



Cardiovascular risk factors: from model development to clinical application

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Abstract: Cardiovascular diseases (CVDs) are the leading cause of death globally, accounting for an estimated 19.8 million deaths in 2022, representing approximately 32% of all global deaths. Finding out the cause of CVDs through the study of model development. The research is based on the secondary data published in medical journals and reports. The main cause found as Risk factors are variables that predict an individual's likelihood of developing CVD and can be broadly categorized into modifiable and non-modifiable factors (2). Modifiable risk factors, such as tobacco use, unhealthy diet, physical inactivity, and harmful alcohol consumption. Many models are being developed to identify and prevent. The CVDs are preventable with proper health regulation guidelines if applied by individuals, and awareness is also required among the people.

Keywords: Cardiovascular, causes, models, preventable, risk factors.

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Introduction

Cardiovascular diseases (CVDs) are the leading cause of death globally, accounting for an estimated 19.8 million deaths in 2022, representing approximately 32% of all global deaths. Of these deaths, 85% were due to heart attack and stroke(1). The prevention of cardiovascular disease (CVD) is a priority in global health, and risk factors are essential elements under investigation (1). Risk factors are variables that predict an individual's likelihood of developing CVD and can be broadly categorized into modifiable and non-modifiable factors (2). Modifiable risk factors, such as tobacco use, unhealthy diet, physical inactivity, and harmful alcohol consumption, are particularly important because they can be altered through lifestyle



changes and medical interventions (1)(3). Non-modifiable risk factors include age, sex, and family history(4).

Models and Development of Risk Assessment

To move beyond simply identifying risk factors to quantifying an individual's risk, various prediction models have been developed. These models integrate multiple risk factors to estimate a patient's absolute risk of a cardiovascular event over a specific time period, typically 10 years(5).

Framingham Risk Score (FRS): One of the most influential and widely adopted models is the Framingham Risk Score, which was developed from the data of the Framingham Heart Study in 1948 in the United States (6). The FRS, and its subsequent updates, uses a multivariable regression equation to predict the 10-year risk of developing coronary heart disease based on age, sex, total cholesterol, high-density lipoprotein (HDL) cholesterol, systolic blood pressure, and smoking status (5)(6).

Pooled Cohort Equations (PCE): In the United States, the American Heart Association (AHA) and American College of Cardiology (ACC) have developed the Pooled Cohort Equations (PCE) for risk estimation. These equations, derived from a diverse population, predict the 10-year risk of atherosclerotic cardiovascular disease (ASCVD), which includes stroke and heart attack (7).

SCORE2 and QRISK: In Europe, the European Society of Cardiology (ESC) recommends the use of SCORE2 and SCORE2-OP (Older Persons) models. These are based on contemporary European populations and are used to estimate the 10-year risk of fatal and non-fatal CVD events(8). In the United Kingdom, algorithms like QRISK have been developed using a large database of electronic health records, which allows for the inclusion of a wider range of risk factors, such as socioeconomic status and certain chronic diseases, providing a more refined risk prediction (9).

CARFKL: Cardiovascular Disease Risk Factors Knowledge Level Scale is a questionnaire designed to assess an individual's knowledge of cardiovascular disease risk factors. It was developed and validated in Turkey.



The initiation and development of these models typically involve large-scale, prospective cohort studies that follow a population over many years, collecting data on risk factors and tracking the incidence of cardiovascular events. Multivariable statistical techniques, such as Cox proportional hazards models, are then used to identify the strongest predictors and develop a scoring system (10).

Application and Adoption in Clinical Practice

The primary use of these risk models is for the primary prevention of CVD, meaning they are applied to individuals who have not yet had a cardiovascular event (7). The models are used to:

Stratify risk: Patients are categorized into risk groups (e.g., low, intermediate, high risk), which helps guide clinical decision-making and resource allocation (5).

Guide treatment decisions: A high-risk score may prompt a clinician and patient to consider more intensive interventions, such as starting statin therapy, antihypertensive medication, or lifestyle counseling, to reduce risk (7, 11). For example, the AHA/ACC guidelines recommend statin therapy for individuals with a 10-year ASCVD risk of 7.5% or higher (7).

Enhance patient-provider communication: The calculated risk score provides a clear, quantitative measure that can facilitate a shared decision-making process between patients and their healthcare providers (5).

The widespread adoption of these models is encouraged by international guidelines from organizations such as the World Health Organization, the AHA, and the ESC, which recommend their use to target high-risk individuals for preventive interventions (9). However, it is important to note that risk models are not perfect and should be used as a guide, not a definitive diagnosis. They may not account for all potential risk factors, and their accuracy can vary across different populations and ethnic groups (9).

Conclusion

Cardiovascular risk factor assessment is a critical component of modern preventive medicine. The development of sophisticated risk prediction models, initiated through large-scale epidemiological studies like Framingham, has transformed the approach to CVD prevention.



These models, including the Framingham Risk Score, Pooled Cohort Equations, and SCORE2, are now widely adopted in clinical practice to identify individuals at high risk and guide tailored preventive interventions. By providing a quantitative estimate of risk, these tools empower clinicians to make evidence-based decisions and engage patients in the shared goal of reducing the global burden of cardiovascular disease. Continuous refinement and validation of these models across diverse populations remains an important area of ongoing research to ensure equitable and effective CVD prevention strategies worldwide (9)(11).

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