ORIGINAL PAPER

doi: 10.5455/medarh.2023.77.455-459
MED ARCH. 2023; 77(6): 455-459
RECEIVED: OCT 06, 2023
ACCEPTED: NOV 24, 2023

1Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia
2Faculty of Medicine, Universitas Islam Sumatera Utara, Medan, Indonesia

Corresponding author: Ichwan Alamsyah Lubis, Faculty of Medicine, Universitas Islam Sumatera Utara. Address: Jalan STM No. 77, Suka Maju, Medan Johor, Medan 20146, North Sumatra, Indonesia. Phone: +6285262631985. E-mail address: ichwan.alamsyah@fk.uisu.ac.id. ORCID ID: https://orcid.org/0000-0002-7926-2614.

Identifying Adult Population at Risk for Undiagnosed Diabetes Mellitus in Medan City, Indonesia Targeted on Diabetes Prevention

Fazidah Aguslina Siregar[1], Asfriyati[1], Tri Makmur[2], Ramadhan Bestari[2], Ichwan Alamsyah Lubis[2], Umar Zein[2]

ABSTRACT

Background: Diabetes mellitus is a health problem in Indonesia, where its prevalence rises annually. The condition may negatively impact one's quality of life and lead to significant complications—over 50% of patients with type 2 diabetes mellitus, the most common diabetes type worldwide. To implement diabetic prevention interventions and achieve effective diabetes mellitus control, screening for undiagnosed diabetes mellitus in high-risk populations is essential. **Objective:** This study aimed to identify people at risk for undiagnosed diabetes mellitus using the Finnish Diabetes Risk Score (FINDRISC) and oral glucose tolerance test (OGTT). **Methods:** This cross-sectional study was carried out, which involved 300 people in Medan City between the ages of 30-75. The study was conducted between July 14 and October 20, 2020. The Finnish Diabetes Risk Score and anthropometric measurements (weight, height, and waist circumference) were used to evaluate each respondent. Low, medium, and high-risk outcome categories were created. All responders underwent oral glucose tolerance tests, with results classified as normal, prediabetes, or diabetes. The Chi-square test was used to examine the data and identify potential risk variables for diabetes mellitus. **Results:** Of 300 individuals, 91.7% were female, and 8.3% were male. 33.7% of participants had a low risk of acquiring diabetes, 55.0% had an intermediate risk, and 11.3% had a high risk. 70% of participants who took an oral glucose tolerance test had blood glucose levels that were normal (less than 100 mg/dl), 18.7% had blood glucose levels suggestive of prediabetes (between 100 and 125 mg/dl), and 11.3% had blood glucose levels suggestive of diabetes (126 mg/dl or higher). Ages 54 to 64 years and older, high body mass index and central obesity, a lack of vegetables and fruits in the daily diet, inactivity, uncontrolled hypertension, a history of hyperglycemia, and a family history of diabetes were all linked to a significant increase in the risk of developing diabetes. Most respondents at low risk of developing type 2 diabetes had normal blood sugar levels, while those at high risk of developing type 2 diabetes had high blood glucose levels ($p = 0.005$). **Conclusion:** Oral glucose tolerance testing and the FINDRISC questionnaire may be used to identify individuals who are at high risk for developing diabetes and to encourage them to adopt healthy behaviours.

Keywords: undiagnosed diabetes mellitus, FINDRISC questionnaire, potential risk, diabetes prevention.

1. BACKGROUND

The prevalence of diabetes mellitus tends to increase annually, making it a global health concern. The disease might affect people's quality of life and productivity. The World Health Organization (WHO) defines it as a silent epidemic. Globally, there were 463 million diabetics as of 2019, and the International Diabetes Federation predicted that number to increase to 578 million by 2030 and 700 million by 2045. Type 2 diabetes mellitus that has not been diagnosed is common in persons between 20 and 79 (1). In the world, type 2 diabetes is more prevalent and often affects people between 20 and 79. According to estimates, 50% of people have undiagnosed diabetes. Two-thirds of people with diabetes live in urban areas. Type 2 diabetes has a socioeconomic impact, and the estimated costs of health services related to the disease were USD 825 billion by 2030 and USD 845 billion by 2045. In addition, the illness may result in fatal complications. About 4.2 million deaths from diabetes were predicted to occur in 2019 (2).

Southeast Asia was the third-highest region for diabetes mellitus worldwide, with a prevalence rate of 11.3%. It was estimated that there will be 151.5 million cases of diabetes mellitus worldwide in 2045, up from 88 million cases in 2019 and 90.2 million cases in 2021. About 46.2 million persons (51.3%) have undiagnosed diabetes mellitus (3). Indonesia has the seventh-highest prevalence of diabetes mellitus in the world, after China, India, the USA, Brazil, Russia, and Mexico, and it is predicted that in 2045 it will hold the eighth-highest position with a prevalence of 16,6 million people have diabetes (1,3). According to data from Basic Health Research, 69.6% of people with diabetes in Indonesia were undiagnosed, while the prevalence of the disease was 6.9% in 2013 and 8.5% in 2018 (4). According to estimates, 14.1 million people in Indonesia will have diabetes by 2030. North Sumatra has the 13th highest number of diabetes mellitus cases in Indonesia, with a prevalence of 2.3% (5).

To determine a person's risk of developing type 2 diabetes in the future, screening for the disease is necessary. An oral glucose tolerance test is one tool that the general population can use to screen for diabetes (6). In a prior study, the Finnish Diabetes Risk Score (FINDRISC) was used to identify type 2 diabetics who had not yet been diagnosed (7). This tool has been accepted for diabetes prevention in primary healthcare because it is straightforward and simple to use in identifying people at elevated risk for type 2 diabetes in many countries over the following ten years (8–15). In Brazil, these tools were also modified for awareness campaigns (16). In order to identify people who are at risk of acquiring type 2 diabetes, the FINDRISC questionnaire and an oral glucose tolerance test are being used in this study as screening tools.

2. OBJECTIVE

This study aimed to identify people at risk for undiagnosed diabetes mellitus using the Finnish Diabetes Risk Score (FINDRISC) and oral glucose tolerance test (OGTT).

3. MATERIAL AND METHODS

This observational study with a cross-sectional design was conducted in 6 six subdistricts in Medan City from July 14, 2020, to October 21, 2020. A Sample of 300 respondents aged 30 to 75 years were selected from six sub-districts using purposive sampling.

The participant's data on the FINDRISC questionnaire were gathered through interviews, including socio-demographic, behavioural, and made anthropometric measurements (weight, height, and waist circumferences) by a researcher after obtaining informed consent and ethical approval from the Faculty of Medicine, Universitas Sumatera Utara (Reference code number 129/ KEP/ USU 2020). Height was measured using a Microtoise GEA stadiometer, and body weight was assessed using a digital scale to calculate body mass index.

The questionnaire consists of 8 items, including age (45 years 0 points; 45-54 years 2 points; 55-64 years 3 points; 65 years 4 points), body mass index (25 kg/m2 0 points; 25-30 kg/m2 1 point; 30 kg/m2 3 points), waist circumference (male: 94 cm and female: 80 cm 0 points; male: 94-102 cm and female: >88 cm 3 points; male: >102 cm and female: >88 cm 4 points), Physical activity for at least 30 minutes per day (yes 0 points; and no 2 points); daily consumption of fruits and vegetables (every day 0 points; not every day 1 point); history of antihypertensive drug treatment (no 0 points and yes 2 points); High blood sugar history (if the respondent had ever been discovered to have high blood glucose level in a health examination during an illness or during pregnancy (no 0 points and yes 5 points)) as well as a family history of Type 2 diabetes melitus, score based on relatives who have been diagnosed with the disease (no 0 points; yes: grandparent, relative, uncle, aunt 3 points; yes: parents, siblings, son, daughter 5 points). Respondents at low risk scored under 7, those at moderate risk scored between 7 and 14, and high risk scored over 20. All respondents also underwent a fasting oral glucose tolerance test. The results of the fasting oral glucose tolerance test were classified as normal when the fasting blood glucose level was less than 100 mg/dl, prediabetes when it was between 100 and 125 mg/dl, and diabetes when it was 126 mg/dl or higher.

The Statistical Package for Social Science (Release 24.0 software, SPSS, Inc., Chicago, Illinois, USA) was used to analyze the data. Frequency distributions, mean, and standard deviation are used to present the descriptive analysis of the variables and chi-square analysis to find possible diabetes mellitus risk factors.

4. RESULTS

A total of 300 people take part in this study. 8.3% of them were men, and 91.7% of them were women. According to Table 1, among all respondents, the mean age was 49.76 (7.66) years, the mean body weight was 65.58 (12.58 kg), the mean height was 152.68 (8.38 cm), the mean blood sugar level was 103.29 (48.33 mg/dl), and the mean of FINDRISC score was 8.82 (4.64).

On average, out of 300 respondents, 48.3% were between the ages of 45 and 54, 37% had a body mass index between 25 and 30 kg/m2, 70% had central obesity, 80.7% consumed fruit and vegetables daily, 76.0% engaged in physical activity, 50.0% had taken antihypertensive medication in the past, 90.3% had no history of high blood sugar, and 77.7% had no relatives with diabetes (Table 2).

The results of this study (Table 3) showed that 11.3% of respondents had a high risk, 55.0% had a moderate risk, and 33.7% had a low risk of developing type 2 diabetes.

Variable	Frequency	Percentage (%)
Sex		
Female	275	91.7
Male	25	8.3
Age	49.76*	7.66
Body weight	65.58*	12.58
Height	152.68*	8.38
Blood glucose	103.29*	48.33
FINDRISC score	8.82*	4.64

Table 1. Characteristic of respondents

Variable	Frequency	Percentage (%)
Age (years)		
< 45	81	27.0
45-54	145	48.3
55-64	62	20.7
>64	12	4.0
BMI (kg/m$^{2)}$		
< 25	92	30.7
25-30	111	37.0
>30	97	32.3
Waist circumference (cm)		
M :<94 F: < 80	90	30.0
M: 94-102 F:80-88	82	27.4
M:> 102 F : >88	128	42.6
Physical activity		
Yes	228	76.0
No	72	24.0
Vegetable and Fruits Consumption		
Daily	242	80.7
No daily	58	19.3
Hypertension		
With medication	150	50.0
Without medication	150	50.0
History of hyperglycaemia		
Yes	29	9.7
No	271	90.3
Family History with Diabetes mellitus		
No	233	77.7
Yes, grand parent	11	3.7
Yes, parents	56	18.7

Table 2. Distribution of components of the FINDRISC Score in 300 respondents

Risk Diabetes category	Frequency	Percentage (%)
Low risk	101	33.7
Moderate risk	165	55.0
High risk	34	11.3

Table 3. Risk Diabetes Category based on FINDRISC Score

Results	Frequency	Percentage (%)
Normal	210	70.0
Prediabetes	56	18.7
Diabetes	34	11.3

Table 4. Oral Glucose Tolerance Test Results

In the oral glucose tolerance test, 210 respondents (70.0%) had normal blood glucose levels, 56 respondents (18.7%) had prediabetes (blood glucose levels between 100 and 125 mg/dl), and 34 respondents (11.3%) had diabetes (blood glucose levels 126 mg/dl or higher) as presented in Table 4.

As much 39 (48.1%) of respondents under 45 had a low chance of getting type 2 diabetes mellitus in the ten years to come, while the ages of 54 and 64 and more than 64 had a moderate risk (p 0.005). In comparison, 23 (23.7%) of respondents with a body mass index > 30 kg/m2 had a high risk, whereas 56 (60.9%) of respondents with a body mass index 25 kg/m2 had a low risk (p 0.005). The low risk was found in 86 (73.3%) of respondents who had no central obesity, 142 (67.6%) of respondents with central obesity had a moderate risk, and 33 (15.7%) of respondents had a high risk (p<0.005) as much 85 (37.3%) of respondents who reported engaging in physical exercise had low risk, compared to 40 (55.6%) and 16 (22.2%) of those who reported engaging in no physical activity, who had a moderate risk, and having a high risk (p=0.005). A moderate risk was identified in 30 (51.7%) of respondents who did not eat vegetables and fruits every day, a high risk was discovered in 14 (24.1%) of respondents, and a low risk was found in 87 (81.5%) of respondents who did(p< 0.005). As many as 18 (12.0%) of respondents receiving therapy for hypertension had a low risk for diabetes. In comparison, 60 (40.0%) of respondents not receiving treatment for hypertension had a moderate risk, and 7 (4.7%) of respondents had a high risk (p 0.005). As many as 10 (37.3%) of the respondents without a history of hyperglycemia had a low risk, while

Variable	Number (%) Respondents at Risk of Developing Diabetes			p
	Low Risk	Moderate Risk	High Risk	
Age (years)				
< 45	39 (48.1)	36 (44.4)	6 (7.4)	
45-54	51 (35.2)	71 (54.5)	15 (10.3)	0.001
54-64	8 (12.9)	42 (67.7)	12 (19.4)	
>64	3 (25.0)	8 (66.7)	1 (8.3)	
BMI (kg/m2)				
< 25	56 (60.9)	32 (34.8)	4 (4.3)	0.000
25-30	41 (36.9)	63 (56.8)	7 (6.3)	
>30	4 (4.1)	70 (72.2)	23 (23.7)	
Central obesity				
Yes	35 (16.7)	142 (67.6)	33 (15.7)	0.000
No	86 (73.3)	23 (25.6)	1(1.1)	
Physical Activity				
Yes	85 (37.3)	125 (54.8)	18 (7.9)	0.001
No	16 (22.2)	40 (55.6)	16 (22.2)	
Vegetables and fruits consumption	87 (81.5)	135 (55.8)	20 (8.3)	0.002
Daily	14 (24.1)	30 (51.7)	14 (24.1)	
Non daily				
Hypertension				
Without medication	83 (55.3)	60 (40.0)	7 (4.7)	0.001
With medication	18 (12.0)	105 (70.0)	27 (18.0)	
History of hyperglycaemia				
Yes	0 (0.0)	7 (24.1)	22 (75.9)	0000
No	10 (37.3)	158 (58.3)	12 (4.4)	
Family History with Diabetes mellitus	2 (3.0)	42 (62.7)	23 (34.3)	0.000
Yes	99 (42.5)	123 (52.8)	11 (4.7)	
No				

Table 5. The Risk of Developing Type 2 Diabetes Mellitus According to The FINDRISC Score Components

Risk Category	Number (%) Respondents with oral Glucose Tolerance Test			p
	Normal	Prediabetes	Diabetes	
Low risk	87(86.1)	9 (8.9)	5 (5.0)	
Moderate risk	110 (66.7)	35(21.2)	20 (12.1)	0.000
High risk	13 (38.2)	12 (35.3)	9(26.5)	

Table 6. The Risk Category of Developing Type 2 Diabetes Mellitus and Oral Glucose Tolerance Test

22 (75.9%) of the respondents with a history of hyperglycemia had a high risk ($p < 0.005$). Twenty-three respondents (34.3%) who had a family history of diabetes had a high risk, while 99 (42.5%) respondents with no family history of diabetes had a low risk ($p < 0.005$) (Table 5).

Respondents with low risk received scores under 7, those with medium risk had scores between 7 and 14, while those with high risk received scores over 20. Oral glucose tolerance tests were performed on all respondents while they were fasting. When the blood glucose level was less than 100 mg/dl, the fasting oral glucose tolerance test results were classed as normal, prediabetes when they were between 100 and 125 mg/dl, and diabetes when they were 126 mg/dl or higher.

In this study, there were 300 participants. Of those, 87 (86.1%) had a low risk of type 2 diabetes and had normal blood sugar levels, while 21 (61.8%) had a moderate and high risk of type 2 diabetes and had high blood glucose levels ($p=0.005$) (Table 6).

5. DISCUSSION

The FINDRISC risk score is accepted as a screening tool to identify type 2 diabetes mellitus at its early stages. Of the 300 participants in this study, we discovered that 33.7% had low risk, 55.0% had moderate risk, and 11.3% had a high risk of developing type 2 diabetes mellitus in the next ten years. Among 32772 individuals in Italian, 22.1% had low risk, 43.3% had slightly raised risk, 19.3% had moderate risk, 13.9% had high risk, and 1.4% had extremely high risk (17). In a subsequent study, the prevalence of diabetes has increased and now stands at 8.65% in Hungary (18). 5.2% of students and 1.8% of students in a Middle Eastern had moderate diabetes risk, respectively (19). The study of the Columbian population, undiagnosed diabetes was found to be 2.59% prevalent and prediabetic responders had a 7.5 per 100 person-year incidence rate of the disease (20). A study in large-scale European population showed that FINDRISC is a simple and high-performance tool to predict the risk of developing diabetes (21). People with lower FINDRISC scores will implement preventive intervention.

In our study, a percentage of participants aged 54 to 64 had a high risk and a moderate risk of acquiring type 2 diabetes mellitus. The findings indicated that the prevalence of diabetes mellitus rises with age. In this study, there was a moderate risk of diabetes in 67.6% of respondents with central obesity and 72.2% with Basal metabolic indices > 30 kg/m2. Diabetes risk increases with both central obesity and Basal metabolic indices. Insulin receptor sensitivity and insulin receptor number are both decreased in fat cells. As a result, insulin resistance will rise (22). As many as 85 (37.3%) of respondents who engaged in the physical exercise had a low chance of getting diabetes. In comparison, 40 (55.6%) of respondents who did not engage in physical activity had a high chance of getting diabetes. Exercise improves insulin sensitivity and lowers the chance of impaired glucose tolerance testing (22).

As many as 87 (81.5%) respondents who included vegetables and fruits in their daily diet had a low risk of getting diabetes. In contrast, 30 (51.7%%) respondents who did not include vegetables and fruits in their daily diet had moderate risk. Consuming fruits and vegetables has been linked to reduced mortality and incidence of several health problems, including obesity and hypertension. Furthermore, due to their high fibre, low glycemic load, low energy density, and high vitamin content, consuming fruits and vegetables has been linked to a lower risk of type 2 diabetes (23).

In this study, 60 (40.0%) of the unmedicated hypertensive study participants had a moderate risk, and 7 (4.7%) had a high risk. Up to 22 (74.9%), individuals with a history of hyperglycemia were at high risk of type 2 diabetes. In addition, 23 (34.3%) of the respondents had a significant risk of acquiring diabetes due to a family history of the disease. Parental history of hypertension and type 2 diabetes are related to dyslipidemia, chronic hypertension, and obesity (24).

As a screening tool, the oral glucose tolerance test (OGTT) is more effective at identifying the presence of diabetes mellitus (25). In this study, 61.8% of people at high risk of type 2 diabetes based on FINDRISC score had high blood sugar levels (greater than 100 mg/dl), compared to 86.1% of participants at low risk of type 2 diabetes mellitus. This research demonstrated that the FINDRISC score might be a screening tool for identifying diabetes mellitus. Therefore, screening techniques for early detection in high-risk adult groups in the direction of early intervention include the FINDRISC questionnaire and the oral glucose tolerance test.

6. CONCLUSION

The FINDRISC questionnaire and oral glucose tolerance test could be used as affordable approaches to target the high-risk adult population, and they were further encouraged to have an early intervention by adopting healthy lifestyles.

- **Acknowledgments**: We thank the Medan Health Office for granting permission for this research, the Rector of Universitas Sumatera Utara for his assistance, and all those who participated in the study. .
- **Informed Consent Statement**: All participants signed informed consent about the subject of the study..
- **Author's contribution**: FAS, A, and TM contributed to the conception and design. FAS and A substantially contributed to data acquisition, analysis, and interpretation. FAS and IAL participated in article preparation for drafting. RB and UZ revised it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. ata Availability Statement: data analyzed in this study can be obtained by direct contact with the author.
- **Conflict of inerest**: The authors declare no conflict of interest.
- **Financial support and sponsorship**: We appreciate the financial assistance for this research from the Indonesian Ministry of Research and Higher Education.

REFERENCES

1. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract. 2022;183:109119.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. Diabetes Res Clin Pract. 2019;157:107843.
3. Ogurtsova K, Guariguata L, Barengo NC, Ruiz PL-D, Sacre JW, Karuranga S, et al. IDF diabetes Atlas: Global estimates of undiagnosed diabetes in adults for 2021. Diabetes Res Clin Pract. 2022;183:109118.
4. Nugroho PS, Tianingrum NA, Sunarti S, Rachman A, Fahrurodzi DS, Amiruddin R. Predictor Risk of Diabetes Mellitus in Indonesia, based on National Health Survey. Malaysian J Med Heal Sci. 2020;16(1).
5. Kementerian Kesehatan Republik Indonesia. Laporan Nasional Riskesdas 2018. Badan Penelitian dan Pengembangan Kesehatan. Jakarta; 2018.
6. Gruss SM, Nhim K, Gregg E, Bell M, Luman E, Albright A. Public health approaches to type 2 diabetes prevention: the US National Diabetes Prevention Program and beyond. Curr Diab Rep. 2019;19:1–11.
7. Saleem SM, Khan SMS, Jan SS. Finnish diabetic risk score: a tool for predicting risk of undiagnosed type 2 diabetes mellitus. Ann Med Health Sci Res. 2017;
8. Savić S, Stanivuković S, Lakić B. Ten-year risk assessment for type 2 diabetes mellitus using the Finnish Diabetes Risk Score in family medicine. Med Glas. 2020;17(2):517–22.
9. Omech B, Mwita JC, Tshikuka J-G, Tsima B, Nkomazna O, Amone-P'Olak K. Validity of the Finnish Diabetes Risk Score for detecting undiagnosed type 2 diabetes among general medical outpatients in Botswana. J Diabetes Res. 2016;2016.
10. Winkler G, Hídvégi T, Vándorfi G, Balogh S, Jermendy G. Prevalence of undiagnosed abnormal glucose tolerance in adult patients cared for by general practitioners in Hungary. Results of a risk-stratified screening based on FINDRISC questionnaire. Med Sci Monit Int Med J Exp Clin Res. 2013;19:67.
11. Janghorbani M, Adineh H, Amini M. Evaluation of the Finnish Diabetes Risk Score (FINDRISC) as a screening tool for the metabolic syndrome. Rev Diabet Stud RDS. 2013;10(4):283.
12. Wang J, Stancakova A, Kuusisto J, Laakso M. Identification of undiagnosed type 2 diabetic individuals by the finnish diabetes risk score and biochemical and genetic markers: a population-based study of 7232 Finnish men. J Clin Endocrinol Metab. 2010;95(8):3858–62.
13. Lindstrom J, Tuomilehto J. The diabetes risk score: a practical tool to predict type 2 diabetes risk. Diabetes Care. 2003;26(3):725–31.
14. Meijnikman AS, De Block CEM, Verrijken A, Mertens I, Corthouts B, Van Gaal LF. Screening for type 2 diabetes mellitus in overweight and obese subjects made easy by the FINDRISC score. J Diabetes Complications. 2016;30(6):1043–9.
15. Štiglic G, Fijačko N, Stožer A, Sheikh A, Pajnkihar M. Validation of the Finnish Diabetes Risk Score (FINDRISC) questionnaire for undiagnosed type 2 diabetes screening in the Slovenian working population. Diabetes Res Clin Pract. 2016;120:194–7.
16. Correr CJ, Coura-Vital W, Frade JCQP, Nascimento RCRM, Nascimento LG, Pinheiro EB, et al. Prevalence of people at risk of developing type 2 diabetes mellitus and the involvement of community pharmacies in a national screening campaign: a pioneer action in Brazil. Diabetol Metab Syndr. 2020;12:1–11.
17. Milovanovic S, Silenzi A, Kheiraoui F, Ventriglia G, Boccia S, Poscia A. Detecting persons at risk for diabetes mellitus type 2 using FINDRISC: results from a community pharmacy-based study. Eur J Public Health. 2018;28(6):1127–32.
18. Jermendy G, Nádas J, Szigethy E, Széles G, Nagy A, Hídvégi T, et al. Prevalence Rate of Diabetes Mellitus and Impaired Fasting Glycemia in Hungary: Crosssectional Study on Nationally Representative Sample of People Aged 20-69 Years. Croat Med J. 2010;51(2):151–6.
19. Al-Shudifat A-E, Al-Shdaifat A, Al-Abdouh AA, Aburoman MI, Otoum SM, Sweedan AG, et al. Diabetes risk score in a young student population in Jordan: a cross-sectional study. J Diabetes Res. 2017;2017.
20. Gomez-Arbelaez D, Alvarado-Jurado L, Ayala-Castillo M, Forero-Naranjo L, Camacho PA, Lopez-Jaramillo P. Evaluation of the Finnish Diabetes Risk Score to predict type 2 diabetes mellitus in a Colombian population: A longitudinal observational study. World J Diabetes. 2015;6(17):1337.
21. Mavrogianni C, Lambrinou C-P, Androutsos O, Lindström J, Kivelä J, Cardon G, et al. Evaluation of the Finnish Diabetes Risk Score as a screening tool for undiagnosed type 2 diabetes and dysglycaemia among early middle-aged adults in a large-scale European cohort. The Feel4Diabetes-study. Diabetes Res Clin Pract. 2019;150:99–110.
22. Wei J, Liu X, Xue H, Wang Y, Shi Z. Comparisons of visceral adiposity index, body shape index, body mass index and waist circumference and their associations with diabetes mellitus in adults. Nutrients. 2019;11(7):1580.
23. Halvorsen RE, Elvestad M, Molin M, Aune D. Fruit and vegetable consumption and the risk of type 2 diabetes: a systematic review and dose–response meta-analysis of prospective studies. BMJ Nutr Prev Heal. 2021;4(2):519.
24. Alharithy MK, Alobaylan MM, Alsugair ZO, Alswat KA. Impact of family history of diabetes on diabetes control and complications. Endocr Pract. 2018;24(9):773–9.
25. Pareek M, Bhatt DL, Nielsen ML, Jagannathan R, Eriksson K-F, Nilsson PM, et al. Enhanced predictive capability of a 1-hour oral glucose tolerance test: a prospective population-based cohort study. Diabetes Care. 2018;41(1):171–7.