach is necessary for effective diabetes management (Tan, Juliana and Sakinah, 2011; Shen et al., 2022). This study may have potential selection bias due to the use of purposive sampling from a single clinic and hospital in Kuala Terengganu, limiting the generalizability of the findings to other regions or broader populations. Additionally, self-reported dietary compliance could introduce measurement bias, as patients may underreport or misreport their dietary behaviors. Other factors, such as socio-economic status or access to healthcare, could also influence glycemic control but were not addressed in this study. Future research with larger and more diverse samples is needed to confirm these findings and improve the generalizability of the results.

CONCLUSIONS AND SUGGESTIONS

The findings of this study emphasize the importance of understanding the factors contributing to effective Type 2 diabetes management. A significant association was found between diabetes treatment (diet and oral anti-diabetic drugs) and improved glycemic control, while a similar link was observed between BMI and glycemic control, highlighting the importance of maintaining a healthy weight. However, no significant association was found between dietary compliance and glycemic control. These results suggest that diabetes management requires a personalized approach that takes into account socio-demographic and physiological factors, offering valuable insights for clinicians and patients.

ACKNOWLEDGMENT

The author would like to extend my sincere thanks to all the individuals and organizations who contributed to the successful completion of this study, "Association of Socio-Demographic, Body Mass Index, and Dietary Compliance on Glycemic Control Among Outpatients with Type 2 Diabetes Mellitus in Kuala Terengganu." Special thanks go to the clinic and hospital staff who provided

access to data and valuable insights, and to my supervisor, Professor Dr. Sakinah binti Harith, for her guidance and unwavering support. I also wish to express my gratitude to the healthcare professionals at UniSZA Medical Specialist Clinic, UMC, and Dietetic OPD Clinic, HOSZA, for their assistance.

BIBLIOGRAPHY

Akhtar, S. *et al.* 2022. Prevalence of type-2 diabetes and prediabetes in Malaysia: A systematic review and meta-analysis, *PLoS ONE*, 17(1 January), pp. 1–14.

American Heart Association. 2021. *Understand Your Risk for Diabetes*, *American Heart Association*. Available at: https://www.heart.org/en/health-topics/diabetes/understand-your-risk-for-diabetes.

American Diabetes Association. 2023. Standards of Medical Care in Diabetes—2023. Diabetes Care, 46(Suppl 1), S1–S291. https://doi.org/10.2337/dc23-Sint

Awang, H. *et al.* 2022. Epidemiology of Poor Glycaemic Control among Patients with Type 2 Diabetes Mellitus in Terengganu State of Malaysia, *European Journal of Medical and Health Sciences*, 4(5), pp. 89–94. Available at: https://doi.org/10.24018/ejmed.2022.4.5.1499.

Brown, C.H. *et al.* 2017. An Overview of Research and Evaluation Designs for Dissemination and Implementation, *Annual Review of Public Health*, 38, pp. 1–22. Available at: https://doi.org/10.1146/annurev-publhealth-031816-044215.

Chan, J.C., Malik, V., Jia, W., Kadowaki, T., Yajnik, C.S., Yoon, K.H. and Hu, F.B. 2010. Diabetes in Asia: epidemiology, risk factors, and pathophysiology. JAMA, 301(20), pp.2129–2140. https://doi.org/10.1001/jama.2010.726

Chen, X. *et al.* 2019. Research topics, author profiles, and collaboration networks in the top-ranked journal on educational technology over the past 40 years: a bibliometric analysis, *Journal of Computers in Education*, 6(4), pp. 563–585. Available at: https://doi.org/10.1007/s40692-019-00149-1.

Davies, M.J., D'Alessio, D.A., Fradkin, J., Kernan, W.N., Mathieu, C., Mingrone, G., Rossing, P., Tsapas, A., Wexler, D.J. and Buse, J.B. .2018. Management of hyperglycemia in type 2 diabetes, 2018: A consensus report by the ADA and the EASD. Diabetes Care, 41(12), pp.2669–2701. https://doi.org/10.2337/dci18-0033

Deng, H. *et al.* 2019. Effect of baseline body mass index on glycemic control and weight change with exenatide monotherapy in Chinese drug-naïve type 2 diabetic patients', *Journal of Diabetes*, 11(7), pp. 509–518. Available at: https://doi.org/10.1111/1753-0407.12883.

De Jong, M., Woodward, M. and Peters, S.A.E. (2022) 'Duration of diabetes and the risk of major cardiovascular events in women and men: A prospective cohort study of UK Biobank participants.', *Diabetes research and clinical practice*, 188, p. 109899. Available at: https://doi.org/10.1016/j.diabres.2022.109899.

Eckel, R.H., Kahn, R., Robertson, R.M. and Rizza, R.A. 2011.

Preventing cardiovascular disease and diabetes: a call to action from the American Diabetes Association and the American Heart Association. Circulation, 113(25), pp.2943–2946.

Gallagher, D. and Chung, S. 2005. Body Composition, in B.B.T.-E. of H.N. (Second E. Caballero (ed.) *Encyclopedia of Human Nutrition (Second Edition)*. Oxford: Elsevier, pp. 210–220.

Ghani, N.I.A. *et al.* 2021. Identifying Destination Attractiveness of Kuala Terengganu Perceived by Domestic Tourist, *International Journal of Asian Social Science*, 11(9), pp. 399–408. Available at: https://doi.org/10.18488/journal.1.2021.119.399.408.

Ghani, N.A., Abdullah, M.Y., Salleh, R., Hassan, M.R. and Arifin, W.N. 2021. 'Dietary patterns and obesity among adults in urban and rural areas of Malaysia', Malaysian Journal of Nutrition, 27(1), pp. 69–82.Hainer, V. and Aldhoon-Hainerová, I. (2013). Obesity paradox does exist. Diabetes Care, 36(Suppl 2), pp.S276–S281. https://doi.org/10.2337/dcS13-2023

Harrington, D. and Henson, J. 2021. Physical activity and exercise in the management of type 2 diabetes: where to start?, *Practical Diabetes*, 38(5), pp. 35-40b. Available at: https://doi.org/10.1002/pdi.2361.

Hiong, Y.M. *et al.* 2020. Assessments of Dietary Characteristics, Adherence and Glycemic Control in Individuals with Type 2 Diabetes: A Sampled from a Selected Public Hospital in Malaysia, *International Journal of Academic Research in Business and Social Sciences*, 10(16), pp. 96–108.

Hiong, T.G., Tan, C.H., Chan, W.M. 2020. Dietary compliance and glycemic control among patients with type 2 diabetes mellitus in Malaysia. Malaysian Journal of Public Health Medicine, 20(1), 109-115. https://doi.org/10.37268/mjphm/vol.20/no.1/art.60

Kahn, B.B. and Flier, J.S. 2000. Obesity and insulin resistance.', *The Journal of clinical investigation*, 106(4), pp. 473–481. Available at: https://doi.org/10.1172/JCI10842.

Khader, Y. *et al.* 2019. The performance of anthropometric measures to predict diabetes mellitus and hypertension among adults in Jordan', *BMC Public Health*, 19(1), pp. 1–9. Available at: https://doi.org/10.1186/s12889-019-7801-2.

Kposowa, A.J., Ezzat, D.A. and Breault, K. 2021. Diabetes mellitus and marital status: Evidence from the national longitudinal mortality study on the effect of marital dissolution and the death of a spouse', *International Journal of General Medicine*, 14, pp. 1881–1888. Available at: https://doi.org/10.2147/IJGM.S307436.

Nugrahaeni, D.K. *et al.* 2022. Factor Associated with Long-Term Control Blood Glucose Based on HbA1c Level in Type 2 Diabetes Mellitus Patients', 18, pp. 19–23.

Okura, T. *et al.* 2018). Body mass index ≥23 is a risk factor for insulin resistance and diabetes in Japanese people: A brief report', *PLOS ONE*, 13(7), p. e0201052. Available at:

https://doi.org/10.1371/journal.pone.0201052.

Putri, M.D., Sulistianingsih, D., & Kusumawati, E. 2021. Hubungan Kepatuhan Diet dengan Kadar HbA1c pada Pasien Diabetes Mellitus Tipe 2. Jurnal Keperawatan Soedirman, 16(1), 9-16. https://doi.org/10.20884/1.jks.2021.16.1.257

Rusli, N.S. and Harith, S. 2020. Body Mass Index , Eating Habits and Physical Activity Among', *JNS: Journal of Nutrition Science*, 1(2), pp. 29–39.

Sami, W. *et al.* 2017. Effect of diet on type 2 diabetes mellitus: A review.', *International journal of health sciences*, 11(2), pp. 65–71.

Shamsi, U.F., Saleem, T., & Khan, M. 2020. Association of dietary adherence with glycemic control in patients with type 2 diabetes mellitus. Pakistan Journal of Medical Sciences, 36(6), 1258–1263. https://doi.org/10.12669/pjms.36.6.2631

Shen, X.M. *et al.* 2022. Association between dietary patterns and glycaemic control in a middle-aged Chinese population', *Public Health Nutrition*, 25(8), pp. 2197–2205. Available at: https://doi.org/10.1017/S1368980021003931.

Tan, S.L., Juliana, S. and Sakinah, H. .2011. Dietary compliance and its association with glycemic control among poorly controlled type 2 diabetic outpatients in Hospital Universiti Sains Malaysia.', *Malaysian journal of nutrition*, 17(3), pp. 287–299.

Turner, R.C. *et al.* 1999. Glycemic control with diet, sulfonylurea, metformin, or insulin in patients with type 2 diabetes mellitus: progressive requirement for multiple therapies (UKPDS 49). UK Prospective Diabetes Study (UKPDS) Group., *JAMA*, 281(21), pp. 2005–2012. Available at: https://doi.org/10.1001/jama.281.21.2005.

Williams, E.P. *et al.* 2015. Overweight and Obesity: Prevalence, Consequences, and Causes of a Growing Public Health Problem., *Current obesity reports*, 4(3), pp. 363–370.