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Research Article

Coronary heart disease Risk Scores and their correlation with Angiographic Severity Scores

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Abstract

Aim: To study correlation between Framingham risk score, PROCAM score and Vascular age, individual components of lipid profile and the coronary atherosclerosis identified by coronary angiography severity scores.

Material and Methods: Patients undergoing coronary angiogram for evaluation of IHD were study subjects. The patients were initially assessed by thorough history of presence of the CHD risk factors. They were examined, anthropometric data were collected, Fasting lipid profile was tested. Coronary angiography was done and severity scoring of coronary lesions was done by Jenkins' scoring.

Results and data analysis: A total of 36 male and 11 female patients who underwent coronary angiography were studied. The distribution of rest of the risk factors- BMI, Vascular age, PROCAM score and angiographic severity scores were found to have no significant gender difference. The coronary angiographic severity scores showed best correlation with Framingham risk scores for coronary heart disease (p=0.00), lesser correlation with the Vascular age of the individual (p=0.01), still lesser correlation with PROCAM scores (p=0.04) and no correlation with WHR and BMI values. Age (p=0.001) and the Framingham risk score were found to influence the angiographic severity scores most (p=0.000), PROCAM scores to a lesser extent (p=0.01). Individual components of lipids were not found to influence angiographic severity scores significantly.

Conclusion: Framingham score for ischemic heart disease best correlates with angiographic severity scores. Individual components of lipid profile, BMI, Waist Hip Ratio do not correlate with coronary angiography severity scores.

Keywords: Jenkins score, Framingham risk score, vascular age

1. Introduction

Coronary heart disease is the most common cause of the mortality worldwide across all continents and countries. It is now possible to identify the severity of the coronary artery disease with availability of coronary angiography. But the coronary angiography is an invasive procedure and hence cannot be performed on all the patients. Also, it is a procedure associated with less, but some procedural risk, because of which many patients are not willing to undergo the test. Cardiac risk scores like Framingham score have been designed to stratify patients according to likelihood of having coronary heart disease. But accuracy of cardiac risk scores in predicting severity of coronary artery disease has not been tested in many studies till now. The cardiac risk scores, if found to correlate with the severity of angiographic severity, can be a handy tool for the clinicians in assessing the severity of coronary heart disease in the patients as well as for referring the patients for the interventions at the right time, thus avoiding unnecessary interventional procedures.

2. Material and methods

The study was carried out after getting clearance from the institutional ethics committee of institute Karnataka

Institute of Medical Sciences. The study subjects were the patients admitted at our institute for undergoing coronary angiography. A total of 36 male and 11 female patients who underwent coronary angiography for evaluation of coronary heart disease and were willing to be part of the study were included in the study. The patients were initially evaluated clinically. Each of the patient was interviewed and presence of factors such as hypertension, smoking, family history of coronary heart disease was noted. The anthropometric data were collected Body Mass Index (BMI) and Waste Hip Ratio (WHR) were calculated. Serum fasting lipid profile was tested. The Framingham risk score, PROCAM score and Vascular age were calculated for every patient.

Coronary angiography was performed after taking informed consent. Scoring of severity of coronary heart disease was performed by a Jenkins' scoring system.[1] The coronary circulation was divided into eight proximal segments. As the distal segment disease is difficult to be quantified, only the lesions involving proximal segments were scored. The segments scored included.

1. Left main coronary artery.
2. Left anterior descending artery (LAD) up to junction of mid and distal third of the vessel.
3. The proximal third of major septal branch of LAD.
4. Proximal third of major diagonal branch of LAD.
5. Circumflex coronary artery (CFX) up to the junction of middle and distal third of the vessel.
6. Proximal third of major obtuse marginal branch of CFX.
7. Right coronary artery (RCA) up to and including origin of posterior descending coronary artery (PDA).
8. Proximal third of PDA.

If PDA was supplied by CFX, CFX lesions till origin of PDA as well as RCA lesions up to origin of the middle and distal third of the vessel were included. The percentage of narrowing of each of the coronary arteries was noted by the maximal narrowing of particular artery in all projections. The severity of coronary artery narrowing was graded as follows.

Normal coronaries- 0 point. Less than 50% stenosis of the luminal diameter-1 point. 50 to 74% stenosis- 2 points. 75-99% stenosis- 3 points. 100% obstruction-4 points. The total coronary angiographic severity was calculated for each patient after adding up points of each lesion of coronary artery.

Statistical analysis- The data were analyzed using the software SPSS. Mean and standard deviation for each continuous variable was calculated separately for males and females. The correlation between the Framingham risk scores, PROCAM scores, Vascular age and the coronary angiographic severity scores was tested by Carl Pearson's correlation coefficient method. The influence of Framingham risk scores, PROCAM scores, Vascular age on coronary angiographic severity was tested by the multivariate regression analysis.

3. Result and Data Analysis

Our study included total of 47 patients. The distribution of the cardiac risk factors, results of laboratory investigations and the anthropometric data are summarized in Table 1.

Table 1: Baseline characteristics of the patients

	MALES (n=36)	FEMALES (n=11)	TOTAL (n=47)
AGE	55.17±9.24	56.36±12.19	55.45±9.87
DIABETES	55.6%	27.3%	48.8%
HTN	47.0	36.6	44.6
Family hist	25%	36%	27.7%
Smoking	38.9%	0%	29.8%
Weight	69.36±7.67	62.81±6.98	67.82±7.95
Height	165.86±5.73	158±5.44	164.02±6.54
T.Chol	184.52±41.66	175.90±33.67	182.51±39.76
LDL	121.83±28.26	121.72±21.86	121.80±26.68
HDL	38.58±7.61	37.27±5.23	38.27±7.09
TGL	158.91±45.43	159.90±40.80	159.14±43.96

48.8% of patients in the study were diabetics and 44.6% were found to have hypertension. 27.7% were smokers and 29.8% had significant family history of coronary heart disease. There was significant gender difference in Waist Hip Ratio (WHR), as expected. And Framingham risk scores were higher in males. But distribution of rest of the risk factors- BMI, Vascular age, PROCAM score and angiographic severity scores were found to have no significant gender difference (Table 2).

Table 2: Comparison of male and female with different variables

Variable	Sex	n	Mean	SD	t-value	P-value
Waist-hip ratio	Male	36	0.95	0.05	7.2769	0.0000*
	Female	11	0.83	0.05		
BMI	Male	36	25.48	3.49	0.1828	0.8558
	Female	11	25.25	3.52		
Vascular age	Male	36	75.14	8.88	0.9798	0.3324
	Female	11	71.36	16.94		
PROCAM	Male	36	9.64	7.33	-0.9249	0.3600
	Female	11	12.36	11.89		
Framingham score	Male	36	12.53	10.74	2.8844	0.0060*
	Female	11	3.00	3.16		
Angiography score	Male	36	12.78	3.58	1.2184	0.2294
	Female	11	11.36	2.50		

*$p<0.05$

All the cardiac risk score considered in the study are influenced by the blood pressure readings and the serum lipid profiles, the values of which are readily altered by the antihypertensive and the hypolipidemic medications. In order to negate the influence of medications on results, the results were re-analyzed by dividing the patients into two groups, one receiving treatment and the other not receiving treatment. But there was no significant difference in distribution of WHR, BMI, Vascular age, the cardiac risk scores and also the angiographic severity scores between both the groups (Table 3).

Table 3: Comparison of with and without treatment with different variables

Variable	Treatment	N	Mean	SD	t-value	P-value
Waist-hip ratio	With Rx	36	0.92	0.07	-0.1471	0.8837
	Without Rx	11	0.92	0.07		
BMI	With Rx	36	25.42	3.56	-0.0140	0.9889
	Without Rx	11	25.44	3.28		
Vascular age	With Rx	36	74.81	11.29	0.6062	0.5474
	Without Rx	11	72.45	11.13		
PROCAM	With Rx	36	10.81	8.92	0.7649	0.4483
	Without Rx	11	8.55	7.23		
Framingham score	With Rx	36	10.81	11.29	0.6057	0.5477
	Without Rx	11	8.64	6.34		
Angiography score	With Rx	36	12.78	3.23	1.2184	0.2294
	Without Rx	11	11.36	3.80		

The correlation between the convention risk factors for coronary heart disease, namely Waist Hip Ratio (WHR), Body Mass Index (BMI), and the coronary heart disease risk scores was analyzed by Karl Pearson's correlation coefficient (Table 4).

Table 4: **Correlation between Angiography score with Vascular age, PROCAM, Framingham score, Waist-hip ratio and BMI scores by Karl Pearson's correlation coefficient method**

Variables	r-value	t-value	p-values
Waist-hip ratio	0.1342	0.9082	0.3686
BMI	-0.0087	-0.0583	0.9537
Vascular age	0.3810	2.7647	0.0082*
PROCAM	0.2963	2.0815	0.0431*
Framingham score	0.8237	9.7465	0.0000*

*p<0.05

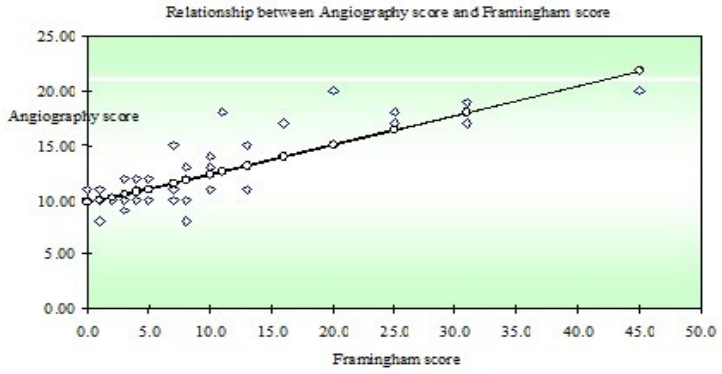
The coronary angiographic severity scores showed best correlation with Framingham risk scores for coronary heart disease (p=0.00), lesser correlation with the Vascular age of the individual (p=0.01), still lesser correlation with PROCAM scores (p=0.04) and no correlation with WHR and BMI values. The influence of the age, each of the component of the lipid profile, known cardiac risk factors and cardiac risk scores was further assessed by multiple linear regression (Table 5).

Table 5: Multiple linear regression analysis of Angiography score by Age, Vascular age, Lipid profile, PROCAM, Framingham score, Waist-hip ratio and BMI scores

Independent variables	Regression Coefficient	SE of regress. coefficient	t-value	p-level
Intercept	11.3769	3.8300	2.9705	0.0050*
Age	0.0156	0.644	2.9705	0.0009*
HDL	-0.099	0.068	2.1145	0.1537
LDL	-0.011	0.036	0.0898	0.7659
TGL	-0.003	0.013	0.392	0.8441
T. cholesterol	0.051	0.028	3.2781	0.77772
Waist-hip ratio	-4.2814	4.9943	-0.8572	0.3963
BMI	-0.0111	0.0955	-0.1167	0.9077
Vascular age	0.0219	0.0261	0.8369	0.4075
PROCAM	0.0872	0.0336	2.5987	0.0129*
Framingham score	0.2699	0.0282	9.5682	0.0000*
$R=0.8707$, $R^2=0.7582$, Adjusted $R^2=0.7287$, $F(5,41)=25.720$ $p<0.05$, S, Std.Error of estimate: 1.7638				

*p<0.05

Age (p=0.001) and the Framingham risk score were found to influence the angiographic severity scores most (p=0.000), PROCAM scores to a lesser extent (p=0.01) and rest of the factors including Vascular age (p=0.41), BMI (p=0.90), WHR (p=0.39), total serum cholesterol (p=0.77), HDL (P=0.15), LDL (0.76), triglycerides (p=0.84) were not found to have significant influence on the angiographic severity scores. The linear relationship between angiographic severity scores and Framingham risk score observed in the study has been shown in the graph below.



4. Discussion

With the life increasingly becoming stressful and also cardiovascular diseases increasing world-wide, more and more people are aware as well as apprehensive of the occurrence of cardiovascular events in them. Though non invasive assessment of coronary heart diseases is possible with Tread Mill Test, the accuracy is often the concern for the patients as well as the doctors. Imaging information related to atherosclerotic burden can be particularly helpful to predict risk of coronary heart disease events, but the cost of such procedures is relatively great compared with the low cost of health risk screening.[2] Coronary angiography, although is gold standard for accurate assessment of coronary heart disease, the invasive nature of the procedure, the cost of the procedure and also the small risk of complications associated with it act as deterrent for many individuals. Hence there is a need to identify coronary heart disease risk score which comes close to angiography for predicting severity of coronary heart disease. These Coronary heart disease risk scores allow physicians to assess individual cardiovascular risk and to prescribe cholesterol-lowering drugs and aspirin appropriately and cost-efficiently. They also allow to set target cholesterol levels according to the estimated risk. Each score is a practical tool to support decisions with its advantages and limits.[3]

Our study was carried out to find out the accuracy of coronary heart disease risk scores for identifying severity of coronary atherosclerosis detected by coronary angiography. We used the Jenkins' scoring system for coronary angiographic scoring. We chose this because of simplicity and also because regardless of the degree of heterogeneity among Coronary angiographic severity scoring systems, scores derived from different systems of scoring correlate to a high degree each other and consistently also. Such a high degree of correlation between coronary angiographic severity scores indicates that the measured proportion of intra-individual disease burden remains consistent despite increasing complexity of scoring systems.[4] We found the Framingham Risk Score to be most closely correlating with the coronary angiography severity scores. The PROCAM score and Vascular age were slightly less correlated with angiographic risk scores. BMI, WHR and individual components of lipid profile were found to have no influence on the angiographic severity scores.

Framingham risk score is used to predict the 10 year risk of developing coronary heart disease in people with no history of cardiovascular disease.[5] The Framingham score has been developed based on data from a sample of the Framingham Heart and Offspring studies. Framingham risk score considers sex, age, total cholesterol, HDL cholesterol, systolic blood pressure, and smoking. This score, although quite accurately predicts coronary artery disease, the accuracy falls somewhat in the older age groups[6,7]. Framingham Risk Scoring system has been found to underestimate risk in socioeconomically deprived individuals.[8] We have found this to be correlating best with the coronary angiographic severity scores. PROCAM score is also a risk score to predict risk of coronary heart events and is derived from the European PROCAM study, performed in a population of 5000 participants in Münster, Germany. It is now called the Münster Heart Study, a large prospective epidemiological investigation performed among the working population in Münster and the northern Ruhr regions of Germany.

"Heart Age" or "Vascular Age" is a simple risk score to convey expression of age-appropriate cardiovascular risk based on the output of Framingham Risk Scores and shown to promote more accurate risk perception in users.[9] It is a simple method for communicating risk and as a target to aim for could have substantial population health benefits. We found both PROCAM score and the Vascular age to be influencing coronary angiographic risk scores less strongly when compared with Framingham Risk Scores.

The utility of Framingham Risk Score and PROCAM score estimating equations was tested by Italian team in Italy (CUORE). They found that both these coronary heart disease (CHD) scoring systems overestimated CHD risk in Italian men and after calibration of the Framingham equations it was possible to reliably predict CHD events in their study cohort.[10] Similarly several other Risk scores have also been developed. QRISK scoring in United Kingdom and ASSIGN scoring in Scotland have been developed considering the effects of social deprivation. The QRISK algorithm predicts total cardiovascular disease risk (QRISK) using several anthropometric parameters, components of lipid profile, family history of CHD in first degree relative aged less than 60, area measure of deprivation, and existing treatment with antihypertensive agent.

The association between blood levels of lipids and CAD is well established[11-20]. Though lipids are proven risk factors for coronary heart disease, their serum levels do not correlate with coronary atherosclerosis burden identified by coronary angiography severity scores. The same was noted in our study also and we found no correlation between values of any of the components of lipid profile and angiography severity scores. This is not surprising because atherosclerosis is a

disease of multifactorial cause. In addition to both qualitative and quantitative changes in lipoprotein levels, hypertension, abnormalities in platelets and circulating catecholamines, stress, and as yet undefined genetic factors have all been implicated[21,22].

The above mentioned risk scores have been proposed to understand the probability of risk of coronary events by the medical professionals so that it can be communicated to the general population in simple way. But as can be inferred from our study, the coronary heart disease risk scores, and Framingham Risk Score in particular, can also be considered to be surrogate markers of severity of atherosclerosis disease burden. Framingham Risk Scores correlate best with angiographic severity score, though PROCAM score and Vascular age correlate to a lesser extent. As a result, Framingham Risk Score can be used confidently as a guide to plan coronary angiography and also to explain the prognosis without intervention. On the other hand, because non invasive identification of coronary heart disease is possible far more easily and accurately, unnecessary coronary intervention procedures can be avoided, especially in resource limited settings, thus reducing the financial burden on the patients and also the complications associated with the procedures. Thus coronary heart disease risk scores and Framingham Risk Scores in particular, can be used as powerful tools for coronary heart disease risk stratification.

4.1 Limitations of the study

The Jenkins method used in our study used to quantify severity of coronary atherosclerosis takes only the proximal coronaries into consideration. Distal coronary disease was not included because of the difficulty to quantify lesions in distal portion of coronaries uniformly.

5. Conclusion

1. Coronary heart disease risk scores correlate with coronary angiographic severity scores.
2. Framigham score for ischemic heart disease best correlates with angiographic severity scores.
3. Coronary heart disease risk scores, and Framingham Risk Score in particular, can be considered to be surrogate markers of severity of atherosclerosis disease burden in an individual.
4. Individual components of lipid profile, BMI, Waist Hip Ratio do not correlate with coronary angiography severity scores.

This study adds

Several scoring systems have been proposed to identify individuals at risk for coronary heart disease. But it has not been tested if they really correlate with coronary angiographic severity. Framingham score, a simple method of assessing coronary heart disease risk correlates well with Jenkins angiographic severity scoring system and can be used to identify patients for coronary angiography, thus avoiding unnecessary coronary interventional procedures.

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