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Eating Attitudes and Behaviors in Relation to Type 2 Diabetes Risk among Young Adults: A Cross Sectional Study

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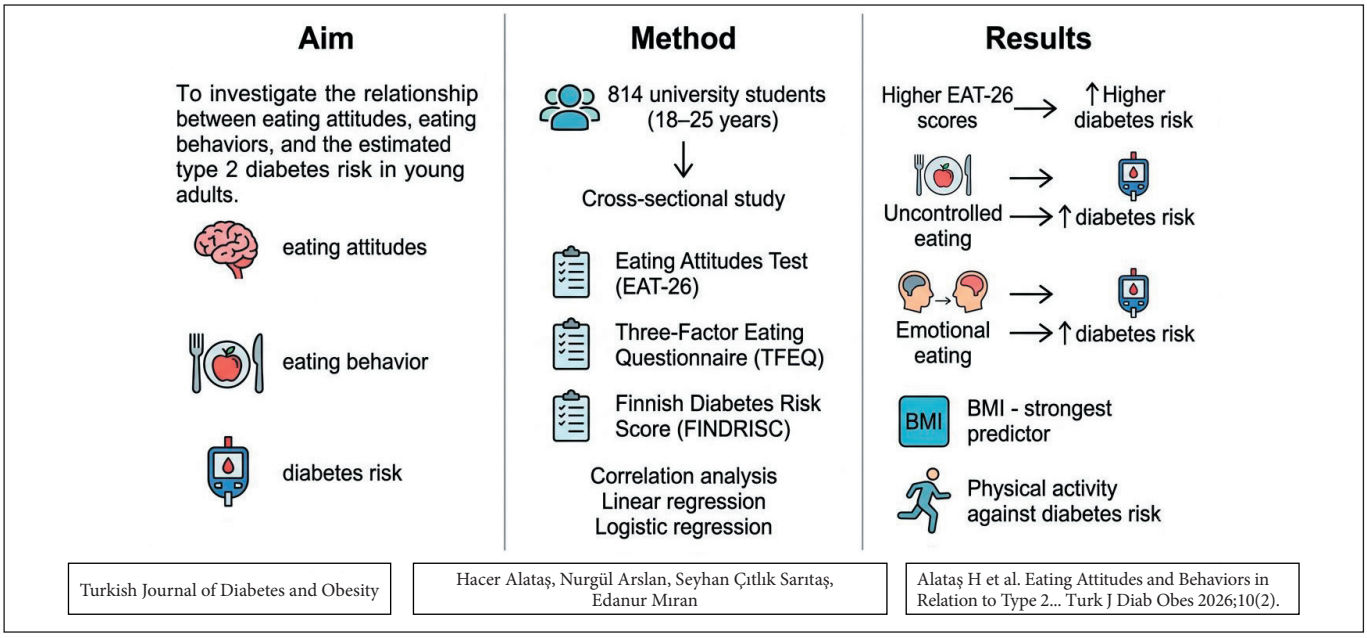
GRAPHICAL ABSTRACT



ABSTRACT

Aim: This study examined the relationship between eating-related attitudes, eating behavior patterns, and estimated type 2 diabetes risk in young adults.

Material and Methods: The cross-sectional sample consisted of 814 university students aged 18–25 years, including 300 males and 514 females. Participants completed an anonymous web-based questionnaire. Eating attitudes were measured using the Eating Attitudes Test-26 (EAT-26), while cognitive restraint, uncontrolled eating, and emotional eating were assessed through the Three-Factor Eating Questionnaire (TFEQ). Estimated type 2 diabetes risk was calculated with the Finnish Diabetes Risk Score (FINDRISC). Correlation analyses were used to examine relationships among the study variables. Hierarchical linear regression was conducted for the continuous FINDRISC score, and binary logistic regression was used to evaluate factors associated with elevated estimated diabetes risk.

Results: The participants had a mean age of 20.92 ± 1.76 years. Female participants had higher EAT-26 scores than males (14.25 ± 9.42 vs. 10.42 ± 8.12, $p < 0.001$) and were more frequently above the EAT-26 cut-off of ≥20 (22.18% vs. 12.67%, $p < 0.001$). FINDRISC scores

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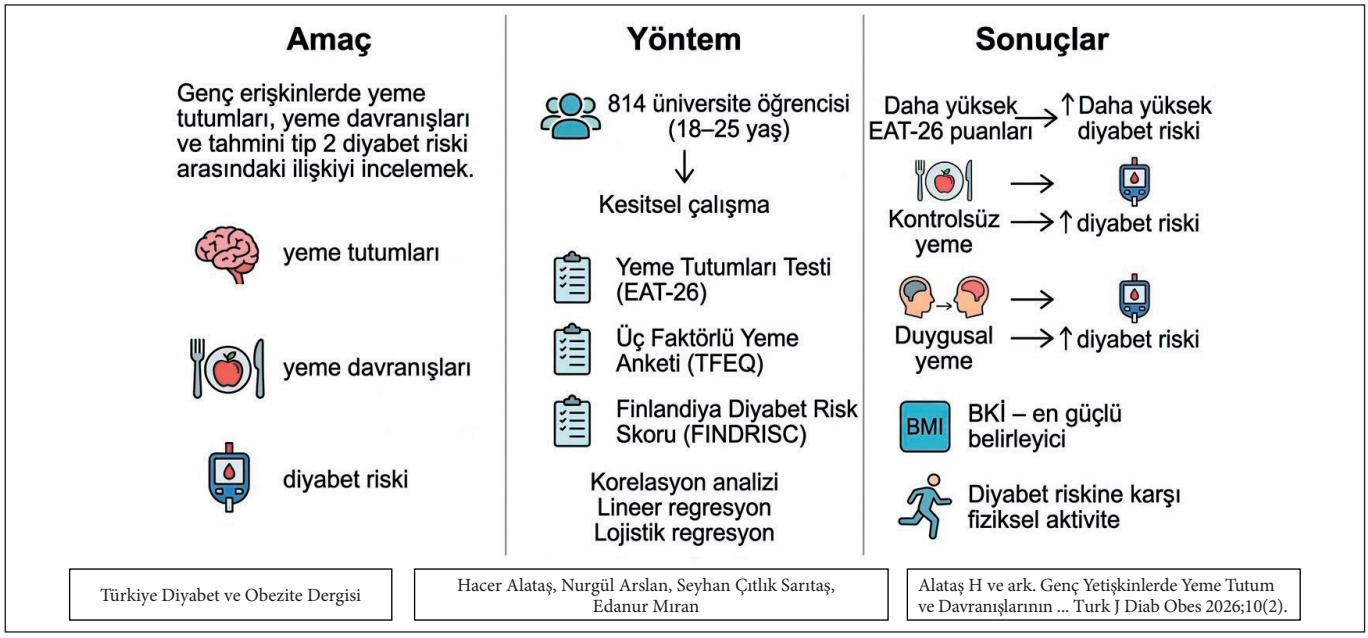
increased in parallel with EAT-26 total score (r = 0.18, p < 0.001), uncontrolled eating (r = 0.24, p < 0.001), emotional eating (r = 0.19, p < 0.001), and BMI (r = 0.62, p < 0.001). In the hierarchical regression model, EAT-26 total score and uncontrolled eating remained significantly related to FINDRISC score. Logistic regression also showed that higher EAT-26, uncontrolled eating, and emotional eating scores were associated with greater odds of elevated estimated type 2 diabetes risk.

Conclusion: Less favorable eating attitudes and stronger uncontrolled and emotional eating tendencies were linked to higher estimated type 2 diabetes risk in young adults. Early assessment of eating-related attitudes and behaviors may therefore support prevention-oriented approaches in this population.

Keywords: *Young adults, Type 2 diabetes risk, FINDRISC, Eating attitudes, Eating behaviors*

Genç Yetişkinlerde Yeme Tutum ve Davranışlarının Tip 2 Diyabet Riski ile İlişkisi: Kesitsel Bir Çalışma

GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışmanın amacı, genç yetişkinlerde yeme tutumları ve yeme davranışlarının tahmini tip 2 diyabet riski ile ilişkisini değerlendirmektir.

Gereç ve Yöntemler: Bu kesitsel çalışmaya, 18–25 yaş arası 814 üniversite öğrencisi (300 erkek, 514 kadın) dahil edilmiştir. Veriler anonim bir çevrim içi anket aracılığıyla toplanmıştır. Yeme tutumları Yeme Tutum Testi-26 (EAT-26), yeme davranışları ise Üç Faktörlü Yeme Anketi (TFEQ) alt ölçekleri ile değerlendirilmiştir. Tahmini tip 2 diyabet riski Finlandiya Diyabet Risk Skoru (FINDRISC) kullanılarak belirlenmiştir. Değişkenler arasındaki ilişkiler korelasyon analizi ile incelenmiştir. FINDRISC skoru için hiyerarşik doğrusal regresyon analizi, artmış tahmini tip 2 diyabet riski için ise lojistik regresyon analizi uygulanmıştır.

Bulgular: Katılımcıların ortalama yaşı 20.92 ± 1.76 yıl olarak bulunmuştur. Kadınların EAT-26 toplam puanı erkeklerden daha yüksek bulunmuştur (14.25 ± 9.42'ye karşı 10.42 ± 8.12, p < 0.001) ve EAT-26 skoru ≥20 olanların oranı kadınlarda daha fazladır (%22.18'e karşı %12.67, p < 0.001). FINDRISC toplam skoru EAT-26 toplam puanı (r = 0.18, p < 0.001), kontrolsüz yeme (r = 0.24, p < 0.001), duygusal yeme (r = 0.19, p < 0.001) ve BKİ (r = 0.62, p < 0.001) ile pozitif yönde ilişkili bulunmuştur. Hiyerarşik doğrusal regresyon analizinde EAT-26 toplam puanı ve kontrolsüz yeme FINDRISC toplam skoru ile ilişkili bulunmuştur. Lojistik regresyon analizinde EAT-26 toplam puanı, kontrolsüz yeme ve duygusal yeme artmış tahmini tip 2 diyabet riski ile ilişkili bulunmuştur.

Sonuç: Problemli yeme tutumları ile kontrolsüz ve duygusal yeme davranışları, genç yetişkinlerde daha yüksek tahmini tip 2 diyabet riski ile ilişkili bulunmuştur. Bu bulgular, genç yetişkinlerde yeme davranışlarının erken dönemde değerlendirilmesinin tip 2 diyabet riskine yönelik önleyici stratejiler açısından yararlı olabileceğini düşündürmektedir.

Anahtar Sözcükler: *Genç yetişkinler, Tip 2 diyabet riski, FINDRISC, Yeme tutumları, Yeme davranışları*

INTRODUCTION

Type 2 diabetes (T2D) is one of the most important and rapidly increasing public health challenges worldwide. Although T2D is commonly regarded as a disease of middle and older adulthood, recent evidence suggests that metabolic risk factors begin to accumulate much earlier in life. Increasing rates of overweight, unhealthy dietary habits, sedentary behavior, and psychosocial stress among young people indicate that the foundations of future diabetes risk may already be present during adolescence and early adulthood (1).

Early adulthood is a particularly important period in this regard. During these years, individuals establish lifestyle habits that may persist into later life. At the same time, young adults frequently experience major changes in daily routines, social environments, academic responsibilities, and living conditions (2,3). These transitions may disrupt regular eating patterns and contribute to unhealthy food choices, emotional eating, and loss of control over eating, even among individuals without diagnosed metabolic disease (4,5).

Eating behaviors are shaped not only by what individuals eat, but also by how and why they eat. Eating attitudes and behaviors such as emotional eating, uncontrolled eating, cognitive restraint, and problematic beliefs about food may influence energy intake, body weight regulation, and metabolic health (6,7). Previous studies have linked maladaptive eating behaviors with weight gain, insulin resistance, and unfavorable cardiometabolic profiles (8-10) . However, much of this evidence has been derived from clinical, middle-aged, or older adult populations, while less is known about how these behaviors are associated with estimated diabetes risk in younger and non-clinical populations (11-13).

Risk prediction scores for T2D provide a practical and non-invasive approach for identifying individuals who may have an increased estimated risk before the onset of overt disease (14). These tools combine demographic, anthropometric, lifestyle-related, and clinical history variables and are increasingly used in research and preventive health settings (15,16). The Finnish Diabetes Risk Score (FINDRISC) is one of the most widely used diabetes risk assessment tools. Although FINDRISC was originally developed for adult populations, it may also provide useful information on the early clustering of lifestyle- and anthropometry-related risk factors in young adults when interpreted as an estimated risk indicator rather than a diagnostic tool (17).

Despite increasing interest in the behavioral determinants of metabolic health, studies examining the association of eating attitudes and eating behaviors with estimated T2D risk among young adults remain limited (18). Understanding these associations in a non-clinical young adult population may help identify early behavioral markers that can be considered in prevention-oriented strategies.

Therefore, this study aimed to evaluate the association of eating attitudes and eating behaviors with estimated T2D risk among young adults using a cross-sectional design. The main research question was whether problematic eating attitudes and dysregulated eating behaviors are associated with higher FINDRISC scores and increased estimated T2D risk. We hypothesized that higher EAT-26 scores and higher uncontrolled and emotional eating scores would be associated with higher estimated T2D risk.

MATERIAL and METHODS

Study Design, Participants, and Sample Size

This cross-sectional study was carried out among students enrolled at Malatya Turgut Ozal University, Malatya, Türkiye, during the 2025–2026 academic year. Participants were recruited through online announcements and student communication networks using convenience sampling. Eligibility was limited to volunteers aged 18–25 years who provided informed consent.

Data were obtained through a structured, self-administered questionnaire created in Google Forms. Initial screening questions were used to determine eligibility. Individuals who reported type 2 diabetes or a metabolic condition that could influence body weight, glucose regulation, or eating behavior including thyroid disease, polycystic ovary syndrome, Cushing's syndrome, chronic kidney disease, or chronic liver disease were excluded. Pregnancy, lactation, a current eating disorder diagnosis, and the use of medications known to alter appetite or body weight were also exclusion criteria. The participant selection process is presented in Figure 1.

Ethical approval was granted by the Malatya Turgut Ozal University Health Sciences Scientific Research Ethics Committee, Türkiye (decision no. E-30785963-020-348515; meeting date: 20 November 2025; meeting no. 13). Before accessing the questionnaire, participants received information about the study purpose, voluntary participation, and confidentiality of responses. Electronic informed consent was then obtained. All procedures were conducted in accordance with the Declaration of Helsinki.

The minimum sample size was calculated in G*Power version 3.1 for multiple linear regression. Based on the small-to-moderate associations previously reported between eating behaviors and metabolic risk indicators in young, non-clinical populations, an effect size of $f^2 = 0.05$ was assumed (19-21). With $\alpha = 0.05$, 80% power, and a maximum of 12 predictors, the minimum required sample was

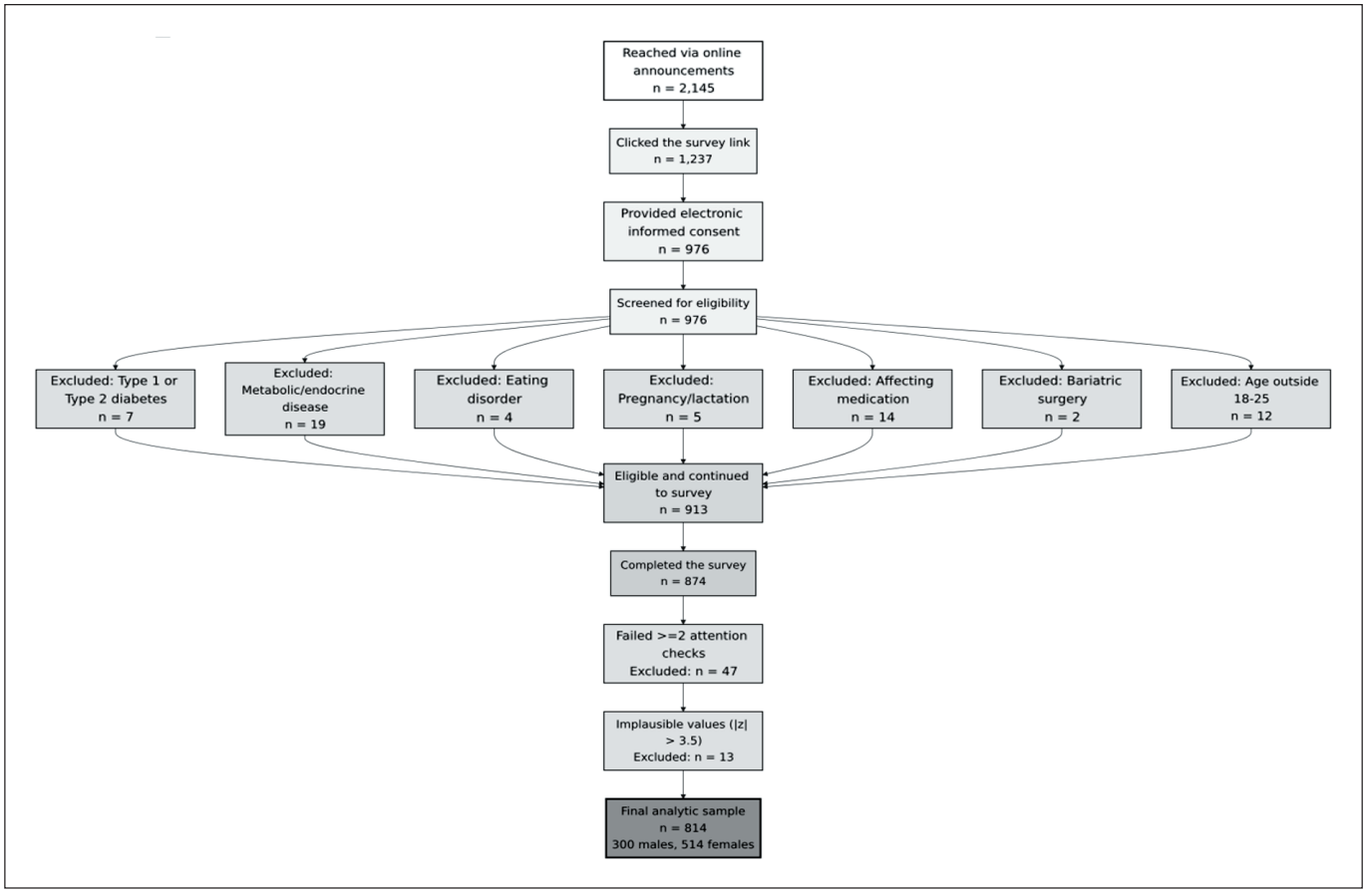


Figure 1: Flow diagram of participant inclusion and exclusion.

Not. Of 2,145 students reached via online announcements, 1,237 clicked the survey link, 976 provided electronic informed consent, and 814 were included in the final analysis. Exclusions were: medical ineligibility (n = 63), incomplete survey (n = 39), failed attention checks (n = 47), and implausible values (n = 13). The final sample consisted of 814 young adults (300 males, 514 females).

370 participants. A larger sample was sought to improve estimate precision and compensate for possible exclusions or incomplete submissions. The final analysis included 814 participants.

Data Collection Procedure

Data collection took place between January and February 2026. After completing the eligibility screening, qualified participants proceeded to the main questionnaire. The survey contained items on demographic characteristics and self-reported anthropometric measurements, together with the Eating Attitudes Test-26, the Three-Factor Eating Questionnaire, and the Finnish Diabetes Risk Score.

All questionnaire items were set as mandatory, preventing item-level missing data. Three attention-check items were inserted to support response quality. Participants who failed at least two of these checks were excluded according to the predefined protocol. Completion time was also reviewed, and questionnaires finished in less than 20% of the median completion time were flagged and examined manually.

Before the main data collection, the questionnaire was piloted with 15 students who were not included in the final sample. This pilot was used to estimate completion time and identify unclear wording.

Eating Attitudes Test-26

Eating-related attitudes were measured using the Eating Attitudes Test-26, a 26-item self-report screening instrument developed by Garner et al. to assess symptoms and attitudes associated with disordered eating. Responses are recorded on a six-point Likert-type scale, and higher total scores indicate more problematic eating attitudes. A score of 20 or above was used as the conventional threshold for possible disordered eating risk, consistent with the original scoring approach and previous validation research (22).

The Turkish adaptation and psychometric assessment of the EAT-26 in university students were conducted by Ergüney-Okumuş and Sertel-Berk. In the present sample, the scale showed good internal consistency, with a Cronbach's α of 0.86 (23).

Three-Factor Eating Questionnaire

Eating behavior dimensions were assessed with the Three-Factor Eating Questionnaire. The original instrument developed by Stunkard and Messick evaluates cognitive restraint, disinhibition or uncontrolled eating, and hunger. Revised applications commonly assess cognitive restraint, uncontrolled eating, and emotional eating. Items were scored according to standardized procedures, with higher scores reflecting stronger expression of the relevant eating behavior trait (24).

The Turkish validity and reliability study was conducted by Küçükerdönmez and colleagues. In the current sample, Cronbach's α values were 0.79 for cognitive restraint, 0.82 for uncontrolled eating, and 0.87 for emotional eating, indicating acceptable-to-good internal consistency (25).

Finnish Diabetes Risk Score

Estimated type 2 diabetes risk was evaluated using the Finnish Diabetes Risk Score, a non-invasive screening instrument developed by Lindström and Tuomilehto. The score incorporates age, body mass index, waist circumference, physical activity, daily fruit and vegetable intake, family history of diabetes, previous high blood glucose, and antihypertensive medication use. Total scores range from 0 to 26, with higher values reflecting greater estimated diabetes risk (26).

Although FINDRISC was originally designed for adult populations, it was used here as an indicator of estimated diabetes risk and the clustering of lifestyle- and anthropometry-related risk factors in young adults, rather than as a diagnostic measure. For categorical analyses, established FINDRISC categories were applied. A score of 9 or higher was accepted as increased estimated risk, corresponding to the slightly elevated or higher-risk category used in previous validation studies (27).

Statistical Analysis

Statistical analyses were performed in IBM SPSS Statistics version 26.0. The dataset was first checked for completeness, consistency, implausible values, and potential outliers. EAT-26 and TFEQ scores were calculated according to their original scoring procedures. Internal consistency was examined using Cronbach's α.

Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Distributional characteristics were evaluated using histograms, Q–Q plots, and the Kolmogorov–Smirnov test. Sex-based comparisons were conducted with independent-samples t-tests for continuous variables and chi-square tests for categorical variables. Pearson correlation analysis was used to examine bivariate relationships among eating attitudes, eating behaviors, BMI, and estimated type 2 diabetes risk.

Hierarchical multiple linear regression was used to assess the association of eating attitudes and eating behaviors with the continuous FINDRISC score. Model 1 included the EAT-26 total score and TFEQ subscale scores. Age and sex were added in Model 2. Variables that form part of the FINDRISC calculation—including BMI, waist circumference, physical activity, daily fruit and vegetable intake, family history of diabetes, previous high blood glucose, and antihypertensive medication use—were not entered as independent predictors to avoid overlap with the outcome. Multicollinearity was evaluated using variance inflation factors. Model performance was summarized with R^2, adjusted R^2, change in R^2, F statistics, and the Durbin–Watson statistic.

Binary logistic regression was additionally conducted for increased estimated diabetes risk, defined as FINDRISC ≥9. Crude models were first estimated separately for each predictor. The adjusted model included eating attitude and eating behavior variables, age, and sex, while excluding the structural components of FINDRISC. Findings were reported as odds ratios with 95% confidence intervals. Model performance was assessed using Nagelkerke R^2, the Hosmer–Lemeshow goodness-of-fit test, classification accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve. All analyses were two-sided, and statistical significance was accepted at $p < 0.05$.

RESULTS

A total of 814 young adults were included in the final analyses, comprising 300 males and 514 females (Figure 1). The overall mean age was 20.92 ± 1.76 years. Males were slightly older than females (21.10 ± 1.80 vs. 20.82 ± 1.73 years, $p = 0.040$). Most participants were aged 18–20 years (44.23%) or 21–23 years (45.95%). The distribution of participants across faculties differed by sex ($p = 0.030$); females were more frequently enrolled in health sciences, whereas males were more commonly represented in engineering or science programs. Smoking status also differed significantly between sexes ($p < 0.001$), with current smoking reported by 28.00% of males and 14.01% of females. The proportion meeting the physical activity recommendation of at least 150 min/week was higher among males than females (60.67% vs. 48.64%, $p < 0.001$). Mean BMI was 24.08 ± 3.82 kg/m² in the overall sample and was higher in males than females (24.74 ± 3.65 vs. 23.69 ± 3.88 kg/m², $p < 0.001$). Other sociodemographic, lifestyle, and health-related characteristics are summarized in Table 1.

Table 1. Sociodemographic, lifestyle, and health-related characteristics of participants by sex.

Variable	Total (n = 814)	Male (n = 300)	Female (n = 514)	p-value
Age (years), mean ± SD	20.92 ± 1.76	21.10 ± 1.80	20.82 ± 1.73	0.040
Age group, n (%)				0.120
18–20	360 (44.23)	122 (40.67)	238 (46.30)	
21–23	374 (45.95)	148 (49.33)	226 (43.97)	
24–25	80 (9.83)	30 (10.00)	50 (9.73)	
Year of study, n (%)				0.010
1st	216 (26.54)	68 (22.67)	148 (28.79)	
2nd	210 (25.80)	76 (25.33)	134 (26.07)	
3rd	196 (24.08)	82 (27.33)	114 (22.18)	
4th+	192 (23.58)	74 (24.67)	118 (22.96)	
Faculty/School, n (%)				0.030
Health sciences	244 (29.98)	74 (24.67)	170 (33.07)	
Engineering/Science	232 (28.50)	102 (34.00)	130 (25.29)	
Social sciences	268 (32.92)	98 (32.67)	170 (33.07)	
Other	70 (8.60)	26 (8.67)	44 (8.56)	
Living arrangement, n (%)				0.040
With family	318 (39.07)	108 (36.00)	210 (40.86)	
Dormitory	254 (31.20)	88 (29.33)	166 (32.30)	
Shared house	170 (20.88)	76 (25.33)	94 (18.29)	
Alone	72 (8.85)	28 (9.33)	44 (8.56)	
Perceived economic status, n (%)				0.090
Low	144 (17.69)	50 (16.67)	94 (18.29)	
Middle	590 (72.48)	214 (71.33)	376 (73.15)	
High	80 (9.83)	36 (12.00)	44 (8.56)	
Smoking status, n (%)				<0.001
Never	612 (75.18)	202 (67.33)	410 (79.77)	
Current	156 (19.17)	84 (28.00)	72 (14.01)	
Former	46 (5.65)	14 (4.67)	32 (6.23)	
Physical activity ≥150 min/week, n (%)	432 (53.07)	182 (60.67)	250 (48.64)	<0.001
Daily fruit/vegetable intake, n (%)	318 (39.07)	96 (32.00)	222 (43.19)	<0.001
BMI (kg/m²), mean ± SD	24.08 ± 3.82	24.74 ± 3.65	23.69 ± 3.88	<0.001
BMI category, n (%)				<0.001
Underweight (<18.50)	62 (7.62)	12 (4.00)	50 (9.73)	
Normal weight (18.50–24.99)	468 (57.49)	156 (52.00)	312 (60.70)	
Overweight (25.00–29.99)	214 (26.29)	106 (35.33)	108 (21.01)	
Obesity (≥30.00)	70 (8.60)	26 (8.67)	44 (8.56)	
Waist circumference (cm), mean ± SD	80.46 ± 10.22	84.18 ± 9.84	78.30 ± 9.92	—
Family history of diabetes, n (%)	238 (29.24)	82 (27.33)	156 (30.35)	0.350
History of high blood glucose, n (%)	28 (3.44)	10 (3.33)	18 (3.50)	0.900
Antihypertensive medication, n (%)	34 (4.18)	12 (4.00)	22 (4.28)	0.840

Notes: Data are expressed as mean ± standard deviation for continuous measures and as number (percentage) for categorical measures. Differences between males and females were evaluated using the independent-samples t-test or chi-square test, as appropriate. Percentages were calculated within each sex group. No p-value was reported for waist circumference because its clinical interpretation is based on sex-specific thresholds. BMI, body mass index.

Eating attitudes, eating behavior dimensions, and estimated type 2 diabetes risk according to sex are shown in Table 2. The mean EAT-26 total score was 12.84 ± 9.10. Females had higher scores than males (14.25 ± 9.42 vs. 10.42 ± 8.12, p < 0.001). Overall, 18.67% of participants had an EAT-26 score of 20 or higher, and this proportion was greater among females than males (22.18% vs. 12.67%, p < 0.001). Females also had higher cognitive restraint, uncontrolled eating, and emotional eating scores than males (all p < 0.001). The mean FINDRISC score was 6.18 ± 3.42 and did not differ significantly by sex (p = 0.080). However, FINDRISC risk-category distribution varied between males and females (p = 0.040), and 8.84% of the total sample was classified in the moderate/high-risk category.

The correlation findings are presented in Table 3. FINDRISC total score showed positive correlations with EAT-26 total score (r = 0.18, p < 0.001), cognitive restraint (r = 0.11, p < 0.01), uncontrolled eating (r = 0.24, p < 0.001), emotional eating (r = 0.19, p < 0.001), and BMI (r = 0.62, p < 0.001). EAT-26 total score was also positively related to cognitive restraint (r = 0.28, p < 0.001), uncontrolled eating (r = 0.34, p < 0.001), and emotional eating (r = 0.41, p < 0.001).

Table 4 presents the hierarchical linear regression models for FINDRISC total score. In Model 1, EAT-26 total score (B = 0.04, 95% CI: 0.02–0.06, p = 0.004), uncontrolled eating (B = 0.39, 95% CI: 0.23–0.55, p < 0.001), and emotional eating (B = 0.13, 95% CI: 0.01–0.25, p = 0.036) were significantly associated with FINDRISC score, whereas cognitive restraint was not significant (p = 0.206). After age and sex were added in Model 2, EAT-26 total score (B = 0.03, 95% CI: 0.01–0.06, p = 0.032) and uncontrolled eating (B = 0.36, 95% CI: 0.20–0.52, p < 0.001) remained significant. Emotional eating was of borderline significance (B = 0.11, 95% CI: −0.01–0.23, p = 0.056), while cognitive restraint and sex were not associated with FINDRISC score. Model 2 accounted for 8.3% of the variance in FINDRISC total score (R^2 = 0.083, adjusted R^2 = 0.076, p < 0.001).

Table 2. Eating attitudes, eating behaviors, and estimated type 2 diabetes risk by sex (n = 814).

Measure		Total (n = 814)	Male (n = 300)	Female (n = 514)	p-value
EAT-26 total score	**(Score ± SD)**	12.84 ± 9.10	10.42 ± 8.12	14.25 ± 9.42	<0.001
EAT-26 score ≥20	**n (%)**	152 (18.67)	38 (12.67)	114 (22.18)	<0.001
TFEQ Cognitive Restraint	**(Score ± SD)**	45.32 ± 17.18	41.86 ±16.74	47.33 ± 17.10	<0.001
TFEQ Uncontrolled Eating		39.74 ± 15.22	37.18 ±14.86	41.22 ± 15.29	<0.001
TFEQ Emotional Eating		36.58 ± 18.40	31.22 ±17.10	39.66 ± 18.54	<0.001
FINDRISC total score		6.18 ± 3.42	6.46 ± 3.50	6.02 ± 3.36	0.080
FINDRISC risk category	**n (%)**				0.040
Low		554 (68.06)	196 (65.33)	358 (69.65)	
Slightly elevated		188 (23.10)	78 (26.00)	110 (21.40)	
Moderate/high		72 (8.84)	26 (8.67)	46 (8.95)	

Notes: Continuous outcomes are reported as mean ± standard deviation, whereas categorical outcomes are shown as number and column percentage. Sex-based comparisons were performed using independent-samples t-tests for continuous variables and chi-square tests for categorical variables. EAT-26, Eating Attitudes Test-26; TFEQ, Three-Factor Eating Questionnaire; FINDRISC, Finnish Diabetes Risk Score.

Table 3. Correlations among eating attitudes, eating behaviors, BMI, and estimated type 2 diabetes risk (n = 814).

Variable	EAT-26 total score	TFEQ Cognitive Restraint	TFEQ Uncontrolled Eating	TFEQ Emotional Eating	BMI	FINDRISC total score
EAT-26 total score	1.00					
TFEQ Cognitive Restraint	0.28***	1.00				
TFEQ Uncontrolled Eating	0.34***	0.22***	1.00			
TFEQ Emotional Eating	0.41***	0.18***	0.49***	1.00		
BMI	0.12**	0.09*	0.21***	0.16***	1.00	
FINDRISC total score	0.18***	0.11**	0.24***	0.19***	0.62***	1.00

Notes: **The table presents Pearson correlation coefficients. Statistical significance is indicated as follows: *p < 0.05, **p < 0.01, and *p < 0.001. BMI, body mass index; EAT-26, Eating Attitudes Test-26; TFEQ, Three-Factor Eating Questionnaire; FINDRISC, Finnish Diabetes Risk Score.

Table 4. Hierarchical linear regression analysis for FINDRISC total score.

Predictor and Model indicator	Model 1 B	SE	95% CI for B	β	p-value	Model 2 B	SE	95% CI for B	β	p-value
EAT-26 total score	0.04	0.01	0.02–0.06	0.10	0.004	0.03	0.01	0.01–0.06	0.07	0.032
TFEQ Cognitive Restraint	0.07	0.04	-0.04–0.18	0.04	0.206	0.06	0.04	-0.05–0.17	0.03	0.286
TFEQ Uncontrolled Eating	0.39	0.08	0.23–0.55	0.17	<0.001	0.36	0.08	0.20–0.52	0.16	<0.001
TFEQ Emotional Eating	0.13	0.06	0.01–0.25	0.07	0.036	0.11	0.06	-0.01–0.23	0.06	0.056
Age	—	—	—	—	—	0.13	0.06	0.01–0.25	0.07	0.034
Sex, female vs male	—	—	—	—	—	-0.18	0.24	-0.65–0.29	-0.03	0.452
Model fit										
R^2	0.073					0.083				
Adjusted R^2	0.068					0.076				
ΔR^2	—					0.010				
p-value for ΔR^2	—					0.018				
F statistic	15.86				<0.001	12.12				<0.001
Durbin–Watson	—					1.95				
VIF range	1.10–1.56					1.11–1.62				

Notes: FINDRISC total score was entered as the dependent variable. The first model contained the EAT-26 total score and the three TFEQ dimensions; age and sex were subsequently added in Model 2. Variables already included in the calculation of FINDRISC were excluded from the predictor set to prevent mathematical overlap with the outcome. Coefficients for TFEQ dimensions indicate the estimated change in FINDRISC per 10-point increase. Coefficients for EAT-26 and age correspond to a 1-point and 1-year increase, respectively. Sex was coded as 0 for males and 1 for females. B, unstandardized regression coefficient; SE, standard error; CI, confidence interval; β, standardized coefficient; VIF, variance inflation factor.

Table 5. Binary logistic regression analysis for increased estimated type 2 diabetes risk.

Predictor and Model indicator	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
EAT-26 total score	1.15	1.09–1.22	<0.001	1.09	1.02–1.17	0.012
TFEQ Cognitive Restraint	1.08	0.99–1.18	0.083	1.03	0.94–1.13	0.540
TFEQ Uncontrolled Eating	1.26	1.15–1.38	<0.001	1.20	1.08–1.34	0.001
TFEQ Emotional Eating	1.18	1.10–1.27	<0.001	1.10	1.01–1.20	0.031
Age	1.06	1.00–1.13	0.047	1.07	1.00–1.14	0.048
Sex, female vs male	0.96	0.70–1.33	0.810	0.88	0.62–1.25	0.472
Model fit and performance						
-2 Log Likelihood				684.30		
Nagelkerke R^2				0.112		
Hosmer–Lemeshow p-value				0.583		

Notes: Elevated estimated diabetes risk, defined as a FINDRISC score of 9 or above, was the binary outcome. Crude odds ratios were obtained from separate univariable models. The multivariable model simultaneously included EAT-26 score, TFEQ dimensions, age, and sex; variables constituting the FINDRISC score were not re-entered as predictors. Odds ratios for EAT-26 represent a 5-point increase, while odds ratios for TFEQ dimensions represent a 10-point increase. OR, odds ratio; CI, confidence interval; FINDRISC, Finnish Diabetes Risk Score.

The binary logistic regression findings for increased estimated type 2 diabetes risk are provided in Table 5. In the crude analyses, EAT-26 total score, uncontrolled eating, and emotional eating were each significantly associated with increased estimated risk (all $p < 0.001$), while cognitive restraint was not. In the adjusted model, higher EAT-26 total score (OR = 1.09, 95% CI: 1.02–1.17, p = 0.012), uncontrolled eating (OR = 1.20, 95% CI: 1.08–1.34, p = 0.001), and emotional eating (OR = 1.10, 95% CI: 1.01–1.20, p = 0.031) remained significantly related to increased estimated risk. The adjusted model yielded an ROC-AUC of 0.70 (95% CI: 0.64–0.76).

DISCUSSION

This study evaluated the association of eating attitudes and eating behaviors with estimated type 2 diabetes risk among young adults. The main findings showed that EAT-26 total score, uncontrolled eating, and emotional eating were positively associated with FINDRISC total score and increased estimated type 2 diabetes risk. In contrast, cognitive restraint was not significantly associated with FINDRISC total score or increased estimated risk after adjustment. It should also be noted that the correlations between eating attitude/behavior variables and FINDRISC were weak in magnitude. Therefore, these findings should be interpreted as modest associations rather than strong individual-level predictive effects.

The present findings are consistent with previous studies indicating that diabetes risk-related factors may already be observed in young adult and university populations. Al-Shudifat et al. evaluated diabetes risk among university students using FINDRISC and reported that 5.2% of students were at moderate risk and 1.8% were at high risk for diabetes (28). In the present study, 8.84% of participants were classified in the moderate/high FINDRISC risk category. Although the rates are not directly comparable because of differences in population characteristics and risk classification, both studies suggest that a subgroup of university-aged young adults may already have an elevated estimated diabetes risk. This supports the relevance of early, non-invasive risk assessment in young adult populations, even before the development of clinically apparent disease.

The association between problematic eating attitudes and estimated diabetes risk observed in our study is also in line with evidence from student samples. Hamurcu and Batar examined eating disorder risk, physical activity, and FINDRISC diabetes risk among nutrition and dietetics students and reported that eating disorder risk was an important factor to consider when evaluating diabetes risk in university students (29). Similarly, in the present study, higher EAT-26 scores were associated with both higher FINDRISC total score and increased estimated type 2 diabetes risk. This finding indicates that problematic eating attitudes may be observed together with early metabolic risk indicators in young adults. Nevertheless, given the weak magnitude of the association and the cross-sectional design of the study, this result should be interpreted as an association rather than a causal relationship.

Our findings also complement the study by Kes and Can Cicek, who investigated mindful eating, obesity, and type 2 diabetes risk among university students (30). They reported that mindful eating was associated with BMI and type 2 diabetes risk. While their study focused on mindful eating and our study focused on disordered eating attitudes and TFEQ-based eating behavior traits, both studies point to the relevance of eating-related behavioral patterns in estimated diabetes risk among young adults. Taken together, these findings suggest that diabetes prevention in young adults may benefit from considering not only dietary intake but also eating-related psychological and behavioral characteristics.

Among the TFEQ dimensions, uncontrolled eating showed the most consistent association with estimated type 2 diabetes risk in the present study. Uncontrolled eating reflects difficulty regulating food intake, reduced control over eating episodes, and susceptibility to overeating in response to external or internal cues. Previous TFEQ-based research has shown that uncontrolled eating is associated with higher BMI and less favorable eating patterns (31,32). Similarly, Alqahtani and Alhazmi reported significant relationships between eating behavior dimensions and BMI in an adult sample (33). In the present study, uncontrolled eating was positively correlated with BMI and FINDRISC total score and remained associated with FINDRISC total score in the adjusted linear regression model. It was also associated with increased estimated diabetes risk in logistic regression. These results suggest that uncontrolled eating may be one of the more relevant eating behavior dimensions in relation to estimated metabolic risk among young adults.

Emotional eating was also associated with increased estimated type 2 diabetes risk in the logistic regression model. This finding is consistent with literature showing that emotional eating is related to higher BMI, stress-related eating, and less favorable dietary patterns (33,34). Emotional eating may be particularly relevant in university populations because young adults often experience academic stress, irregular schedules, changes in living conditions, and altered food environments. Alqahtani and Alhazmi emphasized that demanding schedules and high-stress environments may influence emotional and uncontrolled eating behaviors (33). In the present study, emotional eating was positively correlated with FINDRISC total score and was associated with increased estimated risk in logistic regression. However, its association with FINDRISC total score became borderline after adjustment in the hierarchical linear regression model, suggesting that its relationship with estimated diabetes risk may be weaker or partly shared with other eating behavior dimensions.

In contrast to uncontrolled and emotional eating, cognitive restraint was not significantly associated with FINDRISC total score or increased estimated type 2 diabetes risk after adjustment. This finding may be explained by the complex nature of cognitive restraint. For some individuals, cogni-

tive restraint may reflect planned and health-oriented regulation of food intake, whereas for others it may reflect reactive dieting, weight concern, or attempts to compensate for overeating. Therefore, its relationship with body weight and metabolic risk indicators may vary across samples. This interpretation is consistent with TFEQ-based studies showing that cognitive restraint, uncontrolled eating, and emotional eating represent related but distinct eating behavior constructs (31,32). In the present study, cognitive restraint showed weaker correlations with FINDRISC than uncontrolled and emotional eating, and it did not remain significant in the adjusted regression analyses.

The strong correlation between BMI and FINDRISC total score should also be interpreted carefully. BMI is one of the structural components of FINDRISC, and therefore a strong association between BMI and FINDRISC is expected. The FINDRISC tool includes age, BMI, waist circumference, physical activity, fruit/vegetable intake, antihypertensive medication use, previous high blood glucose, and family history of diabetes as scoring components (35,36). For this reason, BMI and other FINDRISC components were not included as independent predictors in the revised regression models. This analytical decision was made to avoid overlap with the outcome variable and to reduce the risk of mathematical coupling. As a result, the revised models focused on the association of eating attitudes and eating behavior variables with estimated diabetes risk, independent of re-entering the components already used to calculate FINDRISC.

The use of FINDRISC in this young adult sample also requires careful interpretation. FINDRISC was originally developed to estimate future type 2 diabetes risk in adult populations (35,36) . In very young adults, several FINDRISC components, such as age-related risk points, previous hyperglycemia, hypertension history, and antihypertensive medication use, are generally uncommon. Therefore, FINDRISC may have limited discriminatory capacity in this age group. In the present study, FINDRISC was used not as a diagnostic tool but as a practical indicator of estimated diabetes risk and clustering of lifestyle- and anthropometry-related risk factors. This approach is consistent with previous studies that have applied FINDRISC in young adult or university populations to identify early risk profiles (28,29,36-38).

From a prevention perspective, the findings suggest that eating attitudes and eating behavior traits may be considered alongside non-invasive diabetes risk assessment in young adults. However, the weak magnitude of the correlations should be emphasized. The results do not suggest that problematic eating attitudes or dysregulated eating behaviors alone strongly determine diabetes risk. Rather, they indicate that EAT-26 score, uncontrolled eating, and emotional eating may coexist with higher estimated diabetes risk in a subgroup of young adults. Therefore, screening approaches in university health settings may benefit from including brief assessments of eating attitudes and eating behaviors, particularly when combined with lifestyle and anthropometric risk evaluation.

The relatively large sample and the use of established instruments to assess eating attitudes, eating behavior dimensions, and estimated type 2 diabetes risk are notable strengths of this study. Nevertheless, several limitations should be considered. Because of the cross-sectional design, the direction of the observed relationships cannot be determined. In addition, data were collected through an online self-administered questionnaire, and anthropometric and lifestyle variables were based on self-report, which may have introduced reporting or measurement errors. FINDRISC was originally developed for adult populations and may have limited discriminatory ability in very young adults; therefore, it was interpreted here as an estimated risk indicator rather than a diagnostic tool. Finally, diabetes risk was evaluated using a risk score rather than biochemical markers, and the significant correlations between eating behavior variables and FINDRISC were modest in magnitude.

In conclusion, problematic eating attitudes and dysregulated eating behaviors, particularly uncontrolled and emotional eating, were associated with higher estimated type 2 diabetes risk in young adults. Although these relationships were modest, the findings indicate that eating-related attitudes and behaviors may be considered together with non-invasive diabetes risk assessment in early prevention strategies for this population.

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Author's Contributions
All authors contributed to data collection, manuscript preparation, and critical review of the final text.

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The authors declare that they have no conflicts of interest.

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All procedures involving human participants were conducted in accordance with the ethical standards of the relevant institutional and national research committees and with the Declaration of Helsinki and its subsequent amendments.

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