Original article

A Diabetes Risk Screening In Northern Cyprus: What We Learned With FINDRISC

Serpil Özsoy[1], Emel Özer[2]

[1]Faculty of Health Sciences, Department of Nutrition and Dietetics, Near East University, Nicosia, Cyprus;
[2]Turkish Diabetes Dietician Association, Istanbul, Turkey

Abstract. *Background:* According to the data of IDF 2019, 463 million people with diabetes live in the world and it is predicted that this number will increase by 51% in the next 25 years and reach 700 million. T2 D is increasing due to industrialization, obesity, decreased physical activity and unhealthy lifestyle behaviors. Especially in individuals with a high risk of diabetes, physical activity intervention, development of healthy eating habits, obesity management and behavior change intervention reduce the development of diabetes by 58%. *Objective:* The aim of this research was to determine diabetes risk score of nurses with FINDRISC questionnaire. The FINDRISC questionnaire is a cost-effective and fast-applied scoring that does not require any intervention. *Method:* FINDRISC questionnaire was applied to the participants by face-to-face interview technique. *Results:* It was determined that as the age, body mass index and waist circumference values increased parallel with the total score of FINDRISC. *Conclusion:* It is important to perform screening studies to identify high-risk groups for Type 2 diabetes in order to prevent or delay the development of Type 2 diabetes. It is thought that identifying high-risk individuals and preventing the development of diabetes by lifestyle changes can reduce both direct expenditures for medical care associated with the disease and indirect expenditures associated with loss of income and productivity.

Key Words: Prediabetes, diabetes, diabetes risk, diabetes prevention, FINDRISC

Introduction

Diabetes, which is described as epidemic due to its dramatic increase in prevalence, is the 4th most common disease among non-communicable diseases and has been among the top 10 causes of death in the last two decades (1). According to Diabetes Atlas published by the International Diabetes Federation (IDF), 463 million individuals with diagnosed and undiagnosed diabetes are living with diabetes in 2019 and this number will increase by 51% in the next 25 years to reach 700 million (2). It is estimated that global health expenditure due to diabetes is 760 billion USD/year and will reach 825 million USD by 2030 (2). Long-term undiagnosed diabetes can lead to a further increased risk of diabetes-related complications, increased healthcare utilization and, ultimately, the cost of the disease (3).

It is reported that one out of every two adults living with diabetes in the 20-79 age group worldwide is not aware of the current situation, so early diagnosis is very important (2). It is emphasized that in order to reduce the burden of diabetes, which place a heavy burden on healthcare systems with its high morbidity and mortality rate, the risk groups for diabetes should be defined and clinical diabetes should be prevented or delayed with prevention programs(4). According to the evidence-based data, there is no effective and reliable method to prevent Type 1 diabetes, although, Type 2 diabetes (T2D) is a preventable health problem (5).

Many studies have shown that the risk of T2D development can be reduced by lifestyle changes or oral antidiabetic drugs in individuals with impaired glucose tolerance (IGT) (6).Studies showing the efficacy of lifestyle change in the prevention of diabetes are also included in the Da Qing study (6), The Finnish Diabetes Prevention Study (DPS) (7), the Diabetes Prevention Program (DPP) (8) and the Malmö study (9) are cited as an example.Diabetes development can be reduced by 58% by increasing physical activity, developing healthy eating habits, obesity management and behavior change intervention in individuals with high T2D risk (10,11) .

Because of 50% of people with T2D have both undiagnosed and untreated for a variable period of time,screening for T2D is recommended in people with high risk factors. Screening questionnaires, developed to reduce the number of people who need laboratory testing, are widely used because they contain the main risk factors and can be easily performed by trained personnel and even by the screened people(12).The Finnish Diabetes Risk Score (FINDRISC) questionnaire can be easily applied on a social scale to identify people with high risk for T2D. It is a simple, quickly applicable, cheap, non-intervention, and reliable T2D screening tool(7). The IDF reports that individuals who have a high score in the screening test should follow the recommended diagnostic procedure, and the most commonly used procedure is the fasting blood glucose level measurement, which is also accepted as a screening test (12).

According to the results of screening studies conducted in Northern Cyprus in 2008, the prevalence of IGT was determined as 18% and the prevalence of diabetes as 11% (13). 12 Based on the first screening data of Turkish Cypriots in 1996, it was reported that the prevalence of IGT and diabetes were quite high (13.5%, 7.3%, respectively) (14).The diabetes prevalence in Northern Cyprus, which is higher than the world average, emphasizes the urgent need for strategic plans to prevent diabetes. Identifying people at risk of developing diabetes, actions to increase awareness of T2D as a preventable disease, and structured intervention programs may be effective in reducing the prevalence of T2D and IGT in Turkish Cypriots and limiting the social and economic burden of diabetes.

The aim of this study is to determine the risk levels for T2D of the nurses who work in the most comprehensive university hospital through the FINDRISC survey for the first time in Northern Cyprus, and to evaluate the presence of metabolic risk together with anthropometric measurements.

Material and methods

The study was planned to be conducted with 147 nurses between the ages of 19-65 working at the Near East University (NEU) Hospital. Inclusion criteria in the study were 1) not being diagnosed with diabetes in a health institution; 2) not being pregnant or breastfeeding 3) willing participants to participate in the study. The study was carried out between December 2014 and March 2015, by interviewing nurses who met the inclusion criteria (n = 111), at the NEU hospital services (Figure 1).

A questionnaire including FINDRISC questionnaire was applied to the participants with 'One-on-One Interview Technique'. Question form applied; It consists of three sections: a- general information, b- anthropometric measurements, c- diabetes riskquestionnaire. While anthropometric measurements (body weight, height, waist circumference) were taken, non-stretch tape measure and Tanita - HD 318 were used and recorded in the questionnaire form. The implementation of the questionnaire took an avarege of 25 minutes.

FINDRISC developed and designed by Adj. Prof Jaana Lindstrom and Prof. Jaakko Tuomilehto from the National Institute for Health and Welfare, Helsinki, Finland (15). It has eight scored questions, with the total test score providing a measure of the probability of developing type 2 diabetes over the following 10 years. The test covers questions about age, body mass index (BMI), waist circumference, antihypertensive medication and history of high blood sugar, physical activity, and daily consumption of fruits, berries, or vegetables. The highest score obtained by summing up the scores given according to the answers is 26 points. The definition of diabetes risk degree and 10-year risk ratio according to the total score obtained was made according to the criteria determined for the evaluation of FINDRISC (Table 1) (16).

The arithmetic mean (x) and standard deviation (S) values of the quantitative data were determined.

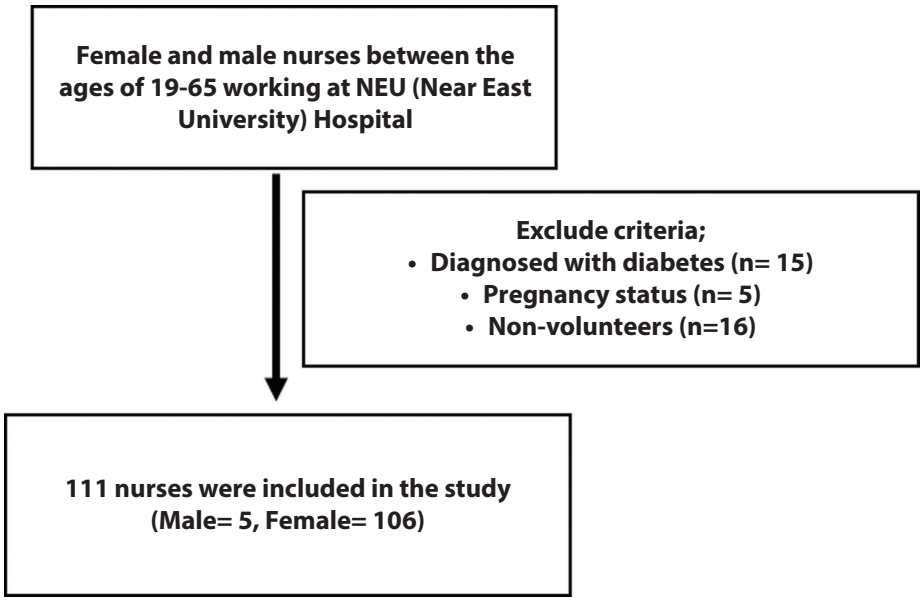

Figure 1. Study Sample

Table 1. Evaluation of the total Finnish Diabetes Risk Score (FINDRISC).

Total Score	Risk Degree	10-Year Risk
< 7	Low	% 1
7 – 11	Slightly Elevated	% 4
12 – 14	Moderate	% 16
15 – 20	High	% 33
> 20	Very High	% 50

The qualitative data obtained or the quantitative data converted into qualitative data were expressed as number (n) and percentage (%). Since the universe was studied, no statistical test was used to measure the sample's ability to represent the universe. However, descriptive statistics applications were carried out with the SPPS 18.0 statistics program.

Results

111 nurses, 5 males (4.5%) and 106 females (94.5%), with a mean age of 34.5±12.4 years, participated in the study (Table 2). Average body weight, height, body mass index and waist circumference of the participants, respectively; 66.1±15.3 kg, 162.9±6.4 cm, 24.7±4.8 kg / m^2 and 85.3±12.4 cm (Table 2).

When evaluating the answers to the FINDRISC questionnaire, 72.1% of the participants are under the age of 45, 19.8% are between the ages of 45-54 and 8.1% are between 55-64 years old. It was determined that the BMI of 59.5% of the participants was less than 25kg/m^2, 31.5% was between 25-30kg/m^2(overweight), 9% was higher than 30kg/m^2(obesity). While 35.2% of the participants were found to have a high waist circumference that could contribute to the development of chronic diseases, 64.8% of them were found to have waist circumference within normal ranges. The rate of those who reported exercising for 30 minutes every day was 17.1%, and the rate of those who did not exercise for 30 minutes every day was 82.9%. 80.2% of the participants stated that they consume fruits, berries orvegetables every day, 9.9% of them use drugs for high blood pressure. The rate of participants whose blood glucose is said to be borderline or high by a physician or any healthcare personnel is 13.5%. 59.5% of the participants (n = 66) reported that any member of their family was diagnosed with diabetes. The proportion of people diagnosed with diabetes among their first-degree relatives was 18.3% (n=18), and the rate of people diagnosed with diabetes in their second-degree relatives was 40.5%(Table 2).

When the risk rating and risk ratio of participantswere evaluated for the next 10 years according to the FINDRISC, it was determined that 30.6 % of

Table 2. Descriptive characteristics of the participants

	n (%)	X ±SD
Gender		
Male	5 (4.5)	
Female	106 (94.5)	
Total	111 (100)	
Age (x ±S)		34.5 ±12.4
Anthropometric measurements		
Body weight (kg)		66.1 ± 15.3
Height (cm)		162.9 ±6.4
BMI (kg/m²)		24.7 ±4.8
Waist circumference (cm)		85.3 ±12.4
Distribution of the waist circumference classification in terms of the development of chronic diseases		
Normal (E≤102 cm, K≤ 88 cm)	72 (64.8)	
High risk (E>102 cm, K>88 cm)	39 (35.2)	
Body Mass Index (BMI) classification		
< 18.5 (weak)	7 (6.3)	
18.5- 24.99 (normal)	59 (56.2)	
25.00- 29.99 (overweight)	35 (31.5)	
≥ 30.00 (obese)	10 (9)	

participants were in 'low risk', 33.3% were in 'slightly elevated risk', 25.2% were in 'moderate risk', 9.9 % were in 'high risk' and 1% were in 'very high risk' groups (Figure 2). In other words, 63.9% of the participants (n=71) were found to have low and mild diabetes risk in the next 10 years, while 36.1% (n=40) were in the moderate-high-very high risk group.

Mean body weight, height, BMI and waist circumference values of participants according to risk groups were given in Table 3. It was determined that the mean BMI was 22±3.3 kg / m²of 34 participants with low diabetes risk, and the mean BMI of 11 participants with high diabetes risk was 29.4±7.9 kg / m² ($p<0.05$). In the study population, it was observed that the participants (77.8%) who were evaluated as overweight and obese according to BMI were distributed to the medium-high-very high group when FINDRISC questionnaire score was evaluate.

Discussion

Considering the social and economic burden that diabetes and diabetes-related complications bring to

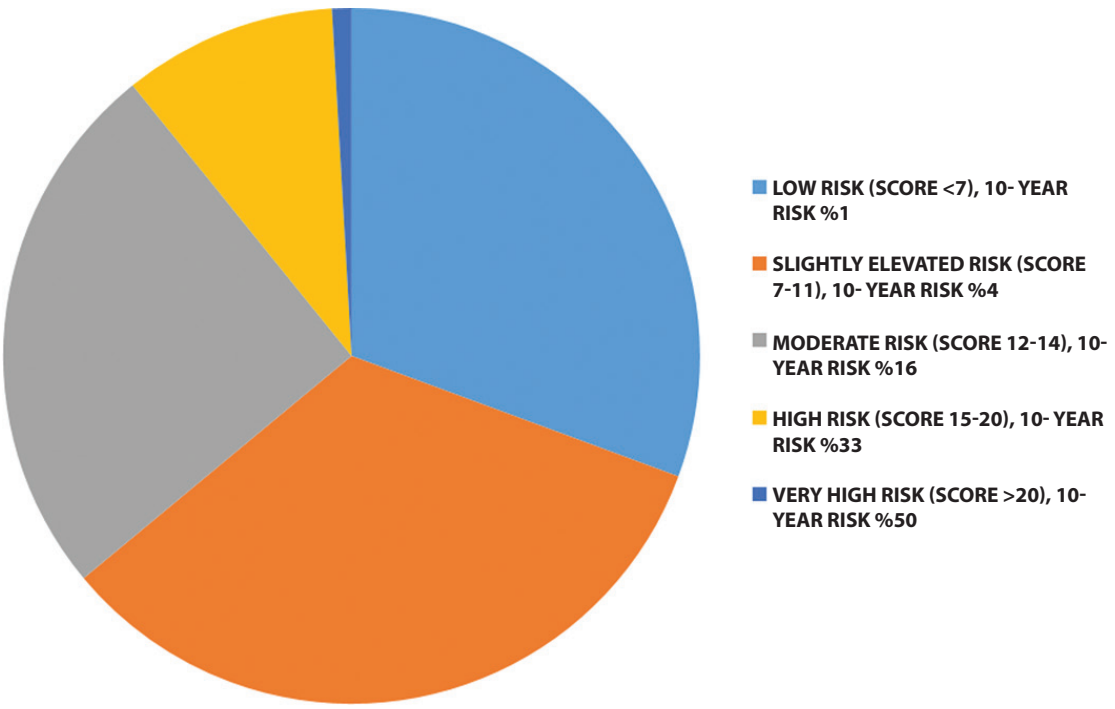

Figure 2. Distribution of participants by Finnish Diabetes Risk Score (FINDRISC) and risk rating

Table 3. Anthropometric measurements of participants according to risk score

Risk Score	**< 7**	7 - 11	12- 14	– 20	>20
BMI (kg/m²)	22.7 ± 3.3	22.8 ± 3.1	28.02 ± 3.9	29.4 ± 7.9	27.6*
BW (kg)	59.3 ± 8.2	61.2 ± 8.5	74.2 ± 10.7	82.3 ± 32.6	74.2*
H (cm)	161.8 ± 7.1	163.7 ± 6.3	162.7 ± 5.3	163.7 ± 8.1	164*
WC (cm)	77.7 ± 8.5	81.6 ± 8.1	93.9 ± 8.9	98.7± 19	91.5*

BMI: Body Mass Index, BW: Body Weight, H:Height, WC: Waist circumference, *: Since there is only one person in this group, standard deviation was not taken into consideration.

both the society and the individual, screening in the preclinical period and identifying high-risk individuals is an important step for prevention (17). It is recommended to use a two-stage application to identify individuals at high risk for T2DM. In the first step, a risk score obtained from non-invasive screening scales should be applied to identify subjects at high risk of having or developing T2DM, and in the second step as a confirmatory test in high-risk individuals fasting glucose, oral glucose tolerance test (OGTT) or glycosylated hemoglobin (HbA1c) test is recommended (18).

Waist circumference measurement alone can be descriptive for the risk of chronic diseases. If waist circumference is ≥ 88 cm in women and ≥ 102 cm in men considered as a risk for the development of chronic diseases (19). Böhme *et al.*(20), in a study conducted in France on 19,951 people to evaluate the risk of T2D, 53.2% (n=10.611) of the participants stated that the waist circumference was not at the values that would indicate the risk of chronic disease. They reported that the rate of those with a high risk of chronic disease was 23.8% (n=4.741), and the rate of those with a very high risk of chronic disease was 23.1% (n=4.599). In our study, as shown in Table 2, 64.8% (n=72) of the participants do not have the risk for chronic diseases development according to their waist circumference (Male <102cm, Female<88cm). In our study, it was determined that 39 participants (35.2%) whose waist circumference values were higher than the normal value they should be (E> 102cm, F> 88 cm) had a high risk for chronic diseases development.

In parallel with lifestyle changes, there has been a dramatic worldwide increase in the prevalence of T2D over the past century. One of the most important reasons for this increase is the increasing prevalence of obesity (21). A study showed that Asian Americans with a BMI 30.00 kg / m_2 had a higher incidence of diabetes (22). According to the Nurse's Health Study (NHS) data, having a BMI 24 kg/m² increases the risk of T2D(23). In a cohort study investigated the relationship between high BMI values and abdominal obesity and T2D, the risk of developing T2D was found to be 1.3 times higher in people with a BMI and waist circumference above normal than people having normal values. Based on the findings of this study, it can be said that in our study the risk of developing T2D may be increased in the participants whose BMI and waist circumference are higher than they should be (35.2%; 40.5%, respectively).

The data of the 'Turkey Diabetes Epidemiology Study I (TURDEP-I) (24) and the Turkey Diabetes Epidemiology Study II (TURDEP-II) (25), which were conducted at 12-year intervals in Turkey, together with the increase in obesity prevalence showed that the prevalence of prediabetes and T2D increased. In 12 years, IGT increased by 107% and the prevalence of central obesity increased by 40%, while the prevalence of T2D increased by 97%, reaching to 13.7%. It has been reported that the prevalence of diabetes increases with age, 10% of the Turkish population from the 40 ages and 20% after the 50 ages have diabetes. According to data of TEKHARF study, abdominal obesity and chronological age are risk factors for the development of diabetes for both genders. In the same study, it was reported that a 6 cm enlargement in the waist circumference increases the risk of developing diabetes by 43% in men and the presence of diabetes increases the risk of developing coronary heart disease by 81%, independent of other risk factors (26). In this study, although the chronological age of 27.9% of the participants was> 45 years, we found that as waist circumference and BMI increased in parallel with the findings

of the literature, the degree of diabetes risk increased according to FINDRISCquestionnaire score ($p<0.05$).

Atayoğlu et al.(27), aimed to determine the T2D risk in the Kayseri region of Turkey, by using FINDRISC in their studies. The researchers found that 37.3% (n=557) of adults (n=1500) were in the very low risk group, 33.3% (n = 501) in the low risk group, 12.3% (n=185) in the medium risk group, 13.9% (n=501) were in the high-risk group and 3.2% (n = 48) were in the very high-risk group. In our study we found that 30.6% (n=34) of the participants were in the very low risk group, 33.3% (n=37) in the low risk group, 25.2% (n=28) in the medium risk group, 9.9% (n=11) were in the high risk group and 0.9% (n= 1) in the very high risk group (Figure 2). In both studies, the proportion of people in the low risk group was found to be the same.

The study that designed by *Cassano et al.*(28),was aimed to determine the T2D risk of participants with T2D risk questionnaire. According to the results of this study, it was found that the average BMI (29.4±7.9 kg / m^2) and the average waist circumference (93.9±19 cm) of the people with high diabetes risk were above normal values. *Saleem et al.*(29), conducted a study with 1530 people in Hawan and aimed to determine the T2D risks of the participants using the FINDRISC questionnaire.According to the results of this study, it was found that the number of overweight and obese people was higher among people with medium-high-very high risk of diabetes according to FINDRISC. In our study, we found that approximately ¾ of the participants evaluated as overweight and obese had a medium-high-very high risk score according to the FINDRISC.

Physical inactivity is an important modifiable risk factor contributing to the development of obesity and T2D by negatively affecting body composition, adipocyte-myocyte distribution, and sensitivity of insulin receptors (30). According to the results of TEKHARF study, the proportion of sedentary people in Turkish society increases in parallel with age and the level of physical activity in women is lower than men in all age groups(26). In our study, the majority of the participants (82.9%), of which 94% were women, reported that they did not exercise regularly. It is thought that the intense work pace of the nurses participating in the study and their frequent working night shifts may be the reasons that prevent them from exercising regularly.

It is emphasized that people with T2D in their first degree relatives carry a higher risk in terms of insulin resistance and diabetes than those without T2D in their family (31).*Huang et al*, examined the relationship between abdominal obesity, genetic predisposition, and T2D risk in their study that included participants from the Nurses' Health Study (NHS) and the Health Professionals Follow-up Stduy (32). According to the results of the study, they found that genetic predisposition (genetic score) was associated with high risk of T2D. In our study, in line with the literature,the number of people with diabetes in close relatives was higher in the group at high risk for T2D development.

The Mediterranean diet and DASH diet, which are described as healthy eating models, recommend consuming 3-6 portions of vegetables and fruits daily (31,32). Unhealthy nutritional habits, which is among the modifiable risk factors of T2D, may increase the risk of T2D (35). As shown in Table 4, 80.2% of the participants consumed fruits, berries vegetables and every day, while 19.8% (n=22) did not. In a meta-analysis study conducted to examine the relationship between vegetable-fruit consumption and T2D risk performed by *Wang et al.*(36),revealed that high vegetable-fruit consumption is associated with low T2D risk.

International Committee of Diabetes Experts states that people with a high risk of diabetes should be included in prevention programs and that they should have diabetes screening preferably with fasting plasma glucose measurement every 3 years after the age of 40(37). Canadian Public Health Agency has modified the FINDRISC questionnaire which is used in the National Diabetes Prevention Program in Finland and named as CANRISK for clinicians. According to CANRISK, the risk score distribution is divided into 3 groups. 0-14 points were determined as low-moderate risk, 15-20 points as high risk and> 21 as very high risk, and the high risk group should be screened every 3-5 years, and the very high risk group should be screened with HbA1c measurement every year (38). In the study of *Coşansu et al.*(39), the rate of participants with a diabetes risk score ≥ 15 points was found to be 7.9%. according to the FINDRISC survey.

Table 4. Distribution of the answers given to the Finnish Diabetes Risk Score (FINDRISC) questionnaire

Variable	**n (%)**
Age Groups	
<45 years	80 (72.1)
45 – 54 years	22 (19.8)
55 – 64 years	9 (8.1)
BMI(kg/m²)	
< 25	66 (59.5)
25 – 30	35 (31.5)
>30	10 (9)
Waist circumference (cm)	
M<94, F<80	37 (33.3)
M:94-102, F:80-88	35 (31.5)
M>102, F>88	39 (35.2)
Exercising for at least 30 minutes a day	
Yes	19 (17.1)
No	92 (82.9)
Consuming fruits and vegetables every day	
Yes	89 (80.2)
No	22 (19.8)
Medication status for high blood pressure	
Yes	11 (9.9)
No	100 (90.1)
History of high blood glucose level	
Yes	15 (13.5)
No	96 (86.5)
Diabetes history in the family	
None	45 (40.5)
1. degree	18 (18.3)
2. degree	45 (40.5)
3. degree	3(2.7)

When we evaluate our study findings according to the CANRISK questionnaire classification, it is seen that the rate of participants with high and very high risk scores did not change, and the rate of participants with low-medium risk group was 89%. According to both FINDRISC and CANRISK, 12 participants (11%), who are in the high and very high risk group, screening tests at the recommended times and taking them into the diabetes prevention program can prevent T2D. As a matter of fact, it has been reported that the training provided by dietitians and frequent visits were effective in the reduction of T2D incidence by 58% in both DPP and DPS(10,11).

Prevention of T2D with intensive lifestyle program, body weight reduction of 5% or more, the rate of meeting energy from fat 30%, saturated fat 10%, daily fiber intake 15 g per 1000 kcal and 30 minutes every day exercise has been effective (40). As shown in diabetes prevention studies, dietitians can reduce the incidence of T2D by gaining healthy eating habits and contributing to a healthy lifestyle (10,11). Prediabetes has been shown to be associated with an increased risk of all-cause mortality and cardiovascular disease in the general population and in people with atherosclerotic cardiovascular disease (41). Detection and management of prediabetes can contribute to the primary and secondary prevention in both T2D and cardiovascular disease.

Although there is no up-to-date data on health expenses due to diabetes in people with diabetes living in Northern Cyprus, it is estimated that the annual cost of health, health expenditures for diabetes and complications caused by diabetes in 2015 will reach $ 50 million for approximately 40,000 people with diabetes (42). Identifying people at high and very high risk of diabetes among Turkish Cypriots and taking them into a structured curriculum-based lifestyle change program may also be effective in preventing the anticipated cost of diabetes in the North Cyprus.

In conclusion, this study is the first diabetes screening performed with FINDRISC in people who have not been diagnosed with diabetes in Northern Cyprus. It has been experienced that FINDRISC is a practical, useful screening tool in the assessment of people with high risk of diabetes. In order to prevent diabetes, people at risk can be identified in a wider population. Managing modifiable risk factors such as unhealthy nutrition and physical inactivity through lifestyle intervention programs can reduce the rate of diabetes prevalence in Turkish Cypriots. Maintaining healthy eating habits from the first years of life and ensuring body weight management can effectively prevent the risk of non-communicable chronic diseases, especially obesity, and can reduce the direct and indirect costs of diabetes.

Limitations: Although we included all the nurses working at the NEU Hospital, our result suggest that our sample size was insufficient for advanced statistical analysis. I think it would be more beneficial to conduct studies designed in this way in a wider population with financial support and to perform advanced screening with OGTT in groups with high and very high diabetes risk.

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References

1. World Health Organization. Diabetes. 2018; Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes
2. Atlas IDFD. International Diabetes Federation. Vol. 266, The Lancet 1955. 134–137 p.
3. Dall TM, Yang W, Halder P, et al. The economic burden of elevated blood glucose levels in 2012: Diagnosed and undiagnosed diabetes, gestational diabetes mellitus, and prediabetes. Diabetes Care 2014;37(12):3172–9.
4. Shubrook JH, Chen W, Lim A. Evidence for the Prevention of Type 2 Diabetes Mellitus. J Am Osteopath Assoc 2018;118(11):730–7.
5. Eyre H, Kahn R, Robertson RM, et al. Preventing cancer, cardiovascular disease, and diabetes: a common agenda for the American Cancer Society, the American Diabetes Association, and the American Heart Association. Circulation 2004;109(25):3244–55.
6. XIAO-REN PAN M, GUANG-WEI Li M, YlNG-HUA HU M, et al. Effects of Diet and Exercise in Preventing NIDDM in People With Impaired Glucose Tolerance. Diabetes Care 1997;20(4):537–44.
7. Tuomilehto J, Lindström J, Eriksson JG, et al. Prevention of Type 2 Diabetes Mellitus by Changes in Lifestyle among Subjects with Impaired Glucose Tolerance. N Engl J Med 2001;344(18):1343–50.
8. England TN. Reduction of the incidence of type 2 diabetes with lifestyle intervention or metformin. Int Urol Nephrol 2002;34(1):162–3.
9. Eriksson KF, Lindgärde F. Prevention of Type 2 (non-insulin-dependent) diabetes mellitus by diet and physical exercise The 6-year Malmö feasibility study. Diabetologia 1991;34(12):891–8.
10. JAANA LINDSTR ¨OM M, 1, ANNE LOUHERANTA P, 2, MARJO MANNELIN M, 3, et al. The Finnish Diabetes Prevention Study (DPS). Diabetes Care [Internet] 2003;26(12):3230–6. Available from: http://care.diabetesjournals.org/content/26/12/3230.short
11. Group TDPP (DPP) R, From the Diabetes Prevention Program Coordinating Center, Biostatistics Center G, Washington University, Rockville M. The Diabetes Prevention Program (DPP): Description of lifestyle intervention. Diabetes 2002;25(12):2162171.
12. Aschner P. New IDF clinical practice recommendations for managing type 2 diabetes in primary care. Vol. 132, Diabetes Research and Clinical Practice 2017. 169–170 p.
13. Cyprus Turkish Diabetes Association. What is the Number of Diabetics in Our Country? [Internet]. Available from: https://diyabetdernegi.com/#sss001
14. Satman I, Dincçag N, Yılmaz MT, et al. Northern Cyprus: another high prevalence area of diabetes and impaired glucose tolerance in the Mediterranean. Diabetologia 1997;40(A185).
15. International Diabetes Federation. Finnish Type 2 Diabetes Risk Assessment Form [Internet]. Available from: https://www.idf.org/296-homepage/about-wdd/511-prevention-of-type-2-diabetes.html
16. Lindström J, Tuomilehto J. The diabetes risk score. Diabetes Care 2003;26(3):725–31.
17. Barry E, Roberts S, Oke J, Vijayaraghavan S, Normansell R, Greenhalgh T. Efficacy and effectiveness of screen and treat policies in prevention of type 2 diabetes: Systematic review and meta-analysis of screening tests and interventions. BMJ 2017;356.
18. Bernabe-Ortiz A, Perel P, Miranda JJ, Smeeth L. Diagnostic accuracy of the Finnish Diabetes Risk Score (FINDRISC) for undiagnosed T2DM in Peruvian population. Prim Care Diabetes [Internet] 2018;12(6):517–25. Available from: https://doi.org/10.1016/j.pcd.2018.07.015
19. Pekcan G. Beslenme durumunun saptanması. T.C. Sağlık Bakanlığı Temel Sağlık Hizmetleri Genel Müdürlüğü Beslenme ve Fiziksel Aktiviteler Daire Başkanlığı 2008. 1–52 p.
20. Böhme P, Luc A, Gillet P, Thilly N. Effectiveness of a type 2 diabetes prevention program combining FINDRISC scoring and telephone-based coaching in the French population of bakery/pastry employees. Eur J Clin Nutr [Internet] 2020;74(3):409–18. Available from: http://dx.doi.org/10.1038/s41430-019-0472-3
21. Wild, Roglic, Green, Sicree & K. Estimates for the year 2000 and projections for 2030. World Health 2004;27(5).
22. Linde RB, Palaniappan LP. Subgroups in a Clinical Population 2012;93(2):248–54.
23. Carey VJ, Walters EE, Colditz GA, et al. Body fat distribution and risk of non-insulin-dependent diabetes mellitus in women: The nurses' health study. Am J Epidemiol 1997;145(7):614–9.
24. Satman I, Yilmaz T, Sengül A, et al. Population-based study of diabetes and risk characteristics in Turkey: Results of the Turkish Diabetes Epidemiology Study (TURDEP). Diabetes Care 2002;25(9):1551–6.
25. Satman I, Omer B, Tutuncu Y, et al. Twelve-year trends in the prevalence and risk factors of diabetes and prediabetes in Turkish adults. Eur J Epidemiol 2013;28(2):169–80.

26. Adult T, Factor R. TEKHARF 2003-2004 taramas › kat › l › mc › lar › n › n genel beslenme örüntüsü ve beslenme al › flkanl › klar ›. 2006;34(6):331–9.
27. Atayoglu AT, Inanc N, Başmisirli E, Çapar AG. Evaluation of the Finnish Diabetes Risk Score (FINDRISC) for diabetes screening in Kayseri, Turkey. Prim Care Diabetes 2020;14(5):488–93.
28. Cassano PA, Rosner B, Vokonas PS, Weiss ST. Obesity and body fat distribution in relation to the incidence of non-lnsulin-dependent diabetes mellitus: A prospective cohort study of men in the normative aging study. Am J Epidemiol 1992;136(12):1474–86.
29. Mohammed Saleem S. Finnish Diabetic Risk Score: A Tool for Predicting Risk of Undiagnosed Type 2 Diabetes Mellitus. Ann Med Heal Sci Res [Internet] 2017;7:295–8. Available from: https://www.amhsr.org/articles/finnish-diabetic-risk-score-a-tool-for-predicting-risk-of-undiagnosed-type-2-diabetes-mellitus.pdf
30. Eaton CB, Hartman SJ, Perzanowski E, et al. A randomized clinical trial of a tailored lifestyle intervention for obese, sedentary, primary care patients. Ann Fam Med 2016;14(4):311–9.
31. ADA. ADA standards of diabetes care 2021. Vol. 44, The journal of clinical and applied research and education 2021. p. S21–226.
32. Huang T, Qi Q, Zheng Y, et al. Genetic predisposition to central obesity and risk of type 2 diabetes: Two independent cohort studies. Diabetes Care. 2015;38(7):1306–11.
33. Bach-Faig A, Berry EM, Lairon D, et al. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr 2011;14(12A):2274–84.
34. [2000 WKG. Medical nutrition therapy for renal disorders. Nutrition and Diet Therapy.
35. Toplak H, Hoppichler F, Wascher TC, Schindler K, Ludvik B. Obesity and type 2 diabetes. Wien Klin Wochenschr 2016;128(2):196–200.
36. Wang PY, Fang JC, Gao ZH, Zhang C, Xie SY. Higher intake of fruits, vegetables or their fiber reduces the risk of type 2 diabetes: A meta-analysis. J Diabetes Investig 2016;7(1):56–69.
37. 16-1-1_Diyabet_Raporu.pdf.
38. Screening for type 2 diabetes in the adults population 2012 [Internet]. p. Canadian Task Force on Preventive Health Care. Available from: https://canadiantaskforce.ca/wp-content/uploads/2016/08/2012-type-2-diabetes-clinician-findrisc-en.pdf
39. Cosansu G, Celik S, Özcan S, Olgun N, Yıldırım N, Gulyuz Demir H. Determining type 2 diabetes risk factors for the adults: A community based study from Turkey. Prim Care Diabetes [Internet] 2018;12(5):409–15. Available from: https://doi.org/10.1016/j.pcd.2018.05.001
40. Odetti PR, Borgoglio A, De Pascale A, Rolandi R, Adezati L. Prevention of diabetes-increased aging effect on rat collagen-linked fluorescence by aminoguanidine and rutin. Diabetes 1990;39(7):796–801.
41. Cai X, Zhang Y, Li M, et al. Association between prediabetes and risk of all cause mortality and cardiovascular disease: Updated meta-analysis. BMJ 2020;370:848–9.
42. Cyprus Diabetes Workshop 2015.

Correspondence
Serpil Özsoy
Near East University
Faculty of Health Sciences
Department of Nutrition and Dietetics
Mersin 10 Turkey
Phone:+90 392 2236464 Ext: 3434
Fax: :+90 392 2236461
E-mail: serpil_ozsoy@hotmail.com