(International Print/Online Journal)

SJIF IMPACT FACTOR: 4.617
GADIF IMPACT FACTOR: 1.49

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume1, Issue 4, Page No: 117-126
November-December 2018

Various Cardiovascular Risk Scores and the Barriers in Their Utilization

Sudha Bala [1], Jayathra Datla [2]
Assistant Professor, Department of Community Medicine , ESIC Medical College, Hyderabad
Student, Masters in public health, School of Medical Sciences, University of Hyderabad

Corresponding Author:

Jayathra Datla
Student, Masters in public health, School of Medical Sciences,
University of Hyderabad

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

ABSTRACT

Background and Aim: Cardio Vascular Diseases are the leading cause of death globally and these death rates are expected to rise to 23.6 million by 2030. Several Risk estimation systems are developed for assessing the future risk of CVD events. This article reviews various CVD risk estimation systems and the barriers associated with their effective utilization.

Methods: Literature search was done through Google Scholar, Cochrane libraries, and Pub med search engines. **Inclusion criteria**: studies looking on 10 models of CVD risk scores–FRS, SCORE, ASSIN, QRISK-1, QRISK-2, PROCAM, WHO/ISH, Reynolds Risk Score, ACC/AHA ASCVD risk calculator and JBS2 risk calculator and barriers associated with their usage. **Exclusion criteria**: studies which are assessing at the critical statistical analysis of effectiveness of these CVD risk score algorithms, their cost effectiveness and also barriers associated with these risk scores at the statistical level.

Results: This paper highlights the various cardiovascular risk scores available with their strengths and limitations and also the barriers in their utilization were identified at physician level, patient level, health system level and risk score algorithm level.

Conclusion: Substantial limitations do exist in the risk scoring algorithms in use and there are also efforts being made to increase their validity by adjusting them with regional CVD data. In order to increase the utilization and to gain maximum benefit from a CVD risk score the health care professionals are encouraged to use the cardiovascular risk equation that they feel most appropriate for day-to-day risk evaluation and management.

Keywords: Risk score, Cardiovascular disease, risk estimation.

INTRODUCTION

Cardio Vascular Disease is a global problem that affects every ethnic group and is the leading cause of death worldwide(1). The mortality rate due to CVD is expected to rise to 24 million by 2030 (2). In such scenario risk prediction plays a critical role in the prevention of CVD. To estimate the risk of future cardiovascular events and for effective implementation of prevention strategies clinicians need reliable tools to identify individuals at high risk for developing CVD. For this purpose, multivariable risk assessment tools, combining different sets of variables have been developed and validated such as Framingham risk score (Risk FRS)(3,4,5). Prospective Cardiovascular Munster Score (PROCAM)(3,14), Systemic Coronary Risk Evaluation (SCORE)(3,5,7,8), QRISK(1,3,12,13), and the more recently developed World Health Organization/International Society of Hypertension CVD risk prediction charts (Risk WHO)(3,15), American College of Cardiology/ American Heart Association (ACC/AHA)(17) pooled cohort equations (Risk ACC/AHA) and the 3rd Joint British Societies' risk calculator (Risk JBS)(18) etc. Although these CVD risk scores have attracted considerable attention, their effect on clinical outcomes is uncertain due to the limitations of the risk score algorithms and also barriers that prevent their effective utilization at various levels. The current study focuses on the strengths and limitations of various cardiovascular risk scores and identifying the barriers that prevent their effective utilization at various levels.

Objectives: The two main objectives of this review article are

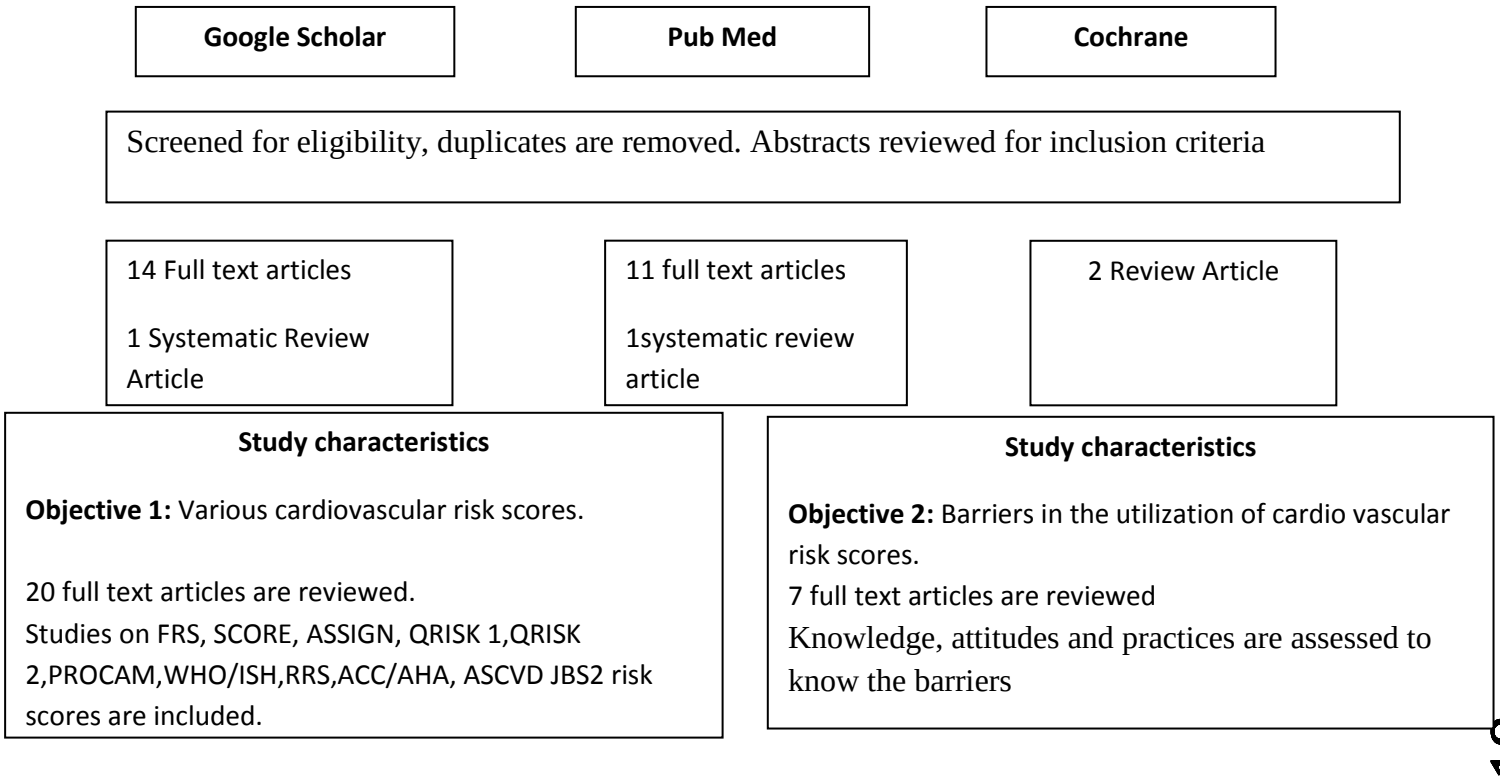
A) To identify the various cardiovascular risk score available with their strengths and limitations.
B) To find the barriers for the utilization of the cardiovascular risk scores.

Methodology

Searching: We conducted a literature search of systemic analysis and full text articles which included observational and comparison studies to identify various cardiovascular risk scores that are used to estimate future CVD risk their strengths and limitations and barriers associated with the effective utilization of CVD risk scores. Studies were identified through searches of Google Scholar, Cochrane libraries, and Pub med. Additional studies were identified through hand searches of key references lists and WHO Regional databases. Studies in English were included, and the literature search covered studies published from 2002 to January 2018. The search strategy included combinations of the terms: Cardiovascular risk scores, risk assessment, comparison of cardio vascular risk scores, limitations, strengths, barriers, knowledge, attitudes and practices.

Inclusion/exclusion criteria: We included comparison and observational studies looking only on 10 models of CVD risk scores those are –FRS, SCORE, ASSIN, QRISK-1, QRISK-2, PROCAM, WHO/ISH, Reynolds Risk Score, ACC/AHA ASCVD risk calculator and JBS2 risk calculator. Included studies could either be an intervention focused on the assessment of a particular CVD risk scores among the chosen 10 models and barriers associated with usage which only concentrated on knowledge, attitude and practices of healthcare providers and patients. We limited our search to studies conducted only on the above mentioned 10 risk models and rest were excluded. We did not include studies looking at the critical statistical analysis of effectiveness of these CVD risk score algorithms, their cost effectiveness and also barriers associated with these risk scores at the statistical level.

Data extraction: Studies were screened using a two-stage process: First we screened titles and abstracts in order to select studies published in English that potentially met the inclusion criteria. Then we reviewed the shortlist of studies to assess whether studies met the inclusion criteria.



Volume 1, Issue 4; November-December 2018; Page No. 117-126

Results:

Search results ----- studies. After excluding duplicates and considering abstracts for relevant inclusion criteria, 27 full text articles were reviewed. Observational and comparison studies were found and were organized into the following categories: cardiovascular risk scores, strengths and limitations of the risk scores and barriers in their utilization. After excluding studies , we were able to conduct review on two categories of Cardiovascular risk scores : Strengths and limitations of cardiovascular risk scores and barriers for their effective utilization at various levels. The results of review articles are as follows.

Table 1: VARIOUS CARDIOVASCULAR RISK SCORES

RISK SCORE	ESTIMATE	AGE RANGE	VARIABLES ASSESSED	STRENGTHS	LIMITATIONS
Framingham Risk Score (3) (4) (5) (2008)	10-year risk of CVD events	30-75	Dyslipidemia , Age, Sex, HTN Treatment, Smoking and Total Cholesterol.	*Framingham Risk Score gives an indication of the likely benefits of prevention. *Validated in the USA, both in men and women, both in European Americans and African American.	. *Overestimate (or underestimate) risk in populations other than the US population. *Underestimated risk in diabetic & patients with F/H/O CHD. *Inferior performance when compared with other models.(6)
SCORE Risk Model(3) (5) (7) (8)	10-yr risk of CVD mortality	40-65	Gender, Age, Smoking SBP, Total Cholesterol.	*It accommodates more of the heterogeneity across Europe in terms of baseline CVD risk. *Simple and easy to use. *The use of CVD mortality as the end point facilitates the recalibration process.	*Restricted age range of application (40-65).(9) *Recalibration approach most likely leads to overestimation of risk in the healthy subpopulation where SCORE is going to be used. (9) *The SCORE prevention paradox.(9) *Estimates risk of fatal CVD events only(9)
ASSIGN SCORE(3 , 10)	10-yr risk of CVD events	30-74	Sex, Age, Total Cholesterol, HDL Cholesterol, SBP, Smoking—No. of Cigarettes, Diabetes,	*ASSIGN addresses the issues of social deprivation and family history of disadvantaged, high-risk, minority groups	*Only based on Scottish populations. *Not reported any studies of external validation.(3)

Volume 1, Issue 4; November-December 2018; Page No. 117-126

			Area-Based Index Of Deprivation, Family History Of CHD.	thus shifting preventive treatment towards the socially deprived in the population(10) *Uses a quantitative measure of smoking.	
QRISK - 1(1) (12)	10-yr risk of CVD events	35-74	Sex, Age, Total Cholesterol To HDL, Cholesterol Ratio, SBP, Smoking Status, Diabetes, Area-Based Index Of Deprivation, Family History, BMI, Antihypertensive Use.	*Better calibrated to the UK population than either the Framingham model or ASSIGN. *It includes additional variables which improve risk estimates for patients with a positive family history or those on antihypertensive treatment	* Only from England and Wales. *QRISK is not based on a cohort study with randomly selected participants. *The hazard ratio for TCL/HDL in cholesterol is completely inconsistent with numerous previous studies. *Underestimates risk in European Populations.
QRISK-2(3) (13)	10-yr risk of CVD events	35-74	Sex, Age, Total Cholesterol To HDL Cholesterol Ratio, SBP, Smoking Status, Diabetes, Area-Based Index Of Deprivation, Family History, BMI, Antihypertensive Treatment, Ethnicity, Chronic Diseases	*Ethnicity influences cardiovascular risk, so using the QRISK2 may help to reduce health inequalities that arise when people are misclassified using tools that exclude ethnicity.	*Not reported any studies of external validation. *large missing data. *The inclusion of postcode as a measure of deprivation may limit the applicability of this tool in areas outside the UK. *The risk factors were measured at varying times relative to the date of study entry and not specifically for the purposes of the study .
PROCAM(3) (14)	2 separate scores calculate 10-yr risks of major coronary events and cerebral	20-75	Age, Sex, LDL Cholesterol, HDL Cholesterol, Diabetes, Smoking, SBP.	*Takes into account family history of premature myocardial infarction, diabetes and triglycerides.	*Only based on German males. *Underpowered for risk estimation for women.(14) *Included only the "hard" end points of definite myocardial infarction or sudden coronary death.(14)

Volume 1, Issue 4; November-December 2018; Page No. 117-126

	ischemic events.				
WHO/ISH(3,15)	10-yr risk of CVD events	40-79	Sex, Age, SBP, Smoking Status, Diabetes ,Total Cholesterol. *Different charts available for Worldwide Regions .	*The risk prediction charts were developed separately for each WHO sub region.(15) *Using available information excluding lipid measurement is particularly well suited to areas in the developing world where access to medical facilities is limited.(15)	*Charts were developed by creating a hypothetical dataset for each region—on the basis of the risk factor prevalence in that area. *Not reported any studies of external validation
REYNOLDS RISK SCORE(3) (11) (16)	10-yr risk of incident myocardial infarction, stroke, coronary revascularization, or cardiovascular death	45-80	Sex, Age, SBP, Smoking, Hs CRP, Total Cholesterol HDL Cholesterol, F/H/O Premature MI(Parent Age<60) Hba1c If Diabetic.	*Separate risk scores are available for men and women(16),(11) *High-sensitivity C-reactive protein and family history are independently associated with future cardiovascular events and have been incorporated into risk prediction models.(11,16)	*Limitations related to ethnicity, socioeconomic status and age exist in RRS as the score was developed for Caucasian patients aged 45years or older who live in developed countries.
ACC/AHA ASCVD RISK CALCULATOR(17)	10-year risk of atherosclerotic cardiovascular disease	40-79	Age , Gender, Race, Total cholesterol, HDL , SBP , DBP, Treated for high BP, diabetes, Smoking status.	*Provides statin recommendations(17)	*Overestimated the risk .(17)

Volume 1, Issue 4; November-December 2018; Page No. 117-126

JOINT BRITISH SOCIETIES 2 **RISK CALCULATOR** (18)	10-year risk estimation of CVD	30–75	Age, sex, SBP, DBP, TC, HDL, TC/HDL, TG, smoking, glucose, central obesity, S.A origin, FHx, LVH	*Well-established model *Has been validated in different populations	*Less accurate for women and ethnic minority groups. *Estimates the risk of CHD alone but not other CVD's.

The Barriers for the effective utilization of Cardiovascular Risk Scores Exist At Various Levels And Can Broadly Be Classified As Follows.

Patient Specific Barriers

There are wide spread variations in lifetime risk level, prevalence of risk factors based on ethnicity or socio-economic strata. So, the Risk-scoring assessments developed in one patient population may over or underestimate when applied to other population and the strength of the risk scores changes with population health status.(19)(20). Most of the risk scores require various biochemical investigations that are required for which the patient may show non-compliance due to inability to afford requested investigations. The problem encountered in a general and regular application of risk scores in primary care is that the specific physician-patient interaction is neglected and so the patient may become suspicious if other themes are addressed that may take consultation time away from his or her stated concern.(21).

Physician Specific Barriers

Lack of knowledge is only one reason among many for the underuse of risk scores by the physicians. Majority of them fear that the risk assessment scores might over simplify (58%) or lead to over use of medical therapy (54%) especially among men and elderly individuals as *"risk scores do not allow calculation of risk in the elderly"* (80.0% in Germany vs 67.5% in the ROE). (19) (20) (22). They believe that the number of individuals who would need primary prevention for CVD could double compared with baseline numbers and thus an increase in numbers of patients receiving medications may result in higher healthcare costs.(19) Another widely recognized barrier is Time constraint as conducting a risk assessment requires time but this is not possible as the length of patient visits are usually very low in Public Health Care settings which allows for very little discussion(23). The physicians are very unclear about the differences between scores and the benefits and drawbacks of more recent scores derived in partially treated populations. They also exhibited substantial variation in opinion about whether they could legitimately use any risk score to show patients the change in risk from treatment and, if so, how best to do that(20) (24). Many studies have shown that though majority of physicians recognize the importance of cardiovascular risk scores, they still believe their own estimation to be more accurate and use a subjective assessment of cardiovascular risk rather than specific risk calculators in practice.(25). A survey of 36 Australian GPs indicated that CVD risk assessment was more valuable as a patient education tool than as an aid for treatment decisions.(26)

Health System Specific Barriers

In the low and middle income countries the health care system at the primary level is not well equipped at present for routine risk-score use due to lack of facilities required for the assessment of Biochemical parameters for CVD risk stratification(15) which include - lack of human resources, lack of lab facilities, lack of reimbursement for time and resources spent, increase in medication prescription and diagnostics, lack of appropriate preventive programs for those patients identified as being at increased risk requiring intensified behavioral interventions or regular checkups.(18),(21)

Risk Scores Specific Barriers

The different CVD scores available have wide variations as they are developed outside a specific physician-patient interaction. This can increase the chance that an individual's risk may differ substantially from the risk predicted by a population-based instrument. (21)Current 10-year risk models have the limitation that they are drawn from

Volume 1, Issue 4; November-December 2018; Page No. 117-126

populations in adult age spectrum making the age the most crucial variable(27).Because of which the modest elevations in risk factors in younger adults (men <45 years of age and women <65 years of age) will have less effect on their 10-year risk leading to underestimation. This is strengthened by the fact that though many younger patients have significant risk factor burden, they do not reach treatment thresholds based on current ATP-III recommendations (27) The 10-year risk equations are unable to predict the greater long term risk of CVD especially among men as the methods and data available for life term risk estimation are limited. The Cardiovascular risk scores fail to adjust for changes in treatment effects during the years of follow-up and underestimate the predicted risk as they only measure baseline risk factors to predict future cardiovascular morbidity and mortality. This makes the use of most cardiovascular risk scores for treatment decisions problematic(25). The outcomes of the CVD Risk scores are unclear even the Framingham study risk scores have been criticized for the inclusion of 'soft'(subjective) outcomes such as angina(25). The SCORE study cohorts, unlike the Framingham study, were not designed specifically to study CVD, and for this reason SCORE predicts only fatal CVD events, excluding non-fatal events.(28)

Discussion

The use of computerized instruments that allow time-saving and practical risk calculations, ideally for different diseases simultaneously based on medical record data, and improved computer-generated visual presentation of risk estimates including aspects of behavior modification as part of the presentation of risk estimates gives good results (19). This has been proven by a study from New Zealand that shows the use of computerized risk-prediction instruments can considerably increase the frequency of risk-score use and documentation of a patient's risk in private practice(29). Development of patient educational materials may be necessary to increase patient understanding, and this may also facilitate physician–patient communication(23). Further studies are needed for examining the effect of global CVD calculation on actual patient outcomes. A local validation and the demonstration that risk scores may actually help in refining and improving therapies and outcomes in particular would certainly be of help. To promote the utilization of CVR scores in clinical practice, effective communication among CVRPT stakeholders and health care policy makers, adopting a simple, cost effective CVRPT, and physician training are suggested (25). Long-Term and Lifetime Risk Estimation as an Adjunct to 10-Year Risk Estimation as suggested by Canadian2 and AHA3 guidelines are needed to assess the burden of disease in a population, predict the future burden of disease, and directly compare lifetime risks between common diseases. Pencina et al recently published a quantitative method for estimating long-term (30-year) risks for CVD that also accounts for competing risks (30). By comparison with subclinical atherosclerosis imaging data the concept of identifying younger individuals at low short-term but high lifetime risk was recently validated .In the Coronary Artery Risk Development in Young Adults Study among 32 to 47 years of age group, >90% of participants had a 10-year predicted risk <10% however approximately half of them had high predicted life time risk of >=39% therefore it is recommends to Lower treatment thresholds for younger adults (eg- treat those <50 years of age with 10-year risk >5%)(31). A study has shown that the correlation between non-laboratory-based and laboratory-based risk scores is very high for both men and women, so relatively simple tools can be used to detect potentially large numbers of high-risk individuals especially in low resource settings. (32)

Conclusion

Risk scoring algorithms can be used not only to produce a risk estimate but also to help in determining preventive measures which would provide the most benefit for reducing CVD risk. Most of the risk scores in use have substantial limitations like recalibration, the effect of incorporating newer risk factors and the challenges of risk estimation in the young and the old that needs more research. The amended NICE guidelines now encourage healthcare professionals to use the cardiovascular risk equation that they feel most appropriate for day-to-day risk evaluation and management. In fact, many current algorithms were adjusted with regional CVD data to increase their validity. Our future goal is implementation of a global risk-scoring algorithm which is standardized, easy to use and that which thoroughly evaluates CVD risk.

Acknowledgements

Volume 1, Issue 4; November-December 2018; Page No. 117-126

We hereby take the opportunity to thank Prof.Dr.P.Prakash Babu Dean, School of Medical Sciences,University of Hyderabad for permitting me to be a part of the Internship Program at ESIC Hospital. I would also like to thank Dr.Anita C.T. Associate Professor, School of Medical Sciences, University of Hyderabad and Dr.Ajitha.K, Associate Professor, School of Medical Sciences, University of Hyderabad for their continuous coordination and support throughout the Internship Program.

We express our sincere gratitude to Dr.Harshal Pandve, H.O.D, Department of Community Medicine, ESIC Hospital and to all the Staff of ESIC hospital and the team of Community Medicine in particular for giving their valuable time and support.

References:

1. Vilahur G, Badimon JJ, Bugiardini R, Badimon L. Perspectives: The burden of cardiovascular risk factors and coronary heart disease in Europe and worldwide. Eur Heart J Suppl. 2014 Jan 1;16(suppl_A):A7–11.
2. WHO | About cardiovascular diseases [Internet]. WHO. [cited 2018 Jul 6]. Available from: http://www.who.int/cardiovascular_diseases/about_cvd/en/
3. Cooney MT, Dudina AL, Graham IM. Value and Limitations of Existing Scores for the Assessment of Cardiovascular Risk. J Am Coll Cardiol. 2009 Sep;54(14):1209–27.
4. Chow CK, Joshi R, Celermajer DS, Patel A, Neal BC. Recalibration of a Framingham risk equation for a rural population in India. J Epidemiol Community Health. 2009 May;63(5):379–85.
5. Baena-Díez JM, Grau M, Sánchez-Pérez R, Altes-Vaques E, Salas-Gaetjens LH, Hernández-Ibáñez MR. The REGICOR-calibrated function provides a better classification of high-risk patients on statin treatment in the Spanish population than the Framingham or SCORE classifications. Rev Esp Cardiol. 2009 Oct;62(10):1134–40.
6. Siontis GCM, Tzoulaki I, Siontis KC, Ioannidis JPA. Comparisons of established risk prediction models for cardiovascular disease: systematic review. BMJ. 2012 May 24;344(may24 1):e3318–e3318.
7. Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, et al. European guidelines on cardiovascular disease prevention in clinical practice: executive summary. Fourth Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease prevention in clinical practice (constituted by representatives of nine societies and by invited experts). Eur J Cardiovasc Prev Rehabil Off J Eur Soc Cardiol Work Groups Epidemiol Prev Card Rehabil Exerc Physiol. 2007 Sep;14 Suppl 2:E1-40.
8. Backholer K, Hirakawa Y, Tonkin A, Giles G, Magliano DJ, Colagiuri S, et al. Development of an Australian cardiovascular disease mortality risk score using multiple imputation and recalibration from national statistics. BMC Cardiovasc Disord [Internet]. 2017 Jan 6 [cited 2018 Jul 5];17. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5219754/
9. Mortensen MB, Falk E. Limitations of the SCORE-guided European guidelines on cardiovascular disease prevention. Eur Heart J. 2016 Dec 9;ehw568.
10. Woodward M, Brindle P, Tunstall-Pedoe H, for the SIGN group on risk estimation*. Adding social deprivation and family history to cardiovascular risk assessment: the ASSIGN score from the Scottish Heart Health Extended Cohort (SHHEC). Heart. 2005 Dec 30;93(2):172–6.
11. Ridker PM, Buring JE, Rifai N, Cook NR. Development and Validation of Improved Algorithms for the Assessment of Global Cardiovascular Risk in Women: The Reynolds Risk Score. JAMA. 2007 Feb 14;297(6):611.
12. Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, May M, Brindle P. Derivation and validation of QRISK, a new cardiovascular disease risk score for the

Volume 1, Issue 4; November-December 2018; Page No. 117-126

United Kingdom: prospective open cohort study. BMJ. 2007 Jul 19;335(7611):136.

13. Collins GS, Altman DG. Predicting the 10 year risk of cardiovascular disease in the United Kingdom: independent and external validation of an updated version of QRISK2. BMJ. 2012 Jun 21;344(jun21 1):e4181–e4181.
14. Assmann G. Simple Scoring Scheme for Calculating the Risk of Acute Coronary Events Based on the 10-Year Follow-Up of the Prospective Cardiovascular Munster (PROCAM) Study. Circulation. 2002 Jan 22;105(3):310–5.
15. Raghu A, Praveen D, Peiris D, Tarassenko L, Clifford G. Implications of Cardiovascular Disease Risk Assessment Using the WHO/ISH Risk Prediction Charts in Rural India. PloS One. 2015;10(8):e0133618.
16. Ridker PM, Paynter NP, Rifai N, Gaziano JM, Cook NR. C-Reactive Protein and Parental History Improve Global Cardiovascular Risk Prediction: The Reynolds Risk Score for Men. Circulation. 2008 Nov 25;118(22):2243–51.
17. DeFilippis AP, Young R, Carrubba CJ, McEvoy JW, Budoff MJ, Blumenthal RS, et al. An Analysis of Calibration and Discrimination Among Multiple Cardiovascular Risk Scores in a Modern Multiethnic Cohort. Ann Intern Med. 2015 Feb 17;162(4):266.
18. Ofori SN, Odia OJ. Risk assessment in the prevention of cardiovascular disease in low-resource settings. Indian Heart J. 2016 May;68(3):391–8.
19. Hobbs FDR, Jukema JW, Da Silva PM, McCormack T, Catapano AL. Barriers to cardiovascular disease risk scoring and primary prevention in Europe. QJM. 2010 Oct 1;103(10):727–39.
20. Liew SM, Blacklock C, Hislop J, Glasziou P, Mant D. Cardiovascular risk scores: qualitative study of how primary care practitioners understand and use them. Br J Gen Pract. 2013 Jun 1;63(611):401–7.
21. Müller-Riemenschneider F. Barriers to Routine Risk-Score Use for Healthy Primary Care Patients: Survey and Qualitative Study. Arch Intern Med. 2010 Apr 26;170(8):719.
22. Tawfik MY, Fahim AE, Ismail MA, Moussa SA. Barriers to The Utilization of Cardiovascular Risk Prediction Tools as Perceived by Primary Health Care and Family Physicians. Egypt J Community Med. 2015;33(1):18.
23. van Steenkiste B, van der Weijden T, Stoffers HEJH, Grol R. Barriers to implementing cardiovascular risk tables in routine general practice. Scand J Prim Health Care. 2004 Mar;22(1):32–7.
24. Fuster V. Are predictive risk scores useful? Nat Rev Cardiol. 2009 Aug;6(8):493.
25. Liew SM, Doust J, Glasziou P. Cardiovascular risk scores do not account for the effect of treatment: a review. Heart. 2011 May 1;97(9):689–97.
26. Torley D, Zwar N, Comino EJ, Harris M. GPs' views of absolute cardiovascular risk and its role in primary prevention. Aust Fam Physician. 2005 Jun;34(6):503–4, 507.
27. Lloyd-Jones DM. Cardiovascular Risk Prediction: Basic Concepts, Current Status, and Future Directions. Circulation. 2010 Apr 20;121(15):1768–77.
28. ELISAF M, TZOUVELEKIS E, NIKAS N, THE OBO, INVESTIGATORS GE. Primary Prevention of Cardiovascular Disease in Greece: Greek Results of the EURIKA Study. :10.
29. Wells S, Furness S, Rafter N, Horn E, Whittaker R, Stewart A, et al. Integrated electronic decision support increases cardiovascular disease risk assessment four fold in routine primary care practice. Eur J Cardiovasc Prev Rehabil Off J Eur Soc Cardiol Work Groups Epidemiol Prev Card Rehabil Exerc Physiol. 2008 Apr;15(2):173–8.
30. Pencina MJ, D'Agostino RB, Larson MG, Massaro JM, Vasan RS. Predicting the 30-Year Risk of Cardiovascular Disease: The

Volume 1, Issue 4; November-December 2018; Page No. 117-126

Framingham Heart Study. Circulation. 2009 Jun 23;119(24):3078–84.

31. Berry JD, Liu K, Folsom AR, Lewis CE, Carr JJ, Polak JF, et al. Prevalence and progression of subclinical atherosclerosis in younger adults with low short-term but high lifetime estimated risk for cardiovascular disease: the coronary artery risk development in young adults study and multi-ethnic study of atherosclerosis. Circulation. 2009 Jan 27;119(3):382–9.
32. Gaziano TA, Abrahams-Gessel S, Alam S, Alam D, Ali M, Bloomfield G, et al. Comparison of Nonblood-Based and Blood-Based Total CV Risk Scores in Global Populations. Glob Heart. 2016 Mar;11(1):37-46.e2.

Volume 1, Issue 4; November-December 2018; Page No. 117-126