Cardiol Cardiovasc Med 2019; 3 (5): 360-368 *DOI: 10.26502/fccm.92920085*

Research Article

Evaluation of Discordance between 10 year Cardiovascular Risk Scores in Indian Patients presenting with Myocardial infarction

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Received: 15 September 2019; **Accepted:** 19 September 2019; **Published:** 23 September 2019

Citation: Abhishek Gaikwad, Yasmin Khan. Evaluation of Discordance between 10 year Cardiovascular Risk Scores in Indian Patients presenting with Myocardial infarction. Cardiology and Cardiovascular Medicine 3 (2019): 360-368.

Abstract

Background: Cardiovascular diseases are rapidly emerging as major cause of mortality and disability in India. Existing Risk Calculators for Cardiovascular Risk have not undergone appropriate validation in Indian Patients. Present Study was undertaken to compare different cardiovascular calculators for CVD risk assessment models in Indian patients presenting with first episode of myocardial infarction.

Methods: This study included 150 patients presenting with first episode of myocardial infarction (MI). 10-year risk of CVD was calculated using three risk assessment models Framingham Risk score (Risk FRS), Revised American College of Cardiology/American Heart Association (Risk ACC/AHA) and WHO Risk Prediction Charts.

Results: Risk FRS recognized the highest number of patients (74%) at high CVD risk (>20% 10 yr CV Risk) while Risk ACC/AHA and WHO ISH Risk calculators provided inferior risk discrimination. Risk FRS and Risk ACC/AHA had good correlation (Pearson's r 0.93, $p<0.001$) but poor agreement when divided into Subcategories. (Kappa =0.022)

Conclusion: FRS seems to be as most useful CVD risk assessment tool in identification of Indian patients at high Cardiovascular Risk.

Keywords: Cardiovascular Risk; Myocardial infarction

Introduction

India is in the throes of a Cardiovascular epidemic. South Asians have been seen to have higher risk of CV disease as compared to other populations [1-7]. Several Studies have shown that Cardiovascular risk among Indians is several times higher than in other ethnic groups and at least four times that of Caucasians [8,9]. Indians tend to develop CVD at a younger age (approximately 10 years) compared to others [5,6]. Both the genetic make-up and the early onset of conventional CV risk factors are believed to contribute to this excess risk [4,6].

Given the high prevalence of Cardiovascular Risk Factors in India, risk prediction models are ideal for recognizing and treating high-risk populations [10]. 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 compute overall Cardiovascular risk [11-13]. Estimation of cardiovascular risk prediction models are important in the prevention and management of CVD. Many risk estimation systems are in existence; Framingham risk score (Risk FRS), American College of Cardiology (ACC) (Risk ACC / AHA) and Joint British Societies risk calculator (Risk JBS) and WHO Risk prediction charts are commonly used [11-14].

While most of these risk estimation models have used some south Asian cohort for their derivation, None of the available risk prediction models have been prospectively validated in Indian patients. Some studies [15-18] have attempted to assess discriminating ability of CVD risk score to diagnose high risk patients (those with established Cardiovascular disease or MI) in Indian patients with conflicting results. Most of these validation studies have used older versions of AHA Risk Score, which has recently been updated [14] with new cohort data and none of these studies include comparative study of discriminaton of these Rsk scores.

Hence, the present study was to determine the comparison and validations of different 10-year CVD risk assessment models (Risk FRS, calibrated Risk ACC/AHA and Risk JBS) in Indian Cohort.

Material and Methods

Our Cohort included 150 consecutive patients admitted in coronary care unit of a tertiary Hospital between Jan 2018 to Jan 2019 with first episode of Myocardial infarction.

The diagnosis Of MI was based on 3rd universal definition of MI. All patients were admitted and managed according to current guidelines for the management of MI

History and clinical examination were done in each patent especially with respect to the presence of significant CVD risk factors.Physical examination consisted of General Physical examination and 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).

Biochemical parameters Fasting and Random blood sugar, Lipid profile was performed in every patient. Systolic and diastolic Blood pressure was recorded in each patient. Ethical clearance for the study was taken from the institutional ethical committee.

Risk Score calculation

Three risk calculators (Risk FRS, WHO ISH RISK and Risk ACC/AHA) were used to calculate 10-year risk of having a major CV event (CV death, MI or stroke) for

every patent. In Risk ACC/AHA calculator, the race was taken into account as an additional factor.

Calculators were available on the following websites (https://www.framingham heartstudy.org/risk-functions/cardiovascular-disease/10-yearrisk.php#, https://sanjaybasu.shinyapps.io/ascvd/). whoshRsk R package. Was used to calculated WHO-ISH RISK. Using different risk calculators, 10-year CVD risks were divided into the five sub- categories -low risk (<10%,10-20%) and high risk (20-30%, 30-40%,>=40%) 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.

Statistical analysis

Statistical analysis was carried out by using R version 3.5.0. Values are expressed as mean± standard deviation or as percentages. Pearson's correlation coefficient (r) was estimated to assess correlation between fRS and ASCVD. Kappa Score was calculated to determine agreement between various subcategories of CV Risk. Bland Altman Plot was constructed to determine bias and variation between FRS and ASCVD Risk Scores. A p-value <0.05 was considered statistically significant.

Results

Baseline Variables

Our cohort consisted of Patients who presented with first episode of MI. Some socio-demographic characteristics of our cohort was as follows :

Age: [Mean = 55.05, SD = 9.71, IQR [32.00, 78.00]. SBP: Mean = 154.27, SD = 18.96, IQR [110.00, 218.00]. DBP: Mean = 91.66, SD = 9.66,IQR [69.00, 126.00].

Around 30 % patients were Alcoholic and had a Family history of CAD, Around 40% were Diabetics. Population was predominantly Male (75.3%) and 42% were Actively Smoking.

70% cases had STEMI while 30% had NSTEMI.

Lipid Parameters were as follows :

HDL: Mean = 39.03, SD = 10.38, IQR[19.00, 74.00]. LDL: Mean = 158.55, SD = 33.01, [75.00, 242.00]. TG: Mean = 178.59, SD = 37.74,IQR [64.00, 273.00] and Total_Cholesterol: Mean = 233.31, SD = 35.06, [154.00, 318.00].

Further Details of Baseline Variables are Provided in Table 1.

Age	Mean (SD)	55.1 (9.7)
Alcohol	NO	109 (72.7)
	YES	41 (27.3)
current_smoker	NO	87 (58.0)
	YES	63 (42.0)
SBP	Mean (SD)	154.3 (19.0)

DBP	Mean (SD)	91.7 (9.7)
Family_History	NO	109 (72.7)
	YES	41 (27.3)
HDL	Mean (SD)	39.0 (10.4)
LDL	Mean (SD)	158.6 (33.0)
TG	Mean (SD)	178.6 (37.7)
Total_Cholesterol	Mean (SD)	233.3 (35.1)
Sex	FEMALE	37 (24.7)
	MALE	113 (75.3)
MI_Type	NSTEMI	45 (30.0)
	STEMI	105 (70.0)
Diabetes	NO	90 (60.0)
	YES	60 (40.0)
Current Hypertension treatment	NO	91 (60.7)
	YES	59 (39.3)
Smoking	NO	87 (58.0)
	YES	63 (42.0)
ASCVD	Mean (SD)	19.7 (15.6)
FRS	Mean (SD)	36.4 (21.6)

Table 1: Baseline Variables

Cardiovascular Risk Scores

Framingham Risk Score (FRS),WHO ISH Risk Score (for South East Asian Region) and 10 yr ASCVD Score by new Pooled Cohort Equations were calculated.

The Scores were as Follows.

FRS: Mean = 36.42, SD = 21.63, [3.60, 90.97].

ASCVD: Mean = 19.69, SD = 15.60, [1.04, 73.57] .

A paired t test was undertaken to evaluate difference between FRS and ASCVD. The Paired t-test show that the difference between FRS and ASCVD (mean of the differences = 16.73%) was significant (t(149) = 21.99, 95% CI [15.23, 18.23], p <0.001).

Thus Framingham Risk Score more accurately identified individuals at higher risk

The Pearson's product-moment correlation between ASCVD and FRS was positive, significant and large (r = 0.93,95% C.I. 0.90-0.95 p < 0.001).

Sub-categories

The number of patients in various subcategories of 10 years risk scores were as follows:

For WHO ISH Risk Score: <10% (n = 45); 10% to <20% (n = 29);>=40% (n = 42);20% to <30% (n = 20) and 30% to <40% (n = 14).

For ASCVD Risk Score : <10% (n = 49); 10% to <20% (n = 51); 20% to <30% (n = 17); 30% to <40% (n = 12) and >=40% (n = 21).

FRS: <10% (n = 8); 10% to <20% (n = 31); 20% to <30% (n = 31); 30% to <40% (n = 26) and >=40% (n = 54).

Tabular representation in Table 2.

Risk Category	FRS-Global	AHA-ASCVD	WHO-ISH
<10%	8 (5.3)	49 (32.7)	45 (30.0)
10% to <20%	31 (20.7)	51 (34.0)	29 (19.3)
20% to <30%	31 (20.7)	17 (11.3)	20 (13.3)
30% to <40%	26 (17.3)	12 (8.0)	14 (9.3)
>=40%	54 (36.0)	21 (14.0)	42 (28.0)

Table 2: 10 years risk scores

Agreement between Scores

The agreement between ASCVD and WHO Risk Categories was Fair (weighted kappa 0.36,95% C.I. 0.18-0.55).

The agreement between FRS and WHO Risk Categories was Poor (weighted kappa 0.03,95% C.I. -0.22 - 0.27).

The agreement between ASCVD and FRS Categories was Poor (weighted kappa 0.022,95% C.I. -0.095 -0.14).

The agreement plot between FRS and ASCVD in Figure 1.

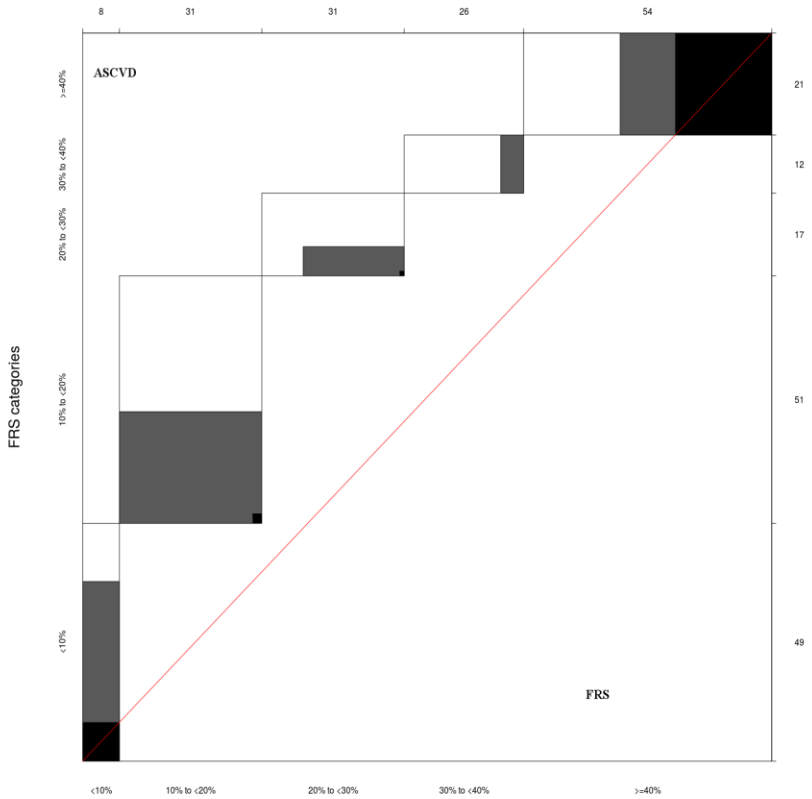

Figure 1: Agreement plot between FRS and ASCVD

Bland Altman Analysis

Bland-Altman analysis was performed to compare FRS with ASCVD. There were 150 observations in our study. The mean risk percentage by FRS was 36.42 .The mean risk percentage by ASCVD was 19.69. There was a mean bias of 16.73 (95% C.I. 15.23 - 18.23) and 95% confidence limits of Agreement from a lower limit of -1.53 to upper limit of 35 implying 95% of differences between the two methods were found in this range. The mean proportional bias was 68.7 % with a 95% Confidence Limit of 66.21 % to 75.52 %. The difference between methods as a function of mean of two methods can be described by the equation y(differences) = 0.34 x(means) + 7.3 implying difference between two measures changes by 0.34 unit with a 1 unit increase in average of cardiovascular risk percentage calculated by two formulas. The Bland Altman Plot between FRS and ASCVD in Figure 2.

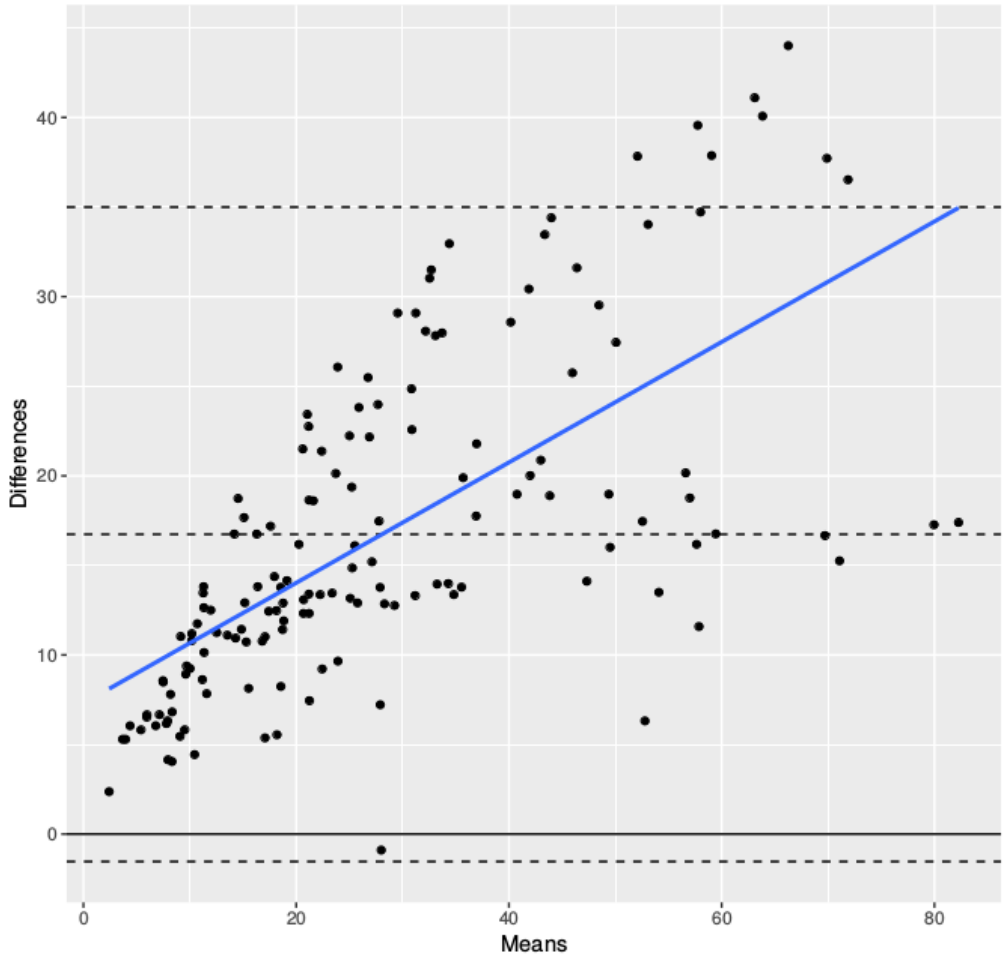

Figure 2: Bland Altman Plot between FRS and ASCVD

Discussion

In our study, Individuals with First episode of MI were classified as non-high risk (<20% 10 year cardiovascular Risk) in Half of Patients using ASCVD Criteria, In One -Third using WHO-ISH Risk criteria and One-Fourth Patients using Framingham Risk Score Criteria.Thus Framingham Risk Score performed best out of three scores in identifying High Risk Patients .

In Studies by Bansal et al., Garg et al and Salaam et al. [15-17] too FRS calculation yielded higher scores than WHO ISH and ASCVD Risk Scores. FRS prediction includes Cardiovascular events like myocardial infarction, Death due to a coronary event, coronary insufficiency, angina, haemorrhagic stroke, transient ischemic attack, peripheral artery disease and heart failure. In contrast WHO-ISH and ASCVD Risk Score estimate risk mainly for myocardial infarction (fatal and non- fatal) and stroke only. This can partially explain the higher individual risk per patients by FRS Score (due to broader coverage). In a Study in UK [18] it was seen that FRS calculation overestimated CV risk by approximately 5%. Bland Altman Plot also shows that overestimation rises with progressively increasing cardiovascular risk. JBS Risk Score calculation was not undertaken in our cohort.

While the correlation between FRS and AHA Risk calculator is good, agreement between their subcategories is poor which shows disadvantages of

categorizing continuous data. Thus instead of using deciles of cardiovascular risk categories, absolute measures should be used and reported.

Our findings are similar to Study by Bansal and Garg where all risk Scores underestimated the 10 year Cardiovascular Risk to varying degrees. Thus we should consider looking at non-conventional measures like CIMT, hsCRP, Coronary Artery Calcium for better estimation. Our Population was slightly older to relatively younger cohort in binoo et al. (mean 36 years) but similar to Bansal and Garg et al. (mean 55-60 years) [15,16].

The strengths of our study is the use of newer AHA Pooled Cohort equation for risk estimation and analysis of evaluation of the agreement between categories of these scores by Kappa Scores and Bland Altman Plot, which has not been done previously to our knowledge in existing literature.

Our study has some limitations - These tools should ideally be measured at baseline and then cohort should be followed up in time for better assessment of risk with time. In our study we used First MI as retrospective proxy for patients with high risk. FRS-CVD is aslo not directly comparable to other tools and may not perform the best in Indians if the same outcomes were to be measured with other scores used in this study.

Conclusion

The present study shows that Most risk scores underestimated Cardiovascular Risk in India population. FRS Global Risk appeared to be most useful CVD risk assessment model in Indian patients. There was better agreement between WHO-ISH and ASCVD than with FRS,but both of them significantly underestimated cardiovascular Risk.

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