Indian Heart Journal xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Indian Heart Journal

journal homepage: www.elsevier.com/locate/ihj

Original Article

Comparison of different cardiovascular risk score calculators for cardiovascular risk prediction and guideline recommended statin uses

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ARTICLE INFO

Article history:
Received 28 November 2016
Accepted 19 January 2017
Available online xxx

Keywords:
Cardiovascular risk calculators
Primary prevention
Myocardial infarction
Cardiovascular risk score

ABSTRACT

Objective: The accuracy of various 10-year cardiovascular disease (CVD) risk calculators in Indians may not be the same as in other populations. Present study was conducted to compare the various calculators for CVD risk assessment and statin eligibility according to different guidelines.
Methods: Consecutive 1110 patients who presented after their first myocardial infarction were included. Their CVD risk was calculated using Framingham Risk score- Coronary heart disease (FRS-CHD), Framingham Risk Score- Cardiovascular Disease (FRS-CVD), QRISK2, Joint British Society risk calculator 3 (JBS3), American College of Cardiology/American Heart Association (ACC/AHA), atherosclerotic cardiovascular disease (ASCVD) and WHO risk charts, assuming that they had presented one day before cardiac event for risk assessment. Eligibility for statin uses was also looked into using ACC/AHA, NICE and Canadian guidelines.
Results: FRS-CVD risk assessment model has performed the best as it could identify the highest number of patients (51.9%) to be at high CVD risk while WHO and ASCVD calculators have performed the worst (only 16.2% and 28.3% patients respectively were stratified into high CVD risk) considering 20% as cut off for high risk definition. QRISK2, JBS3 and FRS-CHD have performed intermediately. Using NICE, ACC/AHA and Canadian guidelines; 76%, 69% and 44.6% patients respectively were found to be eligible for statin use.
Conclusion: FRS-CVD appears to be the most useful for CVD risk assessment in Indians, but the difference may be because FRS-CVD estimates risk for several additional outcomes as compared with other risk scores. For statin eligibility, however, NICE guideline use is the most appropriate.

1. Introduction

Cardiovascular disease (CVD) burden is large and is growing in South Asia.[1] In these countries, the age of onset of first myocardial infarction is on average 10 years earlier as compared with other countries.[2] INTERHEART and INTERSTROKE study found that more than 86% of CVD was attributable to nine key risk factors (smoking, lipids, hypertension, diabetes, obesity, diet, physical activity, alcohol consumption and psychosocial factors).[3,4] Unlike other traditional risk factors, the prevalence of diabetes mellitus is uniformly higher in South Asians than in many other populations.[5] Tobacco use is generally low among South Asian men and very less among South Asian women.[6] South Asian Indians have low HDL and high triglyceride levels. LDL particles are smaller and denser. Lipoprotein (a), C-reactive protein, homocysteine, and plasminogen activator inhibitor-1 levels tend to be higher in South Asians than in white populations.[6,7] So, the risks of having cardiovascular disease with the same traditional risk factors differ in Indian population.

Cardiovascular risk prediction models are important in the prevention and management of cardiovascular diseases. Many risk estimation systems are in existence.[8–13] The best known and probably the most widely used globally is the Framingham Risk Score. Several modified versions of the 10-year Framingham Risk Calculator equation, QRISK2 model, the American Heart Association (AHA) and the American College of Cardiology (ACC) developed Atherosclerotic Cardiovascular Disease (ASCVD) risk score calculator are used in clinical practice to identify and treat high-risk populations as well as to communicate risk effectively.[14] Different guidelines recommend different risk score calculators to assess the 10-year cardiovascular risk and their management depending on their risk scores.[15–18]

There are various concerns when adopting a risk prediction model for the clinical assessment of a patient to determine

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http://dx.doi.org/10.1016/j.ihj.2017.01.015

treatment options. The most important of which is the local applicability and modifiability of the risk model. Considering the Indian population who develop CAD at an earlier age and also have higher frequency of emerging risk factors,[19] the performance of the previous models may not be equal and accurate. Previous study by Kanjilal et al. found that Framingham Risk Score (old version) was able to identify only 5% of their population to be at high risk.[20] Recent retrospective study by Bansal et al. in Indian patients who already had acute myocardial infarction found that the Joint British Society risk calculator 3 (JBS3) performs the best.[21]

So, the present study was conducted with the aims and objectives of comparing the various 10-year cardiovascular risk prediction scores in a patient population who presented with acute myocardial infarction and also to compare the various guideline recommendations for statin eligibility in these patients as a part of primary prevention measure depending on their respective risk scores had they presented just before their clinical event with the same risk factors for their 10-year CV risk assessment.

2. Methods

Consecutive patients of 25–85 years age who were presented with recent history of acute myocardial infarction (MI) were included in the study. The diagnosis of MI was based on 3rd universal definition of MI.[22] All patients underwent detailed clinical evaluation including history and physical examination. Height and body weight were measured and body mass index (BMI) was calculated. Blood pressure was measured and hypertension was defined according to JNC criteria.[23] Smoking was defined according to NHIS definitions.[24] Blood samples were collected at the time of hospital admission and were evaluated for HbA1c levels, random blood sugar level, renal function tests and routine haemogram. Fasting blood samples were collected on the next day and were evaluated for fasting blood sugar levels and lipid profile. HDL level <40 mg/dl in male and <50 mg/dl in female was considered as low HDL while triglyceride level of more than 150 mg/dl was taken as high. The e-GFR (estimated glomerular filtration rate) was calculated from MDRD (Modification of Diet in Renal Disease) study equation.[25] HbA1c levels were measured using Bio-Rad D-10 dual program (Bio-Rad Co., Hercules, CA) using ion-exchange high-performance liquid chromatography. Ethical clearance for the study was obtained from institutional ethical committee.

Based on the data their risk scores were calculated. Online calculators available at www.framinghamheartstudy.org/risk-functions/cardiovascular-disease/10-year-risk.php, http://tools.acc.org/ASCVD-Risk-Estimator/, http://www.qrisk.org/, http://www.jbs3risk.com/JBS3Risk.swf, http://CVdrisk.nhlbi.nih.gov/for Framingham Risk Score-Cardiovascular Disease (FRS-CVD), ACC/AHA Atherosclerotic Cardiovascular Disease (ASCVD) risk score, QRISK2, Joint British Society calculator-3 (JBS3), Framingham Coronary Heart-Disease Risk Score (FRS-CHD) respectively were used for the calculations. WHO/ISH CV risk calculations were done using WHO/ISH chart. Minor adjustments were done in risk factors as per the calculator requirement. All calculators provided the risk score in numeric values except the WHO/ISH model that gave the risk in categories.

We have also divided the risk categories into high (10-year risk score ≥20%) and low risk (10-year risk score <20%) groups in each model to identify which model maximally identifies the high risk groups. For "Statin Eligibility" categorization the respective guideline directed risk calculators and risk score cut offs were used. For this purpose, we have used ACC/AHA 2013 guideline which uses ASCVD risk score and a cut off of ≥7.5% for initiation of moderate to high intensity statin, NICE 2014 guideline which uses QRISK2 risk engine and offers atorvastatin 20 mg daily who have a score ≥10% and Canadian 2012 guideline using FRS CVD risk score with cut off of ≥20% for statin initiation.

Age, gender, systolic blood pressure, total & HDL cholesterol, smoking status and treatment for hypertension were considered in FRS-CHD risk score calculation. Diabetes was considered as a CVD equivalent. In FRS-CVD, diabetes was considered as a risk factor for score calculation. In ASCVD calculator, race was taken into account as an additional factor. In QRISK2 the presence of chronic kidney disease, atrial fibrillation, rheumatoid arthritis, family history of CVD, ethnicity along with body mass index were also considered along with the classical risk factors. JBS3 used the same risk factors for risk score calculation as QRISK2.

2.1. Statistical analysis

Statistical analysis was done using IBM SPSS statistics 20 package. All values were expressed as mean (±standard deviation) or as percentages. Standard descriptive analysis was performed to analyse the baseline characteristics of the study population. The categorized risk estimates derived from the different risk scores were compared either using Wilcoxon's signed rank test for the non-dichotomized risk scores and the dichotomized risk scores were compared using Mc-Nemar test. Pearson's correlation coefficient (r) was estimated to assess the relationship between various risk score calculators. A p value ≤0.05 was considered statistically significant.

3. Results

3.1. Baseline characteristics

Baseline characteristics of the study population are presented in Table 1. The average age of the whole population was 57.3 ± 9.5 years. Males were predominant. Only 3.6% of the study population had young MI patients. Most were non-obese subjects with average BMI of 26.1 ± 18.4 kg/m^2. The prevalence of hypertension, smoking, diabetes mellitus (DM) was almost similar, each constituting about 30% of the study population. Average LDL was lower than expected i.e. 86.7 ± 32.2 mg/dl. A low HDL and high triglyceride were highly prevalent. Only 2.5% had a family history of premature CVD. Around 85% suffered a STEMI. Only 8 of our patients were known cases of chronic kidney disease (CKD), 1 had

Table 1
Baseline characteristics of the study population (n = 1110).

Parameter	Value (%)*
Age (years)	57.3 ± 9.5
Gender (Male/Female)	886/114
BMI (kg/m^2)	26.1 ± 18.4
SBP (mm Hg)	130.3 ± 19.1
DBP (mmHg)	79.0 ± 9.4
LDL (mg/dl)	86.7 ± 32.2
HDL (mg/dl)	31.9 ± 8.7
TG (mg/dl)	186.9 ± 120.8
RBS (mg/dl)	134.9 ± 66.6
Serum creatinine (mg/dl)	1.1 ± 0.3
Hypertension	179 (32.2%)
Diabetes	184 (33.1%)
Smoker	175 (31.5%)
Family history of premature CVD	14 (2.5)
Myocardial Infarction type	1019 (83.7)
STEMI	91 (16.3)
NSTEMI	
Young MI (<40 year old)	40 (3.6)

*Numbers in parentheses indicate% of total population. Abbreviations: BMI = Body mass index, SBP = Systolic blood pressure, DBP = Diastolic blood pressure, LDL = Low density lipoprotein, HDL = High density lipoprotein, TG = Triglyceride, RBS = Random blood sugar, MI = Myocardial infarction, STEMI = ST elevation myocardial infarction, NSTEMI = Non ST elevation myocardial infarction.

Please cite this article in press as: N. Garg, et al., Comparison of different cardiovascular risk score calculators for cardiovascular risk prediction and guideline recommended statin uses, Indian Heart J (2017), http://dx.doi.org/10.1016/j.ihj.2017.01.015