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Original Research Article

Clinical comparison of different cardiovascular risk scores for cardiovascular risk prediction in Indian patients

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ABSTRACT

Background: Cardiovascular diseases (CVD) are the main cause of mortality and disability in India. Early and sustained exposure to behavioral risk factors leads to development of CVD. The present study was conducted to compare different cardiovascular calculators for CVD risk assessment models in young Indian patients presenting with myocardial infarction.
Methods: This study included 85 patients with myocardial infarction (MI). Their predicted 10-year risk of CVD was calculated using three clinically most relevant risk assessment models viz. Framingham Risk score ($Risk_{FRS}$), American College of Cardiology/American Heart Association ($Risk_{ACC/AHA}$) and the 3rd Joint British Societies risk calculator ($Risk_{JBS}$).
Results: $Risk_{FRS}$ recognized the highest number of patients (15.4%) at high CVD risk while $Risk_{ACC/AHA}$ and $Risk_{JBS}$ calculators provided inferior risk assessment but statistically significant relationship. $Risk_{FRS}$ and $Risk_{ACC/AHA}$ (Pearson's r 0.870, $p<0.001$).
Conclusions: $Risk_{FRS}$ seems to be as most useful CVD risk assessment model in young Indian patients. $Risk_{FRS}$ is likely to identify the number of patients at 'high-risk' as compared to $Risk_{JBS}$ and $Risk_{ACC/AHA}$.

Keywords: Cardiovascular risk calculators, Myocardial infarction, Primary prevention

INTRODUCTION

Cardiovascular disease (CVD) is one of the leading causes of premature death. In order to reduce the CVD mortality rate, some preventive measures of "at high risk" individuals are necessary. Risk factor such as smoking, cholesterol, high blood pressure, diabetes, obesity and alcohol consumption have been considered more than 86% of CVD.[1]

CVD risk prediction models are ideal for recognizing and treating high-risk populations.[2] The cardiovascular (CV) risk assessment is carried out by determining the occurrence and severity of CV risk factors using risk calculator and prediction charts to overall CV risk.[3]

Estimation of cardiovascular risk prediction models are important in the prevention and management of CVD. Many risk estimation systems are in existence for improving the management of population groups, such as Framingham risk score ($Risk_{FRS}$) and the American Heart Association (AHA) and the American College of Cardiology (ACC) ($Risk_{ACC/AHA}$) and the 3rd iteration of Joint British Societies risk calculator ($Risk_{JBS}$).[4-6]

However, these risk calculators are based on epidemiological data and applicable only to those patients from which the data has been obtained. Currently, none of the available risk prediction models are authenticated in Indian patients. Some studies have attempted to assess CVD risk score in Indian patients with limited evidence.[7]

Hence, the present study was to determine the comparison and validations of different 10-year CVD risk assessment models ($Risk_{FRS}$, $Risk_{ACC/AHA}$ and $Risk_{JBS}$) in young Indian patients.

METHODS

The study included 85 consecutive subjects with age <40 years, who presented with a history of myocardial infarction (MI) between Jan 2015-Jan 2016. The diagnosis of MI was based on the 3rd universal definition of MI.[8] All patients were admitted to the cardiac care unit and control, according to the existing recommendations for the management of patients.[9,10]

Clinical assessment was executed as a feature of their administration and included point by point history and physical examination. History was acquired in regards to earlier CVD, the presence of significant CVD risk factors and the displaying side effects. The physical examination included a recording of essential parameters and the examination of Cardiovascular (CV) system. Height and body weight were measured and body mass index (BMI) was calculated. Smoking, diabetes and hypertension were defined according to the National Health Interview Survey (NHIS) and Behavioral Risk Factor Surveillance System (BRFSS) definitions.[11]

In all patient biochemical investigations were performed including lipid profile, fasting and random blood glucose estimation. Ethical clearance for the study was obtained from the institutional ethical committee. This study was performed as per the Declaration of Helsinki.

The data assembled, 10-year risk of having a major CV event (CV death, MI or stroke) was computed for every patient utilizing the three different risk scores-$Risk_{FRS}$, $Risk_{JBS}$ and $Risk_{ACC/AHA}$. Based on the data their risk scores were calculated by using $Risk_{FRS,}$ $Risk_{ACC/AHA}$ and $Risk_{JBS}$ calculators available on the following websites https://www.framingham heartstudy.org/risk-functions/cardiovascular-disease/10-yearrisk.php#, http://tools. acc.org/ASCVD-Risk-Estimator/ and www.jbs3risk.com. Using different risk calculators, 10-year CVD risks were divided into the two categories - low risk (<20%) and high risk (≥20%) groups in each model to identify which model maximally identifies the high-risk groups. Age, gender, total and HDL cholesterol, diabetes, smoking status and treatment for hypertension were considered in FRS-CVD risk score calculation. In $Risk_{ACC/AHA}$ calculator, the race was taken into account as an additional factor.[12] In $Risk_{JBS}$ the presence of chronic kidney disease, atrial fibrillation, family history of CVD, ethnicity along with body mass index was also considered along with the classical risk factors.[12]

Statistical analysis

Statistical analysis was carried out by using Microsoft excel spreadsheet (version 2007, Microsoft Corp, Seattle, Washington). Values are expressed as mean± standard deviation or as percentages. For multiple risk categories, either using Wilcoxon's signed rank test or using Chi-square test. Pearson's correlation coefficient (r) was estimated to assess using the Spearman rank test. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline characteristics

Baseline characteristics of the study population are shown in Table 1. The mean age of the study subjects was 36.04±4.3 years and 76 (89.4) were males. The predictable, CV risk factors in the study subjects were hypertension (20%), diabetes (29.4%) and current smokers (52.9%). Around 21.1% had a family history of premature CVD. The mean body-mass index was 24.8±2.9 kg/m^2. Average LDL was 134.27±38.5 mg/dl. A low HDL and high triglyceride were extremely prevalent. Approximately 58 (68.2%) presented with STEMI while 5 (5.9 %) had chronic stable angina (CSA).

Table 1: Baseline characteristics of the study population (n = 85).

Parameter	Value (%)
Age	36.04±4.3
Male gender	76 (89.4)
Hypertension	17 (20)
Diabetes mellitus	25 (29.4)
Current smokers	45 (52.9)
Alcohol	38 (44.7)
Family history	18 (21.1)
Dyslipidemia	12 (14.1)
BMI (kg/m^2)	24.8±2.9
HDL (mg/dl)	36.20±11.09
LDL (mg/dl)	134.27±38.5
TG (mg/dl)	146.52±81.8
MI type	
STEMI	58 (68.2)
NSTEMI	22 (25.9)
CSA	5 (5.9)

*Numbers in parameter indicate% of total population. Abbreviations: BMI = Body mass index, LDL = Low density lipoprotein, HDL = High density lipoprotein, TG = Triglyceride, MI = Myocardial infarction, STEMI = ST elevation myocardial infarction, NSTEMI = Non ST elevation myocardial infarction, CSA-Chronic Stable Angina

10-year CV risk according to the different risk scores

The 10-year CVD risk assessment was calculated in all patients using $Risk_{FRS}$, $Risk_{ACC/AHA}$ and $Risk_{JBS.}$ As shown in Table 2 and Figure 1. $Risk_{FRS}$ CVD risk score identified a maximum number of these young Indian patients as being 'at high-risk' (15.4% with ≥20% risk). RiskJBS (1.28% with ≥20% risk) and $Risk_{ACC/AHA}$ (3.4% with ≥20% risk) had identified the low proportion of

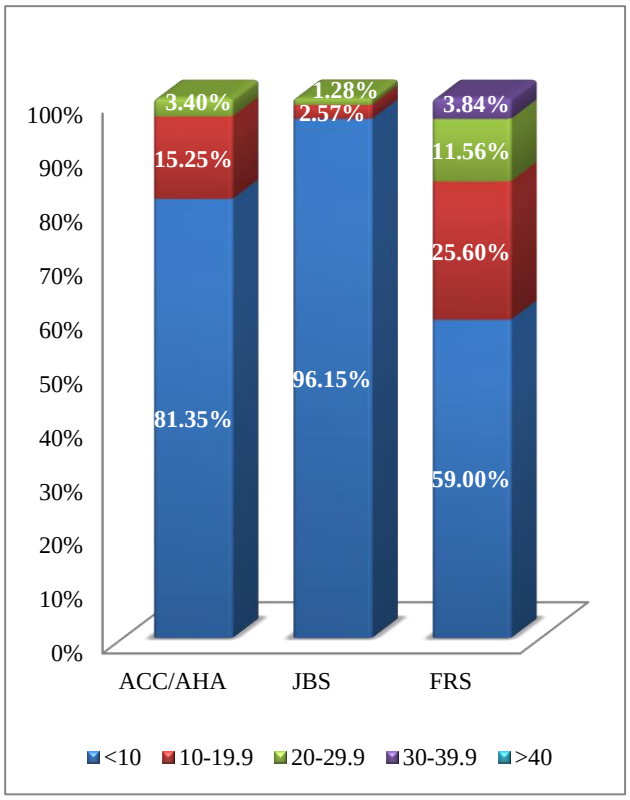
patients with high risk, however, RiskFRS identified the highest proportion of the patients as being 'at high-risk' (15.4% with ≥20% risk). Correlations of all three scores estimates derived using dichotomized CVD risk scores (<20% and ≥20%) were assessed using Spearman rank test.

Statistically significant correlations were found between the scoring systems $Risk_{FRS}$ and $Risk_{ACC/AHA}$ (Pearson's r 0.870, p-value 0.0001) as shown in Figure 2 respectively.

Table 2: Estimated 10-year risk scores of CV events according to different risk assessment models in the study population.

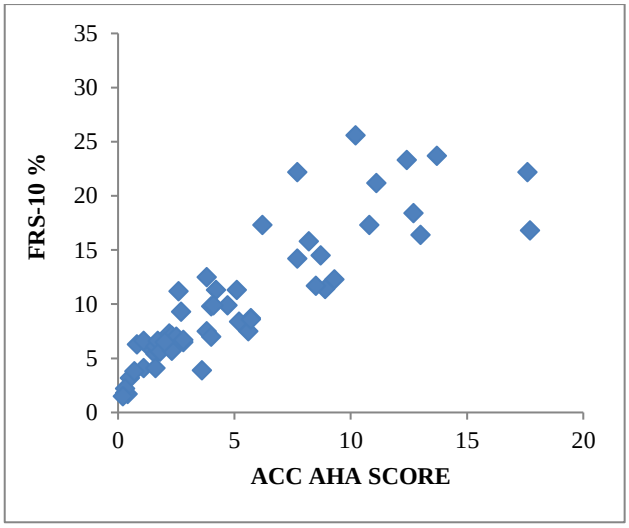
10yr CV risk category	ACC/AHA (n=59)	JBS (n =78)	FRS (n=78)	p-value
<10 %	48 (81.35)	75(96.15)	46 (59)	<0.0001
10-19.9 %	9 (15.25)	2 (2.57)	20(25.6)	
20-29.9 %	2 (3.4)	1 (1.28)	9(11.56)	
30-39.9 %	0	0	3 (3.84)	
>40 %	0	0	0	

p value <0.0001 for all comparisons of risk models. CV, cardiovascular; FRS, Framingham risk score; ACC, American College of Cardiology; AHA, American Heart Association; JBS, Joint British Society



FRS, Framingham risk score; ACC, American College of Cardiology; AHA, American Heart Association; JBS, Joint British Society.

Figure 1: The estimated 10-year risk scores of CV events according to the three risk assessment models.



FRS, Framingham risk score; ACC, American College of Cardiology; AHA, American Heart Association

Figure 2: The correlation between the 10-year risk estimates derived using the FRS risk score and the ACC/AHA risk score.

DISCUSSION

The results of the present study show the comparison of different CVD risk assessment models in Indian patients with MI. $Risk_{FRS}$ model could stratify a number of patients into high CVD risk. $Risk_{ACC/AHA}$ and $Risk_{JBS}$ risk score could recognize a low number of patients for CVD. Assessment of the risk of future CV events is a primary concept in preventive cardiology. However, the major CVD risk factor is determined by using a different risk calculator and prediction charts. Several risk scoring calculators are available for this specific purpose. The $Risk_{FRS}$ which was created in 1998 anticipated only coronary heart disease risk but another general risk forecast tool was developed in 2008 to predict the general CV risk USA.[13]

Furthermore, the FRS-CVD risk score associated with a large combination of CVD outcomes including myocardial infarction, coronary death, coronary insufficiency, angina, ischemic stroke, haemorrhagic stroke, transient ischemic attack, peripheral artery disease and heart failure. In contrast, the other risk engines/ tools estimate risk mainly for myocardial infarction and stroke only.[12] Subsequently, in a young individual, the assessed 10-year CV risk as indicated by FRS is perpetually low, in spite of the multiple of various CVD risk factors. This has important implications for the Indian population in whom CVD has a tendency to happen in younger age than the western population.[7,14]

Similarly, the "2013 ACC/AHA guideline on the assessment of CV risk" provides clear recommendations for estimating CVD 'at high risk'.[5] The essential goal for developing $Risk_{ACC/AHA}$ has demonstrated the cholesterol management among adults and the task force prescribes

this new risk score is utilized rather than $Risk_{FRS}$.[15] However, the accuracy of $Risk_{ACC/AHA}$ is based on data from multiple community-based populations and applicable in American populations, has become an issue of significant debate.[16] The JBS3 risk calculator is a novel and exciting tools that are recommended for the prevention of CVD. Existing prevention strategies tend to focus on patients at relatively short-term (10-year) risks and upon specific thresholds for pharmacological therapies. This approach is intelligent and has been successful in guiding treatment to those at higher risks that remain to gain the greatest advantage.[6]

CV risk evaluation in Indians

The evaluations of CV risk among inhabitant Indian patients are significantly challenging. A substitute approach is to apply the different scoring system in a similar population group and their accuracy to determine which one is probably going to be more accurate. Similar findings were reported by Kanjilal et al, they compared three different risk scoring systems-$Risk_{FRS}$, $Risk_{JBS}$, and the European score in patients with CVD.[7] It was found that increased levels of lipids, pro-thrombotic, pro-inflammatory and serological markers of three risk results determined <5% population as being 'at high-risk'.

In a previous study by Bansal et al, the JBS risk score was found to be the best risk calculator, as it could show 55.9% of their study population at high risk using ≥20% as the cut-off for a high- risk score.[3] JBS risk calculator identified the largest proportion of the patients as being at "high-risk" but FRS and ACC/AHA-ASCVD risk score calculator performing lower than JBS to identify the high risk. In the Framingham risk calculator, they had used the updated FRS global CVD risk score expected to give a higher score value but was found to perform worse than the JBS risk score.

In our study, we found that $Risk_{FRS}$ was good in stratifying the most number of patients into high risk. In contrast, $Risk_{JBS}$ and $Risk_{ACC/AHA}$ were much inferior. At present $Risk_{FRS}$ may be the most suited CV assessment model for use in a young subset of Indian patients. These effects might be due to several more risk factors such as hyperlipidemia and family history of premature CVD. In addition, this risk factor probably will increase the precision of risk prediction. It must be noted that all the accessible CV risk assessment models have been designed just to predict future CVD risk events and not for use in a cross-sectional way as has been done in the present study.[17]

This study has some limitations. First, the study was performed with cross-sectional analysis and the small study population; thus, results should be interpreted with caution. Second, we have included only the young patients presenting with MI and were able to collect a sensible number of hard CV events to get significant conclusions from it.

CONCLUSION

The present study shows that $Risk_{FRS}$ appeared to be most useful CVD risk assessment model in Indian patients, $Risk_{FRS}$ is likely to identify more number of patients at 'high-risk' as compared to $Risk_{JBS}$ and $Risk_{ACC/AHA}$.

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