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Original Article

Relationship between different cardiovascular risk scores and measures of subclinical atherosclerosis in an Indian population☆

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ABSTRACT

Background: Relative accuracy of the various currently available cardiovascular (CV) risk assessment algorithms in Indian patients is not known.

Methods: This study included 194 consecutive patients (mean age 49.6 ± 10.3 years, 84.5% males) attending a CV disease prevention clinic at a tertiary center in north India. Four risk assessment models [Framingham Risk score ($Risk_{FRS}$), American College of Cardiology/American Heart Association pooled cohort equations ($Risk_{ACC/AHA}$), the 3rd iteration of Joint British Societies' risk calculator ($Risk_{JBS}$) and the World Health Organization/International Society of Hypertension risk prediction charts ($Risk_{WHO}$)] were applied. The estimated risk scores were correlated with carotid intima-media thickness (CIMT) and coronary calcium score (CCS) using nonparametric statistics (Chi-square test, Kruskal–Wallis test and Spearman rank correlation).

Results: Overall, $Risk_{ACC/AHA}$ and $Risk_{WHO}$ significantly underestimated CV risk as compared to $Risk_{JBS}$ and $Risk_{FRS}$, with $Risk_{JBS}$ being the least likely to underestimate the risk (patients with coronary artery disease who were found to have ≥20% CV risk- 21.4% with $Risk_{ACC/AHA}$, 17.9% with $Risk_{WHO}$, 41.4% with $Risk_{FRS}$, and 58.6% with $Risk_{JBS}$). Further, only $Risk_{JBS}$ and $Risk_{FRS}$, but not $Risk_{ACC/AHA}$ and $Risk_{WHO}$, demonstrated consistent relationship with CIMT and CCS (Spearman rho 0.45 and 0.46 for $Risk_{JBS}$ and 0.39 and 0.36 for $Risk_{FRS}$ for CIMT and CCS respectively, all p values < 0.001).

Conclusions: The present study shows that in Indian subjects $Risk_{JBS}$ appears to provide the most accurate estimation of CV risk. It least underestimates the risk and has the best correlation with CIMT and CCS. However, large-scale prospective studies are needed to confirm these findings.

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1. Introduction

Estimation of the risk of future atherosclerotic cardiovascular (CV) events is an important step in the management of the patients requiring primary prevention of CV disease. The ability to quantify CV risk allows objective assessment of the 'seriousness' of the illness, provides a means to communicate the same to the patient and his family, and most importantly, forms the basis on which a number of important therapeutic decisions are taken.[1,2]

A number of CV risk scoring systems are currently available for use in different population groups, such as Framingham risk score ($Risk_{FRS}$),[3,4] Prospective Cardiovascular Munster Score (PROCAM),[5] Systemic Coronary Risk Evaluation (SCORE),[6] World Health Organization/International Society of Hypertension (WHO/ISH) CV disease risk prediction charts ($Risk_{WHO}$)[7] and the more recently developed American College of Cardiology/American Heart Association (ACC/AHA) pooled cohort equations ($Risk_{ACC/AHA}$)[8] and the 3rd iteration of Joint British Societies' risk calculator ($Risk_{JBS}$).[9] However, as these risk algorithms are based on epidemiological data, they are applicable only to those populations from which the data has been derived. Unfortunately, none of the currently available risk prediction models is based on Indian data or has been prospectively validated in Indians. Although a few studies have attempted to evaluate the relative accuracy of these western CV risk scores in Indians, the evidence remains grossly limited.[10,11] We, therefore, sought this study to compare the accuracy of four clinically relevant CV risk assessment algorithms- $Risk_{FRS}$, $Risk_{JBS}$, $Risk_{ACC/AHA}$ abd $Risk_{WHO}$- in a north Indian population. The risk estimates derived using these four algorithms were correlated with carotid intima-media thickness (CIMT) and coronary calcium score (CCS)- the two well established measures of subclinical atherosclerosis and reliable predictors of future risk of CV events.

2. Methods

This cross-sectional study included consecutive subjects attending a CV disease prevention clinic at a tertiary care center in north India. The subjects were eligible to be included in the present study if they-

- were ≥30 years of age,
- had undergone computed tomographic (CT) coronary angiography along with CCS estimation,
- did not have previously known coronary artery disease (CAD), and
- did not have any other concomitant major cardiac illness.

Thus, a total of 194 subjects were included in the study. All subjects underwent clinical evaluation, biochemical investigations and measurement of CIMT. In addition, as mentioned above, all subjects had already undergone CCS estimation.

The clinical evaluation included history regarding the presence or absence of CV risk factors, duration of CV risk factors, symptoms suggestive of CAD etc. Physical examination included height, weight & blood pressure (BP) measurement and the examination of CV system. BP was measured in the right arm in supine position, using a standard sphygmomanometer. Biochemical investigations included a fasting lipid profile and fasting & 2-h post-prandial blood glucose estimation.

For the purpose of the present study, hypertension was defined according to Joint National Committee (JNC) 7 guidelines as systolic BP ≥ 140 mm Hg or diastolic BP ≥ 90 mm Hg or previous history of hypertension or self reported use of antihypertensive medications.[12] Diabetes mellitus was defined as fasting blood glucose ≥126 mg/dl or 2-h postprandial blood glucose ≥200 mg/dl or pharmacological treatment for diabetes or previous history of diabetes mellitus. Family history was considered positive if a coronary event had occurred in a male first degree relative before the age of 55 years or a female first degree relative before the age of 65 years. Smoking or tobacco use in any form during the preceding month was also considered to be a CV risk factor.

2.1. Estimation of CV risk

Based on the information collected, 10-year risk of having a major CV event [CV death, myocardial infarction (MI) or stroke] was calculated for each patient using $Risk_{FRS}$, $Risk_{JBS}$, $Risk_{ACC/AHA}$ and $Risk_{WHO}$. However, as $Risk_{ACC/AHA}$ and $Risk_{WHO}$ limit 10-year risk estimation only to the individuals ≥40 years of age, those <40 years of age ($n = 37$) were excluded when calculating 10-year risk estimates using these two algorithms. Similarly, $Risk_{FRS}$ could not be applied in 2 patients as they were >74 years of age and $Risk_{JBS}$ could not be applied in 3 patients because their body-mass index values were not available.

$Risk_{FRS}$ and the $Risk_{ACC/AHA}$ calculators are available for download from the websites https://www.framinghamheartstudy.org/risk-functions/cardiovascular-disease/10-year-risk.php# and http://my.americanheart.org/professional/StatementsGuidelines/Prevention-Guidelines_UCM_457698_SubHomePage.jsp respectively. $Risk_{JBS}$ is available as an online calculator at www.jbs3risk.com. The WHO/ISH risk prediction charts are included as part of the 'Guideline for assessment and management of cardiovascular risk' available at the WHO website (http://www.who.int/cardiovascular_diseases/publications/Prevention_of_Cardiovascular_Disease/en/). The chart applicable for South-East Asian region D (which includes Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Maldives, Myanmar and Nepal) was used in the present study.

Using these risk assessment models, 10-year absolute CV risk estimates were derived and divided in to the following three categories – <10%, 10–19.9% and ≥20%. $Risk_{WHO}$, however, only provides range estimates and not the absolute risk estimates.

2.2. CIMT assessment

CIMT measurement was performed following the standard protocol.[13] Distal common carotid artery (CCA) was imaged on both sides with a 7.5 MHz frequency linear array