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Evaluation of sociodemographic and nutrition-related factors for type 2 diabetes risk: a sample from Turkiye

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Abstract

Background Considering the increasing prevalence of diabetes, we aimed to evaluate the risk of diabetes in our sample and its relationship with sociodemographic and nutrition-related factors.

Methods We conducted the study in Afyonkarahisar province of Turkiye with participants aged 18–65 years. In this face-to-face study, we used a questionnaire on sociodemographic information and general dietary habits and the FINDRISC screening tool. We also recorded participants' 24-hour food recall and assessed anthropometric measurements. We analyzed epidemiological data using binary logistic regression models to assess possible risk factors associated with the presence of diabetes risk.

Results Overall, this study included 3,990 participants, 50.03% ($n = 1996$) and 49.97% ($n = 1994$) of whom were males and females, respectively. The FINDRISC score was higher in females ($p = 0.001$), married individuals ($p < 0.001$), those with lower education levels ($p < 0.001$), and participants diagnosed with the disease by a doctor ($p < 0.001$). Additionally, having a body mass index (BMI) of > 30 kg/m^2 increased the risk by 7.33 folds compared with having a BMI of < 25 kg/m^2. Significant but very low correlation coefficients were found between main meal consumption, energy, lipid and iron intake and diabetes risk ($p < 0.001$).

Conclusions Our findings suggest that increasing age, increasing BMI, lower education level, and having a disease diagnosis can be significant risk factors for diabetes. However, more studies are needed to clarify risk factors, especially those related to nutrition.

Keywords Type 2 diabetes mellitus: FINDRISC, Sociodemographic factors, Nutrition, Obesity

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Introduction

Type 2 diabetes is a chronic condition that occurs when the body does not produce enough insulin or cannot use it effectively; it affects several individuals worldwide [1]. The International Diabetes Federation (IDF) Diabetes Atlas 2021 [2] has reported that 536.6 million individuals aged 20–79 years have diabetes in 2021, and by 2030, 643 million individuals are expected to be affected. Age is a significant determinant of diabetes. Moreover, it has been reported that the prevalence is 12.1% and 8.3% in urban and rural areas, respectively. The Turkish Epidemiology Survey of Diabetes, Hypertension, Obesity, and Endocrine Disease II (TURDEP-II) has stated that the increase in the prevalence of prediabetes and diabetes from 2010 to 2021 was 24.3% and 35.2%, respectively, in the general population. Furthermore, it was estimated that diabetes prevalence would reach 17.5% in 2030 and 19.2% in 2045 [3]. These findings have indicated that type 2 diabetes will become a growing problem considering its associated complications.

Diabetes development and occurrence depend on several modifiable and nonmodifiable risk factors. Family history, race and ethnicity, gestational diabetes, and age are the nonmodifiable risk factors, which are estimated to be the most common among middle-aged adults and those aged over 45 years. Smoking, suboptimal blood pressure, physical inactivity, high glycated hemoglobin values, suboptimal low-density lipoprotein cholesterol, and suboptimal body weight or body mass index (BMI) are the modifiable risk factors [4, 5]. The impact of nutrition is also undeniable, especially considering its contribution to the development of modifiable risk factors. Inadequate whole grain, fruit, vegetable, legume, and nut consumption and increased red and processed meat, sugar-sweetened beverage, and refined grain consumption are risk factors [6].

By controlling these risk factors, type 2 diabetes can be prevented or delayed [4]. Therefore, minimizing these risk factors and screening and diagnosing diabetes at an early stage are highly significant. The IDF has recommended that individuals at risk should be screened, and when the screening test is positive, a diagnostic test should be performed. Additionally, it has reported that validated tools including the Finnish Diabetes Risk Score (FINDRISC) can be useful for screening [7]. Similarly, the Society of Endocrinology and Metabolism of Turkiye [8] has suggested that validated tools such as the FINDRISC and American Diabetes Association risk score can be used for practical screening of at risk individuals. We here aimed to measure the prevalence of diabetes risk using a validated questionnaire (FINDRISC) and evaluate the association of this risk with sociodemographic characteristics and dietary habits. Accordingly, our hypotheses are as follows:

Hypothesis 1 Increased risk of diabetes will be associated with sociodemographic variables such as increasing age, lower educational level and history of disease.

Hypothesis 2 High BMI and high waist/hip ratio will increase the risk of diabetes.

Hypothesis 3 Energy and nutrient intake and meal frequency will be associated with diabetes risk.

Research design and methods

Description of sample

This cross-sectional study was conducted in Afyonkarahisar, which is located in the Aegean Region and has a population of 751.344 individuals [9]. Adults between 18 and 65 years who applied to Afyonkarahisar Health Sciences University Health Application and Research Center Hospital and who volunteered to participate in this study were included. Participants who were already diagnosed with diabetes, under 18 years of age, or over 65 years of age were excluded from the study. The number of participants was calculated as 207 using the G*power program (Heinrich-Heine-Universität Düsseldorf, Germany), with an error margin of $\alpha = 0.05$ and 95% test power, taking into account the studies in the literature [10–12]. However, to compensate for any shortcomings that may arise during data collection and differences between the sample and the general population, a larger sample was targeted.

Measures

In this face-to-face study, a questionnaire on sociodemographic characteristics and general dietary habits as well as the FINDRISC were used, and 24-h food recalls of the participants were taken in the data collection process. Moreover, body weight, height, and waist and hip circumference measurements were taken (Supplementary File 1).

FINDRISC

The FINDRISC screening tool was developed in Finland to estimate the risk of type 2 diabetes [13, 14]. This easy-to-use tool is widely used in several studies because it does not query laboratory testing [11, 15]. Furthermore, the Society of Endocrinology and Metabolism of Turkiye has recommended its use for identifying individuals at risk of prediabetes and diabetes [8]. In this questionnaire, age, BMI, waist circumference, physical activity status, history of hypertension and blood glucose levels, and family history are scored. The following is the classification of the scores (in points) obtained: <7, very low; 7–11, low; 12–14, moderate; 15–20, high; and >20, very high. Based on these scores, it estimates the risk of diabetes development for the next 10 years [11–14].

Anthropometric measurements

Participants' body weights were measured using a digital scale sensitive up to 100 g, wearing light clothing and no shoes. Height was measured while the participants were standing, without shoes, and in the Frankfort plane. Waist and hip circumferences were also measured using a tape measure. BMI was calculated using the following formula: body weight (kg)/height^2 (m^2) and categorized according to the BMI classification of the World Health Organization (WHO) [16].

Twenty-four–hour food recalls

The 24-h food consumption of the participants was investigated together with their amounts. Additionally, they were asked to report the amount of beverages and water they consumed during the day. The energy and nutrient contents of food consumption records were analyzed using BeBiS software (Pacific Electric Electronics Ltd. Comp. Istanbul, 2021) [17]. Adequacy of energy and nutrient intake was calculated on the basis of the estimated average requirement (EAR) values recommended by the Institute of Medicine [18–23].

Ethical consideration

Before study initiation, ethical approval was obtained from Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (date, September 11, 2020; approval number, 2020/409). Participants were also asked to approve the informed consent form. All processes were conducted consistent with the principles of the Declaration of Helsinki.

Statistical analysis

All statistical analyses were performed using Statistical Package for the Social Sciences 19.02 for Windows (Armonk, NY, IBM Corp.) [24]. Descriptive statistics were presented as means (±) standard deviations (min–max), frequency distributions, and percentages. The comparisons of dichotomous categories were made using the chi-square test. The t-test was used for comparisons between two groups, ANOVA for comparisons of three or more groups and Tamhane test for multiple comparisons. Spearman correlation coefficient was used to analyze the relationships between variables. To evaluate possible risk factors associated with the presence of diabetes risk, epidemiological data were analyzed using binary logistic regression models. In the logistic regression, diabetes risk (yes or no) was a dependent variable. To obtain a minimal model containing only significant variables, forward Wald stepwise elimination of all non-significant variables was applied. $p < 0.05$ was considered statistically significant.

Table 1 Anthropometric measurements of the participants

	Females (n = 1,994) ($\bar{x}$ ± SD)	Males (n = 1,996) ($\bar{x}$±SD)
BMI (kg/m^2)	25.58 ± 5.72	25.65 ± 3.70
Height (m)	1.62 ± 0.66	1.74 ± 0.70
Weight (kg)	67.03 ± 13.92	77.19 ± 11.55
Waist/hip ratio	1.31 ± 21.84	0.98 ± 2.75

BMI: Body Mass Index

Results

Participants' characteristics

A total of 4,400 individuals participated in this study. However, 410 of these participants were excluded from this study because they were diagnosed with diabetes. This study continued with 3,990 participants, 50.03% (n = 1996) and 49.97% (n = 1994) of whom were males and females, respectively. The mean age of the male and female participants was 39.79 ± 14.33 and 35.78 ± 13.59 years, respectively.

Most of the participants (30.6%) were high school graduates. Moreover, 53.8% stated that they had a disease diagnosed by a doctor. The most commonly reported diseases were hypertension (10.5%), cardiovascular diseases (7.5%), and eye diseases (7.2%) (data not shown).

Anthropometric measurements of the participants

The BMIs of the female and male participants were 25.58 ± 5.72 and 25.65 ± 3.70 kg/m^2, respectively. When waist/hip ratios were calculated, females' and males' waist/hip ratios were 1.31 ± 21.84 and 0.98 ± 2.75, respectively (Table 1).

FINDRISC scores according to Sociodemographic Factors and Dietary habits

The mean diabetes risk score of the participants was 7.90 ± 5.02. According to sex, females (8.03 ± 5.24) showed higher risk scores than males (7.76 ± 4.79; p = 0.001). Additionally, 10.6% of the participants were in the high and very high risk categories. Diabetes risk distributions of the participants did not show significant differences according to sex (p = 0.094) (Supplementary Table 1).

Evaluating the FINDRISC scores of the participants according to sociodemographic variables revealed that married participants had higher diabetes risk scores than single participants ($p < 0.001$). Additionally, participants with a bachelor's degree had lower risk scores than those with a lower education level ($p < 0.001$). Participants previously diagnosed by a doctor with a disease had higher risk scores ($p < 0.001$) (Table 2).

The energy intakes of the male and female participants were 1,679.2473 ± 582.45830 and 1,485.7960 ± 523.46784 kcal, respectively. Assessing the adequacy of nutrient intakes according to the EAR values showed that fiber, vitamin E, vitamin C, potassium,

Table 2 Evaluation of the FINDRISC score according to sociodemographic variables and diagnosed disease status

Variable	Total Score	*p**	*p***
Marital Status (*t-test, $p < 0.05$)			
Married	9.01 ± 5.01	$p < 0.001$	-
Single	5.79 ± 4.32		
Education Level (*ANOVA test for comparison between groups, **Tamhane test for multiple comparisons)			
Illiterate[1]	11.87 ± 4.63	$p < 0.001$	0.702 [1–2]
Literate[2]	10.80 ± 5.69		0.543 [1–3]
Primary school[3]	9.84 ± 5.09		0.022 [5–6]
Secondary school[4]	7.93 ± 4.98		< 0.001 (all other comparisons)
High school[5]	6.78 ± 4.61		
Bachelor's degree[6]	6.18 ± 4.13		
Doctor-Diagnosed Disease Status (*t-test, $p < 0.05$)			
Yes	8.96 ± 5.20	$p < 0.001$	-
No	6.66 ± 4.50		

*ANOVA test for comparison between groups; **Tamhane test for multiple comparisons

and calcium intakes were below the recommended levels (Supplementary Table 2).

The relationship between nutritional factors and diabetes risk scores is presented in Table 3. Although significant relationships were observed between diabetes risk scores and main meal consumption, energy, lipid, and iron intakes, the correlation coefficient was in the very low range.

Evaluating the association of some sociodemographic factors and anthropometric measurements with diabetes risk revealed that age and BMI were positively associated with diabetes risk score, risk degree, and 10-year risk. However, a significant relationship between waist/hip ratio and diabetes risk score was not observed (Table 4).

According to the multivariate logistic regression analysis results, the diabetes risk scores of the participants in the 45–54-year, 55–64-year and > 64 year age groups were 3.11, 3.45 and 4.72-fold higher, respectively, than those in the < 45-year age group. The risks were 7.33- and 2.56-fold higher in participants with BMIs of > 30 and 25–30 kg/m^2, respectively, than those in participants with BMIs of < 25 kg/m^2. The waist/hip ratio being higher than the cutoff point specified in the literature [25] increased the risk by 1.45 times, and the presence of hypertension increased it by 2.17 times (Table 5).

Discussion

Type 2 diabetes is a serious health problem that can affect millions of individuals worldwide with increasing prevalence [2] and can trigger various chronic medical conditions, thereby leading to comorbidities [26]. Therefore, various health authorities have recommended that individuals at risk should be screened [7, 8]. Accordingly, this study was conducted to evaluate the risk of diabetes and its relationship with sociodemographic factors and nutritional habits.

Evaluating the anthropometric measurements of the participants revealed that their mean BMI (females, 25.58 ± 5.72 kg/m^2; males, 25.65 ± 3.70 kg/m^2) corresponded to the pre-obesity classification in the BMI categories of the WHO [16]. Waist/hip ratios were 0.98 ± 2.75 and 1.31 ± 21.84 for males and females, respectively. A ratio of ≥ 0.90 and ≥ 0.85 cm for males and females, respectively, is defined as metabolic risk [25]. Therefore, stating that our sample is under metabolic risk is possible.

The mean diabetes risk score of the participants was 7.90 ± 5.02, corresponding to the slightly elevated risk category in the risk classification [13, 14]. Although most of the participants were in the low risk categories, 10.6% were in the very high or high risk categories. A study conducted by Sezer et al. in Turkiye reported that 9.5% of the participants aged 20–64 years were at a risk of diabetes in the next 10 years [27]. Another study conducted in the two largest cities of Turkiye, Istanbul and Ankara, showed that 7.9% of the participants with a mean age of 39.35 ± 10.40 years were in the high and very high risk groups [12]. Atayoğlu et al. [11], in a study conducted with participants from Turkiye, stated that 17.1% of the participants were in the very high and high risk groups. The TURDEP-II study, based on a large nationwide population-based field survey, revealed that the estimated age-adjusted prevalence of known diabetes in the general population in Turkiye increased from 7.8 to 8.6% between 2010 and 2021 [3]. Considering these findings in the literature, our sample has a diabetes prevalence that cannot be ignored. Moreover, the mean waist/hip ratio was higher than the cutoff point, indicating this metabolic risk.

Sociodemographic factors are significant diabetes risk determinants [28]. Sex is one of these factors; therefore, we analyzed sex differences in diabetes risk. Although diabetes risk distribution did not differ between sexes, we noted that females had significantly higher risk scores than males. Furthermore, previous studies in the literature observed that females are a higher risk group for diabetes [11, 12]. The TURDEP-II study emphasized that diabetes prevalence was higher in females and in individuals with a higher mean age [3]. In females, psychosocial stress, higher BMI, longer daytime sitting time, physical activity, and genetic and biological differences between the sexes may lead to this condition [28–30].

Additionally, decreasing education level, increasing age, marital status, and having a disease other than diabetes are risk factors for diabetes [3, 31, 32]. In our study, married individuals, those with lower education level, and those with a history of the disease had higher diabetes risk scores. The clearest example of this finding in our study was that hypertension increased diabetes risk

Table 3 Evaluation of the relationship between nutritional factors and diabetes risk scores

	Ten-Year Risk	Total Score	Main Meal Consumption	Snack Consumption	Energy	Carbohydrate	Protein	Lipid	Fiber	Cholesterol	Vitamin A	Vitamin E	Vitamin K	Vitamin C	Vitamin B12	Fe	K	Na	Total Liquid Consumption	Ca
Ten-Year Risk	1																			
Total Score	0.844**	1																		
Main Meal Consumption	0.047**	0.060**	1																	
Snack Consumption	−0.012	−0.045**	0.018	1																
Energy	−0.048**	−0.051**	0.086**	0.031	1															
Carbohydrate	−0.018	−0.019	0.079**	−0.008	0.897**	1														
Protein	−0.034*	−0.027	0.083**	0.006	0.716**	0.514**	1													
Lipid	−0.075**	−0.082**	0.051**	0.092**	0.686**	0.327**	0.508**	1												
Fiber	−0.018	−0.014	0.092**	0.037*	0.539**	0.571**	0.398**	0.222**	1											
Cholesterol	−0.041**	−0.028	0.029	0.011	0.302**	0.091**	0.496**	0.409**	0.003	1										
Vitamin A	0.022	0.023	0.042**	0.017	0.088**	0.058**	0.105**	0.094**	0.126**	0.164**	1									
Vitamin E	−0.029	−0.040*	0.029	0.085**	0.391**	0.207**	0.138**	0.595**	0.219**	0.100**	0.064**	1								
Vitamin K	−0.020	0.005	0.095**	0.035*	0.285**	0.227**	0.261**	0.244**	0.436**	0.086**	0.326**	0.261**	1							
Vitamin C	0.011	0.025	0.059**	0.079**	0.121**	0.107**	0.088**	0.095**	0.280**	−0.002	0.263**	0.198**	0.613**	1						
Vitamin B12	−0.008	−0.013	0.025	0.013	0.118**	0.035*	0.253**	0.137**	−0.015	0.318**	0.719**	0.032*	0.102**	0.058**	1					
Fe	−0.041**	−0.035*	0.090**	0.058**	0.748**	0.677**	0.705**	0.445**	0.733**	0.297**	0.247**	0.246**	0.481**	0.274**	0.227**	1				
K	−0.017	−0.016	0.093**	0.130**	0.574**	0.477**	0.577**	0.403**	0.645**	0.179**	0.164**	0.237**	0.443**	0.399**	0.068**	0.750**	1			
Na	−0.021	−0.005	0.091**	0.005	0.441**	0.331**	0.409**	0.393**	0.236**	0.148**	0.058**	0.183**	0.208**	0.071**	0.058**	0.342**	0.292**	1		
Total Liquid Consumption	−0.033*	−0.037*	0.086**	−0.046**	0.191**	0.172**	0.188**	0.100**	0.144**	0.077**	0.060**	0.050**	0.138**	0.073**	0.062**	0.172**	0.157**	0.098**	1	
Ca	0.004	0.018	0.099**	0.104**	0.378**	0.218**	0.476**	0.396**	0.250**	0.219**	0.141**	0.085**	0.273**	0.199**	0.134**	0.328**	0.486**	0.397**	0.160**	1

Spearman Correlation Coefficient, *$p < 0.05$, **$p < 0.001$

Table 4 Evaluation of some sociodemographic characteristics and anthropometric measurements of the participants in relation to diabetes risk

		Age	Body Weight	BMI	Waist/Hip Ratio	Total Score	Risk Degree	Ten-Year Risk
Age	r	1						
Body Weight	r	0.339**	1					
BMI	r	0.453**	0.821**	1				
Waist/Hip Ratio	r	0.022	−0.013	−0.010	1			
Total Score	r	0.504**	0.405**	0.522**	0.012	1		
Risk Degree	r	0.465**	0.372**	0.486**	0.006	0.940**	1	
Ten-Year Risk	r	0.408**	0.316**	0.419**	−0.001	0.844**	0.915**	1

BMI: Body Mass Index

Table 5 Multivariable logistic regression models to explain the high FINDRISC scores among the surveyed sample

	B	Wald	Sig.	Exp (B)	95% CI Exp (B)	
					Lower	Upper
Age (years)		75.23	< 0.001			
< 45 (*n* = 2669)	Ref.					
45–54 (*n* = 676)	1.14	53.18	< 0.001	3.11	2.29	4.22
55–64 (*n* = 447)	1.24	46.02	< 0.001	3.45	2.41	4.93
> 64 (*n* = 198)	1.55	48.55	< 0.001	4.72	3.05	7.29
Marital Status (Married$_n$=2609, Single$_n$=1381)	0.41	4.69	0.030	1.50	1.04	2.16
Occupation		16.14	0.003			
Housewife (*n* = 1108)	Ref.					
Civil servant (*n* = 574)	−0.50	5.12	0.024	0.61	0.40	0.94
Retired (*n* = 370)	−0.09	0.24	0.624	0.92	0.65	1.30
Student (*n* = 772)	−1.30	11.69	< 0.001	0.27	0.13	0.57
Other (*n* = 1166)	−0.36	5.54	0.019	0.7	0.52	0.94
BMI (kg/m^2)		135.69	< 0.001			
< 25 (*n* = 1958)	Ref.					
25–30 (*n* = 1371)	0.94	28.61	< 0.001	2.56	1.81	3.61
> 30 (*n* = 661)	1.99	120.42	< 0.001	7.33	5.14	10.46
Waist/Hip Ratio (High$_n$=1436, Low$_n$=2554)	0.37	9.40	0.002	1.45	1.14	1.85
Hypertension (Yes$_n$=418, No$_n$=3572)	0.77	30.17	< 0.001	2.17	1.65	2.86
Constant	−3.87	393.39	< 0.001			

by 2.17 folds. Moreover, participants aged 45–54, 55–64 and > 64 years had 3.11, 3.45 and 4.72-fold higher risks of diabetes, respectively, than those aged < 45 years. Considering these findings, which are compatible with the literature, stating that increasing age, married status, low education level, and disease history may be risks factors for diabetes is possible.

Notably, anthropometric measurements are a significant risk factor for diabetes, especially in its relationship with nutritional status. In particular, high BMI, waist circumference, and waist/hip ratios are associated with an increased diabetes risk [33, 34]. In our study, BMI was positively correlated with diabetes risk scores, and the risk of diabetes increased 7.33 and 2.56 folds in participants with BMIs of > 30 and 25–30 kg/m^2, respectively, compared with those with BMIs of < 25 kg/m^2. Additionally, having a waist/hip ratio above the cutoff point specified in the literature [25] increased the risk by 1.14 folds. These results demonstrated that anthropometric measures are significant risk factors for diabetes, even if they are not the only indicator of risk.

Evaluating the adequacy of nutrient intakes of the participants showed that fiber, vitamin E, potassium, and calcium intakes were below the recommended levels. The results of the Turkish Nutrition and Health Survey 2017 [35, 36] revealed that inadequate potassium, fiber, calcium, and vitamin E consumption in Turkiye are 87.8%, 67.2%, 52.6%, and 32.9%, respectively. The findings of this study suggested that deficiencies in these nutrients in Turkiye exist and that precautions should be taken for this situation.

Nutritional habits are essential cornerstones in diabetes formation or prevention. In particular, emphasis is placed on the role of insufficient vegetable and fruit consumption and high salt, table sugar, and processed food consumption in diabetes risk development [37, 38]. Although the association between diabetes risk and carbohydrate consumption is frequently attributed to the consumption of added sugars [39], a meta-analysis of 18 prospective cohort studies reported that intake of more than 70% of energy from carbohydrates was associated with an increased risk [40]. Moreover, of note, dietary fiber, as a carbohydrate source, may be inversely associated with the risk of type 2 diabetes and may play a role as a protective dietary factor [41]. However, in our study, a significant relationship between dietary carbohydrate and fiber consumption and diabetes risk was not observed. It is believed that the reason why this relationship is not significant is likely because fiber consumption in our population is far below the recommended level.

Although data on the relationship between dietary protein intake and the risk of type 2 diabetes are inconsistent, high protein intake may be associated with an increased risk [42, 43]. In our study, no significant associations were noted between diabetes risk and protein intake, which is likely because the participants in our study did not show very high protein intakes. Examining the data evaluating the relationship between dietary fats and diabetes risk emphasized that although no significant relationship was observed between total fat intake and diabetes risk, omega-3 fatty acids may reduce the risk, whereas trans fatty acids may increase it [44–46]. Significant associations were noted between diabetes risk and total fat intake but with very low correlation coefficients. These findings confirm that total fat intake is not consistently associated with diabetes risk, consistent with the literature.

Additionally, meal frequency, a nutrition-related factor, should be discussed with respect to diabetes risk because it is a significant factor that can affect metabolic health [47]. However, this aspect remains controversial. A cohort study by Baheti et al. [47] suggested that reduced meal frequency especially dinner frequency can reduce diabetes risk. A prospective study by Wan et al. [48] reported that consuming four meals per day reduced the likelihood of developing diabetes compared with three meals. In our study, positive and significant associations but with very low correlation coefficients were noted between total diabetes risk score, 10-year risk, and main meal consumption. Therefore, we believe that meal frequency remains a controversial issue for diabetes risk and should be further investigated.

Considering the literature and the findings of our study, there is no clear consensus on the most effective dietary pattern for diabetes prevention and management. New dietary approaches have been explored, but studies have reported different findings [49–51]. Regarding this issue, a meta-analysis of 42 randomized controlled trials reported that the ketogenic diet, Mediterranean diet, moderate-carbohydrate diet and low glycemic index diet may be effective for glycemic control [49]. Another meta-analysis of 20 randomized controlled trials suggested that low-carbohydrate, low glycemic index, Mediterranean and high-protein diets may be effective in improving cardiovascular risk markers in people with diabetes and should be considered in the overall strategy of diabetes management [50]. Daneshzad et al. [51] emphasized that adherence to a modified Nordic diet based on the consumption of traditional foods from Scandinavian countries, including whole grains, fruits, low-fat dairy products, oily fish such as salmon, cabbage and root vegetables, was associated with reduced obesity, LDL-C and blood pressure in type 2 diabetics. Taking into account these findings and our research, there is a need to elucidate dietary patterns that may be effective in the prevention and management of diabetes.

Strengths of the study

One of the strengths of this study is that it represents a large population of 3990 people. Secondly, the number of male and female in the population is close to each other and homogenization is achieved at this point. Third, the study examined the influence of multiple factors such as sociodemographic factors and nutritional status for diabetes risk.

Limitations of the study

This study had some limitations. First, food consumption records were collected from the participants by the recall method, which may have led to inadequacies in estimating energy and nutrient intakes. Second, this study was conducted in a relatively small city in Turkiye. Therefore, this limitation should not be overlooked when generalizing these findings to the population in Turkiye.

Conclusions

In conclusion, the risk of diabetes was higher in females, married participants, and participants with lower education level. Moreover, we determined that increasing age, increasing BMI and waist/hip ratio, and a diagnosis of hypertension increased diabetes risk. Examining nutrition-related factors revealed that although main meal consumption, energy, and lipid and iron intakes were associated with diabetes risk, the correlation was weak. These findings indicate that society should be made aware of the fact that increasing age, obesity, high waist/hip ratio, disease history and nutritional status may pose a risk for diabetes and that public health policies should be developed. However, larger-scale studies are needed to elucidate issues that are not yet consistent, especially regarding the effects of nutritional status on diabetes risk.

Abbreviations

BMI	Body Mass Index
EAR	Estimated Average Requirement
FINDRISC	Finnish Diabetes Risk Score
IDF	International Diabetes Federation
TURDEP-II	The Turkish Epidemiology Survey of Diabetes, Hypertension, Obesity, and Endocrine Disease II
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-21940-z.

Supplementary File 1: Questionnaire Used in the Study. Supplementary Table 1: Evaluation of diabetes risk distribution of participants according to sex; Supplementary Table 2: Evaluation of energy, macro-, and micronutrient intakes of the participants by sex

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Author contributions
All authors have contributed sufficiently to the manuscript and have approved the final version. KEKÇ: conceptualization, methodology, data collection and extraction, project administration, writing—review and editing. DT: conceptualization, interpretation of data, data analysis. MB: interpretation of data, supervision, writing—review and editing. LT: conceptualization, methodology, interpretation of data. MK: interpretation of data, writing—original draft. MİP: methodology, data collection and extraction. ND: methodology, data collection and extraction. DB: supervision, writing—review and editing.

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Data availability
The datasets used and/or analysed during the current study and materials used are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Before study initiation, ethical approval was obtained from Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (date, September 11, 2020; approval number, 2020/409). Participants were also asked to approve the informed consent form.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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