Assessment of cardiovascular risk in hypertensive patients: a comparison of commonly used risk scoring programs

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Several calculation modalities are used today for cardiovascular risk assessment. Cardiovascular risk assessment should be performed in all hypertensive patients. Risk assessment methods being based on the population in which the patient lives and the inclusion of factors such as ethnicity variations, socioeconomic status, and medication use will contribute to improvements in risk assessments. The results should be shared with the patient, and modifiable risk factors must be effectively treated.

Hypertension is one of the major cardiovascular risk factors. However, blood pressure (BP) is not the only determinant of cardiovascular risk. Cardiovascular risk (CVR) assessment needs to be determined by assessing the effect of blood pressure together with other risk factors. The most important reason for determining CVR factors is that significant decreases in mortality and morbidity can be achieved with the treatment of correctable risk factors. It also plays a major role in the initiation and management of treatment.¹

WHAT ARE CVR FACTORS?

Traditional risk factors include age, gender, BP, total cholesterol, high-density lipoprotein, smoking, diabetes mellitus, family history of cardiovascular disease, microalbuminuria, or GFR < 60 ml/min, a sedentary lifestyle, and body mass index. Some are modifiable and others unmodifiable. New risk factors have begun being investigated in recent years. These new risk factors include homocysteine, hsCRP, fibrinogen, triglyceride, HbA1c, lipoprotein a, plasma myeloperoxidase, red cell glutathione peroxidase 1, ethnic origin, socioeconomic status, and use of antihypertensive drugs.

MEASUREMENT OF CARDIOVASCULAR RISK

Some important points need to be considered when determining CVR. A test may have different levels of efficacy in determining short- or long-term risks. It also needs to be easily applicable, have a high predictive value in CVR assessment, and be accurately reproducible.²

The main aim in determining CVR is to predict cardiovascular endpoints that may emerge within a certain time period.¹,² There are differences between endpoints in the various CVR prediction modalities used for this purpose, however. Initially CVR estimates were made for the next 5 years, and CV events and mortality were defined as endpoints. In light of subsequent developments, cardiovascular, cerebrovascular, peripheral vascular events, and mortality started to be defined as endpoints. Moreover, CVR estimates began to be projected for the next 10 years. Factors included in initial risk scoring were age, gender, systolic BP, smoking, and diabetes mellitus, while in later years, factors such as HDL, family history, triglycerides, and...
HbA1c levels began to be used in different scoring predictors. Global CVR calculation considers the cumulative impact of all factors beyond the simple effect of each factor alone. In the majority of the predictive tools, the proportional hazards technique is used, based on semi-parametric Cox or parametric Weibull methods. There are several important concepts involved in these calculation techniques. The first is the concept of discrimination, the power to distinguish whether or not a clinical endpoint will result. The second important concept is calibration, the measurement of the extent to which predicted results match the clinical outcomes. Another concept is reclassification, which measures the effect of an additional factor on a clinical endpoint when a new risk factor is added to a risk calculation technique.

Several calculation modalities are used today for CVR assessment. The most frequently employed are Framingham, SCORE, PROCAM, Reynolds, QRISK, ASSIGN, ARIC, Progetto CUORE, and Personal Heart 2007 (Table 1). Methods of determining CVR are based on population studies. Risk calculation is performed with the determination of factors included in the calculation in light of these studies and of the strength of these factors. In some CVR calculations, charts showing risk factors and what the total risk will be are used, while in others scores are given for each factor, if present, and risk is calculated on the basis of the total score. Today, no matter what the intermediate stages of the calculation technique are employed, data being entered into an electronic environment have accelerated not only the obtaining of results, but also the calculation speed, as well as improving the ease of application. It must not be forgotten, however, that there are differences in calculation techniques and that population differences can affect evaluation techniques and risk assessment.

### Differences Between CVR Assessment Methods

The first and widely used globally CVR assessment method is the Framingham risk score (Table 1). This is an assessment modality based on a study performed on a population in the USA. In later years, the number and type of risk factors have been updated. Electrocardiography and left ventricle hypertrophy were used in the first two versions, though these parameters are not employed in later versions. Depending on the population in which the study was performed, however, adjustments are necessary if it is to be performed in other populations.

### Table 1 | Commonly used risk assessment methods, websites, advantages, and shortcomings

| Risk assessment methods and website | Advantages | Shortcomings |
|-----------------------------------|------------|--------------|
| Framingham                        | The first and widely used | A single population |
| http://cvdrisk.nhlbi.nih.gov/     | Most complete data         | Family history, ethnicity, and SCE status not used in determining risk |
| calculator.asp                     | Nonfatal as well as fatal CVD events are used as endpoints | Overestimated or underestimated in different countries |
| SCORE                             | Antihypertensive treatment use as a risk predictor | DM was not a predictor for the European SCORE |
| http://www.escardio.org/           | Ease of use                | Antihypertensive treatment not used as a risk predictor |
| communities/EACPR/toolbox/health-professionals/Pages/SCORE-Risk-Charts.aspx | Can be adapted according to the countries | Family history, ethnicity, and SCE status unused in determining risk |
| PROCAM                           | Large population study from different countries | Only fatal CVD events endpoints used |
| http://www.chd-taskforce.de/       | Relative risk charts for young people | There are limited data for women |
| procam_interactive.html           |                          | Antihypertensive treatment not used as a risk predictor |
| ARIC 2003                         | Antihypertensive treatment use as a risk predictor | Only CHD used as endpoints |
| www.aricnews.net/riskcalc/html/RC1.html | The use of family history as a predictor | Family history and SCE status not used in determining risk |
| Reynolds                         | The use of lipid-lowering agents as a predictor | BP self-reported |
| www.reynoldsriskscore.org         | The use of hsCRP as a predictor | Antihypertensive treatment not used as a risk predictor |
| QRISK                             | Very large sample size     | Ethnicity and SCE status not used in determining risk |
| www.qrisk.org                     | Family history, ethnicity, antihypertensive treatment, and SCE status used in determining risk | There are missing data |
| ASSIGN 2007                       | The use of family history as a predictor | Data are retrospective GP records |
| http://assign-score.com           | Uses a quantitative measure of smoking, family history, and SCE status used in determining | Antihypertensive treatment not used as a risk predictor |
| Progetto CUORE                    | Antihypertensive treatment use as a risk predictor | DM not included as a predictor |
| www.cuore.iss.it/sopra/calc-rischio_en.asp | Physical activity, BMI (for women), and family history used as a risk predictor | Ethnicity not used in determining risk |
| Personal Heart 2007               |                               | Family history, ethnicity, and SCE status not used in determining risk |
| www.heart.org/HEARTORG            |                               | Previous diagnosis of hypertension, DM, hypercholesterolemia used in determining risk |

Abbreviations: BMI, body mass index; BP, blood pressure; CVD, cardiovascular disease; CHD, coronary heart disease; DM, diabetes mellitus; GP, general practices; hsCRP, high sensitive C reactive protein; SBP, systolic blood pressure; SCE, socioeconomic.
The SCORE calculation technique is a system based on 12 prospective studies in 11 countries in Europe. SCORE is an evaluation system that does not include diabetes mellitus (DM) as a risk assessment determinant, although DM is an important risk factor of cardiovascular events. This represents a significant difference between SCORE and other CVR assessment methods. Another important difference between it and other evaluation methods is that SCORE includes fatal cardiovascular events as an endpoint (Table 1). Total cholesterol/HDL ratio was used in the first version, while in the new risk assessment, and parallel to the new dyslipidemia guidelines, HDL has been added as a separate variable.4

The PROCAM assessment method is a system based on research in Germany, mainly involving industrial workers. In the first version, gender difference was not used in risk assessment. One important difference is that family history was first included in the assessment parameters in this calculation method, in contrast to other systems (Table 1).

ARIC 2003 is an assessment modality based on research in the USA. One important feature of this system is the use for the first time of antihypertensive therapy as a determining factor in risk assessment. The possibility of initial risk changing with treatment in subsequent years needs to be borne in mind. Apart from ARIC, antihypertensive use is also employed as a determining factor in the final version of Framingham, Progetto CUORE 2004, SHS 2006, and QRISK. In fact, lipid-reduction therapy and anti-platelet therapy may clearly also be separate factors in risk determination in addition to antihypertensive therapy. However, only Reynolds uses lipid-reduction therapy as a risk determination factor (Table 1). Use of platelet-inhibiting drugs is still not used in risk assessment in any system.

The ASSIGN 2007 and QRISK scoring systems were developed as a result of research in Great Britain (Table 1). The most important feature of these two assessment systems is that socioeconomic status was used as a risk determinant for the first time.

ERRORS IN THE ASSESSMENT OF CVR
Absolute risk in young people may be underestimated due to their youth. Younger age may lead to the masking of true risk despite the presence of many significant risk factors. In contrast, the risk calculation error in the elderly may be an overestimation of absolute risk because of advanced age. A significant problem in addition to overestimation in risk assessment is that this can lead to associated overmedication. Ethnicity variation is another cause of risk assessment error. Adjustments in terms of ethnicity data therefore need to be made in risk assessment methods. On the other hand, consideration of variation in socioeconomic status that has emerged as a risk determinant in recent years will reduce assessment errors. One important source of risk assessment error is the medications used by patients. Finally, it should not be forgotten that there might be parameters that vary throughout a patient’s life that that need to be updated at intervals.

CONCLUSION AND RECOMMENDATIONS
CVR assessment should be performed in all hypertensive patients, the results shared with the patient, and modifiable risk factors effectively treated. Risk assessment methods being based on the population in which the patient lives and the inclusion of factors such as ethnicity variations, socioeconomic status, and medication use will contribute to the improvement of risk assessments.

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