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Original Research

Determining the effect of diet quality on nutritional status and type 2 diabetes risk in adult females

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Abstract

Aim: This study aimed to determine the effect of diet quality on nutritional status and type 2 diabetes risk in adult females.

Material and Method: This study was conducted between January and March 2022 with the participation of 120 adult females who applied to Özel Maltepe Ersoy Hospital, Nutrition, and Diet Polyclinic for body weight control. The researchers recorded participant information form, IPAQ-SF, 24-hour retrospective food consumption record form, and FINDRISK data through face-to-face interviews. NAR and MAR scores were used to determine the diet quality of individuals.

Results: It was determined that as body weight, BMI, waist circumference, waist-height ratio, neck circumference, body fat percentage, and fat mass values increased, the diabetes risk scores of individuals increased ($p<0.05$). It was determined that decreasing lean body mass and percentage increased the risk of diabetes ($p<0.05$). Biochemical parameters FBG, Insulin, HOMA-IR, TC, LDL-C, and TG values were found to be higher in individuals with high and very high diabetes risk compared to other individuals ($p<0.05$). It was determined that the risk of diabetes decreased as the physical activity levels of individuals increased ($p<0.05$). Diabetes risk score, and it was determined that there was no correlation between the biochemical parameters ($p>0.05$).

Discussion: It has been determined that individuals' anthropometric values, body composition, and physical activity level are important factors in the risk of diabetes. Appropriate health policies should be developed considering this situation.

Keywords

Nutritional Status, Type 2 DM, Diet Quality

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Introduction

The prevalence study conducted regularly by the Turkish Diabetes Epidemiology Study Group (TURDEP II) in our country determined that diabetes mellitus (DM) is 14.6% prevalent in adults and elderly individuals [1]. In a report published in 2000, the World Health Organization (WHO) estimated that the number of individuals with DM would increase by approximately 3.5 million by 2030; however, this number was reached in 2014 [available at:https://www.who.int/publications/i/item/definition-and-diagnosis-of-diabetes-mellitus-and-intermediate-hyperglycaemia]. The low level of physical activity in society and the adoption of a low-quality diet are the reasons for the increase in the incidence of DM. In type 2 DM, a quality diet treatment should be applied to ensure blood glucose regulation. Therefore, healthy and quality nutrition forms the basis of therapy for type 2 DM [2].

Consuming foods with high energy content and low nutritional value, as well as fast food and high-energy drinks, increases the risk of obesity. A diet rich in dietary fiber and a low glycemic index reduces the risk of obesity [3]. In the study by Saraf-Bank et al., high diet quality positively affected some biochemical parameters [4]. It was determined that BMI, waist circumference, and body fat mass increases were associated with low diet quality [5].

This study aimed to determine the effect of diet quality on nutritional status and Type 2 DM risk in adult females.

Material and Methods

The study universe consisted of 170 females who applied to Okan Hospital Nutrition and Diet Polyclinic between January and March 2021. The sample size was calculated at a 95% confidence level using the Raosoft Sample Size Calculator program based on the universe number, and the minimum number of people to be included in the study was determined as 119 people. This cross-sectional study was conducted on 120 adult females who applied to Özel Maltepe Ersoy Hospital Nutrition and Diet Polyclinic for body weight control between January and March 2022. The inclusion criteria for the study were determined as follows: the participants were female, between the ages of 19 and 65, were not pregnant or lactating, did not have any problems speaking and understanding Turkish, and participated in the study voluntarily. Participant information form prepared by the researchers by compiling the literature, International Physical Activity Questionnaire-Short Form (IPAQ-SF), "three-day 24-hour retrospective food consumption record form used in calculating diet quality" and Finnish Diabetes Risk Score (FINDRISC) were applied to individuals who met the participation conditions by face-to-face interview. Regularly calibrated Inbody 270®, a Bioelectrical Impedance Analysis (BIA) device, was used to measure body weight and composition. When individuals apply to the hospital, the biochemical parameters that are routinely measured are Fasting Blood Glucose (FBG) mg/dL, Fasting Insulin mg/dL, Homeostatic Model Assessment Insulin Resistance (HOMA-IR), Total Cholesterol (TC) mg/dL, Low-Density Lipoprotein-Cholesterol (LDL-C) mg/dL, High-Density Lipoprotein-Cholesterol (HDL-C) mg/dL, Triglyceride (TG) mg/dL and Thyroid Stimulating Hormone (TSH) mU/mL and were recorded in the participant information form. After applying to the clinic, the individuals participating in the study were questioned about their food consumption for three consecutive days, one on the weekend and two on the weekdays. Food consumption was recorded in the BEBİS 7.2 program, and the energy and macronutrient elements consumed by the individuals were calculated. Nutrient Adequacy Ratio (NAR) and Mean Adequacy Ratio (MAR) are based on comparing the nutrient intakes of individuals with reference values. Individuals who volunteered to participate in the research were asked to read and sign the Voluntary Consent Form.

Statistical Analysis

The responses to the questionnaire and scale questions directed to the individuals for the research were recorded in the SPSS Statistics 22 program for analysis. "Student's t-test" was used for the difference between two independent groups, 'Mann Whitney U test' was used for the comparison of two parameters that do not conform to normal distribution, 'Anova test' was used for the comparison of at least three groups of numerical variables that show normal distribution, and 'Kruskal Wallis test' was used for the comparison of at least three groups that do not show normal distribution. The relationship between two independent categorical variables was tested by chi-square analysis. The relationship between two numerical parameters was analyzed using a bivariate correlation test. The statistical significance level in the tests was evaluated as $p<0.05$.

Ethical Approval

This study was approved by the Ethics Committee of the Okan University Science, Social, and Non-Interventional Health Sciences Research Ethics Committee (Date: 2021-12-29, No: 147/17).

Results

This study was conducted with 120 adult females with a mean age of 38.7±13.56 years. The average body weight of the individuals was 79.3±15.16 kg, and the average BMI was 30.4±6.09 kg/m^2. The proportion of individuals with an average

Table 1. Evaluation of individuals' diet quality scores and diabetes risk scores according to the classification of anthropometric measurements.

	MAR score $\bar{x}$ ± SS	p	FINDRISK Score $\bar{x}$ ± SS	p
BMI classification				
Normal (18.5-24.9 kg/m^2)	104.3 ±17.57 ^{a}	0.017**	6.9 ±5.22 ^{a}	0,000**
Overweight (24.9-29.9 kg/m^2)	110.1 ±21.55		12.5 ±4.53 ^{b}	
Obese (30-39.9 kg/m^2)	121.4 ±33.82 ^{b}		20.3 ± 3.47 ^{c}	
Waist circumference classification				
Normal (< 80 cm)	103.6 ±20.22 ^{a}	0.011**	6.0 ±4.91 ^{a}	0,000**
Risk (81-88 cm)	107.8 ±21.52		10.3 ±4.75 ^{b}	
High Risk (≥ 88 cm)	118.5 ±30.36 ^{b}		18.5 ± 4.54 ^{c}	
Waist-height ratio classification				
Normal (<0.5cm)	102.5 ±17.33	0.004*	8.3 ±5.62	0,000*
Risk (≥ 0.5 cm)	117.2 ±29.37		16.7 ±5.79	
Neck circumference classification				
Normal (< 34 cm)	110.6 ±23.80	0.067*	11.4 ±6.42	0,000*
Risk (≥34 cm)	117.3 ±31.07		18.3 ±5.02	

* Mann-Whitney U test was performed., **Kruskal Wallis test was performed
P values considered statistically significant are shown in bold (p<0,05)
A,b: there is a statistically significant difference between the groups

waist circumference value was determined as 13.3%; the proportion of individuals in the risk and high-risk groups was determined as 23.4% and 63.3%, respectively. The average FBG value was 99.9±14.96 mg/dL, and the TC value was 204.7±45.24 mg/dL. The proportion of individuals not doing physical activity was 93.3%, and the proportion of individuals doing insufficient physical activity was 6.7%. The average Metabolic Equivalent Task (MET) value of the individuals was calculated as 171.0±241.64 min/week. Body weight, BMI, Waist circumference, body fat percentage, and body fat mass averages were higher in individuals who did not do physical activity than in individuals who did insufficient physical activity; however, no statistical significance was found (p>0.05). Lean body percentage value was calculated as 58.4±7.11% in individuals who did not do physical activity and 66.89±10.83% in individuals who did insufficient physical activity. Statistical significance was found between these two means (p<0.05).

Table 1 evaluates individuals' diet quality scores and diabetes risk scores according to the classification of anthropometric measures. The rate of individuals with high diet quality was 91.7%, while the rate of individuals with inadequate diet quality was 1.6%. The total diet quality score was defined as 114.0±27.81 points. Diet scores of individuals with normal body weight (104.3±17.57) were found to be significantly lower than the diet scores of obese individuals (121.4±33.82) (p<0.05). The diet quality scores of individuals with waist circumference and waist-height ratio in the normal range were significantly lower than those in the other group (p<0.05). No significant difference was found between biochemical parameters and diet quality classification (p>0.05). The mean diabetes risk score of individuals with normal body weight (6.9±5.22) was found to be significantly higher than the scores of overweight (12.5±4.53) and obese (20.3±3.47) individuals (p<0.05). The diabetes risk score of individuals with waist circumference, waist-height ratio, and neck circumference in the normal range was lower than that of individuals in the risk group (p<0.05). Lean body mass and lean body percentage values were found to be significantly higher in individuals with low and mild diabetes risk than in individuals with high and very high diabetes risk (p<0.05).

The average biochemical parameters of individuals according to diabetes risk classification are given in Table 2. According to this table, FBS, insulin, HOMA-IR, TC, LDL-C, and triglyceride values were higher in individuals with high and very high diabetes risk than in others (p<0.05). In the current study, the diet quality score did not differ according to diabetes risk classification (p>0.05). When the anthropometric measurements of individuals were evaluated according to their diabetes risk classification, it was determined that 51.5% of individuals with a high risk of diabetes and 94.1% of individuals with a very high risk of diabetes were obese (p<0.05). There was no individual with a high-risk waist circumference among individuals with low diabetes risk. It was determined that all individuals with very high diabetes risk had a high-risk waist circumference (p<0.05). A significant relationship was found between waist-

Table 3. Correlation of individuals' FINDRISK total score with different parameters

	FINDRISK score	p
	r	
Scales		
MAR score	0.184	0.045*
IPAQ-SF	-0.386	0,000**
Demographic Characteristics		
Age (years)	0.115	0.210
Anthropometric Measurements		
Body weight (kg)	0.417	0,000**
BMI (kg/m^2)	0.505	0,000**
Waist circumference (cm)	0.377	0,000**
Waist height ratio (cm)	0.400	0,000**
Neck circumference (cm)	0.269	0.003*
Body fat percentage (%)	0.346	0,000**
Body fat mass (kg)	0.461	0,000**
Lean body percentage (%)	-0.228	0.013*
Lean body mass (kg)	-0.275	0.003*
Biochemical Parameters		
FBG (mg/dL)	0.065	0.480
Insulin (mg/dL)	0.034	0.714
HOMA-IR	0.029	0.753
TC (mg/dL)	0.115	0.210
LDL-C (mg/dL)	0.063	0.495
HDL-C (mg/dL)	0.005	0.955
Triglyceride (mg/dL)	0.024	0.794
TSH (mU/mL)	-0.086	0.352

bivariate correlation, *p<0.05, **p<0.001
P values considered statistically significant are shown in bold (p<0.05)

Table 2. Mean biochemical parameters of individuals according to diabetes risk classification

	FINDRISK classification					p
	Low (n:14) x ± SS	Light (n:24) x ± SS	Middle (n:15) x ± SS	High (n:33) x ± SS	Very high (n:34) x ± SS	
FBG (mg/dL)	92.5±7.25	92.5±5.02	91.6±4.17	104.0±13.39	107.9±20.26	0
Insulin (mg/dL)	7.4±3.89	7.6±3.95	9.8±3.48	12.3±5.27	13.6±8.70	0
HOMA-IR	1.7±0.89	1.7±0.91	2.2±0.79	3.2±1.39	3.9±3.88	0
TC (mg/dL)	183.1±44.40	196.5±36.58	198.3±34.20	199.9±44.53	226.8±49.62	0.017
LDL-C (mg/dL)	110.4±34.61	123.4±26.66	129.7±26.82	134.2±31.56	147.6±37.57	0.012
HDL-C (mg/dL)	63.1±21.69	58.4±10.40	54.3±7.93	53.5±9.23	57.6±12.39	0.308
Triglyceride (mg/dL)	79.9±21.33	88.6±51.92	110.3±45.96	119.0±82.95	157.3±64.41	0
TSH (mU/mL)	2.2±0.95	2.1±0.87	2.6±1.16	2.5±1.76	2.8±2.27	0.825

Kruskal Wallis test was performed.
P values considered statistically significant are shown in bold (p<0.05)

height ratio and neck circumference classification and diabetes risk classification ($p<0.05$).

It was found that as the IPAQ-SF score, lean body mass, and percentage of individuals increased, FINDRISK scores decreased ($p<0.05$). It was found that as body weight, BMI, waist circumference, waist-height ratio, neck circumference, body fat percentage, and fat mass values increased, diabetes risk scores of individuals increased ($p<0.05$). It was found that there was no correlation between diabetes risk score and biochemical parameters ($p>0.05$) (Table 3).

Discussion

This study was planned to determine the effect of diet quality on nutritional status and Type 2 DM risk in adult females. Today, due to changing diets and low physical activity levels, there are disruptions in the balance of energy intake, which paves the way for obesity. Obesity brings with it many complications. One of these complications is Type 2 DM. In the treatment of this disease, it is essential to have a quality diet treatment to control blood glucose levels [2]. Diet quality is seen to have a very influential role in preventing and treating DM [6].

The average BMI of the individuals in the study was determined as 30.4±6.09 kg/m^2. It was determined that 37.5% of the individuals were overweight, and 44.2% were obese. In a survey conducted in Cyprus to determine nutritional status, women's average BMI was 24.9±5.4 kg/m^2. The average waist circumference was found to be 83.4±16.6 cm [7], while in a study conducted in Istanbul, the prevalence of obesity in individuals was determined to be 6.7% [8]. This rate is considered high since our study was conducted by individuals who applied for body weight control.

It was determined that none of the individuals participating in the study did sufficient physical activity. The rate of individuals who did not do physical activity was 93.3%, and the rate of individuals who did insufficient physical activity was 6.7% in the study conducted by Aslan et al. [9], it was concluded that the rate of females who did physical activity was 7.8%. In a study of professionals working at a desk, the proportion of individuals doing sufficient activity was only 11.0% [10]. The employment status of the individuals was not questioned in this study, but it was determined that 82.5% had a high school education or higher. Considering that the individuals worked desk jobs, this situation can be associated with the high rate of individuals who did not engage in physical activity.

Diet quality is a concept related to the nutritional habits of individuals [11]. Studies have stated that a quality diet plan reduces the risk of developing chronic diseases and contributes to the quality of life of individuals [12, 13]. In our research, the rate of individuals with high diet quality was determined as 91.7%, the rate of those who need to be improved as 6.7%, and the rate of those who are inadequate as 1.6%. In the study of Yosaee [14], the rate of individuals with high, moderate, and low diet quality was determined as 0.7%, 55.9%, and 43.4%, respectively. In this study, the diet scores of individuals with average body weight were significantly lower than those of obese individuals ($p<0.05$). When the literature is examined, the number of studies indicating that diet quality and BMI have an inverse relationship is relatively high [4, 14]. Studies suggest that the relationship between diet quality and body composition is unclear and that the relationship between diet quality and BMI is insignificant for females. This is because females may have healthier eating habits even with a high BMI [15, 16]. The fact that our study yielded results that were opposite to those of the literature can be explained by the fact that the NAR and MAR score scales we used were unsuitable for our sample and that these scores are used to measure nutritional deficiencies, especially in developed countries. It is thought that the NAR and MAR scores yielded results opposite to those of the literature in a sample with a high obesity rate because values such as total energy intake, sodium, and cholesterol were not evaluated by [17].

In the study, the proportion of individuals with low, mild, moderate, high, and very high diabetes risk scores was determined as 11.7%, 20.0%, 12.5%, 27.5%, and 28.3%, respectively. In a study in which diabetes risk was measured using the FINDRISK scale, the proportion of individuals with low, mild, moderate, high, and very high diabetes risk scores was determined as 11.1%, 39.1%, 22.9%, 23.8%, and 3.2%, respectively [18]. In another study conducted in Italy for a similar purpose, the proportion of individuals with very high diabetes risk was 4.9% [19]. A cross-sectional study in our country stated that 15.1% of individuals were in the high and very high-risk groups [20]. The high proportion of individuals with high and very high diabetes risk in this study can be associated with the high rate of individuals being overweight and obese.

In the study, the diabetes risk score average of individuals with normal body weight was found to be significantly lower than the score of overweight and obese individuals. The diabetes risk score of individuals with waist circumference, waist-height ratio, and neck circumference within the normal range was lower than that of individuals in the risk group. In addition, body weight, BMI, waist circumference, waist-height ratio, body fat percentage, and body fat mass average were found to be significantly higher in individuals with very high diabetes risk compared to other individuals. Lean body mass and lean body percentage values were found to be significantly higher in individuals with low diabetes risk and lightweight compared to individuals with high and very high diabetes risk. Studies have reported that the risk of DM increases as BMI and waist circumference increase [21, 22]. A cohort study determined that losing body weight reduced the risk of Type 2 DM [23]. A high BMI value causes an increase in free fatty acids in the body. This leads to increased blood glucose levels and decreased insulin secretion, which leads to adverse effects [24].

Limitations of the Study

Our study was conducted between January and March 2022, and only with individuals who applied to Özel Maltepe Ersoy Hospital Nutrition and Diet Clinic for body weight control, and the community who did not apply to the health institution was not screened. In addition, surveys such as 3-day food consumption records and questionnaires are based on the statements of individuals. Despite this, the survey forms obtained with the statements of individuals in our study were meticulously checked, and the accuracy of the forms was confirmed by the individuals who participated in the research and were added to the survey.

Conclusion

In conclusion, as the BMI values of individuals in the current

study increase, the risk of diabetes also increases. The diabetes risk of individuals with waist circumference, waist-height ratio, and neck circumference in the normal range was lower than the score of individuals in the risk group. FBS, insulin, HOMA-IR, TC, LDL-C, and triglyceride values were found to be higher in individuals with high and very high diabetes risk compared to others. There were no obese individuals among individuals with low diabetes risk. There were no individuals with normal BMI among individuals with very high diabetes risk. It was determined that the diabetes risk of individuals decreased as their physical activity levels increased. As body weight, BMI, waist circumference, waist-height ratio, neck circumference, body fat percentage, and fat mass values increased, the diabetes risk scores of individuals increased. It was determined that the decrease in lean body mass and percentage also increased the risk of diabetes. As a result of our study, it was determined that anthropometric values, body composition, and physical activity level were quite influential in reducing the risk of diabetes.

For this reason, society should be screened with health policies developed before people can apply to a health institution. Dietitians should also educate people about nutrition, especially in schools. The diet quality scale we used in our study did not provide results that align with the literature; however, this study should be conducted on a larger sample using another diet quality scale instead.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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