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ORIGINAL ARTICLE

Analysis of the risk factors associated with Diabetes Mellitus in the adult population attended at the "Tulcán Sur" health center

Análisis de los factores de riesgo vinculados con la Diabetes Mellitus en la población adulta atendida en el centro de salud "Tulcán Sur"

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ABSTRACT

Introduction: Diabetes Mellitus type 2 is a growing global concern, with a steadily increasing prevalence and possible pandemic dimensions. Many people with this disease live undiagnosed, it affects their quality of life and increases health care costs.
Objective: to evaluate the risk of having diabetes mellitus (DM) type 2 in adults attending the Centro de Salud Tulcán Sur, Ambato, Ecuador.
Methods: observational, descriptive, cross-sectional, descriptive study carried out on patients attending the "Tulcán Sur" Health Center. A total of 1,835 adults were considered in the first quarter of 2023. The finite population formula was applied with an error percentage of 5 % and a confidence level of 95 %, resulting in a sample of 318.
Results: 61 % of the men and 59 % of the women have ever been diagnosed with high blood glucose levels. Forty-one percent of the male population surveyed reported that their grandfathers, uncles or first cousins (but not fathers, brothers or sons) have had a diagnosis of diabetes. Thirty-six percent of men have a high risk level for developing diabetes in the next 10 years, while 27 % have a slightly elevated risk level.
Conclusions: the application of the FINDRISC test can play a key role in the formulation of early diagnosis programs for diabetes and prediabetes, as well as in the implementation of promotion and prevention strategies.

Keywords: Diabetes Mellitus; Population; Adult; Disease; Diagnosis.

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RESUMEN

Introducción: la Diabetes Mellitus tipo 2 es una preocupación global creciente, con una prevalencia en aumento constante y posibles dimensiones pandémicas. Muchas personas con esta enfermedad viven sin ser diagnosticadas, afecta su calidad de vida y aumenta los costos de la atención médica.
Objetivo: evaluar el riesgo de debutar con Diabetes Mellitus (DM) tipo 2 en adultos que asisten al Centro de Salud Tulcán Sur, Ambato, Ecuador.
Métodos: estudio observacional, descriptivo de corte transversal realizado a pacientes que acuden al Centro de Salud "Tulcán Sur". Se tomaron en cuenta 1.835 adultos en el primer trimestre del 2023. Se aplicó la fórmula de población finita con un porcentaje de error del 5 % y un nivel de confianza del 95 % obteniendo como resultado una muestra de 318.
Resultados: al 61 % de los hombres y al 59 % de mujeres, alguna vez le han detectado niveles altos de glucosa en sangre. El 41 % de la población de hombres encuestados manifiestan que sus abuelos, tíos o primos hermanos (pero no padres, hermanos o hijos) han tenido un diagnóstico de diabetes. El 36 % de los hombres tienen un nivel de riesgo alto para desarrollar diabetes en los próximos 10 años, mientras que un 27 % tiene un nivel de riesgo ligeramente elevado.
Conclusiones: la aplicación de la prueba de FINDRISC puede desempeñar un papel fundamental en la formulación de programas de diagnóstico temprano de diabetes y prediabetes, así como en la implementación de estrategias de promoción y prevención.

Palabras clave: Diabetes Mellitus; Población Adulta; Enfermedad; Diagnóstico.

INTRODUCTION

The World Health Organization (WHO) mentions, "In 2014, 8,5 % of people over 18 years of age had diabetes. In 2019, this condition was the direct cause of 1,5 million deaths and, of all diabetes deaths, 48 % were younger than 70 years of age. Between 2000 and 2019, age-standardized diabetes mortality rates increased by 3 %. In low- and middle-income countries, the diabetes mortality rate increased by 13 %. In contrast, between 2000 and 2019, the probability of dying between the ages of 30 and 70 from one of the four major noncommunicable diseases (cardiovascular disease, cancer, chronic respiratory disease, or diabetes) decreased by 22 % worldwide.[1]

Biojó Gaspar K.,[2] mentions that: "8,5 % of Ecuadorians between 20 and 79 years of age suffer from type 2 diabetes, according to statistics registered by the Ministry of Public Health (MSP), although these figures seem to be far from reality since not all are treated in the public health system but by private doctors. On the other hand, not all people know that they suffer from this condition because they have not had a clinical diagnosis. According to some data, in Ecuador there are about 500 thousand people suffering from diabetes, but only about 100 thousand receive adequate treatment".

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The magazine SATHIRI, Sembrador, mentions: "Within the epidemiological profile of the province of Carchi-Ecuador diabetes is among the top ten causes of morbidity and mortality, despite the great efforts made by the Ministry of Public Health through promotion and prevention measures, this situation has not changed and there are individual and collective beliefs that do not allow them to adhere to the treatment of diabetes".[3]

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood glycemia. Hyperglycemia, or increased blood glycemia, is a common effect of uncontrolled diabetes and, over time, leads to serious damage to many of the body's systems, especially the nerves and blood vessels.[1]

Diabetes is a chronic metabolic disease characterized by elevated blood glucose (or blood sugar) levels, which over time leads to serious damage to the heart, blood vessels, eyes, kidneys and nerves. The most common is type 2 DM, usually in adults, which occurs when the body becomes insulin resistant or does not produce enough insulin. Type 1 DM, once known as juvenile diabetes or insulin-dependent diabetes, is a chronic condition in which the pancreas produces little or no insulin on its own. Symptoms of Diabetes Mellitus include: polydipsia, polyuria, blurred vision, excessive tiredness, polyphagia, fatigue, nocturia, unusual weight loss and others.

Mature adults are more likely to develop type 2 diabetes, because as they get older, they are not physically active and develop overweight or obesity. Excess weight causes insulin resistance and is common in people with type 2 DM. The location of body fat is also important. Excess belly fat is linked to insulin resistance, type 2 diabetes, and heart and blood vessel disease.[4]

Diabetes Mellitus type 2 usually appears in adulthood, it is the most frequent type constituting approximately 90 % of diabetic patients. It is characterized by a complex pathophysiological mechanism, whose main feature is the relative deficit of insulin production and a deficient peripheral utilization of glucose by the tissues (insulin resistance), meaning that the receptors of the cells responsible for facilitating the entry of insulin into the cell itself are damaged. It often develops in the adult stages of life, and is frequently associated with obesity.[4]

Diabetes is a metabolic disease highly associated with increased cardiovascular risk and with progressively increasing prevalence worldwide. The risk of developing cardiovascular disease (CVD) increases two to four times in patients with diabetes mellitus and 75% die from coronary artery disease (CAD) and 25% from cerebral or peripheral vascular disease.[5]

Among the risk factors that are related to the development of type 2 Diabetes Mellitus are described clinical factors such as: high fat intake, particularly saturated (more than 30% of caloric intake/day), high alcohol intake, sedentary lifestyle, high-risk ethnic groups (African Americans, Latinos and Afro-Asians), age over 45 years or 30 years with a BMI greater than 25 kg/m2, family history of DM in first-degree relatives, visceral obesity, arterial hypertension, polycystic ovarian syndrome (PCOS), gestational diabetes, mothers of child weighing more than 4 kg at birth, male hypogonadism.

Metabolic factors: impaired fasting blood glucose (IFG), impaired glucose tolerance (IGT), dyslipidemia, particularly triglycerides greater than 150 mg/dL and HDL-C less than 35 mg/dL(2). Also described are: acanthosis nigricans, macrosomia, hyperandrogenism, early adrenarche, early menopause, multiparity, low birth weight, history of polyhydramnios, stillbirth or newborn died within the first week, gout, hepatic steatosis.[5]

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It is important to determine which of the aforementioned factors can be intervened with promotion and prevention measures aimed at reducing the incidence of this pathology: Overweight and obesity represent the most important factors for the development of DM. The prevalence of obesity is progressively increasing worldwide and especially in Latin America. Any intervention aimed at reducing it will have a direct impact on a lower frequency of the disease. It has been determined that abdominal circumference reflects the visceral (abdominal) fat content, so it may be a better indicator than BMI for the risk of developing DM. It is very important to note that it is the distribution of fat rather than the total fat content that contributes to the development of diabetes.[5]

Obesity is highly correlated with the development of diabetes, approximately two-thirds of patients with type 2 diabetes were obese when diagnosed with the disease and more than half of obese people will develop diabetes. The risk of developing this metabolic disorder increases with excess fat, especially when adiposity accumulates in the abdomen.[6]

Obesity is a risk factor of great importance in relation to the development of DM2, the commitment in its development is closely related to the increase in BMI; said risk for DM2 is directly proportional to excess weight: being the most important risk factor for Diabetes Mellitus type 2 the BMI greater or equal to 25 kg/m2 in adults or to the 85th percentile in children; and in abdominal obesity, the value of abdominal perimeter is greater or equal to 88 cm in women and 102 cm in men. Therefore, any intervention aimed at reducing it will have a direct impact on a lower frequency of the disease.[7]

It has been determined that abdominal circumference reflects the visceral (abdominal) fat content, so it may be a better indicator than BMI for the risk of developing DM2. It is very important to note that it is the distribution of fat rather than the total fat content that contributes to the development of diabetes.[8]

Obesity is a risk factor of great importance in relation to the development of DM, the compromise in its development is closely related to the increase in BMI. It is estimated that 80% of patients at the time of diagnosis of DM are obese. The waist-to-hip ratio is used as an indicator of fat distribution, where high values suggest a central distribution pattern. A waist circumference of 80 cm for women and 94 cm for men.[8]

The WHO refers that obesity is classified in relation to fat phenotype as follows: type I (general), uniform excess body fat. Type II (android), predominance of adipose tissue in the upper half of the body (neck, shoulders, upper abdomen). Type III (visceral), excess fat in viscera and abdomen and type IV (gynecoid), fat in gluteus femoris. Type II in both men and women is clearly associated with an increased risk of developing DM.[8]

Insulin helps blood sugar enter the cells, but nicotine changes the cells so that they do not respond to insulin, and this causes hyperglycemia. The chemicals in cigarettes damage the body's cells and cause inflammation. This also causes the cells to stop responding to insulin. People who smoke have a higher risk of having abdominal fat, which increases the risk of developing DM 2, even if they are not overweight. In general, if you smoke, your chances of developing type 2 diabetes are 30-40 % higher than those of people who do not smoke. The more you smoke, the greater your risk. he more you smoke, the greater your risk. Excessive alcohol consumption can cause inflammation in the pancreas and limit its ability to produce enough insulin.[1]

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It is well known that physical inactivity is an independent predictor of DM in both men and women, so that habitually active subjects have a lower prevalence of diabetes. It is advisable to encourage the general population to take walks of at least 30 minutes three to five times a week.[5]

Sedentary lifestyle is a risk factor that alarmingly increases the development of this disease, insulin resistance is implicated, which is also linked to the lack of physical exercise, the utilization of glucose in the muscle is given by transporters such as glutamate, when there is a decrease of this transporter, it will denote affectation in the entry and metabolism of glucose by the muscle.[6]

It is well known that physical inactivity is an independent predictor of DM 2, both in men and women, so that subjects who are habitually active have a lower prevalence of diabetes; therefore, there is an association between little or no physical activity (less than 150 minutes per week), with the risk of developing DM.[7]

Physical inactivity is a risk factor for DM, the WHO recommends the practice of regular physical activity of moderate intensity at least 30 minutes every day during the week, in patients with DM physical activity reduces between 20 and 60 % the dose-response relationship to treatment with insulin and prevents the appearance of overweight, obesity, both predisposing risk factors for the development of diabetes DM.[8]

It is estimated that currently 60 % of the world's population does not do enough physical activity, adults in developed countries tend to be inactive. Different studies have shown that as little as 30 minutes of moderate exercise per day, five days a week, is sufficient to promote good health and reduce the likelihood of developing DM.[8]

High caloric intake, low dietary fiber intake, carbohydrate overload and predominance of saturated fat intake over polyunsaturated fats may predispose to DM. In our country it is very common to consume simple carbohydrates combined with saturated fats, typical of the popular diet that frequently includes: fried foods, flour, high-fat meats, dairy products rich in cholesterol and saturated fats, low intake of fiber, fruits and vegetables.[5]

Both prehypertensive and hypertensive patients have a higher risk of developing DM, attributed to a greater possibility of having insulin resistance. In the Women's Health Study, in more than 38,000 women health professionals followed for 10 years, a proportional and continuous relationship of basal blood pressure or its progression with the risk of developing DM was revealed. More recently, in a study of 27,806 hypertensives (13,137 men and 14,669 women) followed for 13,3 years, 1,532 new cases of DM occurred and revealed that (2): High normal blood pressure (130-139/85-89 mmHg) was associated with a 1,2-fold risk of developing diabetes. In those with grade 1 HT (140-159/90-99 mmHg), the risk was 1.8 times. In those receiving antihypertensive treatment or with grade 2 HTN (more than 160/100 mmHg), the risk was increased by 2,2 times.[5]

In arterial hypertension, there is insulin resistance, predominantly in skeletal muscle, which mainly involves the conversion of glucose to glycogen, independent of blood flow.

DM is definitely accompanied by a strong genetic predisposition. Those individuals with a diabetic parent have a 40 % chance of developing the disease, if both parents are diabetic the risk rises to 70 %. There is a 70 % concordance in identical twins. So far, more than 20 genes have been identified, among millions of potential genetic changes, associated with DM and most of them are linked to beta cell dysfunction. In the face of genetic susceptibility, the

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environment is crucial in the development of DM and the connection between genes and environment is abdominal fat. As we advance in age the risk of DM increases, however, recent years have seen a decrease in the age of onset in young adults and adolescents. In general, the prevalence of DM is higher in women than in men.

Women with a history of gestational diabetes have an increased risk of DM, decades after their pregnancy, therefore, they should be adequately controlled to prevent the onset of the disease. In PCOS with frank insulin resistance, associated with obesity, there is an increased risk of developing DM and it is necessary to implement measures to reduce insulin resistance.[5]

The FINDRISC scale is a screening tool initially designed to assess the individual risk of developing DM2 within 10 years. The main variables related to the risk of developing DM in this scale are: age, BMI, waist circumference, arterial hypertension with pharmacological treatment and personal history of high blood glucose. It is a test with eight questions, in which each answer is assigned a score, with the final score varying between zero and 26.[9]

The application of the FINDRISC scale is an easy-to-use, reliable, inexpensive and quick screening tool applicable to large population groups, thus allowing the early identification of people at high risk of developing diabetes, allowing the implementation of preventive educational measures that have proven their effectiveness and make it possible to modify and even reverse this high-risk state and delay the onset of the disease, In addition, the identification of patients who suffer from this pathology and have not yet been diagnosed, it is not justified to apply laboratory tests as a screening method in the general population, but only in the population at risk.

METHODS

Observational, descriptive, cross-sectional, cross-sectional study carried out on patients attending Tulcán Sur Health Center. For this research, 1,835 adults were taken into account in the first quarter of 2023. To determine the sample, the finite population formula was applied with an error percentage of 5 % and a confidence level of 95 %, resulting in a sample of 318. Adults who did not give their consent to participate or who had psychological or neurological diagnoses that made them unable to respond were excluded from the study.

The variables used were: age, sex, body mass index, abdominal perimeter, physical exercise, frequency of fruit, vegetable and vegetable consumption, indication of antihypertensive drugs, genetic predisposition, detection of irregular blood glucose values.

The FINDRISC scale was used: a screening instrument designed to assess the individual risk of developing DM2 within 10 years. The main variables related to the risk of developing DM in this scale are: age, BMI, waist circumference, arterial hypertension, pharmacological treatment and personal history of high blood glucose. It is a test with eight questions, in which each answer is assigned a score, with the final score varying between zero and 26.

The data obtained from the individual surveys were grouped and tabulated using the Microsoft Excel program, in absolute and relative frequencies. Anonymity was respected and the consent of the patients was taken into account, and the principles of bioethics framed in the Declaration of Helsinki were respected.

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RESULTS

Thirty-three percent corresponds to male patients aged 55-64 years and for this reason are considered more prone to develop diabetes mellitus, while 31% corresponds to people younger than 45 years without this risk. With respect to women, we found that 51 % correspond to people under 45 years of age without risk of developing DM, while 27 % represent people between 45 and 54 years of age, and 21 % are between 55 - 54 years with higher risk. (Table 1).

Table 1. Distribution of the sample according to age and sex.

Age		Male	%	Female		%
<45 years old	0 pts.	34	31	0 pts.	79	51
45-54 years old	2 pts.	27	24	2 pts.	42	27
55-64 years old	3 pts.	37	33	3 pts.	33	21
> 64 years old	4 pts.	13	12	4 pts.	53	1
Total		111	100		207	100

Source: Field research

83 % of the male patients studied have a Body Mass Index between 25-30 kg/m2, and 2 % >30 kg/m2. On the other hand, 52 % of the women studied have a Body Mass Index over 30 Kg/m2, while a percentage of 40 % have a BMI between 25 - 30 Kg/m2. Eighty-four percent of the men and 92 % of the women have an increased risk of developing type 2 DM secondary to excess weight (Table 2).

Table 2. Distribution of the sample according to sex and body mass index.

Age		Male	%	Female		%
<45 years old	0 pts.	34	31	0 pts.	79	51
45-54 years old	2 pts.	27	24	2 pts.	42	27
55-64 years old	3 pts.	37	33	3 pts.	33	21
> 64 years old	4 pts.	13	12	4 pts.	53	1
Total		111	100		207	100

Source: Field research

Fifty-seven percent of the men surveyed have an abdominal perimeter between 94 - 102 cm, while 29 % have an abdominal perimeter of more than 102 cm. Sixty-four percent of the female population has an abdominal perimeter of more than 88 cm, while 29% corresponds to between 80-88 cm. (Table 3).

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Table 3. Distribution of the sample according to sex and abdominal perimeter.

Male		No.	%	Female		No.	%
< 94 cm	0 pts.	16	14	0 pts.	<80 cm	15	7
94-102 cm	3 pts.	63	57	3 pts.	80-88 cm	59	29
> 102 cm	4 pts.	32	29	4 pts.	>80 cm	133	64
Total		111	100			207	100

Source: Field research

Seventy-five percent of the men in the study do not perform at least 30 minutes of physical activity and only 25 % of the people do perform physical activity. 61 % of the women do not engage in physical activity and only 39 % of the people do so (Table 4).

Table 4. Practice of physical exercise at least 30 minutes per day.

Male		No.	%	Female		%
Yes	0 pts.	28	25	0 pts.	81	39
No	2 pts.	83	75	2 pts.	126	61
Total		111	100		207	100

Source: Field research

There are 60 % of men and 53 % of women who do not consume fruits, vegetables and greens on a daily basis, while 40 % of men and 1 % claim to consume these foods on a daily basis. Forty-seven percent of women and 40 % of men consume fruits and vegetables daily (Table 5).

Table 5. Frequency of consumption of fruits, vegetables and greens.

Male		No.	%	Female	No.	%
Daily	0 pts.	44	40 %	0 pts.	98	47 %
Not daily	1 pts.	67	60 %	1 pts.	109	53 %
Total		111	100 %		207	100 %

Source: Field research

Fifty-two percent of the men mentioned that they had ever been prescribed medication for high blood pressure, while 48 % said they had not. Fifty-seven percent of the women surveyed stated that they had been prescribed medication for hypertension, while 43 % stated the opposite (Table 6).

Table 6. Indication of antihypertensive drugs.

Male		No.	%	Female	%
Yes	2 pts.	58	52 %	89	57 %
No	0 pts.	53	48 %	118	43 %
Total		111	100 %		

Source Field research

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Sixty-one percent of men and 59 % of women have ever been found to have high blood glucose levels. This data indicates that there is a high percentage of the population at risk of developing diabetes in the study population associated with metabolic disease and an alteration in glucose regulation.

Forty-one percent of the male population surveyed stated that their grandparents, uncles or first cousins (but not parents, siblings or children) had been diagnosed with diabetes, and 22 % stated that their parents, siblings or children had also suffered from this metabolic disease. As for women, 22 % of the population said that their grandparents, aunts, uncles or first cousins (but not parents, siblings or children) had been diagnosed with diabetes, and 39 % said that their parents, siblings or children had also suffered from this metabolic disease. Finally, 37 % of women and 39 % of women mentioned not having this link.

Thirty-six percent of the men have a high risk level for developing diabetes in the next 10 years, while 27 % have a slightly elevated risk level, and 24 % have a very high risk level.

Thirty-three percent of women have a high risk level for developing diabetes in the next 10 years, while 24 % have a moderate risk level, and 22 % have a slightly elevated risk level. Only 9 % of men and 15 % of women lack this risk. This may be influenced by a combination of lifestyle risk factors, prevalence of overweight and obesity, genetic predisposition, among other factors.

DISCUSSION

Diabetes Mellitus type 2 is a public health problem, whose worldwide prevalence is constantly increasing, even reaching pandemic proportions, which implies deterioration in the quality of life and high health care costs. Approximately 175 million people, one third of whom could account for up to 60 % of the undiagnosed population.[10]

Identifying individuals with undiagnosed DM2 can be an important first step in preventing and delaying the onset of complications.[8] However, applying universal screening is still controversial. The American Diabetes Association recommends starting screening for DM2 in adults aged 45 years or older, with a family history of diabetes, being overweight or obese, and having an additional risk factor for DM2.[11]

For the early detection of diabetes, it is recommended to use surveys or questionnaires that, when applied to the general population, discriminate people at higher risk of developing DM2. The FINDRISC questionnaire is recommended by the guidelines of the International Diabetes Federation 2 (IDF) as a suitable instrument for the identification of the population at risk of developing DM2.[3]

An interesting aspect of the FINDRISC questionnaire is that its validity as a screening instrument has been evaluated in both longitudinal and cross-sectional studies and that it consistently predicts the longitudinal probability of developing DM2 in the next ten years but is also able to predict the cross-sectional probability at the time of having DM2 or glucose metabolism disorders; that is, it indicates which individuals should undergo investigation with more invasive diagnostic tests, according to established clinical protocols.[12]

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Recently, a group of Latin American experts proposed the validation of the FINDRISC modified by waist cut-off points to assess abdominal obesity, as a recommended tool to perform TOTG and detect prediabetes and diabetes.[13] In Peru, it was found that 17,8 % of a population of 540 participants presented dysglycemia according to the FINDRISC scale, applying a score of 11, had a better discriminatory capacity with a sensitivity of 78,6 % and a specificity of 53 % as a screening for dysglycemia.[1]

In our study we found that 36 % of men have a high risk level for developing diabetes in the next 10 years, while 27 % have a slightly elevated risk level, and 24 % have a very high risk level. In the female population we found that 33% of women have a high risk level for developing diabetes, while 24 % have a moderate risk level, and 22 % have a slightly elevated risk level. Only 9 % of men and 15 % of women lack this risk. This may be influenced by a combination of lifestyle risk factors, prevalence of overweight and obesity, genetic predisposition, among other factors.

We also found that modifiable risk factors such as overweight, inadequate eating habits and sedentary lifestyle have a direct impact on the probability of developing DM. Thus, only 15 % of men and 8 % of women maintain their weight within normal parameters, 75 % of men and 61 % of women do not engage in physical activity and 60 % of men and 53 % of women do not consume the recommended fruits, vegetables and greens.

It is important to highlight that 37 % of the men and 39 % of the women mentioned not having a family history of first or second degree of consanguinity, which shows that in the city of Tulcan approximately 60 % of the population has a higher risk of developing diabetes associated with family history, one of the most important non-modifiable factors in the genesis of DM; hence the need to promote strategies that allow effective intervention in those modifiable factors with the active participation of the individual, family and society.

CONCLUSIONS

These findings highlight the importance of identifying and addressing modifiable risk factors to prevent or delay the onset of diabetes in mature adults. These factors may include weight control, diet, regular physical exercise, and stress management. The application of the FINDRISC test can play a pivotal role in the formulation of early diagnostic programs for diabetes and prediabetes, as well as in the implementation of promotion and prevention strategies. This will allow a more effective public health approach to reduce the incidence of diabetes and improve the quality of life of the adult population.

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