ORIGINAL ARTICLE

UDC: 616.132.2-036-02:616.379-008.64-02
DOI: 10.2298/VSP1405474D

Correlation between the Finnish Diabetes risk Score and the severity of coronary artery disease

Međusobni odnos Finskog skora rizika od dijabetesa i stepena težine koronarne arterijske bolesti

Predrag Djurić*†, Zorica Mladenović*†, Aleksandra Grdinić*†, Dragan Tavčiovski*†, Zoran Jović*, Marijan Spasić*, Žaklina Davičević-Elez*†

***Clinic of Cardiology, Military Medical Academy, Belgrade, Serbia; †Faculty of Medicine of the Military Medical Academy, University of Defence, Belgrade, Serbia**

Abstract

Background/Aim. The FINish Diabetes RIsk SCore (FINDRISC) which includes age, body mass index (BMI), waist circumference, physical (in) activity, diet, arterial hypertension, history of high glucose levels, and family history of diabetes, is of a great significance in identifying patients with impaired glucose tolerance and a 10-year risk assessment of developing type 2 diabetes in adults. Due to the fact that the FINDRISC score includes parameters which are risk factors for coronary artery disease (CAD), our aim was to determine a correlation between this score, and some of its parameters respectively, with the severity of angiographically verified CAD in patients with stable angina in two ways: according to the Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) score and the number of diseased coronary arteries. **Methods.** The study included 70 patients with stable angina consecutively admitted to the Clinic of Cardiology, Military Medical Academy, Belgrade. The FINDRISC score was calculated in all the patients immediately prior to angiography. Venous blood samples were collected and inflammatory markers [erythrocyte sedimentation rate (ESR), leucocytes, C-reactive protein (CRP), total cholesterol, HDL cholesterol, triglycerides and fasting glucose] determined. Coronary angiography was performed in order to determine the severity of coronary artery disease according to the SYNTAX score and the number of affected coronary vessels: 1-vessel, 2-vessel or 3-vessel disease (hemodynamically significant stenoses: more than 70% of the blood vessel lumen). The patients were divided into three groups regarding the FINDRISC score: group I: 5-11 points; group II: 12–16 points; group III: 17–22 points. **Results.** Out of 70 patients (52 men and 18 women) enrolled in this study, 14 had normal coronary angiogram. There was a statistically significant positive correlation between the FINDRISC score and its parameters respectively (age, body mass index-BMI, waist circumference) and the severity of CAD according to the SYNTAX score ($p < 0.001$) and the number of diseased coronary arteries ($p < 0.001$). The patients with higher FINDRISC score (groups II and III) had more severe and extensive CAD according to the SYNTAX score than the group I. The odds ratio with 95% confidence intervals (CI) between the group III and the group I was 5.143 (95% CI 1.299–20.360, $p = 0.002$) and between the group II and the group I 5.867 (95% CI 1.590–21.525, $p = 0.007$). There were no differences in odds ratio for multivessel disease according to FINDRISC score between the group II and the group III [1.141; (95% CI 0.348–3.734). In the group I mean SYNTAX score was 5.18, and more than 70% of patients had normal coronary angiogram. In the group II mean SYNTAX score was 17.06, and more than 70% of patients had 2-vessel disease and 3-vessel disease, and in the group III mean SYNTAX score was 18.89, and 2-vessel and 3-vessel disease had 36.36% and 31.82% patients, respectively. In multiple regression analysis, where SYNTAX score was dependent variable, and age, BMI, waist circumference, FINDRISC score were independent variables, we found that only FINDRISC score was independent predictor of SYNTAX score. **Conclusion.** The obtained results suggest a statistically significant correlation between the FINDRISC score and its parameters (age, BMI, waist circumference) and the severity of CAD according to the SYNTAX score and the number of diseased coronary arteries. The FINDRISC score may be useful in identifying patients at the high risk for coronary artery disease.

Key words:
coronary artery disease; disease progression; risk assessement; diabetes mellitus, type 2; risk factors.

Correspondence to: Predrag Djurić, Clinic of Cardiology, Military Medical Academy, Crnotravska 17, 11 000, Belgrade, Serbia.
E-mail: p.djuric@verat.net

Apstrakt

Uvod/Cilj. Finski skor rizika od dijabetesa (FINDRISC) koji obuhvata nekoliko parametara (godine života, istorija arterijske hipertenzije, indeks telesne mase – BMI, fizička (ne)aktivnost, obim struka, konzumiranje voća, ranije registrovana hiperglikemija, porodično opterećenje za dijabetes) ima puno značaja za identifikaciju bolesnika sa poremećajem glikoregulacije i za procenu 10-godišnjeg rizika od nastanka dijabetesa melitusa tipa 2. Pošto skor FINDRISC čine parametri koji su faktori rizika od koronarne arterijske bolesti (KAB), naš cilj bio je da ispitamo međusobni odnos ovog skora i nekih njegovih pojedinačnih parametara i stepena težine KAB kod bolesnika sa simptomima stabilne angine pektoris na 2 načina: prema skoru *Synergy between Percutaneaus Coronary Intervention with Percutaneans Coronary Intervention with Taxus and Cardiac Surgery* (SYNTAX) i prema broju zahvaćenih krvnih sudova srca. **Metode.** Ispitivanjem je obuhvaćeno 70 bolesnika, hospitalizovanih u Klinici za kardiologiju Vojnomedicinske akademije zbog tegoba tipa stabilne angine pektoris, koji su davali odgovore na pitanja iz upitnika FINDRISC, i kojima su određivane vrednosti inflamatornih markera [sedimentacija eritrocita (SE), leukociti, C-reaktivni protein (CRP), lipidni status (ukupni holesterol, HDL holesterol, trigliceridi), kao i glikemija]. Svim ispitanicima je urađena koronarografija radi utvrđivanja stepena težine KAB prema skoru SYNTAX, kao i prema broju zahvaćenih krvnih sudova srca: jednosudovna, dvosudovna ili trosudovna (hemodinamski značajnim stenozama su smatrane stenoze koje zahvataju više od 70% lumena krvnog suda). Svi bolesnici bili su podeljeni u III grupe u zavisnosti od vrednosti skora FINDRISC (grupa I:5–11 poena, grupa II:12–16 poena, grupa III:17–22 poena). **Rezultati.** Ispitivanjem je bilo obuhvaćeno 52 muškarca i 18 žena. Od 70 ispitanika uključenih u studiju, 14 je imalo normalan koronarografski nalaz. Utvrđena je statistički značajna povezanost između skora FINDRISC, kao i njegovih pojedinačnih parametara (godine, indeks telesne mase, obim struka) sa stepenom težine koronarne arterijske bolesti prema skoru SYNTAX ($p < 0.001$), kao i prema broju zahvaćenih krvnih sudova srca ($p = 0,007$). Šansa za postojanje višesudovne bolesti između grupa III i I iznosila je 5,143 (95% CI 1,299–20,360, $p = 0,002$), a između grupe II i grupe I 5,867 (95% CI 1,590–21,525, $p = 0,007$). Nije bilo statistički značajne razlike između grupe II i grupe III 1,141; (95% CI 0,348- 3,734). U grupi I prosečna vrednost SYNTAX skora iznosila je 5,18, a više od 70% bolesnika je imalo normalan koronarografski nalaz. U grupi II prosečna vrednost SYNTAX skora iznosila je 17,06, a više od 70% bolesnika je imalo dvosudovnu ili trosudovnu KAB. U III grupi prosečna vrednost SYNTAX skora je iznosila 18,89, dvosudovnu i trosudovnu KAB imalo je 36,36%, tj. 31,82% ispitanika. U multiploj regresionoj analizi, gde je skor SYNTAX bio zavisna varijabla, a godine života, BMI, obim struka i skor FINDRISC nezavisne varijable nađeno je da je samo skor FINDRISC bio nezavisan prediktor SYNTAX skora. **Zaključak.** Dobijeni rezultati pokazuju da postoji značajna povezanost skora FINDRISC i njegovih pojedinačnih parametara (godine života, indeks telesne mase, obim struka) sa stepenom težine koronarne arterijske bolesti prema SYNTAX skoru, kao i prema broju zahvaćenih krvnih sudova srca. Skor FINDRISC može biti koristan za identifikaciju bolesnika koji imaju povišen rizik od nastanka koronarne arterijske bolesti.

Ključne reči:
koronarna bolest; bolest, progresija; rizik, procena; diabetes melitus, tip 2, faktori rizika.

Introduction

Coronary artery disease (CAD) is the major cause of mortality in the whole world and also in our country. The FINish Diabetes Risk (FINDRISC) score, which includes the following parameters: age, history of hypertension, body mass index (BMI), physical (in)activity, waist circumference, fruit, vegetables or berries consumption, previously registered hyperglycemia, family history of diabetes, is of a great importance in identifying patients with impaired glucose tolerance and a 10-year risk assessment of developing type 2 diabetes in adults.

Independent risk factor surveys [1] were conducted in Finland, comprising 8,268 men and 9,457 women, aged 25–64 years and free of coronary heart disease (CHD) and stroke at baseline. During the 14-year follow-up 699 incident acute CHD events, 324 acute stroke events, and 765 deaths occurred, and the study confirmed that the FINDRISC score is a reasonably good predictor of CHD, stroke and total mortality in apparently healthy population. A recent study [2] has demonstrated that FINDRISC screening tool has high sensitivity and specificity for detecting diabetes mellitus and impaired glucose tolerance (IGT) and it is a feasible noninvasive tool for screening high-risk individuals in an outpatient heart failure cohort, but there are no available data regarding its prognostic validity in primary prevention and cardiovascular risk assessment in patients with stable angina pectoris.

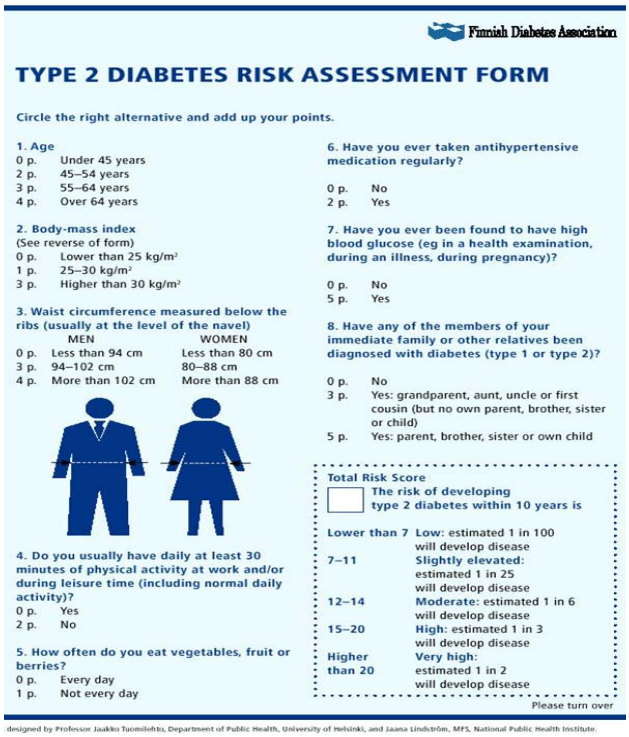
Assessment of CAD severity is a major challenge that cardiologists face every day in their clinical practice. The investigators of the Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) trial developed and validated anatomic scoring system for severity of CAD, which not only quantifies lesion complexity based entirely on angiographic characteristics (the presence of total occlusion, bifurcation or trifurcation, angle and involvement of branch vessels, calcification, lesion length, ostial location, tortuosity and presence of thrombus) [3, 4], but also predicts outcome after PCI in patients with extensive coronary artery disease [5].

Due to the fact that FINDRISC score includes parameters which are risk factors for CAD, we decide do determine correlation between this score, and some of its parameters respectively, with the severity of angiographically verified CAD in patients with stable angina in two ways: according to the SYNTAX score and the number of diseased coronary arteries .

Methods

The study conducted at the Military Medical Academy in Belgrade, included 70 patients with symptoms of stable angina and a number of risk factors for CAD, who were admitted to the Clinic of Cardiology in order to perform coronary angiography. Most patients initially underwent noninvasive cardiac assessment, which include exercise test, or pharmacological dobutamine stress ECHO (assessed as positive for coronary artery disease), while the other had evidence of CAD (previous myocardial infarction, previous percutaneous coronary intervention with stent implantation or revascularization). All the patients with acute or chronic infectious disease, those with chemotherapy or radiotherapy, and those with acute coronary syndrome were excluded. The FINDRISC score was calculated in all the patients immediately prior to angiography. Venous blood samples were collected: inflammatory markers [leucocytes, erytrocyte sedimentation rate (ESR), C-reactive protein (CRP) - we didn`t use high-sensitive CRP, the lowest value was 3.08 mg/dL), total cholesterol, HDL cholesterol, triglycerides and fasting glucose].

We used the FINDRISC score (Figure 1) which includes the following parameters: 1) age: 0 point < 45 years; 2 points: 45–54 years; 3 points: 55–64 years, 4 points > 64


Finnish Diabetes Association

TYPE 2 DIABETES RISK ASSESSMENT FORM

Circle the right alternative and add up your points.

1. Age
0 p. Under 45 years
2 p. 45–54 years
3 p. 55–64 years
4 p. Over 64 years

2. Body-mass index
(See reverse of form)
0 p. Lower than 25 kg/m²
1 p. 25–30 kg/m²
3 p. Higher than 30 kg/m²

3. Waist circumference measured below the ribs (usually at the level of the navel)

	MEN	WOMEN
0 p.	Less than 94 cm	Less than 80 cm
3 p.	94–102 cm	80–88 cm
4 p.	More than 102 cm	More than 88 cm

4. Do you usually have daily at least 30 minutes of physical activity at work and/or during leisure time (including normal daily activity)?
0 p. Yes
2 p. No

5. How often do you eat vegetables, fruit or berries?
0 p. Every day
1 p. Not every day

6. Have you ever taken antihypertensive medication regularly?
0 p. No
2 p. Yes

7. Have you ever been found to have high blood glucose (eg in a health examination, during an illness, during pregnancy)?
0 p. No
5 p. Yes

8. Have any of the members of your immediate family or other relatives been diagnosed with diabetes (type 1 or type 2)?
0 p. No
3 p. Yes: grandparent, aunt, uncle or first cousin (but no own parent, brother, sister or child)
5 p. Yes: parent, brother, sister or own child

Total Risk Score
The risk of developing type 2 diabetes within 10 years is

Lower than 7	Low: estimated 1 in 100 will develop disease
7–11	Slightly elevated: estimated 1 in 25 will develop disease
12–14	Moderate: estimated 1 in 6 will develop disease
15–20	High: estimated 1 in 3 will develop disease
Higher than 20	Very high: estimated 1 in 2 will develop disease

Please turn over

designed by Professor Jaakko Tuomilehto, Department of Public Health, University of Helsinki, and Jaana Lindström, MFS, National Public Health Institute.

Fig. 1 – Finish Diabetes Risk SCore (FINDRISC) to assess the 10-year risk of type 2 diabetes mellitus in adults

years; 2) history of arterial hypertension: 0 point: no, 2 points: yes; 3) BMI: 0 points < 25 kg/m^2, 1 point 25–30 kg/m^2, 3 points > 30 kg/m^2; 4) physical activity: 0 point: yes, 2 points: no; 5) waist circumference: in men 0 point < 94 cm, 3 points 94–102 cm, 4 points > 102 cm in women 0 point < 80 cm, 3 points 80-88 cm, 4 points > 88 cm; 6) fruit, vegetables or berries consumption: 0 point: every day; 1 point: not every day; 7) previously registered hyperglycemia: 0 point: no, 5 points: yes; 8) family history of diabetes: 0 point: no, 3 points yes (grandparent, aunt, uncle, first cousin), 5 points: yes (parent, brother, sister, own child).

All the patients were divided into three groups regarding the FINDRISC score (the group I: 5–11 points, the group II: 12–16 points, the group III: 17–22 points). All the subjects underwent coronary angiography to determine the severity of CAD according to the SYNTAX score (version 2.11) and the number of affected coronary vessels: 1-vessel, 2-vessel or 3-vessel disease (hemodynamically significant stenoses: more than 70% of the blood vessel lumen).

Statistical analysis was performed using SPSS statistical software, a significant difference between the groups was determined by factorial analysis of variance (ANOVA), and χ^2 test to assess the significance of the difference frequency. Nonparametric Spearman coefficient r was used for assessment of correlations between the groups. Statistically significant differences are marked with probability $p < 0.05$.

Comparison of the groups was performed with a multivariable logistic regression analysis and the results were described as odds ratios (Mantel-Haenszel common odds ratios - OR) with 95% confidence intervals (95% CIs). We used multiple regression analysis in order to find the best predictor for the SYNTAX score, as dependent variable, and age, BMI, waist circumference and the FINDRISC score as independent variables.

Results

Baseline characteristics of the patient of all the 3 groups are summarized in Table 1. The patients in the group III were significantly older than the patients in the groups I and II. The patients in groups I and III were mainly female. There was a statistically significant positive correlation between some of the FINDRISC score parameters (age, BMI and waist circumference) and the severity of CAD according to the SYNTAX score ($p < 0.05$). Also, there was a statistically significant correlation between fasting glucose, HDL- cholesterol and the severity of CAD according to SYNTAX score ($p < 0.05$). On the other hand, there was no statistically significant correlation between triglycerides, total cholesterol, creatinine, left ventricular ejection fraction (LVEF) and active smoking and the severity of CAD.

We assessed whether the FINDRISC score could be considered a marker of high cardiovascular risk. There was a statistically significant positive correlation between the FINDRISC score and the severity of CAD according to the SYNTAX score ($p < 0.001$) (Figure 2).

Next, we assessed the OR for multivessel disease according to the FINDRISC score in 3 study groups. Comparison of the groups was performed with multivariable logistic regression analysis and the results were described as OR (Mantel-Haenszel common OR) with 95% CIs. The patients with a higher FINDRISC score (groups II and III) had more severe and extensive CAD according to the SYNTAX score than the group I. The hazard ratio with 95% confidence intervals between the groups III and I was 5.143 (95% CI

Table 1

Baseline characteristics of 3 groups of patients

Characteristics	Group I (n = 17) (5–11 points)	Group II (n = 31) (12–16 points)	Group III (n = 22) (17–22 points)	*p*
Age (years), $\bar{x} \pm SD$	57 ± 8.5	58 ± 9.2	64 ± 6.2	0.017
Sex, [n (%)]				
female	7 (41.2)	2 (6.5)	9 (40.9)	0.004
male	10 (58.8)	29 (93.5)	13 (59.1)	
Glucose (fasting) (mmol/L), $\bar{x} \pm SD$	5.08 ± 0.70	4.97 ± 0.64	5.71 ± 0.93	0.002
Triglycerides (mmol/L), $\bar{x} \pm SD$	1.64 ± 0.91	1.80 ± 1.09	1.75 ± 0.68	0.852
Cholesterol (mmol/L), $\bar{x} \pm SD$	5.74 ± 1.25	5.21 ± 1.26	5.40 ± 1.24	0.376
HDL-cholesterol (mmol/L), $\bar{x} \pm SD$	1.19 ± 0.30	1.01 ± 0.16	1.08 ± 0.25	0.032
Creatinine (μmol/L), $\bar{x} \pm SD$	98.18 ± 21.16	96.90 ± 17.73	101.50 ± 15.80	0.655
Leukocytes (x 10^9), $\bar{x} \pm SD$	6.70 ± 0.90	6.89 ± 1.29	7.42 ± 2.43	0.358
ESR (mm/h), mediana (25–75 percentiles)	7 (6–11)	14 (9–17)	14.5 (11–22)	0.136
Active smoking, n (%)	9 (52.9)	24 (77.4)	14 (63.6)	0.213
BMI (kg/m^2), $\bar{x} \pm SD$	26.50 ± 3.09	25.83 ± 2.73	29.72 ± 4.97	0.001
Waist circumference (cm), $\bar{x} \pm SD$	93.18 ± 6.69	96.10 ± 5.36	99.82 ± 6.27	0.004
LVEF (%), $\bar{x} \pm SD$	59.18 ± 4.43	57.52 ± 7.83	57.41 ± 5.70	0.644
Number of diseased coronary arteries, $\bar{x} \pm SD$	0.71 ± 1.16	1.94 ± 0.81	1.95 ± 0.90	< 0.001

HDL – high density lipoprotein; ESR – erytrocyte sedimentation rate; BMI – body mass index; LVEF – left ventricular ejection fraction.

1.299–20.360, $p = 0.002$). The most notable difference in OR for multivessel disease according to FINDRISC score in our study was between the group II and the group I (5.867; 95% CI 1.599- 21.525, $p = 0.007$) as shown in Figure 3. The low-risk patients for CAD were in the group I (FINDRISC score 5–11).

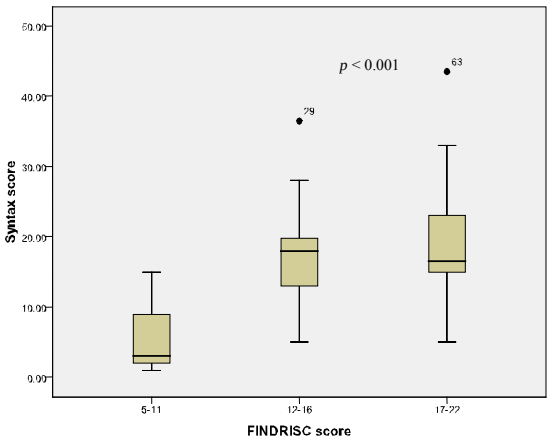


Fig. 2 – Relationship between the Coronary Intervention with Taxus and the Cardiac Surgery (SYNTAX) score and Finish Diabetes Risk SCore (FINDRISC) in the study groups.
The group I: 5–11 points; the group II: 12–16 points; the group III: 17–22 points.

There were no differences in the OR for multivessel disease according to the FINDRISC score between the groups II and III, (1,141; 95% CI 0.348–3.734), which means that all the patients with a score greater than or equal to 12 points were high-risk patients for CAD.

There was a statistically significant positive correlation between the FINDRISC score and the number of affected coronary vessels (total risk $p < 0.001$) (Table 1). In the groups of patients with the score greater than or equal to 12 points more than 70% of the patients had 2-vessel or 3-vessel CAD. In contrast, the patients in the group I had low risk for CAD.

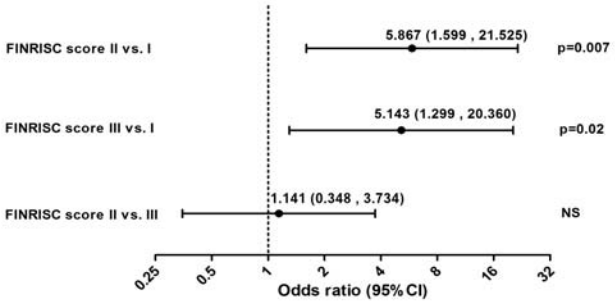


Fig. 3 – Odds ratio with 95% confidence intervals for multivessel disease according to the Finish Diabetes Risk SCore (FINDRISC) in the study groups.
The group I: 5–11 points; the group II: 12–16 points; the group III: 17–22 points.

The patients in the group II (mean value 1.94 ± 08) and the group III (mean value 1.95 ± 0.90) had multivessel CAD in comparison to the patients in the group I (mean 0.71 ± 1.16), i.e. they approximately had 2-vessel CAD. In the group I more than 70% of the patients had normal coronary angiogram; 2-vessel and 3-vessel disease had 17.65% and 11.76% patients, respectively. In the group II more than 70% of the patients had 2-vessel and 3-vessel disease, 25.81% had 1-vessel disease, and only 3% had normal coronary angiogram. In the group III only 4.55% had normal coronary angiogram, 1-vessel disease had 27.27% of the patients, 2-vessel and 3-vessel disease had 36.36% and 31.82% of patients, respectively. CAD was more frequent in the groups II and III than in the group I. The patients who were taking statins, thienopyridines, and nitrates had multivessel disease, which means that they were under optimal medical therapy.

BMI in the group III was higher than in the groups I and II which was statistically significant difference ($p = 0.001$). There was a linear increase in waist circumference through the 3 groups of the patients which was, also, statistically significant ($p = 0.004$).

The values of BMI and waist circumference in the 3 groups of the patients are presented in Figures 4 and 5.

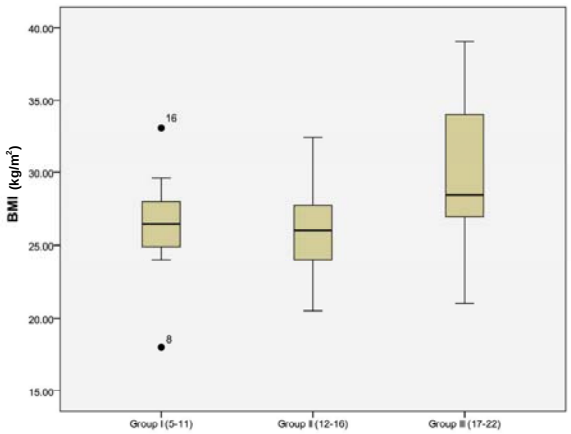


Fig. 4 – Body mass index (BMI) for all the study groups.

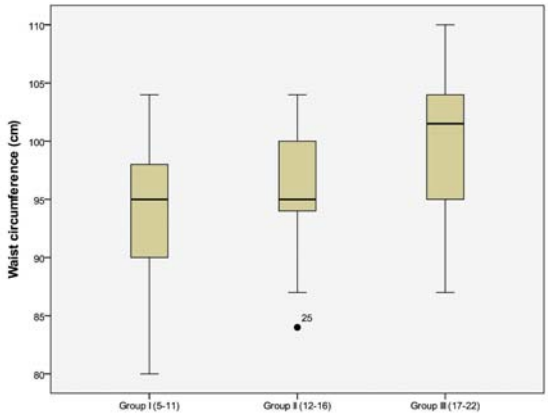


Fig. 5 – Waist circumference for all the study groups.

In multiple regression analysis, where the SYNTAX score was a dependent variable, and age, BMI, waist circumference and the FINDRISC score independent variables we found that only the FINDRISC score was an independent predictor of the SYNTAX score (SYNTAX score = 1.167 + 0.553 × FINDRISC score, $p < 0.001$).

Finally, we studied the correlation between inflammatory markers (ESR, CRP and leukocytes) and severity of angiographically verified CAD according to the SYNTAX score. There was no statistical significance in the values of inflammatory markers between the 3 groups of the patients (Table 1). There was no statistically significant difference in the values of inflammatory markers among the groups I and III: $r = 0.877$ CRP (groups III and I), $p < 0.05$; $r = 0.471$ ESR (groups III and I), $p < 0.05$; $r = 0.790$ Le (groups III and I), $p < 0.05$.

Discussion

To the best of our knowledge, this is the first study about the correlation between the FINDRISC score and the severity of CAD according to the SYNTAX score.

The main result of our study is that there is a statistically significant correlation between the FINDRISC score and its parameters respectively (age, BMI, waist circumference) and the severity of CAD in the patients with stable angina in two ways: according to the SYNTAX score and the number of diseased coronary arteries.

A recent survey [1] has confirmed that FINDRISC screening is a good predictor of coronary heart disease, stroke and total mortality in apparently healthy population, but in our study we tried to determine its prognostic validity in cardiovascular risk assessment in the patients with stable angina. The results obtained in our study are fully consistent with other studies [6], where the correlation between some FINDRISC score parameters, which are classic cardiovascular (CV) risk factors, and CAD were investigated. However, we used the FINDRISC score in order to determine correlation between this score, and the severity of angiographically verified CAD. Our data demonstrated that higher FINDRISC scores indicate a more severe and extensive coronary artery disease according to the SYNTAX score and the number of diseased coronary arteries. The patients in the groups II and III had a higher odds ratio for multivessel disease than in the group I (Figure 3). The most notable difference in our study was between the groups II and I.

There was a statistically significant correlation between some FINDRISC score parameters (BMI, waist circumference) and the severity of CAD. BMI and waist circumference in the group III were higher than in the groups I and II which supports the previously proven association between obesity and the presence of CAD. Obese individuals with increased waist circumference, i.e. those with a higher FINDRISC score, have insulin resistance, which contributes to the development of metabolic syndrome, type 2 diabetes and CAD. A large number of studies [7] have demonstrated that obesity, i.e. BMI greater than 30 kg/m^2, is a significant risk factor for CV disease and death, as well as the development of diabetes. The patients with metabolic syndrome have a two times increased risk of myocardial infarction or stroke compared to healthy population and five times higher risk of diabetes mellitus type 2 (RR 3.77%) [7].

Similar to our study, the large multicenter study (International Day for the Evaluation of Abdominal Obesity – IDEA) [8], which evaluated the correlation between waist circumference and BMI with cardiometabolic risk factors in primary prevention, demonstrated the increased risk of CV disease in patients of both genders, who have a higher waist circumference and BMI. The study, also, showed that the incidence of diabetes can be reduced by 10%, by the reduction of abdominal obesity, which reduces the risk of CAD. Another important study, INTERHEART (a Global Study of Risk Factors for Acute Myocardial Infaction) [9, 10], indicated that abdominal obesity rather than BMI significantly increases the risk of myocardial infarction, which was confirmed in the European Prospective Investigation into Cancer and Nutrition (EPIC-Norfolk) study [11], in 24,508 patients during 9.1 years of follow-up. Abdominal obesity is associated with insulin resistance, which is proinflammatory, proatherogenic [12], with thrombotic potential. Taking into ac-

count the mutual relationship of diabetes and obesity for the development of CV diseases, body weight reduction is very important [13]. Physical activity significantly reduces the risk of type 2 diabetes mellitus, improves insulin resistance, reduces body weight and risk of abdominal obesity. We showed that low risk patients for CAD were in the group of patients with a lower BMI and waist circumference (the group I).

It has been shown that patients with a BMI greater than 25 kg/m^2 have a 3-fold higher risk of developing type 2 diabetes, those with a BMI greater than 30 kg/m^2 have a 10 times higher risk, while those with a BMI greater than 35 kg/m^2 have a 40 times greater risk [14]. A large study (National Health Nutrition Examination Survey) on 15.000 patients [15] demonstrated that increase in waist circumference by 2.5 cm increases TA by 10%, triglycerides by 18%, total cholesterol by 18% and decreases HDL cholesterol by 15%. These results are even more significant considering the fact that the percentage of obese people in the world with a BMI > 25 kg/m^2, from 56% in 1988 was increased to 64% of the total population in 2000.

Our results showed a statistically significant correlation between fasting glucose, HDL- cholesterol and the severity of CAD according to the SYNTAX score ($p < 0.05$). A large metaanalysis, National Cholesterol Education Program (NCEP), conducted in the period 2001–2004, which included 87 studies and 951,083 patients, found that the metabolic syndrome was associated with a 2-fold higher CV risk (RR: 2.35; 95% CI: 2.02–2.73), and 1.5 times higher total mortality (RR: 1.58; 95% CI: 1.39–1.78) compared to healthy population [16, 17].

Elderly subjects are characterized by a high prevalence of CAD but also by a worse prognosis following cardiac events [18]. We found that there was a statistically significant correlation between age and the severity of CAD according to SYNTAX score ($p < 0.05$). In old age advanced atherosclerosis leads to increased incidence of ischemic events, with subsequent hypoperfusion of vital organs.

Most patients with a higher FINDRISC score have a higher odds ratio for developing type 2 diabetes, and greater CV risk, as we found in our study. Macrovascular complications of atherosclerosis are one of the main reasons for patients with type 2 diabetes to have twice or four times greater risk of developing one of the manifestations of ischemic heart disease (angina pectoris or myocardial infarction), and twice or six times greater risk of stroke or peripheral arterial disease [19–21].

Taking into account the mutual relationship of diabetes and obesity for the development of CV diseases, we compared the FINDRISC score, and some of its parameters (age, BMI, waist circumference) as independent variables and the SYNTAX score as a dependent variable. We found that the FINDRISC score was better predictor, providing us more information about the SYNTAX score.

This study investigated the relationship between classic laboratory and metabolic markers that accelerate the process of atherosclerosis (triglycerides, total cholesterol, creatinine, active smoking and inflammatory markers Le, ESR, CRP) and we did not find positive correlation between the 3 groups of patients. But, when we used FINDRISC score, we found that in groups of patients with a score greater than or equal to 12 points more than 70% of patients had 2- vessel or 3- vessel CAD, and severe and extensive CAD according to SYNTAX score.

A number of studies [22] have clearly demonstrated the role of inflammation in all the stages of atherosclerosis, from the formation and rupture of the plaque, to the development of acute coronary syndromes. Given the fact that this study included the patients with stable angina pectoris, we did not find any statistical significance in the values of inflammatory markers (ESR, Le, CRP) among the 3 groups of patients. Another reason may be the fact that we did not use high-sensitive CRP (the lowest value was 3.08 mg/dL) which is the limitation of the study.

Finally, almost all the parameters presented in the FINDRISC score affect a reduced vasodilator response, and paradoxical vasoconstriction in large and in small vessels, even in the absence of structural abnormalities of the blood vessel wall, due to a reduced NO bioavailability [23].

Conclusion

The results of our study showed a statistically significant correlation between the FINDRISC score and its parameters respectively (age, BMI, waist circumference) with the severity of coronary artery disease according to SYNTAX score and the number of diseased coronary arteries.

The FINDRISC score may be useful in identifying patients at the increased risk of coronary artery disease, and with a prognostic value in primary prevention and cardiovascular risk assessment. In the groups of the patients with a score greater than or equal to 12 points more than 70% of patients had 2-vessel or 3-vessel coronary artery disease and more severe coronary disease according to the SYNTAX score.

Our results showED that the incidence and severity of coronary artery disease is associated with a higher FINDRISC score, and that it can be used to estimate the degree of risk for coronary artery disease. The FINDRISC score is also able to identify groups of patients who are at the increased cardiovascular risk, which, under current guidelines do not require further cardiac evaluation.

REFERENCES

1. *Silventoinena K, Pankowb J, Lindstromc J, Jousilahtia P, Hua G, Tuomilehtoa J*. The validity of the Finnish Diabetes Risk Score for the prediction of the incidence of coronary heart disease and stroke, and total mortality. Eur J Cardiovasc Prev Rehabil 2005 12(5): 451−8.
2. *Chacko S, Gow J, Bowell S, Mamas MA, Neyses L*. The Finnish diabetes score predicts impaired glucose tolerance in a heart failure population. Heart 2009; 95 (Suppl 1): A1−A87.
3. *Sianos G, Morel MA, Kappetein AP, Morice MC, Colombo A, Dawkins K,* et al. The SYNTAX Score: an angiographic tool

grading the complexity of coronary artery disease. EuroIntervention 2005; 1(2): 219−27.
4. *Serruys PW, Onuma Y, Garg S, Sarno G, van den Brand M, Kappetein AP,* et al. Assessment of the SYNTAX score in the Syntax study. EuroIntervention 2009; 5(1): 50−6.
5. *Valgimigli M, Serruys PW, Tsuchida K, Vaina S, Morel MA, van den Brand MJ,* et al. Cyphering the complexity of coronary artery disease using the syntax score to predict clinical outcome in patients with three-vessel lumen obstruction undergoing percutaneous coronary intervention. Am J Cardiol 2007; 99(8): 1072−81.
6. *Kinlay S, Ganz P.* Role of endothelial dysfunction in coronary artery disease and implications for therapy. Am J Cardiol 1997; 80(9A): 11I−6I.
7. *Lakka HM, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J,* et al. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. JAMA 2002; 288(21): 2709−16.
8. *Balkau B, Deanfield JE, Després JP, Bassand JP, Fox KAA, Smith SC* et al. International Day for the Evaluation of Abdominal Obesity (IDEA) : A Study of Waist Circumference, Cardiovascular Disease, and Diabetes Mellitus in 168 000 Primary Care Patients in 63 Countries. Circulation 2007; 116(17): 1942−51.
9. *Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F,* et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet 2004; 364(9438): 937–52.
10. *Ounpuu S, Negassa A, Yusuf S.* INTER-HEART: A global study of risk factors for acute myocardial infarction. Am Heart J 2001; 141(5): 711−21.
11. *Khaw KT, Wareham N, Bingham S, Welch A, Luben R, Day N.* Combined impact of health behaviours and mortality in men and women: the EPIC-norfolk prospective population study. PLoS Med 2008; 5(1): e70.
12. *Brown JB, Nichols GA, Perry A*,et al. The burden of treatment failure in type 2 diabetes. Diabet Care 2004; 27(7): 1535−40.
13. *Watts K, Beye P, Siafarikas A, Davis EA, Jones TW, O'Driscoll G,* et al. Exercise training normalizes vascular dysfunction and improves central adiposity in obese adolescents. J Am Coll Cardiol 2004; 43(10): 1823–7.
14. *Colditz GA, Willett WC, Rotnitzky A, Manson JE..* Weight gain as a risk factor for clinical diabetes mellitus in women. Ann Intern Med 1995; 122(7): 481−6.
15. *National Health Nutrition Examination Survey.* Healthy weight, overweight, and obesity among U.S. adults. Available from: www.cdc.gov/nchs/data/nhanes/.../adultweight.pd
16. National Cholesterol Education Program. Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III): Full Report. Bethesda, Md: National Institutes of Health; 2001.
17. *National Cholesterol Education Program.* Expert Panel on Blood Cholesterol Levels in Children and Adolescents: Cholesterol and atherosclerosisin children. Bethesda, Md: National Institutes of Health; 2004.
18. *Alexander KP, Newby LK, Cannon CP, Armstrong PW, Gibler WB, Rich MW,* et al. Acute coronary care in the elderly, part I:Non-ST-segment-elevation acute coronary syndromes: a scientific statement for healthcare professionals from the American-Heart Association Council on Clinical Cardiology: in collaboration with the Society of Geriatric Cardiology. Circulation 2007; 115(19): 2549−69.
19. *Krentz AJ.* Lipoprotein abnormalities and their consequences for patients with type 2 diabetes. Diabetes Obes Metab 2003; 5(Suppl 1): S19−27.
20. *American Diabetes Association.* Standards of medical care in diabetes-2008. Diabetes Care 2008; 31 Suppl 1: S12−54.
21. *American Diabetes Association..* New Revised Guidelines for Prediabetes.Available from: www.diabetes.org [cited 2013 July 31].
22. *Libby P, Ridker PM, Maseri A.* Inflammation and atherosclerosis. Circulation 2002; 105(9): 1135−43.
23. *Hinderliter AL., Caughey M.* Assessing endothelial function as a risk factor for cardiovascular disease. Curr Atheroscler Rep 2003; 5(6): 506−13.

Received on July 18, 2012.
Revised on December 17, 2012.
Accepted on February 14, 2013.