

# Relationship between Finnish diabetes risk score and metabolic syndrome, vitamin d and insulin resistance in women.

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## Abstract

**Objective:** The Finnish Diabetes Risk Score (FINDRISC) is thought to be associated with cardiovascular risk factors separately from type 2 diabetes. We aimed to evaluate the relationship between FINDRISC and metabolic syndrome, vitamin D and insulin resistance in this study.

**Methods:** 115 women were recruited to study. Patients were divided into 5 groups according to FINDRISC score. Metabolic syndrome was assessed in patients with FINDRISC scores, body mass index (BMI), fasting blood glucose (FBG), HbA1c, insulin resistance index (HOMA-IR), high density lipoprotein cholesterol (HDL), triglyceride (TG), systolic and diastolic hypertension.

**Results:** The mean age of the patients was  $30.5 \pm 9$  years, BMI was  $32.4 \pm 6.2$  kg/m<sup>2</sup>, waist circumference was  $98 \pm 13$  cm. HDL:  $46.6 \pm 9$ , HOMA-IR:  $3.6 \pm 2$ . There were (n=34) patients with metabolic syndrome and (n=81) patients without metabolic Syndrome. Patients were divided into 5 groups according to FINDRISC score. There was a significant positive correlation between metabolic syndrome and FINDRISC score (Pearson Chi-square  $r=0.350$ ,  $P=0.001$ ). There was a significant difference between FINDRISC score and age, waist circumference, BMI, HbA1c, HOMA-IR, HDL, systolic and diastolic tension ( $P<0.05$ ). There was no significant difference between FINDRISC Score vitamin D and TG. There was a positive correlation between FINDRISC score and FBG, HbA1c, HOMA-IR, triglyceride, systolic and diastolic blood pressure ( $P<0.05$ ). There was a negative correlation between FINDRISC score and HDL (Person correlation  $r=-0.257$ ,  $P=0.008$ ).

**Conclusions:** Metabolic syndrome in women is associated with increased FINDRISC score. No correlation was found between vitamin D levels and FINDRISC. FINDRISC is not only related with Type 2 DM also associated with cardiovascular risk factors, Systolic-diastolic tension, HDL-C and TG disorder.

**Keywords:** Finnish diabetes risk score; Metabolic syndrome; Vitamin D; Insulin resistance.

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## Introduction

Metabolic syndrome (MS) is one of the most important causes leading to atherosclerotic vascular diseases and type 2 diabetes (Type 2 DM). The main components of metabolic syndrome are abdominal obesity, insulin resistance, increased blood pressure and lipid disorders.

The frequency of the metabolic syndrome varies with increasing age and body weight, as well as with communities examined at the same time. In the United States, the incidence of metabolic syndrome is 27%, and the incidence of metabolic syndrome is increasing faster in women [1]. In Turkey, the prevalence of metabolic syndrome is 38% [2]. Metabolic syndrome is a combination of metabolic risk factors for cardiovascular diseases as well as insulin resistance. Recently, a simple, fast, non-invasive and practical screening tool has been developed to describe the high risk of future type 2 diabetes development in individuals [3,4]. Of these tools, the Finnish Type 2 Diabetes Risk Score (FINDRISC) has been widely used, and has been already validated in different, but mostly Caucasian [3-7] populations for detecting unknown diabetes and the MS. The diagnosis of Type 2 diabetes and cardiovascular diseases is delayed and complications cannot be prevented. Therefore, irrespective of age, individuals with BMI 25 kg / m<sup>2</sup> should be searched from younger ages and more

frequently for individuals with one or more risk factors and who are not pregnant [8]. Vitamin D is considered a complex steroid-hormonal system that regulates calcium homeostasis, and participates in endocrine, autocrine and paracrine processes [9,10]. Vitamin D deficiency has been associated with cell dysfunction and insulin resistance [11]. It has been shown that low vitamin D metabolic syndrome increases risk, as well as low levels of vitamin D in obesity [12,13] and insulin resistance in patients with metabolic syndrome. Only one previous study have reported the association between 25(OH)D3 levels and FINDRISC in subjects with and without obesity [14]. In this study, we aimed to show the relationship between FINDRISC score and metabolic syndrome, vitamin D, insulin resistance, lipids, systolic and diastolic tension.

## Material and Methods

Patients who applied to the internal medicine polyclinic between January and October 2016 were included in the study. Patients with diabetes mellitus, hypertension, thyroid disease, pregnant, persons under 18 years of age, those using drugs that affect vitamin D and calcium metabolism were not included in the study. Number of male patients is 9. The men were removed from work. Because the number of male patients was not statistically significant. 115 female patients were taken into

the study. Metabolic syndrome diagnosis According to the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) -2001, Metabolic glucose)  $\geq 110$  mg / dL) [15].

Subjects were scanned with FINDRISC questionnaire [5], which is easy to use (age, BMI, waist circumference (WC), physical activity, daily consumption of vegetables and fruits, antihypertensive drug use, and personal history of patients Syndrome Diagnostic Criteria were based on at least three of the following 1. Abdominal obesity (waist circumference: 102 cm in males, 88 in females >cm); 2. Hypertriglyceridemia ( $\geq 150$  mg/dL); 3. Low high density lipoprotein (HDL) (<40 mg/dL in males and <50 mg/dL in females); 4. Hypertension (blood pressure  $\geq 130/85$  mmHg ) and 5. Hyperglycaemia (fasting blood with type 2 diabetes was developed to identify high- Hyperglycaemia, and family history of diabetes) to find out the individuals at increased risk for Type 2 DM. According to the diabetes risk score, 5 groups were separated. The risk of developing low-risk and 10-year diabetes mellitus is 1% if group 1 findrisc score <7, mild risk and 4% risk of developing diabetes and group 3 if findrisc score is 7-11, diabetes development 16%, 4th group findrisc score 15-20 high risk and diabetes development 33%, 5th group findrisc score > 20 very high risk and diabetes development 50%.

The body components were evaluated using the Tanita SC 330S instrument. TBW, BMR were evaluated with Tanita. BMI was calculated as weight in kilograms divided by height in meters squared. WC was measured in the mid-way between the underside of the lowest rib and the iliac crest, in centimetres, with subjects standing. Blood pressure, expressed in mmHg was taken on the right arm with the subject in a sitting position after 10 min of rest. Ethics committee approval was taken (71522473/050.01.04/14).

Triglyceride, HDL-cholesterol, fasting blood glucose (FBG) was evaluated as mg/dL. HbA1c and other biochemical results were obtained after 12 h of fasting venous blood samples homeostasis model assessment-insulin resistance (HOMA-IR) was calculated using the equation [fasting glucose (mg / dL)  $\times$  fasting insulin (mu/ml)/405] [16]. 25-OH D3 levels were studied using the Euglobulin clot lysis assay (ECLA) kit (Roche, Germany) and defined as satisfactory by endocrine association criteria ( $\geq 30$  ng/mL).

### Statistical analysis

All statistical calculations were performed using the SPSS 10 program. Normally dispersed variables were analysed with Anova, and anomalous dispersive variables were assessed with Mann-Whitney U test. Pearson choreography was used for continuous variables. Categorical data were evaluated by Chi-Square ( $\chi^2$ ) test. P<0.05 was accepted statistically significant. Results

The mean age of the patients studied was  $30.5 \pm 9$  years, BMI =  $32.4 \pm 6.2$  kg/m<sup>2</sup>, waist circumference:  $98 \pm 13$  cm, HDL cholesterol:  $46.6 \pm 9$ , and insulin resistance (HOMA-IR):  $3.6 \pm 2$ . There were patients with metabolic syndrome (n=34) and patients without (n=81). The general characteristics of patients

with and without metabolic syndrome are also shown in Table 1.

**Table 1:** General characteristics and P values of metabolic syndrome positive and negative patients. SD: Standard Deviation; IQR: Interquartile Range.

|                                | Metabolic syndrome+ (n=34) | Metabolic syndrome- (n=81) | P     |
|--------------------------------|----------------------------|----------------------------|-------|
| Age (year), SD                 | 34.2 (9)                   | 29.2 (8)                   | 0.007 |
| FBG (mg/dL), SD                | 109 (20)                   | 95.2 (8)                   | 0.001 |
| HbA1c (%), SD                  | 5.8 (0.8)                  | 5.4 (0.4)                  | 0.009 |
| HOMA-IR, SD                    | 5.3 (2.6)                  | 2.9 (1.5)                  | 0.001 |
| Waist Circumference (cm), SD   | 107.7 (10)                 | 94.2 (12)                  | 0.001 |
| Systolic tension(mmHg), IQR    | 125 (20)                   | 115 (10)                   | 0.001 |
| Diastolic tension (mmHg), IQR  | 80 (10)                    | 75 (10)                    | 0.001 |
| HDL (mg/dL), SD                | 42 (6)                     | 48.3(9)                    | 0.001 |
| TG (mg/dL), SD                 | 180 (63)                   | 111 (63)                   | 0.001 |
| BMI (kg/m2), SD                | 35.5 (5.3)                 | 31.3 (6.2)                 | 0.002 |
| FINDRISC Score (1,2,3,4,5), SD | 14.2 (4.5)                 | 8.3 (4.4)                  | 0.001 |
| Vitamin D (ng /mL), SD         | 17.6 (7)                   | 15.0 (6)                   | 0.07  |

Patients were divided into 5 groups according to the FINDRISC score Table 2. The general characteristics of the patients are given in Table 3. There was a significant correlation between metabolic syndrome and FINDISC score (Pearson Chi-square  $r=0.350$ ,  $P=0.001$ ). There was no significant difference between FINDRISC score and D vitamin and TG levels ( $P>0.05$ ). There was no correlation between FINDRISC score and D vitamin.

**Table 2:** FINDRISC score by distribution of patients with metabolic syndrome; MS (+): metabolic syndrome positive; MS(-):metabolic syndrome negative.

|        | Findrisc score |    |    |    |   | Total |
|--------|----------------|----|----|----|---|-------|
|        | 1              | 2  | 3  | 4  | 5 |       |
| MS (-) | 28             | 38 | 5  | 9  | 1 | 81    |
| MS (+) | 0              | 10 | 7  | 11 | 6 | 34    |
| Total  | 28             | 48 | 12 | 20 | 7 | 115   |

FINDRISC score was correlated with age, BMI, BCG, HbA1c, HOMA-IR, FAT, FATMAS, free fat mass, total body water (TBW), basal metabolic rate (BMR) And diastolic blood pressure ( $P<0.05$ ). FINDRISC score was correlated with age, BMI, BMI, HbA1c, HOMA-IR, FAT, FATMAS, free fat mass (FFM), total body water (TBW), basal metabolic rate, diastolic and systolic tension blood pressure. There was a negative

correlation between FINDRISC score and HDL (Pearson correlation  $r=-0.257$ ,  $P=0.008$ ).

**Table 3:** General characteristics of patients and P values according to FINDRISC score. FFM: Fat Free Mass; TBW: Total Body Water; BMR: Basal Metabolic Rate; TSH: Thyroid Stimulating Hormone;; BMI: Body Mass Index; ST: Systolic Tension; DT: Diastolic Tension;; triglyceride.

|                         | Findrisc 1  | Findrisc 2  | Findrisc 3  | Findrisc 4   | Findrisc 5  | P     |
|-------------------------|-------------|-------------|-------------|--------------|-------------|-------|
| Age (year)              | 27.0 (7.7)  | 29.7 (8.0)  | 32.6 (10.0) | 34.1 (8.5)   | 44.0 (1.9)  | 0.001 |
| FBG (mg/dL)             | 92.8 (6)    | 97.0 (10)   | 101.0 (9)   | 108.9 (22)   | 107.5 (6)   | 0.001 |
| HbA1c %                 | 5.3 (0.3)   | 5.4 (0.3)   | 5.8 (0.9)   | 5.9 (0.7)    | 6.1 (0.4)   | 0.001 |
| HOMA-IR                 | 2.3 (1)     | 3.6 (2.4)   | 5.1 (3)     | 4.4 (2)      | 3.5 (0.4)   | 0.009 |
| FAT %                   | 31.5 (5)    | 39.5 (5)    | 40.2 (6)    | 43.5 (3)     | 42.0 (3)    | 0.001 |
| FATMAS                  | 22.9 (6)    | 36.0 (9)    | 39.8 (9)    | 41.7 (8)     | 36.2 (8)    | 0.001 |
| FFM                     | 48.4 (2)    | 54.2 (7)    | 58.6 (8)    | 53.2 (3)     | 50.0 (4)    | 0.001 |
| TBW %                   | 35.5 (2)    | 39.7 (5)    | 42.9 (6)    | 39.6 (3)     | 37.0 (4)    | 0.001 |
| BMR (kcal)              | 1532 (127)  | 1702 (195)  | 1820 (239)  | 1710 (133)   | 1600 (110)  | 0.001 |
| TSH (IU/mL)             | 1.8 (1)     | 1.8 (1)     | 3.5 (4)     | 1.9 (1)      | 1.2 (0.3)   | 0.072 |
| WC(cm)                  | 82.5 (5.9)  | 99.9 (9.9)  | 104.5 (8.1) | 109.6 (10.7) | 107.0 (6.8) | 0.001 |
| ST(mmHg)                | 114.6 (6.3) | 118.6 (8.5) | 120.8 (7.9) | 123.2 (7.6)  | 125.7 (7.8) | 0.001 |
| DT(mmHg)                | 73.7 (5.5)  | 75.4 (6.3)  | 79.1 (2.8)  | 77.8 (4.7)   | 77.9 (5.6)  | 0.024 |
| HDL(mg/dL)              | 51.7 (7.5)  | 45.9 (9.6)  | 40.4 (5.7)  | 45.0 (8.0)   | 43.9 (2.1)  | 0.003 |
| TG (mg/dL)              | 119.0 (92)  | 116.5 (51)  | 140.0 (57)  | 164.9 (71)   | 149.0 (22)  | 0.075 |
| BMI(kg/m <sup>2</sup> ) | 26.8 (2.8)  | 32.8 (6.2)  | 34.7 (3.8)  | 36.8 (4.8)   | 35.10 (5.0) | 0.001 |
| VitaminDng/mL           | 14.9 (5.3)  | 15.6 (6.5)  | 13.9 (7.4)  | 17.7 (7.3)   | 16.5 (2)    | 0.531 |

## Discussion

FINDRISC is one of the most commonly used tools to determine type 2 diabetes risk. It includes anthropometric (BMI and WC), metabolic, and lifestyle factors that predict type 2 dm and alterations in glucose metabolism [17]. FINDRISC may be helpful in identifying diabetes in the early stages because the type 2 diabetes diagnosis processes has taken a long time.

The results in this study are based on preliminary studies [18,19] and higher risk for type 2 diabetes by Lima-Martinez et al. [14] (FINDRISC>14), lower risk for type 2 diabetes ) were consistent with studies showing higher age, BMI, WC, FBG, basal insulin, HOMA-IR and blood pressure and lower HDL cholesterol. In our study, patients with higher FINDRISC

scores (1-5) had higher age, BMI, WC, blood sugar, basal insulin, HOMA-IR and blood pressure and lower HDL cholesterol. FINDRISC is not only a tool for scanning type 2 diabetes, it is also a tool for identifying elevated cardio metabolic risk. It can be used to identify metabolic syndrome in high-risk populations [17]. There was a correlation between FINDRISC and the metabolic syndrome in our study. Similar studies have shown the association between FINDRISC and other cardio metabolic markers [14,20]. In our study, we found a negative correlation with HDL cholesterol FINDRISC score in accordance with previous studies [14,21,22]. This may be explained by the inverse relationship that FINDRISC components have with HDL cholesterol. This may be explained by the inverse relation that the FINDRISC components have with HDL cholesterol [23,24]. Recent studies have shown that HDL has the ability to increase uptake of glucose by skeletal muscle [25] and increases insulin secretion from pancreatic beta hysteresis [26], which may also contribute to worsening of low HDL diabetes control. There was a positive correlation between FINDRISC and serum TG levels, which was consistent with previous studies [27]. Also, the waist circumference of patients showing visceral grease increased as the FINDRISC score increased. As visceral fat tissue is more resistant to insulin effects and more sensitive to lipolytic enzymes, more free fatty acid transit in the portal system and increased triglyceride synthesis in the liver can impair the first pass metabolism of insulin [28]. This is consistent with the association of visceral fat with the metabolic syndrome and insulin resistance.

There was a significant positive correlation between scoring with FINDRISC and increased TG, FBG, basal insulin and HOMA-IR. The relationship between basal insulin and HOMA-IR and FINDRISC score was compatible with the literature [29].

Previous studies between vitamin D levels and Type 2 diabetes development have different results. In one of the two studies, there was a lower rate of type 2 diabetes in men with higher D vitamins and a significantly lower rate of diabetes in the other study, but this was not significant in women [30,31].

Studies have shown that low D Vitamin metabolic syndrome affects the risk [32,33]. Vitamin D in obese was found to be low. In some studies, there was no relationship between severe obesity and metabolic syndrome and vitamin D [32]. Although we did not find vitamin D levels low in all patients in our study, we did not find any significant difference in vitamin D levels among those with metabolic syndrome and those without metabolic syndrome. There was no correlation between vitamin D and the metabolic syndrome. There are studies that find a relationship between FINDRISC score and vitamin D [14]. We could not find a relationship between FINDRISC score and vitamin D. This may be due to lifestyle differences such as exposure to sunlight, climatic conditions, protective creams, nutrition, dressing, differences in D vitamin measurement standards, and the use of different cut-off values for vitamin D [34,35]. Because vitamin D is a soluble molecule in fat, fat accumulates in the obese and the bioavailability decreases. For this reason, the serum level can be measured

low even though it is sufficient in the body. Decreased synthesis of 25 (OH) D3 in hepatic steatoza-bound liver may also cause a decrease in vitamin D levels. Also the number of patients taken into the study may have affected the results.

We found a positive correlation between FINDRISC score and systolic and diastolic blood pressure in our study. In this study, FINDRISC was associated with significant insulin resistance.

As a result, individuals with BMI 25 kg/m<sup>2</sup> regard Less of age should be investigated more frequently from younger ages due to diabetes, cardiovascular risk and metabolic syndrome, with one or more risk factors and non-pregnant individuals. As a result of these tests, measures should be taken to prevent or delay the onset of diabetes and cardiovascular events. As the type 2 diabetes diagnosis processes has taken a long time, FINDRISC may be helpful in identifying diabetes and metabolic syndrome in the early stages and therefore preventing diabetic complications.

## Conclusion

In this study we showed that FINDRISC correlated with metabolic syndrome and FINDRISC score was positive with TG and systolic-diastolic tension, and negative with HDL cholesterol. No correlation was found between vitamin D levels and FINDRISC. We believe that FINDRISC can be used not only for predicting diabetes but also for predicting cardiovascular risk. FINDRISC also believes that Type 2 diabetes may be useful in the prevention of cardiovascular disease and its complications.

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