How does the Risk of Type II Diabetes in Relatives of Patients Hospitalized in the Internal Medicine Clinic? A Hospital-Based Survey Study

Vural Doğru et al. How does the Risk of Type II Diabetes in Relatives of Patients Hospitalized

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Abstract
BACKGROUND/AIMS: Type 2 diabetes is an important health problem and its worldwide frequency is increasing day by day. The study was conducted to determine the risk of type 2 diabetes in the relatives of patients hospitalized in internal medicine clinics.
MATERIALS AND METHODS: This descriptive and cross-sectional study consisted of 337 relatives of the patients hospitalized in internal medicine clinics of a university hospital in the south of Turkey. Data were collected using the "Introductory Information Form" and the "Finnish Diabetes Risk Score (FINDRISC)" scale. Chi-squared test, t-test, Mann Whitney-U test, and Binary logistic regression analysis were used for statistical analysis.
RESULTS: The mean age of the research participants was 42.69±15.80 and the mean total FINDRISC score was 9.65±5.51. According to the FINDRISC score, 22.3% of the participants were in the high-risk group. In the one-way analysis, the risk of diabetes was determined significantly high according to random capillary blood glucose level, systolic blood pressure, marital status, educational status, and income status (p<0.005). Moreover, in the logistic analysis, age, body mass index, waist circumference, physical activity and family history of diabetes had a significant effect on the risk of developing type 2 diabetes (p<0.005).
CONCLUSION: About a quarter of the participants were in the high-risk group for developing type 2 diabetes within 10 years. By means of the tools such as The FINDRISC, early detection of individuals at risk of diabetes can be provided to take measures to prevent or delay diabetes.
Keywords: Type 2 diabetes, risk factor, FINDRISC, patients' relatives, screening

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INTRODUCTION

Diabetes is a chronic broad-spectrum metabolism disorder that the organism cannot benefit from carbohydrates (CH), lipids and proteins due to insulin deficiency or insulin-related defects and requires continuous medical care (1). Life expectancy has prolonged as a result of advances in developing technology and health care systems; therefore, the incidence of chronic diseases such as diabetes has increased. Factors such as fast food habits due to working conditions or time constraints, obesity, low physical activity, and family history also pose a risk for diabetes (2,3).

Diabetes is an important public health problem with an increasing global, national, and regional prevalence. According to the 2019 data of the International Diabetes Federation (IDF), there were 463 million (9.3%) individuals aged between 20-79 and diagnosed with Diabetes Mellitus (DM) in the world in 2019 and this number is predicted to reach 578 million (10.2%) by 2030 and 700 million by 2045 (4,5). The increase in DM prevalence is highest in low- and middle-income countries (% 74-96). In Europe, Turkey ranks first in terms of DM prevalence by 11.1% (6.5 million) and almost half of diabetic individuals are not aware of their diagnosis (4,5). Diabetes prevalence was reported to be 7.2% in the Turkish Diabetes Epidemiology Study (TURDEP-I) conducted nationally in our country in 2002 and to reach 13.7% with an approximately 90% increase in TURDEP-II study conducted in 2010 (6,7).

Approximately 90% of all diabetic individuals have type 2 diabetes and go through a prediabetic period in which the symptoms of type 2 diabetes do not appear. The rate of prediabetes is 7.5% in the world and 8.2% in Turkey (4,5,7). These data demonstrate that DM and DM-related complications will significantly increase both in the world and Turkey. Type 2 diabetes is a long-term chronic metabolic disease that progresses asymptomatically for a long period. Significant dysfunctions can develop in organs such as heart, blood vessels, kidneys when symptoms appear and even a secondary disease (such as myocardial infarction, kidney failure) accompanying DM can be diagnosed. Therefore, a delay in the diagnosis of type 2 diabetes may lead to increased morbidity, mortality, and health expenditures (1,4,5). For this reason, it is very important to determine the disease risk and risk factors affecting the development of DM in the prediabetes period, in which symptoms are not seen, to prevent type 2 diabetes and/or bring under control (4,8-12).

The development of diabetes can be prevented or delayed in these risky groups by adopting healthy living habits such as increasing physical activity, healthy nutrition, maintaining normal weight (1,4,8-12). Relatives of patients hospitalized in internal clinics are also at risk for some diseases (such as diabetes, hypertension, obesity) and family history. For this reason, this study was conducted to determine the risk of type 2 diabetes in patients' relatives, inform those at risk about protection and direct them to the relevant units.

The research question is given below:

1. How does the risk of type 2 diabetes in relatives of patients hospitalized in the internal medicine clinic?

MATERIALS AND METHODS

Study Design

This descriptive and cross-sectional study was conducted to determine the risk of type 2 diabetes in the relatives of patients hospitalized in internal medicine clinics.

Study Participants and Sampling

The population of the study consisted of the relatives of patients hospitalized in internal medicine clinics of a university hospital in the south of Turkey between April 2019 and August 2019. The sample size was determined by power analysis taking Type I error of 0.05 and the power of 80% and the sample consisted of 337 patient relatives.

Relatives of patients who were not previously diagnosed with diabetes, who were aged over 18, who had mental and cognitive competence, who did not have hearing, comprehension and speech problems, who agreed to participate in the study, and of whom standing weight and height measurements were possible were included in the study. Those who were previously diagnosed with DM by a physician and who did not accept the blood sugar measurement were excluded.

Data Collection

The research data were collected using the "Introductory Information Form" and the "Finnish Diabetes Risk Score (FINDRISC)" scale. The introductory information form includes variables related to sociodemographic characteristics (such as age, gender, marital status and educational status).

The Diabetes Risk Score (FINDRISC) consists of eight questions about age, body mass index (BMI), waist circumference, exercise, vegetable-fruit consumption, hypertension (HT), history of high blood glucose, and family history. The total FINDRISC score ranges between 0 and 26. A total score below 7 points indicates a low 10-year risk of developing type-2 diabetes; a score between 7-11 points indicates mild risk; a score between 12-14 points indicates moderate risk; a score between 15-20 points indicates high risk; a score above 20 points indicates very high risk (9). The cut-off value of the scale was determined as 15 and above in some studies that used FINDRISC to determine the risk of Type-2 diabetes (10,11). In this study, a FINDRISC score of 15 and above was defined as "high-very high risk" for type 2 diabetes.

Data Collection Procedures

The researchers applied the questionnaire form to the patient relatives who met the inclusion criteria through the face-to-face interview method. Data collection, anthropometric, blood pressure and random capillary blood glucose measurements were performed by the researchers in the patient waiting room. Body weight was measured at standing position to the nearest 0.1 kg on a calibrated "Seca" electronic balance, the participants wearing light clothes and no shoes and body height was measured with a wall-mounted meter. Waist circumference of the participants was measured using a non-stretch tape measure. Participants' BMI was calculated and classified according to the World Health Organization (WHO) criteria. Random blood glucose was determined from a capillary blood sample using a calibrated device from the same brand (Viva Check). Participants' blood pressure was measured from the right arm at the sitting position after a 10-15 minute-rest using an appropriate cuff, a perfect aneroid mercury sphygmomanometer (Erka), and a stethoscope (Erka). Those with a FINDRISC score of 12 and above and RCBG of 140 mg/dl and above were directed to a healthcare facility for further examination. After the evaluation, all participants were informed about their risk levels.

Prior to the research, permission was taken from the Clinical Research Ethics Committee (dated 03.04.2019 and numbered 2019/147) and the university hospital where the study was conducted. Before the implementation of data collection forms, all participants were informed about the purpose of the study, and voluntary and confidentiality principles and their written and verbal consent were taken.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Science 22.0 (SPSS, IBM Corp., Armonk, NY, USA). Numbers, percentages, means, standard deviations were used to evaluate descriptive characteristics. Kolmogrov–Smirnov test was performed to examine the normal distribution similarity. Independent t-test, Chi-squared test and Fisher's exact test were used in the statistical analysis of data. The Mann Whitney-U test was employed for variables that were not normally distributed. Binary logistic regression (BLR) was performed in multivariate analysis. The goodness of fit of the model was assessed with the Hosmer and Lemeshow test (p>0.05) and the significance of the model was assessed with the Omnibus test (p<0.05). Statistical significance was accepted as p<0.05 in all tests.

RESULTS

The mean age of 337 patient relatives was 42.69±15.80. Of the participants, 58.2% were female, 65.6% were married, 61.1% had a middle income, 73% were unemployed or retired, more than half (60.3%) had a high school degree and above.

According to the FINDRISC scores of the participants, the 10-year risk of developing type-2 diabetes was moderate in 15.7%, high in 19.6% and very high in 2.7% (Table 1). Moreover, the mean total FINDRISC score was determined as 9.65±5.51 (Min: 0, Max: 26). The mean FINDRISC score of women (10.45±10.00) was higher than that of men (8.53±8.00) (Z=-2.99, p=0.003).

In the study, the participants with a FINDRISC score of <15 were defined as "low to moderate risk" group and those with a score of ≥15 were defined as "high risk" group. When the socio-demographic characteristics of the participants were compared according to the FINDRISC group, the risk was found to be higher in those who were married (p<0.001), who were illiterate and literate (p<0.001) and who had poor income (p=0.044). There was no significant difference between gender, working status, and RCBG threshold value and the risk groups (p>0.05). Age (p<0.001), RCBG (p=0.001), BMI (p<0.001), waist circumference (p<0.001) and systolic blood pressure (p=0.002) were low in the high risk group, being significantly higher compared to the low to moderate risk group (Table 2).

When the FINDRISC scores were compared according to the variables included in the FINDRISC calculation, the FINDRISC score and the risk level were found to increase as the age, BMI and waist circumference increased. It was determined that 37.7% of those in the 55-64 age group and 47.1% of those aged over 64 were in the high risk group in terms of type-2 diabetes and that this difference was significant (p<0.001). Of those with a BMI of >30 kg/m2, 55.4% were in the high risk group and this difference was significant (p<0.001). 58.1% of men with a waist circumference of >102 cm and 36.9% of women with a waist circumference of >88 cm were in the high risk group and this difference was significant (p<0.001) (Table 3). Those who did not exercise, who had high blood pressure or who used antihypertensive medicine, who had blood glucose at a high level or upper limit and who had a family history of diabetes were in the high risk group in terms of type-2 diabetes (p<0.001); however, there was no significant difference between the groups in terms of vegetable-fruit consumption (p=0.681) (Table 3).

Variables, age (p<0.001), BMI (p<0.001), waist circumference (p<0.003), physical activity and family history of diabetes (p<0.001), had a significant effect on participants' risk of developing Type 2 diabetes. The risk of developing type-2 diabetes in 10 years was found to be 1347 times higher especially in those with a family history of diabetes compared to those without. The risk was determined to be 48 times higher in those who did not exercise than those who did (Table 4).

DISCUSSION

The mean age of the patient relatives was 42.69±15.80 and 22.3% were determined to be in the high and very high risk groups in terms of the 10-year risk of developing type-2 diabetes.

Moreover, the FINDRISC score and risk level were found to increase with increasing age. Insulin resistance may develop with advanced age due to decreased physical activity, increased incidence of accompanying chronic diseases (especially HT) and increased abdominal fat mass, etc.; therefore, the risk of developing type 2 diabetes may increase, as well (2,7,10-13). Cosansu et al. (10) determined the risk of developing type 2 diabetes in 10 years as 7.9%; Kılıç et al. (11) as 11.5%; Awad et al. (14) as 17.6%; İğci et al. (15) as 32% and the risk of developing type 2 diabetes was determined to increase with increasing age. Although the mean age of the patient relatives included in our study group was low, the risk of developing type 2 diabetes in 10 years was found to be high and very high. All these results suggest that type 2 diabetes is a serious health problem.

In our study, the mean total FINDRISC score of the participants was 9.65±5.51 and the mean FINDRISC score of women (10.45±10.00) was found to be higher than that of men (8.53±8.00). This result indicates that the number of risk factors associated with type 2 diabetes is higher in women compared to men. Likewise, Cosansu et al. (10) Berber et al. (16) and Awad et al. (14) found that the FINDRISC score of women was higher than that of men. Ural et al. (17) conducted a systematic meta-analysis study investigating the prevalence of obesity and waist circumference in Turkey and found that the prevalence of both obesity (32.2% in women, 18.2% in men) and abdominal obesity (50.8% in women, 20.8% in men) was higher in women. Moreover, TURDEP II study determined that the prevalence of both DM and obesity was higher in women than in men (7). These results may be associated with the fact that women spend more time on housework, such as cooking, cleaning due to traditional and cultural characteristics, cannot spend time on physical activity, have a more sedentary life and are fatter.

The risk of developing Type 2 diabetes was found to be higher in the patient relatives who were married, who were illiterate and literate and who had poor income. Likewise, Cosansu et al. (10) Lui et al. (18) Ramezankhani et al. (19) and Oruganti et al. (20) reported that individuals with poor income and low educational levels had a higher risk of developing type 2 diabetes in 10 years. Furthermore, the literature states that individuals with low income and educational levels have a low level of health literacy (21, 22). Having a low educational level and poor income can be an obstacle for accessing appropriate resources (correct information, accessing appropriate health services, consuming healthy foods, etc.) and using these resources effectively to prevent, control and manage these risk factors. Some studies also reported that those who are married have a higher risk of developing type 2 diabetes (10, 19). Our study results are consistent with the literature.

In our study, the FINDRISC score and risk level of the participants were found to increase as BMI and waist circumference increased. Moreover, patient relatives who did not exercise were determined to be in the high risk group in terms of type-2 diabetes. Studies reported that obesity is the most important changeable risk factor in the development of type 2 diabetes, that the age of obesity onset and number of obese-years significantly increase the risk of type 2 diabetes (16,20,23,24), that weight loss may prevent or delay the development of type 2 diabetes (4, 8,12,24). In obesity, some hormones (adipokines such as resistin) produced by adipose tissue increase the insulin resistance. Therefore, obesity contributes to the development of type 2 diabetes and type 2 diabetes contributes to the development of obesity (2,12,25). Our study results are consistent with the literature.

Regular physical activity increases glucose tolerance and insulin sensitivity and ectopic adipose tissue decreases by burning extra calories. Additionally, exercising increases glucose utilization by increasing muscle mass (2,12, 26-30). Similar to our findings, the literature reported that individuals with low levels of physical activity have a high risk of developing type 2 diabetes (11,15,20,23,27), and that excessive sitting contributes to the development of type 2 diabetes independent of sociodemographic characteristics and obesity (29). Being

consistent with the literature (10,11,13,15,20,23,27), half of the participants were found to be physically inactive and above normal weight and both variables were determined as independent risk factors in the development of type 2 diabetes.

Those who had high blood pressure and used antihypertensive medicine were found to be in the high-risk group in terms of type 2 diabetes. Likewise, relevant studies determined that individuals who had hypertension and who used antihypertensive medicine had a higher risk of developing type 2 diabetes than normotensive individuals (11,15,16,23). Genetic characteristics, insulin resistance, dyslipidemia and obesity are common risk factors for the development of both type 2 diabetes and HT (31,32). Identifying risky individuals by making screenings with easy-to-apply scales such as FINDRISC and raising awareness will make a significant contribution to both increased quality of life of individuals and reduced morbidity, mortality and costs.

In our study, patients with a family history of diabetes were found to be in the high risk group for type-2 diabetes. Our study results are consistent with those in the studies that reported that individuals who have a family history of DM had a higher risk of developing type 2 diabetes compared to those without a family history (10,16,18,20,23). The literature states that high carbohydrate intake causes oxidative stress and increased inflammatory response in individuals with genetic susceptibility in terms of DM, leading to the impairment of insulin sensitivity and insulin receptor signaling and increasing the risk of developing DM in the long term (3,33,34).

The results cannot be generalized, as the study was conducted in only one hospital. One of the limitations of the study is that it was conducted only in the patient's relatives in the internal medicine clinic. Another limitation is that the random blood glucose level was measured from capillaries, not plasma. However, the targeted sample size was reached and identified risky individuals were informed about protection from type 2 diabetes and directed to the relevant units. These increase the strength of our study.

CONCLUSION

FINDRISC can help early identify individuals at risk of diabetes. In this study, 22.3% of the patient relatives were found to be at high risk in terms of developing type-2 diabetes in 10 years. The risk of developing type 2 diabetes was determined to be higher in women, in those who were married, who had poor income and low educational levels, and those who had a family history of DM. Moreover, our study revealed that the classical risk factors such as physical inactivity, BMI, waist circumference, and HT have an important effect on the development of type 2 diabetes. Therefore, strategies (screenings, training/counseling, guidance to related units) should be developed especially to raise awareness of risky individuals and to prevent and control the development of type 2 diabetes. Performing studies for risk screening can help take early precautions to prevent or delay diabetes.

MAIN POINTS

- The mean score of the relatives of the patients on the FINDRISC was 9.65±5.51. This results show that 22.3% of patients' relatives are at high risk for developing type-2 diabetes within 10 years.
- The mean FINDRISC score of women (10.45±10.00) was higher than that of men (8.53±8.00).
- Age, body mass index and waist circumference increase, physical inactivity and family history of diabetes increased the risk of developing Type 2 diabetes.
- The FINDRISC tool can help early identify individuals at risk of diabetes and take early precautions.

- In terms of type 2 diabetes, screening programs should be applied periodically in order to raise awareness among individuals with a family history of chronic diseases, to prevent and delay the development of DM by identifying risky individuals.

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Table 1. Participants' 10-year risk of developing type-2 DM

Risk level	n	%	Estimated number of Diabetes (n)*
Low: <7 (1/100)	119	35.3	1.1
Mild: 7-11 (1/25)	90	26.7	3.6
Moderate: 12-14 (1/6)	53	15.7	8.8
High: 15-20 (1/3)	66	19.6	22
Very high >20 (1/2)	9	2.7	4.5
*Number of individuals who may be diagnosed with type 2 diabetes in 10 years			

Table 2. Comparison of the socio-demographic variables with 10-year risk of developing type-2 diabetes

Variables	Low and medium risk (<15 points), n (%)	High risk (≥15 points), n (%)	Total (n=337), n (%)	Test values
Gender				
Female	146 (74.5)	50 (25.5)	196 (58.2)	$X^2 = 2.86$
Male	116 (82.3)	25 (17.7)	141 (41.8)	p =0.111
Marital status				
Married	153 (69.2)	68 (30.8)	221 (65.6)	$X^2 = 26.89$
Single	109 (94.0)	7 (6.0)	116 (34.4)	p **<0.001**
Educational status				
Illiterate- literate	8 (61.5)	5 (38.5)	13 (3.9)	$X^2 = 29.73$
Primary school	77 (63.6)	44 (36.4)	121 (35.9)	p **<0.001**
High school	61 (80.3)	15 (19.7)	76 (22.6)	
University and higher	116 (91.3)	11 (8.7)	127 (37.7)	
Working status				
Employed	75 (82.4)	16 (17.6)	91 (27.0)	$X^2 = 1.57$
Unemployed	187 (76.0)	59 (24.0	246 (73.0)	p =0.240
Income				
Poor	76 (76.0)	24 (24.0)	100 (29.7)	$X^2 = 6.22$
Middle	157 (76.2)	49 (23.8)	206 (61.1)	p **=0.044**
Good	29 (93.5)	2 (6.5)	31 (9.2)	
RCBG				
<140 mg/dl	239 (78.6)	65 (21.4)	304 (90.2)	$X^2 = 1.36$
≥140 mg/dl	23 (69.7)	10 (30.3)	33 (9.8)	p =0.271

	39.47±15.28	53.94±12.06		
Age(M±SD)	39.47±15.28	53.94±12.06		Z=-7.09 p **<0.001**
RCBG (M±SD)	107.58±25.38	122.22±51.86		Z=-3.40 p =**0.001**
BMI (M±SD)	25.30 ±4.70	30.37 ± 4.61		t=-8.25 p **<0.001**
Waist circumference (M±SD)	87.21 ± 12.84	102.45 ± 10.22		t=-10.71 p **<0.001**
SBP (mmHg) (M±SD)	118.04 ± 13.23	124.60 ± 15.38		Z=-3.40 p =**0.002**
DBP (mmHg) (M±SD)	75.76± 9.55	77.14 ± 10.88		Z=-.68 p =0.491
M±SD: mean ± standard deviation, SBP: Systolic blood pressure, DBP: diastolic blood pressure, BMI: Body Mass Index, RCBG: Random Capillary Blood Glucose				

Table 3. The distribution of FINDRISC scale scores by FINDRISC variables

Variables	Low and medium risk (<15 points), n (%)	High risk (≥15 points), n (%)	Total (n=337), n (%)	Test values
Age group				
0 point: < 45	169 (92.3)	14 (7.7)	183 (54.3)	$X^2 = 50.77$
2 points: 45–54	42 (62.7)	25 (37.3)	67 (19.9)	p **<0.001**
3 points: 55–64	33 (62.3)	20 (37.7)	53 (15.7)	
4 points: > 64	18 (52.9)	16 (47.1)	34 (10.1)	
BMI (kg/m^2)				
0 point: <25 kg/m^2	133 (93.0)	10 (7.0)	143 (42.4)	$X^2 = 66.60$
1 point: 25–30 kg/m^2	96 (80.0)	24 (20.0)	120 (35.6)	p **<0.001**
3 points: >30 kg/m^2	33 (44.6)	41 (55.4)	74 (22.0)	
Waist circumference (men)				
0 point: <94 cm	176 (95.1)	9 (4.9)	185 (54.9)	$X^2 = 84.66$
3 points: 94-102 cm	60 (66.7)	30 (33.3)	90 (26.7)	p **<0.001**
4 points: >102 cm	26 (41.9)	36 (58.1)	62 (18.4)	
Waist circumference (women)				
0 point: <80 cm	69 (97.2)	2 (2.8)	71 (21.1)	$X^2 = 57.58$
3 points: 80-88 cm	70 (98.6)	1 (1.4)	71 (21.1)	p **<0.001**
4 points: >88 cm	123 (63.1)	72 (36.9)	195 (57.9)	
Physical activity				
0 point: Yes	147 (88.0)	20 (12.0)	167 (49.6)	$X^2 = 20.21$
2 points: No	115 (67.6)	55 (32.4)	170 (50.4)	p **<0.001**
Vegetable-fruit consumption				
0 point: Every day	172 (78.5)	47 (21.5)	219 (65.0)	$X^2 = .228$
1 point: Not every day	90 (76.3)	28 (23.7)	118 (35.0)	p =0.681
Hypertension or use of antihypertensive medicine				
0 point: No	238 (85.6)	40 (14.4)	278 (82.5)	$X^2 = 56.79$
2 points: Yes	24 (40.7)	35 (59.3)	59 (17.5)	p **<0.001**
History of high blood glucose				
0 point: No	239 (87.9)	33 (12.1)	272 (80.7)	$X^2 = 83.51$
5 points: Yes	23 (35.4)	42 (64.6)	65 (19.3)	p **<0.001**

Family history of diabetes				
0 point: No	131 (92.9)	10 (7.1)	141 (41.8)	$X^2 = 35.70$
3 points: Second-degree relatives	52 (74.3)	18 (25.7)	70 (20.8)	p **<0.001**
5 points: First-degree relatives	79 (62.7)	47 (37.3)	126 (37.4)	
BMI: Body mass index, RCBG: Random capillary blood glucose				

Table 4. Binary logistic regression analysis of factors affecting the risk of developing type 2 DM				
Variables	**β**	**P**	**OR**	**95% CI**
Aged	.138	**.000**	1.149	1.068-1.235
BMI	.333	**.000**	1.395	1.167-1.667
Waist circumference	.103	**.003**	1.109	1.036-1.187
RCBG	.007	.444	1.007	0.989-1.026
SBP	.035	.254	1.036	0.975-1.100
Physical activity	3.883	**.000**	48.587	8.683-271.860
Family history of diabetes	7.206	**.000**	1347.989	70.727-25691.358
Marital status	.606	.534	1.833	0.272-12.374
Educational status	-.641	.347	0.527	0.138-2.006
Income	.467	.773	1.595	0.067-38.172
BMI: Body Mass Index, RCBG: Random Capillary Blood Glucose, SBP: Systolic blood pressure, OR: odds ratio, Independent variables: physical activity, family history of diabetes, marital status, educational status and income status were categorical variables and age, BMI, waist circumference, RCBG and SBP were continuous variables				