



## Review paper

## Cardiovascular risk assessment tools: A scoping review



Jennifer Sacramento-Pacheco, RN <sup>a</sup>  
 Gonzalo Duarte-Clímets, RN, PhD <sup>b</sup>  
 Juan Gómez-Salgado, RN, PhD <sup>c, d, \*</sup>  
 Macarena Romero-Martín, RN, MHS <sup>e</sup>  
 María Begoña Sánchez-Gómez, RN, PhD <sup>f</sup>

<sup>a</sup> Polyclinic Centre of Canarias, Santa Cruz de Tenerife, Calle Alfonso Trujillo, s/n (Edificio Temait III), 38300, La Orotava, Santa Cruz de Tenerife, Spain

<sup>b</sup> Multiprofessional Teaching Unit of Family and Community Care, Canary Islands Health Service, Santa Cruz de Tenerife, Hospital Universitario Ntra. Sra. de Candelaria, Ctra. del Rosario, 145, 38010 Santa Cruz de Tenerife, Spain

<sup>c</sup> University of Huelva, Department of Nursing, Facultad de Enfermería, Campus del Carmen, Avda. Tres de Marzo s/n, 21071, Huelva, Spain

<sup>d</sup> Espíritu Santo University, Guayaquil, Ecuador

<sup>e</sup> Red Cross Nursing University Center, University of Sevilla, Avda Cruz Roja s/n. Dpdo, 41009, Sevilla, Spain

<sup>f</sup> University School of Nursing Nuestra Señora de Candelaria, University of La Laguna, Hospital Universitario Ntra. Sra. De Candelaria, Ctra. del Rosario, 145, 38010, Santa Cruz de Tenerife, Spain

## ARTICLE INFORMATION

## Article history:

Received 23 January 2018

Received in revised form

27 September 2018

Accepted 29 September 2018

## Keywords:

Scoping review

Risk assessment

Cardiovascular risk

Cardiovascular risk assessment tools

Cardiovascular diseases

Prevention of cardiovascular disease

## ABSTRACT

**Objectives:** The objective of this review was to describe cardiovascular risk (CVR) assessment methods and to identify evidence-based practice recommendations when dealing with population at risk of developing cardiovascular diseases.

**Review methods and data sources:** A literature review following the Arksey and O'Malley scoping review methodology was conducted. By using appropriate key terms, literature searches were conducted in PubMed, SciELO, Cochrane Library, Dialnet, ENFISPO, Medigraphic, ScienceDirect, Cuiden, and Lilacs databases. A complementary search on websites related to the area of interest was conducted. Articles published in English or Spanish in peer-review journals between 2010 and 2017. Critical appraisal for methodological quality was conducted. Data was extracted using ad-hoc tables and qualitatively synthesized.

**Results:** After eliminating duplicates, 55 325 records remained, and 1432 records were selected for screening. Out of these, 88 full-text articles were selected for eligibility criteria, and finally, 67 studies were selected for this review, and 25 studies were selected for evidence synthesis. In total, 23 CVR assessment tools have been identified, pioneered by the Framingham study. Qualitative findings were grouped into four thematic areas: assessment tools and scores, CVR indicators, comparative models, and evidence-based recommendations.

**Conclusions:** It is necessary to adapt the instruments to the epidemiological reality of the population. The most appropriate way to estimate CVR is to choose the assessment tool that best suits individual conditions, accompanied by a comprehensive assessment of the patient. More research is required to determine a single, adequate, and reliable tool.

© 2018 Australian College of Critical Care Nurses Ltd. Published by Elsevier Ltd. All rights reserved.

## 1. Introduction

Cardiovascular diseases (CVDs) are a group of cardiac and blood vessels pathologies that include, among others, coronary heart disease, cerebrovascular disease (stroke), peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep venous thrombosis, and pulmonary embolism.<sup>1–6</sup> They are the number one cause of death globally.<sup>1–27</sup> They are the first cause of morbidity and health expenditure in the industrialised countries, having a great

\* Corresponding author at: University of Huelva, Department of Nursing, Facultad de Enfermería, Campus del Carmen, Avda. Tres de Marzo s/n, 21071, Huelva, Spain. Tel.: +34 699 99 91 68.

E-mail addresses: [jennifersacramentopacheco@gmail.com](mailto:jennifersacramentopacheco@gmail.com) (J. Sacramento-Pacheco), [gonzaloduarteclimets@gmail.com](mailto:gonzaloduarteclimets@gmail.com) (G. Duarte-Clímets), [jgsalgad@gmail.com](mailto:jgsalgad@gmail.com) (J. Gómez-Salgado), [mromero@cruzroja.es](mailto:mromero@cruzroja.es) (M. Romero-Martín), [begonasanchez@gmail.com](mailto:begonasanchez@gmail.com) (M.B. Sánchez-Gómez).

impact on health and life quality.<sup>8,18,28</sup> In 2012, 17.5 million people died from CVDs, that is, 31% of total deaths, where 7.4 million died from ischaemic heart disease and 6.7 from stroke.<sup>1,3,5,9–11,24,29,30</sup> About 29.7% of deaths in Spain in 2014 were due to CVDs. One-third of deaths is caused by CVDs, where 31% are due to ischaemic heart diseases and 28% due to cerebrovascular diseases.<sup>8,13,31,32</sup> Mortality rates are in decline, but morbidity rates are increasing.<sup>16</sup> By 2020, about 25 million deaths from CVDs are expected.<sup>33</sup>

The vast majority of CVDs could be prevented with an adequate intervention on the cardiovascular risk factors (CVRFs), early detection and treatment being critical in this case.<sup>1,18,34</sup> The modifiable CVRFs include obesity which, together with other factors, may incur in metabolic syndrome and double the chance of a CVD,<sup>8,35–41,38</sup> hypertension (HTN) (main modifiable CVRF whose prevalence increases with age and presents great continental differences<sup>37,38,42</sup>), hypercholesterolemia,<sup>3</sup> diabetes mellitus (whose strict control can reduce its incidence up to 50%, thereby reducing the complications and mortality<sup>37</sup>), sedentary lifestyle (which is associated with a worse metabolic profile<sup>33</sup>), and tobacco use. Among the non-modifiable CVRFs are age (the older the patient, the higher the risk of a CVD), sex (until the age of 55 years, the risk is greater in men, and from 55 years onwards, the risk is equal), socioeconomic level (a low level favours the emergence of CVDs), and globalisation.<sup>1–5,9,11,13,18,29,31–33,37,43</sup> In addition, having suffered a previous cardiovascular event can favour the appearance of a CVD.<sup>18,44</sup> The most prevalent CVD is ischaemic heart disease (more prevalent in men), followed by heart failure, stroke, and arrhythmias.<sup>6,14</sup>

With the appropriate prevention strategies, we could reduce the incidence of CVDs up to 80%.<sup>16</sup> The main competence of nurses is the identification and control of the CVRFs to carry out prevention at the level required by the patient.<sup>1,9,11,18,19,45</sup>

As a rule, the nurse must promote healthy lifestyle habits for the healthy population or the rest, at any age.<sup>1,16,26</sup> Therefore, CVRF assessment, prevention, diagnosis, and control are fundamental.<sup>1,5,9,18,26,46</sup>

The estimation of cardiovascular risk (CVR) is a key point for approaching the best treatment for the patient. It is conducted using tools that calculate the probability of suffering a cardiovascular event over a period of time and that facilitate decision-making about the most appropriate treatment. Therefore, the assessment is the starting point for the intervention and the basis of the health team's action plan. An adequate risk assessment will guide individualised patient care.<sup>4,12,24,26–28,32,38,47–49</sup> A variety of methods have been designed in different parts of the world, although most of them have been validated for middle-aged population, or in areas with a high risk of coronary heart disease. The different tools differ regarding the baseline risk, predictors, and outcomes.<sup>26,32,50,51</sup> Methods to quantify CVR can be qualitative, which are those based on the sum of CVRFs, or quantitative, based on risk prediction scores that estimate the CVD probability.<sup>19,32</sup>

Previous reviews which provided a summary of the literature on CVRF assessment concluded that the predictive ability of CVD risk scores depends on the population they are in which they are being used. They perform well in populations who are similar to the one used to derive the instrument, but in populations with different characteristics, they tend to overestimate or underestimate the risk.<sup>52–54</sup> However, Chamnan et al. suggested that the precision of the instrument was less important than how it is used. Efforts should be made for ensuring that tools are available and applied for risk prediction on the daily clinical routine.<sup>54</sup> The systematic review conducted by Matheny et al.<sup>52</sup> tried to identify which models best predict CVR among patients with diabetes. Results showed that instruments that included specific diabetes variables outperformed general risk predictions with nondiabetic population and vice versa and concluded that diabetes-specific

risk models need further development.<sup>53</sup> Cooney et al. after reviewing the CVD risk scores available pointed out the difficulties of assessing young and elderly population, which remains a challenge. A review of the literature published in 2012 determined that there were 110 methods for the calculation of CVR. The recent scales introduce more items that improve risk discrimination, and it is recommended to balance it with the cost and complexity of the tool.<sup>55</sup>

This article focuses on describing risk assessment tools for the development of CVD to update the evidence synthesised in previous reviews.

## 2. Objective

The objective of the review was to describe CVR assessment methods and to identify evidence-based practice recommendations when dealing with population at risk of developing CVDs.

## 3. Methods

### 3.1. Protocol

This literature review protocol followed the Arksey and O'Malley method of scoping review.<sup>56</sup> The stages are as follows: research question, identifying relevant studies, study selection, charting the data, collating, summarising, and reporting the results.

### 3.2. Research question

The question that guided the development of this review was built up considering the following parameters:

- Population: adult world population at risk of developing CVDs.
- Event: use of assessment tool.
- Outcome: CVDs.

So the following questions were meant to be answered: in adult population, which are the CVR assessment methods or tools described in the recent scientific literature? Do they equally assess the risk? According to the evidence, what are the recommendations for its use?

### 3.3. Identifying relevant studies

#### 3.3.1. Information sources

The electronic databases consulted were Cochrane Plus, SciELO, Medline, PubMed, Medigraphic, Dialnet, ENFISPO, ScienceDirect, Cuiden, and Lilacs. A manual search complemented this on the following websites: World Health Organization, Registre Gironi del Cor (REGICOR), Servicio Canario de Salud (Canary Islands Health Service), Revista Española de Cardiología, and with reference search. The last search date was 15 November 2017.

#### 3.3.2. Search

Medical Subject Headings (MeSH) terms (and their equivalent Descriptores en Ciencias de la Salud [DeCS] terms in Spanish) and key words were combined to construct the search strategies detailed in Tables 1 and 2, which also include databases, date of search, search parameters, articles found, articles selected, and limits.

### 3.4. Study selection

#### 3.4.1. Eligibility criteria

All articles that describe CVR factors in adults, include description and/or screening of CVDs, or reported methods, tools, rates,

**Table 1**  
Electronic search strategy.

Database	Date	MeSH	Total articles	Selected articles	Limits
ScienceDirect	6/2/17	Risk factors AND Cardiovascular Diseases AND Prevalence AND Cardiovascular Diseases	1	1	Year of publication: 2010–17. Language of publication: Spanish/English.
		Risk factors AND Spain	5	1	
		Risk AND Cardiovascular Diseases	5	1	
		Framingham	1	1	
		Framingham AND SCORE	6	1	
ScienceDirect	10/2/17	Forecasting AND Risk Assessment AND Cardiovascular Diseases	5	1	
ScienceDirect	15/2/17	Metabolic Syndrome X AND risk AND Cardiovascular Diseases	1	1	
		Cardiovascular risk calculators	23	2	
SciELO	15/11/17	Risk factors AND Cardiovascular Diseases	9	1	
		Framingham Score	9	1	
		Risk assessment AND Cardiovascular Diseases	27	1	
SciELO	6/2/17	Risk AND Cardiovascular Diseases	15	4	
SciELO	9/2/17	Ankle Brachial Index	55	1	
SciELO	10/2/17	QRISK AND Risk AND Cardiovascular Diseases	22	1	
SciELO	15/2/17	ERICE Study	1	1	
PubMed	6/2/17	Risk factors AND Cardiovascular Diseases	25	1	
PubMed	7/2/17	Cardiovascular risk AND scores	9238	1	
PubMed	10/2/17	Framingham AND PROCAM AND SCORE	44	1	
Medigraphic	10/2/17	Framingham AND SCORE	1	1	
		Forecasting AND Risk Assessment AND Cardiovascular Diseases	1	1	
Medigraphic	15/2/17	Cardiovascular risk calculators	12	1	
Cochrane Plus	15/2/17	SCORE	65 885	1	
		Risk AND Cardiovascular Diseases	211	2	
ENFISPO	15/2/17	Risk AND Cardiovascular Diseases	63	1	
Cuiden	9/2/17	Risk AND Cardiovascular Diseases	1017	10	
Lilacs	10/2/17	SCORE AND Risk AND Cardiovascular Diseases.	243	3	
Dialnet	5/2/17	Risk AND Cardiovascular Diseases AND Therapeutics	22	1	
		SCORE chart	6	1	
		Risk assessment AND Cardiovascular Diseases	56	1	
		Framingham	182	3	
		Metabolic Syndrome X AND World Health Organization	25	1	
		Metabolic Syndrome X AND Islands	7	1	
		Hypertension AND Islands	14	1	
		Risk AND Cardiovascular Diseases AND island	14	3	
Dialnet	6/2/17	Risk factors AND Cardiovascular Diseases	27	1	
		SCORE chart	102	9	
Dialnet	7/2/17	Framingham	183	12	
		REGICOR study	82	1	
Dialnet	8/2/17	Risk AND Cardiovascular Diseases	223	1	

ERICE, Ecuación de Riesgo Cardiovascular Española; ROCAM, Prospective Cardiovascular Münster; REGICOR, Registre Gironi del Cor; SCORE, systematic coronary risk evaluation.

charts, scores, calculators, or scales for the detection and gradation of CVR were included. Those publications whose methodology is not explicit, which did not obtain significant results and did not study both sexes, and those where the results were not applicable in different contexts were excluded.

The search is limited to publications between 2010 and 2017, both in Spanish and English. This article focuses on the recent literature. Previous reviews have been identified describing and comparing the CVR assessment methods or tools, so we tend to update the evidence synthesised in previous reviews,<sup>52–54</sup> included in the latest literature.

### 3.4.2. Study selection

For the process of selection, screening, and eligibility, a preselection is performed by reading titles and abstracts. Then, a critical

appraisal was performed with the corresponding Critical Appraisal Skills Programme español (CASPe)<sup>58</sup> tool according to the design, selecting those publications with a positive answer to five questions or more (including the first two questions) to guarantee a high methodological quality. In those articles whose method did not involve a CASPe instrument, the Berra S et al. tool<sup>58</sup> and/or the Menarguez Puche JF et al. tool<sup>58</sup> were used, selecting articles that showed high- and medium-quality evidence. Finally, an additional analysis for the evidence synthesis was performed using the Scottish Intercollegiate Guidelines Network.<sup>59</sup>

### 3.5. Charting the data

Ad hoc forms in which researchers independently and by pairs included the main characteristics of each study were created (S.P.,

**Table 2**  
Manual search strategy.

Website	Date	Search strategy	Total articles	Selected articles	Limits
Regicor Web	15/2/17	REGICOR Study	1	1	Year of publication: 2010–17. Language of publication: Spanish/English.
WHO	13/2/17	Cardiovascular Diseases	1	1	
Canary Islands Health Service	11/3/17	Guideline AND Atherosclerosis	1	1	
Rev Esp Cardiología	5/2/17	Risk AND Cardiovascular Diseases AND analysis	456	1	
		Risk AND Cardiovascular Diseases	4	1	
		Risk AND Cardiovascular Diseases AND Risk assessment	552	5	

REGICOR, Registre Gironi del Cor; WHO, World Health Organization.

S.G., G.S.). Relevant data for the drafting and synthesis of the different paragraphs were extracted, meeting the objectives of the study. When discrepancies were found, they were subject to revision within the research group until reaching consensus. The results of these forms gave rise to different synthesis tables presented in the study.

**4. Results**

Initial electronic search produced 77 975 references. In addition, 1015 references were identified through manual search on websites. After eliminating duplicates, 55 325 records remained, and 1432 records were selected for screening. Out of these, 88 full-text articles were selected for eligibility criteria, and finally, 67 studies were selected for this review, and 25 studies were selected for evidence synthesis. Fig. 1 shows the screening process according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model. Selected studies are observational, analytical and cohorts' studies and literature reviews. The CASPe scores obtained in the studies ranged between 5.5 and 9.5, showing a medium and high quality of evidence. The level of evidence oscillated between 2++ and 2-, and the degree of recommendation oscillated between B and C, as shown in Table 3.

**4.1. Collating, summarising, and reporting the results**

The scoping review methodology was followed, and data extracted from the studies were included in Table 4.

The outcomes were grouped in four thematic areas: assessment tools and scores, CVR indicators, comparative models, and evidence-based recommendations.

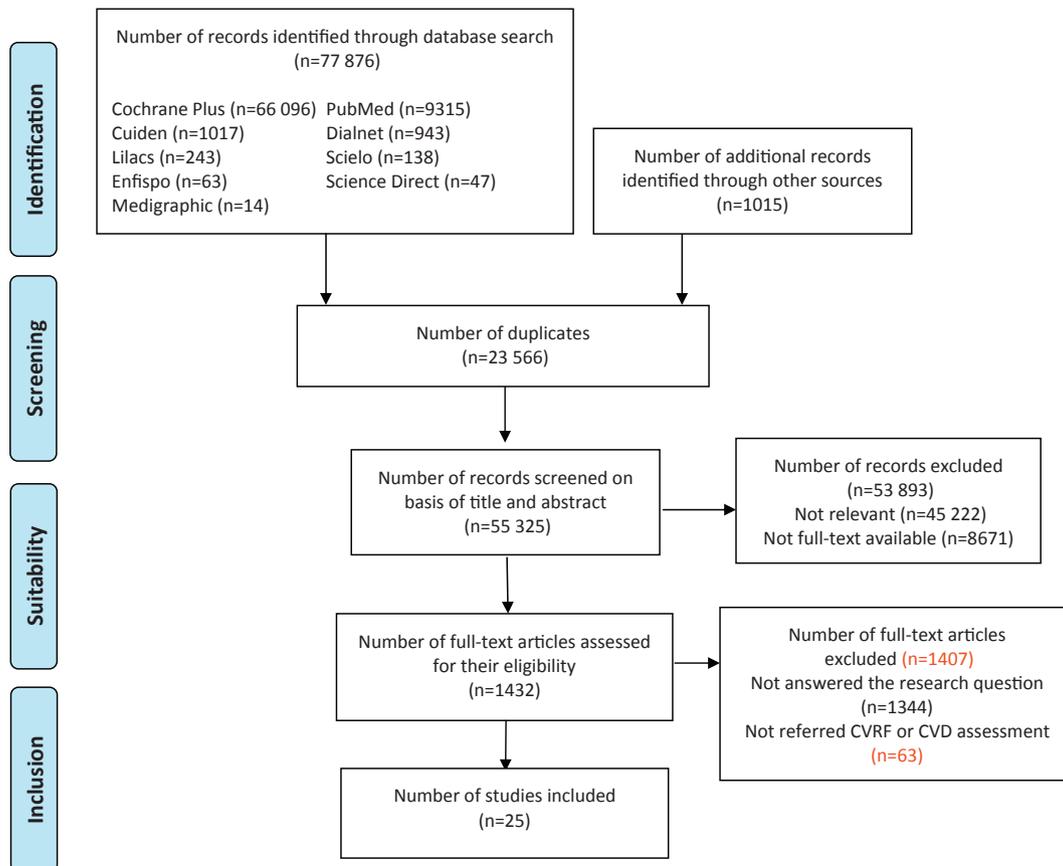
**4.1.1. Assessment tools and scores**

Hereby described are the CVR assessment tools and the characteristics found in the consulted literature. In total, 23 assessment tools have been found. These tools are described in Table 5 and compared in Table 6.

The Framingham study is the pioneer from which the different methods of CVR estimation have appeared, from which the concept of CVR emerged, and from which the relation CVRF–CVD was established.<sup>6,20,33,44,58,61,67,68</sup> Framingham scores are not applicable to all population groups unless they have undergone a recalibration process.<sup>21,35,61,68</sup> Therefore, studies have been carried out to validate, adapt, and contextualise the CVR values in local populations.

Most of the assessment tools predict CVD to a 10-year period, except for Framingham-30, which predicts it to 30 years, and the Australian Calculator, New Zealand score, and Graziano, which predict it to 5 years, as shown in Table 5. The interpretation of risk differs between tools. The cutoff points to interpret the risk vary among the scales. The risk is considered low for values that range between 3% and 30%. On the contrary, the risk is considered high for values that vary between 10% and 70%, as shown in Table 5.

The common risk factors for all tools are age, sex, and tobacco consumption. The systolic blood pressure (SBP), total cholesterol (TC), high density lipoprotein-cholesterol (HDL-C) and diabetes mellitus (DM) are quite frequent, although they are not present



**Fig. 1.** Flow chart of the search strategy. CVD, cardiovascular disease; CVRF, cardiovascular risk factor.

**Table 3**  
Study selection.

Reference	Type of study	Critical appraisal	Level of evidence	Degree of recommendation	Reviewer
Marrugat J. Registre Gironí del Cor. REGICOR study in the regions of Girona 1978–2008. Barcelona: Instituto Municipal de investigación médica. <sup>60</sup>	Cross-sectional	High evidence quality (Berra et al.)	2++	B	S.P., S.G., and G.S.
Brotos C. Impact of the use of the different SCORE tables in the calculation of cardiovascular risk. <sup>61</sup>	Cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Vargas–Velázquez JMA. Probability of coronary event in the next 10 years in diabetic patients according to the Framingham-REGICOR scale. <sup>62</sup>	Observational, descriptive, and cross-sectional	Medium evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Alcocer LA. Stratification of global cardiovascular risk. Comparison of the Framingham and SCORE methods in the Mexican population of the PRIT study. <sup>63</sup>	Cohort study	8/10 (CASPe)	2+	C	S.P., S.G., and G.S.
Lister Del Pino P. Concordance between the PROCAM and Framingham cardiovascular risk scales in men receiving antiretroviral treatment at a national hospital in Lima, Perú 2013. <sup>64</sup>	Analytical and cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Benozzi S. Can the SCORE and NCEP Funtion Charts be Applied in Primary Prevention to Estimate Cardiovascular Risk in the Argentine Population? <sup>65</sup>	Descriptive and cross-sectional	Medium evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Muñoz OM. Concordance between the SCORE chart, Framingham models and the AHA/ACC equations as cardiovascular risk assessors. <sup>66</sup>	Cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Versteylen MO. Comparison of Framingham, PROCAM, SCORE, and Diamond Forrester to predict coronary atherosclerosis and cardiovascular events. <sup>67</sup>	Cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Castro–Sansores C. Comparison of three methods for estimating cardiovascular risk in a population of patients with HIV infection. <sup>68</sup>	Comparative, descriptive, and cross-sectional	High evidence quality (Berra et al.)	2–	C	S.P., S.G., and G.S.
Platek AE. Stratification of cardiovascular risk in patients with atrial fibrillation and obstructive sleep apnoea- validity of the 2MACE score. <sup>69</sup>	Observational and cross-sectional	High evidence quality (Berra et al.)	2–	C	S.P., S.G., and G.S.
Pastori D. Cardiovascular risk stratification in patients with non – valvular atrial fibrillation: the 2MACE score. <sup>70</sup>	Cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Pena–Álvarez V. Cardiovascular risk factors and the ankle-brachial index. <sup>71</sup>	Observational and analytical cohorts	7.5/10 (CASPe).	2+	C	S.P., S.G., and G.S.
Baena–Diez JM. The ankle-brachial index improves the classification of cardiovascular risk: ARTPER/PERART study. <sup>46</sup>	Descriptive and cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Achiong–Alemañy M. Global cardiovascular risk and vascular age: key tools in the prevention of cardiovascular diseases. <sup>19</sup>	Literature review	5.5 (CASPe)	2–	C	S.P., S.G., and G.S.
Mejia C. Factors associated with cardiovascular risk according to Framingham in Huancayo (Peru) taxi drivers. <sup>30</sup>	Analytical, cross-sectional, and observational	Medium evidence quality (Berra et al.)	2–	C	S.P., S.G., and G.S.
Martínez–Linares JM. Comparison of online cardiovascular risk calculators. <sup>23</sup>	Literature review	8.5/10 (CASPe)	2+	C	S.P., S.G., and G.S.
Ruiz–Mori E. Use of the Framingham score as an indicator of the risk factors of cardiovascular diseases in the Peruvian population. <sup>6</sup>	Analytical, observational, longitudinal, and comparative	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Muñoz de Escalona–Rojas JE. Assessment of cardiovascular risk according to the main ocular haemodynamics variables. <sup>21</sup>	Cases management observational and analytical	9.5/11 (CASPe).	2+	C	S.P., S.G., and G.S.
Muñoz O. Validation of the prediction models of Framingham and PROCAM as estimators of cardiovascular risk in a Colombian population. <sup>25</sup>	Cross-sectional	High evidence quality (Berra et al.)	2–	C	S.P., S.G., and G.S.
Reinoso–Barbero L. Prediction of cardiovascular risk and its relationship with the metabolic syndrome and the levels of emerging serological markers in monitoring the health of workers. <sup>41</sup>	Cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Masson W. Clinical Applicability of Framingham 30 – Year Risk Score. Usefulness in Cardiovascular Risk Stratification and Diagnosis Carotid Atherosclerotic Plaque. <sup>20</sup>	Descriptive and cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Marrugat J. Relative Validity of the 10 – Year Cardiovascular Risk Estimate in a Population Cohort of the REGICOR Study. <sup>47</sup>	Cross-sectional	High evidence quality (Berra et al.)	2++	B	S.P., S.G., and G.S.
Armas–Rojas NB. Estimation of cardiovascular risk through tables of the World Health Organization, at the “Héroes del Moncada” health area. <sup>27</sup>	Descriptive and cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.
Amor AJ. Estimation of cardiovascular risk in Spain according to the European guide on prevention of cardiovascular disease in clinical practice. <sup>22</sup>	Cross-sectional	High evidence quality (Berra et al.)	2+	C	S.P., S.G., and G.S.

Table 3 (continued)

Reference	Type of study	Critical appraisal	Level of evidence	Degree of recommendation	Reviewer
Gabriel R. The ERICE score: the New Native Cardiovascular Score for the low – risk and aged mediterranean population of Spain. <sup>50</sup>	Cohort study	High evidence quality (Berra et al.)	2++	B	S.P., S.G., and G.S.

2MACE, 2Major Adverse Cardiac Event; ACC, American College of Cardiology; AHA, American Heart Association; NCEP, National Cholesterol Education Program; RCT, randomized Controlled Trial; REGICOR, Registre Gironi del Cor; SCORE, systematic coronary risk evaluation.

**Level of evidence:**

1+, well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias.

2++, high-quality systematic reviews of case–control or cohort studies.

2+, well-conducted case–control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal.

2–, case–control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.

**Degree of recommendation:**

A, at least one meta-analysis, systematic review, or RCT rated as 1++ and directly applicable to the target population; or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results.

B, a body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 1++ or 1+.

C, a body of evidence including studies rated as 2+, directly applicable to the target population, and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 2++.

in all the tools compared. There are other factors such as body mass index, family history, or race that are shared in some scales, but they are not frequent. This comparison can be seen in Table 6.

#### 4.1.2. CVR indicators

In addition Some parameters that may act as health indicators associated with CVDs were identified. The ankle–brachial index (ABI) is a parameter that measures the relationship between systolic blood pressure of the upper limbs and the distal part of the legs. Patients with ABI values below the normal range have a higher mortality risk, including an increased likelihood of coronary heart disease. It is a cost-effective, easy, and reliable test in its application, but it also requires the action of staff trained in its use.<sup>19</sup> The ABI as a CVR predictor should be applied to people with CVD symptoms during exercise, people aged 50–69 years who have CVRFs, all patients older than 70 years, and those who present a CVRF between 20% and 30%.<sup>19</sup>

In the retina, we can get pictures of the microcirculation, with the advantage that its vessels can be seen through photographs, something beneficial when it comes to rating changes over time. The arteriole–venule relationship predicts coronary risk to 3 years and allows knowing that a diabetic retinopathy can increase CVRFs. In addition, the ophthalmic artery is a branch of the internal carotid artery and contributes to ocular and brain perfusion, being able to assess the cerebrovascular disease risk. Endothelial dysfunction and ocular microvascular disease are associated with kidney disease, which shows that ocular and renal vascular damage may be predictors of CVDs.<sup>23</sup>

The use of imaging techniques is useful in determining CVR. Invasive techniques such as intravascular ultrasound or new techniques such as virtual histology or optical coherence tomography could be used.<sup>34</sup>

Several studies have attempted to assess if biomarkers such as C-reactive protein (CRP), cystine C, lipoprotein-associated phospholipase A2, proadrenomedullin, terminal atrial natriuretic peptide and N-terminal pro b-type Natriuretic Peptide (NT-proBNP) may predict cardiovascular events. There are studies that show that joining biomarkers to risk scores can improve prognostic specificity of the tests.<sup>36,62</sup> Recently, processes such as inflammation, endothelial dysfunction, or hypercoagulability have been associated with cardiovascular damage. The incidence of CVDs and high levels of CRP has been proved; even in a CRP study, it appeared as a predictive factor of low-density lipoprotein. The development of

CVD is related to figures of fibrinogen in blood. Brain natriuretic peptide (BNP) and NT-proBNP plasma concentration is directly related to CVDs. Microalbuminuria and cystatin C have been associated with mortality and CVDs. Other biomarkers such as pregnancy-associated plasma protein A, myeloperoxidase, CD40 ligand, troponin I, or troponin T can also influence the occurrence of CVDs.<sup>36,62</sup>

The apolipoprotein B/apolipoprotein A (ApoB/ApoA) could also determine CVD risk. There is evidence that the ApoB/ApoA reason was the most important risk factor for acute myocardial infarction (AMI).<sup>71</sup> This tends to be particularly useful for patients with DM, especially with normal or low LDL-C, or in patients under treatment with statins. This is because lipoprotein A is the most prevalent antigen in patients who have suffered an AMI related with coronary artery disease in several studies. ApoA is the main protein component of HDL-C, whose effect is cardioprotective against atherosclerosis. ApoB is the only protein component of LDL-C. For this reason, diminished ApoA and/or high ApoB figures correspond to an increased predisposition to CVD.<sup>71</sup>

#### 4.1.3. Comparative models

If we compare the pioneer Framingham score with the systematic coronary risk evaluation (SCORE) adapted to European countries, we note that the SCORE allows assessing any cardiovascular event of atherothrombotic type, not only coronary events, as the Framingham study does, but also fatal cardiovascular events.<sup>63</sup> Amor et al. established that in Spain, the SCORE and REGICOR charts are most commonly used but that REGICOR charts underestimate risk and SCORE charts overestimate it.<sup>22</sup> Comparing Framingham with Prospective Cardiovascular Münster (PROCAM), the Framingham score overestimates the population risk. The variables used in both scores are similar, with the exception that PROCAM replaces TC by LDL-C and takes into account triglycerides (TGC) values and cardiovascular coronary disease family history. Framingham proved to classify more patients as moderate risk than PROCAM and SCORE.<sup>68</sup>

There are more studies comparing the SCORE model with others, showing that SCORE classifies fewer individuals at risk than Framingham. Baena Díez et al.<sup>51</sup> had a similar number of patients with lipid-lowering agents to REGICOR, but with less evidence of effectiveness of treatment.<sup>40,41</sup> Reinos Barbero et al. developed a study comparing the correlation between Framingham and SCORE and established the consistency between both methods. In spite of this consistency, differences between both methods are

**Table 4**

Study selection, population intervention comparison outcome (PICO), quality, level of evidence, and degree of recommendation Scottish Intercollegiate Guidelines Network (SIGN).

Ruiz–Mori E, Segura–Vega L, Agusti–Campos R. Use of the Framingham score as an indicator of the risk factors of cardiovascular diseases in the Peruvian population. <i>Rev Per Car.</i> 2012; 37 (3).			
Research question	In a Peruvian population, is the Framingham score an indicator of CVRFs that allows designing, developing, and applying CVD prevention and promotion strategies?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Comparative and longitudinal observational analytical study. High evidence quality.	24 Peruvian cities in the years 2004 (study 1) and 2010 (study 2). Funding: not stated. Limitations: not stated.	7011 participants in study 1 and 7920 in study 2. Older than 30 years and with no coronary pathology history.	Framingham score was used to determine CVR and vascular age.
Observations	In general, low risk is predominant (63.3% in study 1 and 59.8% in study 2), registering the highest risk in coastal areas. Framingham score is used for its wide epidemiology. High-risk population has increased from 17.8% to 20.7%, affecting more men than women. High CVR is concentrated in coastal areas or in places with a higher development. Educational and socioeconomic level affects CVR. Vascular age is a new concept that helps patients better understand CVR. In the study, participants' vascular age is higher than biological age.		
Evidence quality	2+		
Degree of recommendation	C		
Achiong–Alemañy M, Achiong–Estupiñan F, Achiong–Alemañy F, Afonso de León JA, Álvarez–Escobar MC, Suárez–Medino M. Global cardiovascular risk and vascular age: key tools in the prevention of cardiovascular diseases. <i>Rev Med Elec.</i> 2016; 38 (2).			
Research question	In a Cuban population, which CVR assessment tool reports better outcomes?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Literature review. CASPe 5.5/10	Literature search on online databases with no date, language, or country of origin limitations. 231 articles were reviewed, and 49 were finally included. Funding: not stated. Limitations: not stated.	Not applicable.	Assessment of the different scores found.
Observations	When there is scarce control of CVRFs, there is a high probability of CVDs. The most used charts are Framingham, Score, Joint Task Force of European and other Societies on Coronary Prevention, New Zealand charts, Framingham charts by categories, European and British Societies charts, WHO/ISH charts, Sheffield charts, NCEP ATP III charts, PROCAM charts, REGICOR charts, and Gaziano charts. CVR charts must be adjusted to the epidemiologic reality of each country.		
Level of evidence	2-		
Degree of recommendation	C		
Mejia C, Espejo R, Zevallos K, Castro T, Vargas A, Millan G. Factors associated with cardiovascular risk according to Framingham in Huancayo (Peru) taxi drivers. <i>Rev Asoc Esp Med Trab.</i> 2016; 25 (1):1–49.			
Research question	In a Peruvian population, is there any association between CVR and social factors?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Observational analytical cross-sectional study. Medium evidence quality.	The company and then the sample were asked for permission. Funding: not stated. Limitations: scarcity of samples. No sex variability.	Sample size: 50 (all men). Those who did not complete the questionnaire, who did not answer interest variables, and who did not work during the study months were excluded.	A questionnaire, blood test, and CVR assessment were made with the Framingham score.
Observations	Most participants showed low CVR (88%), and just one in ten showed moderate or high risk. Patients with high risk have significant higher levels of blood sugar ( $p < 0.05$ ). The article relevance is given by the possibility of determining an association between CVR and CVRFs.		
Evidence quality	2-		
Degree of recommendation	C		
Martínez–Linares JM, Medina–García J. Comparison of online cardiovascular risk calculators. <i>Enferm Cardiol.</i> 2016; 23 (67):66–70.			
Research question			
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention

Literature review. CASPe 8.5/10.	Literature review on online search engines. Calculators that were the result of CVR studies in different countries and that estimate CVR at 5 or 10 years, with different results (lethal or not), for the general population and with free access were included. Funding: not stated. Limitations: not stated.	Not applicable.	Assessment of calculators found.
Observations	The Framingham study is the reference one globally, although there are others such as PROCAM study, REGICOR, SCORE (recommended method by the European guidelines), ASSING, Reynolds Risk Score, QRISK2, II Proguetto Cuore, or the Australian Absolute Cardiovascular Disease Risk Calculator. Among the different methods designed, there are differences between the variables or CVRFs they include, between the cardiovascular events they predict, and between the population cohorts studied. However, there are common variables to all calculators, and the general estimation time tends to be 10 years.		
Evidence quality Degree of recommendation	2+ C		
<hr/>			
Brotons C, Moral I, Soriano N, Cuixart L, Osorio D, Botarro D, Puig M, Joaniquet X, Marcos A, Casas A. Impact of the use of the different SCORE tables in the calculation of cardiovascular risk. 2014; 67 (2):94–100. Research question	For a Catalanian population, what impact does SCORE have in high-risk countries, SCORE with cholesterol linked to high-density lipoproteins or SCORE calibrated in the clinical practice?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Carried out in two Barcelona health centres. Funding: not stated. Limitations: almost 75% of initial patients excluded. The percentage of excluded male population is higher, and the average age is lower (this implies that the excluded population is younger). Less prevalence of HTN and hypercholesterolemia in the excluded population (this implies a healthier population). Another limitation is that the population is assisted at health centres, so it is not possible to determine if the outcomes can be extended to the general population. In addition, the variables SBP and CT were registered retrospectively, so it is not possible to assure the quality of the determinations. Tobacco use is underregistered, so patients who did not register tobacco use are considered nonsmokers.	24 948 patients aged between 40 and 65 years of both sexes, of which 3716 were included in the study. Those patients with DM, AMI, ischaemic heart diseases, stroke, or peripheral arterial disease were excluded.	CVR assessment with SCORE charts for high-risk countries, SCORE with cholesterol linked to high-density lipoproteins and SCORE calibrated for the Spanish population. According to the charts outcomes, the percentage of patients who met the objectives and were under lipid-lowering treatment was calculated.
Observations	In Spain, the most recommended CVR charts are the SCORE, followed by the REGICOR and the Framingham score. CVR varies depending on the used method, and lipid-lowering treatment could even be recommended or not depending on the chart used. SCORE charts calibrated for the Spanish population identify more high-risk patients (15.44%) than SCORE—low-risk HDL (4.73%) or SCORE (1.24%)—so there would be a higher percentage of population treated with lipid-lowering agents.		
Evidence quality Degree of recommendation	2+ C		
<hr/>			
Vargas—Velázquez JMA, Escobar—Salinas JS. Probability of coronary event in the next 10 years in diabetic patients according to the Framingham-REGICOR scale. Rev Vir Soc Par Med Int. 2016; 3 (1):53–9. Research question	In diabetic patients from the Hospital Regional de Coronel Oviedo, what is the probability of a coronary event in the following 10 years according to the Framingham score?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Observational descriptive cross-sectional study. High evidence quality.	Review and analysis of the medical records in the year 2013. Funding: not stated. Limitations: incomplete information of medical records, only studying those variables stated in the same.	82 diabetic patients aged between 30 and 76 years of both sexes were included. Those patients whose files were incomplete, wrongly filled in, or with nonrelevant variables were excluded.	Medical record assessment of the 82 patients and determination of CVR by the Framingham score.

(continued on next page)

Table 4 (continued)

Ruiz–Mori E, Segura–Vega L, Agusti–Campos R. Use of the Framingham score as an indicator of the risk factors of cardiovascular diseases in the Peruvian population. Rev Per Car. 2012; 37 (3).			
Research question	In a Peruvian population, is the Framingham score an indicator of CVRFs that allows designing, developing, and applying CVD prevention and promotion strategies?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Observations	CVDs are the leading cause of death in patients with DM. The most frequent CVDRF was hyperglycaemia 97.6% Patients with DM1 have fewer CVRFs than patients with DM2. Results show medium 46%, high 22%, and very high 12% risk of CVD. Framingham score is recommended in routine testing.		
Evidence quality	2+		
Degree of recommendation	C		
Alcocer LA, Lozada O, Fanghanel G, Sánchez–Reyes L, Campos–Franco E. Stratification of global cardiovascular risk. Comparison of the Framingham and SCORE methods in the Mexican population of the PRIT study. Cir Cir. 2011; 79 (2):168–74.			
Research question	In the Mexican population included in the “PRIT” study, which CVR is obtained after the CVR assessment with the SCORE and the Framingham tools?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cohort study. CASPe 8/10	PRIT study database was analysed. Funding: not stated. Limitations: PRIT study is not an outcomes research.	1990 population, both sexes.	Framingham and SCORE charts were used.
Observations	There is a good concordance between both charts. Framingham tool stratified a higher number of medium- (n = 268) and high-risk (n = 130) patients than SCORE (medium n = 133, high n = 4). For the study population, the Framingham is the most recommended method because SCORE underestimates the risk.		
Evidence quality	2+		
Degree of recommendation	C		
Marrugat J, Elosua R, Covas MI, Fitó M, Schröder H. Registre Gironí del Cor. REGICOR study in the regions of Girona 1978–2008. Barcelona: Instituto Municipal de investigación médica. 2008.			
Research question	In a Girona population who has suffered an AMI, what is the relationship between CVRFs and CVR prediction?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	First, the participants are selected, and then, there is a follow-up of the same through visits or via telephone contact. Three cross-sectional studies were carried out in 1995, 2000, and 2005. Funding: funded by different projects and agreements from the year 1990 until 2007. Limitations: not stated.	1748 Girona patients who have suffered an AMI, hospitalised or not, aged between 25 and 74 years.	Determination of CVR by the REGICOR model based on the Framingham cohort and validated for the Spanish population.
Observations	AMI incidence in Spain is low when compared with other European countries (1500/100 000 in men >74 years, 830/100 000 in women >74 years) and presents a great geographical variability. AMI incidence, lethality, and mortality rates increase with age. The Framingham function overestimates real CVR and is only adequate to predict nonlethal AMI or coronary-based death at 10 years. The Framingham function calibration for Spain consisted in the substitution of Framingham CVRFs prevalence and coronary events incidence rate by the Spanish ones.		
Evidence quality	2++		
Degree of recommendation	B		
Lister Del Pino P, León–Amenero G, Leiva–Montejo A, Segura ER. Concordance between the PROCAM and Framingham cardiovascular risk scales in men receiving antiretroviral treatment at a national hospital in Lima, Perú 2013. Rev Peru Med Exp Salud Pública. 2015; 32 (4):731–38.			
Research question	In a Peruvian male population under antiretroviral therapy (ART), what is the concordance between PROCAM and Framingham?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Analytical cross-sectional study. High evidence quality.	Funding: self-funded study. Limitations: reduced applicability of risk estimation for the different populations, selection bias as the access to the sampling was made according to the order of appointment of patients, only men included, small sample with a high error rate and nonrepresentative patients with dyslipidemia.	111 patients included in the study aged between 35 and 65 years, under ART for, at least, one year. Those patients who had suffered an angina, AMI, stroke, or pathologies that can alter the lipid profile were excluded.	Data collecting by a questionnaire developed by the research team and CVR assessment by the PROCAM and the Framingham scores.

Observations	The distribution of patients according to the risk was low, moderate, and high, 81.2%, 13.6%, and 5.4%, respectively, for PROCAM and 71.2%, 25.2%, and 3.6%, respectively, for Framingham. PROCAM overestimates high risk and underestimates low risk.		
Evidence quality	2+		
Degree of recommendation	C		
Benozzi S, Álvarez C, Gómez–Echevarría G, Perruzza F, Pennacchiotti G. Can the SCORE and NCEP Function Charts be Applied in Primary Prevention to Estimate Cardiovascular Risk in the Argentine Population? <i>Rev Argent Cardiol.</i> 2010; 78 (4):346–49.			
Research question	For an Argentinian population, what is the concordance between the SCORE and the NCEP functions?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Descriptive cross-sectional study. Medium evidence quality. Observations	Funding: not stated. Limitations: not stated. The use of CVR scores in primary prevention has its limitations, for instance, they are not applicable to patients with arteriosclerosis and with genetic disorders that predispose people to arteriosclerosis, heavy smokers, or those with an only but decisive factor. Age is also to be considered because it frequently happens that a person is considered to have a high risk because of advanced age and, on the other hand, another person is considered to have low CVR because they are young. There was a moderate concordance between SCORE and NCEP (kappa: 0.452). SCORE and NCEP charts applicability in primary prevention can be a useful and cost-efficient tool in daily practice.	Sampling size of 234 people aged between 40 and 67 years. People with DM and CVD were excluded.	CVR assessment by the SCORE and the NCEP charts.
Evidence quality	2+		
Degree of recommendation	C		
Masson W, Siniawski D, Krauss J, Cagide A. Clinical Applicability of Framingham 30 – Year Risk Score. Usefulness in Cardiovascular Risk Stratification and Diagnosis Carotid Atherosclerotic Plaque. <i>Rev Esp Cardiol.</i> 2011; 64 (4):305–11.			
Research question	In an Argentinian population, what is the CVR stratification according to Framingham to 30 years in relation to the prevalence of the carotid atherosclerotic plaque?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Descriptive cross-sectional study. High evidence quality.	Funding: not stated. Limitations: the carotid atherosclerotic plaque was defined by ARIC, so changing its definition could change its meaning, selection bias, as the participant patients may not be representative of the whole population. High-risk population does not allow clear conclusion.	305 patients of both sexes aged between 20 and 60 years. Those patients with a previous CVD, lipid-lowering treatment, and DM history were excluded.	Use of the Framingham method at 30 years on a population cohort.
Observations	As most methods estimate risk at 10 years, 80% of cardiovascular events affect low CVR population. Framingham score at 30 years reclassified a great number of patients.		
Evidence quality	2+		
Degree of recommendation	C		
Muñoz de Escalona–Rojas JE, Cantero–Hinojosa J, Garrido–Pareja F, Padilla–Torres JF, García–Serrano JL. Assessment of cardiovascular risk according to the main ocular haemodynamics variables. 2013; 98 (789):78–81.			
Research question	In Granada, which degree of association can be seen between the ocular haemodynamic variables and how can CVR be assessed through them?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Case and control analytical observation study. CASPe 9.5/11. Observations	Funding: not stated. Limitations: not stated. There were no significant differences between the CVD cohort and the control group. An interesting finding was that those patients with a higher than or equal to 0.8 rate of resistance of the ophthalmic artery (OA) are 4 times more likely to suffer a CVD (p = 0.01). The endothelial cellular dysfunction and the microvascular illness of the orbital vascularisation are related with chronic renal failure. Echo-Doppler of the OA and its resistance rate assessment could be a method for the determination of CVR.	62 patients (23 with CVD and 39 control people) aged above 55 years. Those with previous or active tobacco use were excluded.	Assessment of the ocular haemodynamic variables by echo-Doppler.
Evidence quality	2+		
Degree of recommendation	C		
Gabriel R, Brotons C, Tormo MJ, Segura A, Rigo F, Elosua R, Carbayo JA, Gavrilá D, Moral I, Toumlehto J, Muíz J. The ERICE score: the New Native Cardiovascular Score for the low – risk and aged mediterranean population of Spain. <i>Rev Esp Cardiol.</i> 2015; 68 (3):205–15.			
Research question	Study details/limitations		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention

(continued on next page)

Table 4 (continued)

Ruiz–Mori E, Segura–Vega L, Agusti–Campos R. Use of the Framingham score as an indicator of the risk factors of cardiovascular diseases in the Peruvian population. <i>Rev Per Car.</i> 2012; 37 (3).			
Research question	In a Peruvian population, is the Framingham score an indicator of CVRFs that allows designing, developing, and applying CVD prevention and promotion strategies?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cohorts study. CASPe 8.5/10	7 cohort studies from different Spanish populations. Funding: Fondo de Investigación Sanitaria (Health Research Fund), Instituto de Salud Carlos III, G03/065 and PI05/1464 grants and RECAVA (Red Temática de Investigación Cooperativa en ECV –Thematic Network for Coepertional Research on CVD-), RD06/0014/0015 grant. Limitations: the Murcian cohort did not have glycaemia data, the classic CVR-predictive factors present weaknesses at advanced age, and in some cases (advanced age people), absolute risk estimation could be less precise.	11 800 patients of both sexes aged above 30 years without a CVD.	Analysis of 7 population studies from Spain to validate a CVR estimation score for the country.
Observations	The ERICE method is based on the Spanish population. It is based on more recent cohorts. It has a good discriminative power (C-statistic = 0.789 in men and C = 0.816 in women).		
Evidence quality Degree of recommendation	2++ B		
Muñoz OM, Ruiz–Morales AJ, Mariño–Correa A, Bustos MM. Concordance between the SCORE chart, Framingham models and the AHA/ACC equations as cardiovascular risk assessors. <i>Rev Colomb Cardiol.</i> 2016.			
Research question	In a Colombian population, what is the concordance between the SCORE, AHA/ACC 2013, and Framingham scores and how does the use of one or another chart affect the patient's risk classification?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Funding: not stated. Limitations: not stated.	800 patients aged between 40 and 74 years and with no CVD.	CVR assessment with Framingham, SCORE, and AHA/ACC 2013 and subsequent analysis of concordance between the scores with the Kappa coefficient.
Observations	There is a scarce concordance between the risk scores analysed. The Kappa coefficient showed a low concordance between adjusted Framingham and each of the SCORE equations (0.28 and 0.22, respectively). There is a low degree of concordance between the different scores, with a better concordance between Framingham and AHA/ACC 2013.		
Evidence quality Degree of recommendation	2+ C		
Versteylen MO, Joosen IA, Shaw LJ, Narula J, Hofstra L. Comparison of Framingham, PROCAM, SCORE, and Diamond Forrester to predict coronary atherosclerosis and cardiovascular events. <i>J Nucl Cardiol.</i> 2011; 18 (5):904–11.			
Research question	In a Dutch population, what is the validity of Framingham, PROCAM, SCORE, and Diamond Forrester to predict coronary atherosclerosis and cardiovascular events?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Funding: not stated. Limitations: the study was based on a population cohort from the Netherlands, so it should be cautiously applied to other populations. The used scores had not been designed for the purpose they were used for, but there were no other methods. An incomplete follow-up is possible.	1296 patients of both sexes. Those who presented unstable angina, prior AMI, prior revascularisation, haemodynamic instability, allergies to contrasts, pregnancy, or renal failure were excluded.	Assessment of four CVR scores and the main cardiovascular events present in patients with stable chest pain.
Observations	Prediction ability for Framingham (0.68 confidence interval: 0.64–0.72) was similar to that for SCORE (0.69 confidence interval: 0.65–0.72). They both were significantly higher than that for PROCAM (0.64 confidence interval: 0.61–0.68), as well as marginally higher than that for Diamond Forrester (0.65 confidence interval: 0.61–0.68). The predicting capacity of Framingham and SCORE was significantly better than that of PROCAM and Diamond Forrester, so Framingham is more reliable to assess risk.		
Evidence quality Degree of recommendation	2+ C		
Marrugat J, Vila J, Baena–Díez JM, Grau M, Sala J, Ramos R, Subirana I, Fitó M, Elosua R. Relative Validity of the 10 – Year Cardiovascular Risk Estimate in a Population Cohort of the REGICOR Study. <i>Rev Esp Cardiol.</i> 2011; 64 (5):385–94.			
Research question	In a Girona population, what is the validity of REGICOR and what is the distribution of cardiovascular events depending on the risk population?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention

Cross-sectional study. High evidence quality.	Funding: co-funded by Instituto de Salud Carlos III-RETIC 06/0009-FEDER (Red HERACLES), FISFEDER (PI081327) and Miguel y Servet Contract (CP06 00100) and Río- Hortega (CM08 00141), Instituto de Salud Carlos III, Madrid, Spain. Limitations: scarcity of coronary events and their incidence being lower in Girona than in the rest of Spain. HTN and dyslipidemia treatment availability does not appear in the Framingham-adapted functions.	A cohort of 4782 participants of both sexes and aged between 25 and 74 years. Those who did not want to participate, who had any CVD, and those under the age of 35 years were excluded.	REGICOR validity determination.
Observations	The outcomes show the relative validity of the tool. The REGICOR function adequately predicts coronary events incidence. More than 50% of cardiovascular events occurred in participants whose 10-year risk was 5%–14.9%.		
Evidence quality Degree of recommendation	2++ B		
Castro–Sansores C, Guerrero–Flores A, Santos–Rivero A, Sarmiento–Coutiño C, Valencia–Serrano N, Bolaños–Caldelas E. Comparison of three methods for estimating cardiovascular risk in a population of patients with HIV infection. <i>Med Int Mex</i> 2011; 27 (5):439–45.			
Research question	In a population with HIV, what is the concordance between the WHO, PROCAM, and Framingham scores?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Descriptive and comparative cross-sectional study. High evidence quality.	Funding: not stated. Limitations: not stated.	35 women and 245 men aged between 20 and 73 years. Pregnant women and patients with a DM2 history, dyslipidemia, or coronary disease before HIV and under GH, testosterone, or steroids treatment were excluded.	To assess the concordance between PROCAM, Framingham, and the WHO charts.
Observations	Prevalence of low-, moderate-, and high-risk patients were 84.4%, 10.7%, and 4.8% by Framingham; 93%, 3.8%, and 3.1% by PROCAM; and 98%, 1.3%, and 0.34% by WHO, respectively. With the three methods, men showed a higher CVR than women and a greater prevalence of CVRFs. The Framingham method overestimates CVR. The concordance between PROCAM and Framingham is low as PROCAM gives lower CVR values than Framingham. The WHO model also gives lower CVR values than Framingham.		
Evidence quality Degree of recommendation	2- C		
Baena–Díez JM, Alzamora Sas MT, Forés–Raurell R, Pera G, Torán–Montserrat P, Sorribes–Capdevila M. The ankle-brachial index improves the classification of cardiovascular risk: ARTPER/PERART study. <i>Rev Esp Cardiol</i> . 2011; 64 (3):186–92.			
Research question	In a Catalanian population, how is CVR reclassified with the use of the ABI?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Descriptive cross-sectional study. High evidence quality.	It was carried out in 28 primary care centres. Funding: not stated. Limitations: outcomes are not applicable to a population aged above 49 years. It cannot be assured that the ABI reclassification improves risk predictions made by other methods.	3406 patients of both sexes. Those who had suffered a CVD were excluded.	Use of the ABI to assess CVR.
Observations	In an environment with low CVR, a great part of the patients can be reclassified as high risk after using the ABI method. In men, using the ABI led to a 5.8% increase in the high-risk category versus Framingham, a 19.1% increase versus REGICOR, and a 4.4% increase versus SCORE. In women, the increases were 78.6% versus Framingham, 151.6% versus REGICOR, and 50.0% versus SCORE. The ABI is an easy, cost-effective, and reliable test that can lead patients to a reclassification of risk.		
Evidence quality Degree of recommendation	2+ C		
Platek AE, Szymanski FM, Filipiak KJ, Dudzik–Płocica A, Krzowski B, Karpinski G. Stratification of cardiovascular risk in patients with atrial fibrillation and obstructive sleep apnea-validity of the 2MACE score. 2017.			
Research question	Do patients with AF and obstructive sleep apnoea have a higher CVR?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention

(continued on next page)

Table 4 (continued)

Ruiz–Mori E, Segura–Vega L, Agusti–Campos R. Use of the Framingham score as an indicator of the risk factors of cardiovascular diseases in the Peruvian population. <i>Rev Per Car.</i> 2012; 37 (3).			
Research question	In a Peruvian population, is the Framingham score an indicator of CVRFs that allows designing, developing, and applying CVD prevention and promotion strategies?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Observational cross-sectional study. High evidence quality.	Funding: not funded. Limitations: the study must be validated for a greater cohort. Studies that clarify the impact of obstructive sleep apnoea treatment on patients with high risk are required.	211 patients of both sexes. Patients with valvular AF, AMI, heart failure decompensation during the six months before the study, estimated life expectancy $\leq 6$ months, chronic lung diseases, neuromuscular disease, hemochromatosis, and neurological or acute psychiatric disorders, or those who did not provide an informed consent, were excluded.	CVR assessment with the 2MACE score.
Observations	A significantly higher percentage of patients with obstructive sleep apnoea were at high risk of cardiovascular disease (29.2% vs. 8.1%; $p < 0.0001$ ). In patients with obstructive sleep apnoea, there is a higher 2MACE score rate than in patients with nonobstructive sleep apnoea ( $2.1 \pm 1.1$ vs. $1.4 \pm 1.0$ ; $p < 0.0001$ ). Conclusions: the obstructive sleep apnoea increases in patients with AF and is related with a higher CVR.		
Evidence quality	2-		
Degree of recommendation	C		
Pastori D, Farcomeni A, Poli D, Antonucci E, Angelico F, Del Ben M, Cangemi R, Tanzilli G, Yoke Hong Li G, Pignatelli P, Violi F. Cardiovascular risk stratification in patients with non – valvular atrial fibrillation: the 2MACE score. <i>Intern Emerg Med.</i> 2016; 11:199–204.			
Research question	In patients with nonvalvular AF, what is the CVR according to the 2MACE score?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Funding: not stated. Limitations: the studies are limited to a Caucasian population under treatment with vitamin K antagonist.	A total of 1089 patients. Those patients with prosthetic heart valves, severe cognitive impairment, infections, cancer, liver failure, or autoimmune diseases were excluded.	Follow-up of a population cohort and its study to validate a new CVR tool.
Observations	The 2MACE score allows defining AMI risk or cardiovascular death in patients with AF. The 2MACE score showed a good ability in discriminating AF patients experiencing MACE both in the internal derivation cohort, with a c-index of 0.79 (95% confidence interval [CI], 0.71–0.90; $p < 0.001$ ) and in the external validation cohort (c-index, 0.66; 95% CI, 0.60–0.73; $p < 0.001$ ). Early identification of patients with AF in risk of cardiovascular complications can improve AF management. The new 2MACE score can be useful for managing CVR stratification in patients with AF.		
Evidence quality	2+		
Degree of recommendation	C		
Pena–Álvarez V. Cardiovascular risk factors and the ankle-brachial index. <i>Metas Enferm.</i> 2015; 18 (7):20–23.			
Research question	In a population from Vigo, what is the relationship between the CVRFs and the predictive values of the ABI in peripheral arterial disease?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Observational analytical cohorts study. CASPe 7.5/10	Funding: none. Limitations: differences between the size of both cohorts and few events obtained in the different study groups.	Population: 21 542 patients. Target population: 7005. Population older than 50 years: 3552 patients. Study population: 321 patients.	Follow-up of two population cohorts and ABI assessment.
Observations	There is no statistically significant evidence between having CVRFs and a pathological ABI. The use of the ABI must be cautiously done as a predictive diagnosis method.		
Evidence quality	2+		
Degree of recommendation	C		
Amor AJ, Masana L, Sorriquer F, Goday A, Calle Pascual A, Gaztambide S, Rojo–Martínez G, Valdés S, Gomis R, Ortega E. Estimation of cardiovascular risk in Spain according to the European guide on prevention of cardiovascular disease in clinical practice. <i>Rev Esp Cardiol.</i> 2015; 68 (5):417–25			
Research question	In a Spanish population, what is the CVR according to the SCORE model?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Funding: not stated. Limitations: outcomes are not representative of a population older than 65 years. The information on CVDs was provided by the patient; there is risk of selection and observation bias due to the type of design, sampling, and participation and risk of recall or interviewer bias.	5072 individuals of both sexes older than 18 years. Those who suffered from an acute illness, who were hospitalised, or who had undergone a recent birth or pregnancy were excluded.	CVR calculation according to the SCORE method.

Observations	Most patients presented a moderate CVR (43.5%), and there were differences between both sexes. People with DM have a high or very high CVR. CVR in population aged between 40 and 65 years is moderate for men and low for women, and a high percentage of individuals do not reach the therapeutic objectives. CVRFs prevalence such as obesity or hypertriglyceridemia is increasing. These data are interesting for the design of CVD prevention programmes to address better therapeutic objectives and a better identification of high-risk individuals.		
Evidence quality	2+		
Degree of recommendation	C		
Armas–Rojas NB, de la Noval–García R, Dueñas–Herrera A, Castillo–Núñez, Suárez–Medina R, Castillo–Guzmán A. Estimation of cardiovascular risk through tables of the World Health Organization, at the “Héroes del Moncada” health area. <i>Rev Cubana Cardiol Cir Cardiovasc.</i> 2014; 20 (1).			
Research question	In a Cuban population, what is the incidence of CVRFs and what is the CVR according to the WHO/ISH charts?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Descriptive cross-sectional study. High evidence quality.	Funding: not stated. Limitations: not stated.	902 individuals of both sexes aged between 40 and 70 years. Those patients with a CVD history or an active CVD were excluded.	CVR determination according to the WHO/ISH and CVRFs prevalence determination.
Observations	The different risk charts have the limitation of being validated for a specific population. CVR increases with age. CVRFs prevalence in this study was high. The general predominance of CVR is low (86.25%). Low CVR can be due to the chart used, and hypertriglyceridemia was the most prevalent risk factor.		
Evidence quality	2+		
Degree of recommendation	C		
Reinoso–Barbero L, Capapé–Aguilar A, Díaz–Garrido R, Santiago–Dorrego C, Gómez–Gallego F, Bamdrés–Moya F. Prediction of cardiovascular risk and its relationship with the metabolic syndrome and the levels of emerging serological markers in monitoring the health of workers. <i>Arch Prev Riesgos Labor.</i> 2014; 17 (2):91–6.			
Research question	In a population from Alcobendas, what is the CVR according to Framingham and SCORE and what is the comparison between the outcomes obtained and three biomarkers and MS?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Funding: funded by Fundación Mapfre Medicina through the grant programme for research 2003/04 and by the European University of Madrid through the grant programme for research with internal funding (proyecto OTRI 2006/uem 05). Limitations: not stated.	248 patients of both sexes aged between 30 and 64 years. Those patients who had suffered an ischaemic heart disease, who were younger than 30 years, who were non-Caucasian, who were under estrogen therapy, or who had serum CRP levels >10 mg/dL were excluded.	CVR assessment with Framingham and SCORE.
Observations	There was a strong correlation between the models ( $r = 0.78$ ); no coherence between them is assumed. CVR determination must be included in occupational health tests, together with abdominal girth measuring, to diagnose the MS.		
Evidence quality	2+		
Degree of recommendation	C		
Muñoz O. Validation of the prediction models of Framingham and PROCAM as estimators of cardiovascular risk in a Colombian population.			
Research question	In a Colombian population, are the Framingham and PROCAM methods applicable?		
Type of study/critical appraisal	Study details/limitations	Characteristics of studied population	Intervention
Cross-sectional study. High evidence quality.	Funding: not stated. Limitations: scarcity of high-risk patients in the cohort. High percentage of patients with lost follow-up.	1013 patients aged between 30 and 74 years were included. Those who had a coronary disease history were excluded.	CVR assessment with PROCAM and Framingham scores.
Observations	The use of scores to determine CVR allows identifying risk patients and the implementation of a treatment. Framingham overestimated patients with low and intermediate risk (predicted to observed ratio, 1.31), with a low ability to separate high-risk from low-risk patients (c-statistic, 0.65). The PROCAM risk function adjusted by sex had better ability to separate high-risk from low-risk patients (c-statistic, 0.74) with good calibration (predicted to observed ratio, 1.07). Framingham assessment outcomes suggest that this score must be used cautiously in low-risk study population or study population without a CVR history given that it overestimated the risk.		
Evidence quality	2-		
Degree of recommendation	C		

ACC, American College of Cardiology; AHA, American Heart Association; ARIC, atherosclerosis risk in communities study; ASSING, Assessing Scottish Intercollegiate Guidelines Network; ATP III, Adult Treatment Panel III; CVD, cardiovascular disease; CVDRF, cardiovascular disease risk factor; CVR, cardiovascular risk; CVRF, cardiovascular risk factor; ISH, International Society of Hypertension; MS, metabolic syndrome; NCEP, National Cholesterol Education Program; PICO, population intervention comparison outcome; PRIT, Prevalencia de factores de Riesgo de Infarto de miocardio en Trabajadores; SIGN, Scottish Intercollegiate Guidelines Network.

**Table 5**  
Summary of the assessment tools identified.

Method/year	Quantitative variables	Time of estimation/ Age range (years)	Risk score	Comments
Framingham, 1991	Age, sex, tobacco use, SBP, TC, LVH, HDL-C, and DM	10 years 35–74 years	<10% low 10%–20% moderate >20% high	The studied population has a high CVD prevalence and risk. Underestimates DM impact as a CVRF. Overestimates CVR in specific countries such as Spain. Estimates coronary risk, not total CVR. Predicting time extended to 30 years. Incorporates BMI as a risk factor.
Framingham-30, 2009	Age, sex, tobacco use, SBP, TC, HDL-C, DM, and BMI	30 years 20–60 years	<10% low 10%–20% moderate >20% high	
Framingham by categories, 1998–99	Age, sex, tobacco use, SBP, TC, HDL-C, and DM	10 years 30–74 years	Not available	Used to estimate the risk of coronary disease (angina, AMI, and coronary death).
SCORE, 2003	Age, sex, tobacco use, SBP, TC, and HDL-C	10 years 45–65 years	<1% low 1%–5% moderate 5%–10% high >10% very high	Evaluates every cardiovascular event, coronary or not. Establishes a risk threshold from which action must be taken. Has different scores adapted to low- or high-risk countries. Does not include DM as a CVD conditioning factor.
ERICE, 2015	Age, sex, tobacco use, HTN, SBP, TC, and DM	10 years 40–80 years	<5% low 5%–9% mild 10%–14% moderate 15%–19% mod-high 20%–29% high >30% very high	Based on Spanish cohorts with a wide age range population group. Takes into consideration pharmacological risk factor treatment. Offers a direct estimation of the total CVD, not only CHD
REGICOR, 1978	Age, sex, tobacco use, SBP, TC, HDL-C, and DM	10 years 35–74 years	<5% low 5%–9% moderate 10%–14% high >15% very high	Validated for the Spanish population. Estimates the risk of angina and AMI. Takes into consideration antihypertensive and anticholesterol treatment.
Sheffield, 1999	Age, sex, tobacco use, HTN, TC, HDL-C, DM, and LVH	10 years 36–70 years	Not available	Developed following Framingham score. Oriented to lipid-lowering treatment with statins.
PROCAM, 2002	Sex, tobacco use, BP, DM, HDL-C, LDL-C, and TGC	10 years 35–65 years	<10% low 10%–20% moderate >20% high	Includes CVRF such as family history. It overestimates high risk and underestimates low risk.
AHA scores, 2013	Age, sex, tobacco use, SBP, TC, HDL-C, and DM	10 years 40–80 years	<7.5% low >7.5% risk	Includes CVRF such as race and hypertension medication use. It estimates risk for a broader atherosclerotic cardiovascular disease (ASCVD). External validation is required for different ethnic population. Studies show that it overestimates risk, recommending treatment with statins to a high percentage of patients.
WHO/ISH charts, 1999	Age, sex, tobacco use, HTN, SBP, TC, and DM	10 years 40–70 years	<10% low 10%–19% moderate 20%–29% high >30% very high	Considers CVRFs such as early menopause (<35 years), obesity, family history, glucose intolerance, TGL figures, or albuminuria.
NCEP ATP III 2001	Age, sex, tobacco use, SBP, BP, TC, and HDL-C	10 years 20–79 years	0–1 risk factor low <10% moderate 10%–20% moderate–high >20% high	Based on the Framingham score. Assesses coronary risk (AMI risk and coronary death). DM is considered a vascular disease instead of a CVRF. Useful with lipid-lowering treatment but not with antihypertensive treatment.
Reynolds, 2007/2008	Age, sex, tobacco use, SBP, TC, HDL-C	10 years 45–80	<5% low 5%–10% moderate 10%–20% high >20% very high	Includes CVRFs such as early CVD family history or CRP. Does not include DM as a risk factor.
QRISK, 2007	Age, sex, tobacco use, HTN, SBP, DM, and BMI	10 years 35–74 years	<20% low >20% high	Includes social CVRFs such as race or socioeconomic situation. Includes emergent disease, renal disease, or AF. Assesses coronary disease risk.
Graziano, 2008	Age, sex, tobacco use, SBP, DM, and BMI	5 years 35–74 years	<30% low 30%–70% moderate >70% high	Adequate when there are no laboratory data. It considers chest pain (angina or not). Economic option for low-budget projects. It assesses the risk of AMI or stroke.
Il Progetto Cuore, 2011	Age, sex, tobacco use, HTN, SBP, TC, HDL-C, and DM	10 years 40–70 years	<3% low 3%–20% moderate >20% high	
Australian calculator, 2012	Age, sex, tobacco use, SBP, TC, HDL-C, and DM	5 years	<10% low 10%–15% moderate >15% high	
2MACE score, 2015	Age, MS, fraction <40%, and thromboembolism		0–7	Was designed to stratify CVR in patients suffering from atrial fibrillation. The higher the score, the higher the risk. Is simple and easy to use.
Diamond–Forrester, 1979	Age, sex, and chest pain		<30% low 30%–70% moderate >70% high	Assesses the risk of coronary artery disease.
New Zealand score, 1995	Age, sex, tobacco use, BP, TC, HDL-C, and DM	5 years 40–70 years	<10% low 10%–15% moderate 15%–20% high >20% very high	Used to measure benefits from antihypertensive and anticholesterol treatment. It fits better the results of clinical trials of hypertension
ASSING, 2006	Age, sex, tobacco use, BP, HTN, TC, HDL-C, and DM	10 years 30–74 years	<10% low 10–20% moderate	Includes social deprivation for the first time and family history of cardiovascular disease, with the classic risk factors.

Table 5 (continued)

Method/year	Quantitative variables	Time of estimation/ Age range (years)	Risk score	Comments
European societies tables, 1998	Age, sex, tobacco use, TC, and SBP	10 years 30–70 years	20–30% high ≥30% very high >20% high risk	Easy to understand from the patient's point of view. Recommended for estimating the risk of angina, MIA, and coronary death.
British Societies tables, 1998	Age, sex, tobacco use, TC, SBP, and HDL-C	10 years 35–74 years	>15% high risk	Not useful for patients with coronary disease, atherosclerosis, familial hypercholesterolemia, hypertension, renal failure, or DM with target organ injury.
Join Task Force of European and other Societies on Coronary Prevention	Age, sex, tobacco use, SBP, TC, and DM	10 years 30–70 years	>20% high risk	Simple and easy to use. Not precise because of its wide age, SBP, and TC ranges.

2MACE, 2Major Adverse Cardiac Event; AHA, American Heart Association; AMI, acute myocardial infarction; ASSING, Assessing Scottish Intercollegiate Guidelines Network; ATP III, Adult Treatment Panel III; BMI, body mass index; CHD, coronary heart disease; CRP, C-reactive protein; CVD, cardiovascular risk; CVR, cardiovascular risk; CVRF, cardiovascular risk factor; ERICE, Ecuación de Riesgo Cardiovascular Española; HDL-C, high-density lipoprotein cholesterol; HTN, hypertension; LDL-C, low-density lipoprotein cholesterol; LVH, left ventricular hypertrophy; MS, metabolic syndrome; NCEP, National Cholesterol Education Program; PROCAM, Prospective Cardiovascular Münster; REGICOR, Registre Gironi del Cor; SCORE, systematic coronary risk evaluation; SBP, systolic blood pressure; TC, total cholesterol; TGC, triglycerides; WHO, World Health Organization.

found: Framingham is more restrictive, and SCORE does not consider DM<sup>35,43</sup> Finally, Lobos Bejarano et al. published in 2015 a study in which on comparing SCORE with Framingham, the latter establishes a broader age range.

#### 4.1.4. Evidence-based recommendations

The evidence synthesis was analysed with the Scottish Intercollegiate Guidelines Network (SING) tool. In Table 3, the outcomes revealed after the critical reading process are described, as well as evidence levels and degree of recommendation. In the light of these outcomes, the main recommendations are as follows.

##### 4.1.4.1. Level of evidence 2+ / Degree of recommendation B

- The Framingham study is the reference study worldwide. CVR charts must be adjusted to the epidemiological reality of each country.
- The Framingham function overestimates the real CVR of the Spanish population and is only adequate to predict nonlethal AMI or coronary death at 10 years.
- The REGICOR function properly predicts the incidence of coronary events.

##### 4.1.4.2. Level of evidence 2+ / Degree of recommendation C

- Among the methods and tools designed, there are differences between the variables or the CVRFs included, the cardiovascular events predicted, and the population cohorts studied. However, there are common variables to all the tools, and the overall estimation time tends to be 10 years.
- Depending on the study population, the predicting capacity of Framingham and SCORE can be better than the PROCAM and Diamond Forrester ones.
- The Framingham tool stratifies a higher percentage of patients with high and medium risk than the SCORE.
- PROCAM overestimates high risk and underestimates low risk when compared with Framingham; the concordance decreases with the risk.

- SCORE charts calibrated for the Spanish population identify more high-risk patients than SCORE—low-risk HDL or SCORE—so there would be a higher percentage of population treated with lipid-lowering agents.

- The level of education and the socioeconomic level influence the CVR.

- One of the primary prevention strategies that must be prioritised is the correct identification and treatment of high-CVR individuals.

- The ABI is an easy, cost-effective, and reliable test that can lead patients to a reclassification of the risk.

- Early identification of patients with auricular fibrillation (AF) at risk of cardiovascular complications can improve AF management. 2Major Adverse Cardiac Event (2MACE) score can be useful for the improvement of CVR stratification in patients with AF.

- Echo-Doppler of the ophthalmic artery and its resistance index assessment could be seen as a method for the determination of CVR.

- In patients with CVR, vascular age is higher than their biological age.

##### 4.1.4.3. Level of evidence 2- / Degree of recommendation C

- In populations with HIV, Framingham overestimates CVR. There is little concordance between PROCAM and Framingham methods as PROCAM offers lower CVR values than Framingham. The WHO model also offers lower CVR values than Framingham. With the three methods, men showed more CVR than women and a higher prevalence of CVRFs.

- The obstructive sleep apnoea is higher in patients with AF and is related with a higher CVR.

## 5. Discussion

Throughout the years, varied research has been published in terms of CVR. Different authors have agreed in the assessment of

**Table 6**  
Outcomes summary. Variables studied by the tools included in the study.

CVRF	Framingham	SCORE	REGICOR	ERICE	Framingham at 30 years	Framingham by categories	New Zealand	In colours	European societies	British societies	WHO/ISH	AHA	Sheffield	NCEP ATP III	PROCAM	Gaziano	Diamond–Forrester	ASSING	QRISK
Age	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Sex	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tobacco use	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
BP					X	X	X							X	X			X	X
HTN				X							X		X					X	X
SBP	X	X	X	X				X	X	X	X	X		X					X
TC	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	
HDL-C	X	X	X		X	X	X			X		X	X	X				X	
LDL-C															X				
HbA1c																			
DM	X		X	X	X	X	X	X			X	X	X		X	X		X	X
LVH													X						
BMI					X											X			X
Early menopause											X								
Obesity											X								
Family history											X				X				X
TGL											X				X				
Glucose intolerance											X								
Albuminuria											X								
Race												X							X
Chest pain																	X		
Socioeconomic situation																		X	X
Emerging diseases																			X
Renal pathology																			X
AF																			X
CRP																			
HR																			
BUN																			
Sodium																			
COPD																			
Duration of exercise																			
MS																			
Thromboembolism																			
Fraction >40%																			

AF, auricular fibrillation; AHA, American Heart Association; ASSING, Assessing Scottish Intercollegiate Guidelines Network; ATP III, Adult Treatment Panel III; BMI, body mass index; BP, blood pressure; BUN, blood urea nitrogen; COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein; CVRF, cardiovascular risk factor; ERICE, Ecuación de Riesgo Cardiovascular Española; HbA1C, glycated hemoglobin; HDL-C, high-density lipoprotein cholesterol; HR, heart rate; HTN, hypertension; LDL-C, low-density lipoprotein cholesterol; LVH, left ventricular hypertrophy; MS, metabolic syndrome; NCEP, National Cholesterol Education Program; PROCAM, Prospective Cardiovascular Münster; REGICOR, Registre Gironi del Cor; SCORE, systematic coronary risk evaluation; TC, total cholesterol; TGL, triglycerides; WHO, World Health Organization.

CVR as a relevant tool for the health field. However, the different methods and tools that can be used for the assessment of CVR classify population in differing ways in each case. In fact, if different methods were applied to the same patient, this person could be classified in different risk stages.<sup>27,66,68</sup>

The variability of the performance of the scales depending on the characteristics of the population has been described before this review. As corrective measures, the validation of the tools for the target population has been suggested.<sup>52–54</sup> The different existing charts can be used in populations others than the initial ones, provided that they undergo a process of calibration and adjustment to the new population. Therefore, the charts must be calibrated and adjusted to the epidemiology of each country to adapt the results to reality. This issue has also been addressed by Khambhati et al., suggesting the joint use of two or more scales to extend the scope of assessed risk factors.<sup>73</sup>

Elosua establishes that the biggest limitation of CVR scores is their low sensitivity. The vast majority of cardiovascular events occur in the age group of intermediate or moderate CVR.<sup>4</sup> This aspect has also been detected by Chamnan et al. who highlighted the inability of scales to measure risk in both young and elderly populations.<sup>54</sup>

Another important limitation of the reviewed scores is that most of them are based on classic CVRFs and do not consider the exposure duration to CVRFs.<sup>4</sup> It is of prime importance that the new CVR assessment methods include factors such as triglycerides (TGL), CRP, pedis pulse, CVD family history, or proteinuria, among others, given that they could improve the specificity of risk assessment. A method that conforms to the reality of the patient must be applied and accompanied by a comprehensive assessment of the same.<sup>19,47</sup> These results are in line with the proposals made by Khambhati et al.<sup>73</sup> to consider nontraditional risk factors or other health determinants such as social support, social networks, socioeconomic status, or mental health disorders.

### 5.1. Limitations

The main limitation than can be found throughout this study is to limit the publication date of articles between 2010 and 2017 as there could be previous articles that could act as a reference. We have tried to compensate this limitation with a complementary manual search in which the most relevant studies have been recovered. Another limitation is the number of articles discarded because they are not available in full text, which may have resulted in omitted relevant information. We have tried to compensate this with the methodological quality of the selected studies, submitting them to a critical appraisal.

## 6. Conclusions

Early detection of CVRFs is essential to initiate treatment and preventive measures. The myriad of risk assessment methods makes it difficult to choose the most appropriate one for the population that is cared for. The most appropriate method to be used is the one that best suits individual conditions, accompanied by a comprehensive assessment of the patient. Despite all the advances made in the field, we can conclude that more population studies are required as well as the development of methods are adapted to the characteristics of the study population and that they are applicable to a wide population range.

### Role of the funding source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### CRedit authorship contribution statement

**Jennifer Sacramento-Pacheco:** Project administration, Conceptualization, Investigation, Methodology, Resources, Validation, Writing - original draft, Writing - review & editing. **Gonzalo Duarte-Clímets:** Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Writing - original draft, Writing - review & editing. **Juan Gómez-Salgado:** Validation, Project administration, Methodology, Resources, Writing - original draft, Writing - review & editing. **Macarena Romero-Martín:** Investigation, Methodology, Resources, Formal analysis, Writing - review & editing. **María Begoña Sánchez-Gómez:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Writing - review & editing, Visualization.

### References

- [1] World Health Organization [Website]. Media centre. 2015 [Updated: January 2015; Access: 19 May 2017]. Available from: <http://www.who.int/mediacentre/factsheets/fs317/es/>.
- [2] Vaquiro-Rodríguez SY, Jofré-Aravena VE. Perfil de riesgo cardiovascular en cuidadores/as informales. *Rev Aladefe* 2016;6(2):54–64.
- [3] Guerrero-Alcedo JM, Sánchez-Angulo J. Factores protectores, estilos de vida saludable y riesgo cardiovascular. *Psicolog Salud* 2015;25(1):57–71.
- [4] Elosua R. Cardiovascular risk functions: usefulness and limitations. *Rev Esp Cardiol* 2014;67(2):77–9.
- [5] Elosua R, Morales-Salinas A. Determinación del riesgo cardiovascular total. Caracterización, modelización y objetivos de la prevención según el contexto sociodemográfico. *Rev Cubana Cardiol Cir Cardiovasc* 2011;17(1):2–15.
- [6] Ruiz-Mori E, Segura-Vega L, Agusti-Campos R. Uso del Score de Framingham como indicador de los factores de riesgo de las enfermedades cardiovasculares en la población peruana. *Rev Per Car* 2012;37(3).
- [7] Anarte-Ruiz C, Núñez-Cózar I, Jerez-Barranco D. Revisión bibliográfica del impacto del conocimiento enfermero en la salud del ciudadano con riesgo cardiovascular. *Rev Paraninfo Digit* 2016;25.
- [8] Royo-Bordonada MA, Lobos JM, Brotons C, Villar F, de Pablo C, Armario P, et al. El estado de la prevención cardiovascular en España. *Med Clin* 2014;142(81):7–14.
- [9] Brevis-Urrutia I, Valenzuela-Suazo S, Sáez-Carrillo K. Efectividad de una intervención educativa de enfermería sobre la modificación de factores de riesgo coronarios. *Cienc Enferm* 2014;20(3):43–57.
- [10] Buitrago LA. Factores de riesgo cardiovascular en estudiantes del programa de Enfermería de la Universidad Libe de Pereira. *Rev Cul Cui* 2012;9(1):36–45.
- [11] División-Garrote JA, Massó-Orozco J, Carrión-Valero L, López-Abril J, Carbayo-Herencia JA, Artigao-Ródenas LM. Evolución de la prevalencia de los factores de riesgo y del riesgo cardiovascular global en población mayor de 18 años de la provincia de Albacete (1992-94 a 2004-06). *Rev Esp Salud Publ* 2011;85(3):275–84.
- [12] Martínez-Gurrión LA, Landeros-López M, Cortés-Mendoza F, Betancourt-Esparza MC, Venegas-Cepeda ML. Riesgo cardiovascular en el personal de enfermería de un hospital de segundo nivel de atención hospitalaria según Framingham. *Rev Mex Enferm Cardiol* 2014;22(1):13–6.
- [13] Forés-Raurell R. Evolución y grado de control de los factores de riesgo cardiovascular tras 5 años de seguimiento y su relación con la incidencia de arteriopatía periférica. *Med Cli* 2017;148(3):107–13.
- [14] Rodríguez-Sánchez E, García-Ortiz L, Gómez-Marcos MA, Recio-Rodríguez JI, Mora-Simón S, Pérez-Arechaederra D, et al. Prevalencia de enfermedades cardiovasculares y de factores de riesgo cardiovascular en mayores de 65 años en un área urbana: estudio DERIVA. *Aten Primaria* 2013;45(7):349–57.
- [15] Sollo-Acuña MJ, Lago-Deibe F, Blázquez-Ballesteros ML, Díaz-Castro O, Alonso-Alonso I. Prevención de la enfermedad cardiovascular en atención primaria. Comparación de la función SCORE para países europeos de bajo riesgo con la tabla calibrada para España. *Semergen* 2011;9:455–61.
- [16] Royo-Bordonada MA, Armario P, Lobos-Bejarano JM, Botet JP, Villar-Álvarez, Elosua R, Brotons-Cuixart C, Cortés O, Serrano B, Camafort-Babkowski M, Gil-Núñez A, Pérez A, Maique A, de Santiago, Nocito A, Castro A, Alegría E, Baeza C, Herranz M, Sans S, Campos P. Adaptación española de las guías europeas de 2016 sobre prevención de la enfermedad cardiovascular en la práctica clínica. *Rev Esp Salud Publ* 2016;90(24).
- [17] Grau M, Elosua R, Cabrera de León A, Guembre MJ, Baena-Díez JM, Vega-Alonso T, et al. Factores de riesgo cardiovascular en España en la primera década del siglo XXI: análisis agrupado con datos individuales de 11 estudios de base poblacional, estudio DARIOS. *Rev Esp Cardiol* 2011;64(4):295–304.
- [18] Sánchez Janáriz H, Amador Demetrio MD, Naranjo Sintes V, Tristacho Ajamil R, Aguiar Bautista A, Alemán Sánchez JJ, et al. Programa de prevención

- y control de la enfermedad vascular aterosclerótica de Canarias. Gobierno de Canarias. Servicio Canario de Salud; 2013.
- [19] Achiong—Alemañy M, Achiong—Estupiñan F, Achiong—Alemañy F, Afonso de León JA, Álvarez—Escobar MC, Suárez—Medino M. Riesgo cardiovascular global y edad vascular: herramientas claves en la prevención de enfermedades cardiovasculares. *Rev Med Elec* 2016;38(2).
  - [20] Masson W, Siniawski D, Krauss J, Cagide A. Clinical applicability of Framingham 30 – year risk score. Usefulness in cardiovascular risk stratification and diagnosis carotid atherosclerotic plaque. *Rev Esp Cardiol* 2011;64(4):305–11.
  - [21] Muñoz de Escalona—Rojas JE, Cantero—Hinojosa J, Garrido—Pareja F, Padilla—Torres JF, García—Serrano JL. Valoración del riesgo cardiovascular en función de las principales variables de la hemodinámica ocular 2013;98(789):78–81.
  - [22] Amor AJ, Masana L, Soriguer F, Goday A, Calle Pascual A, Gaztambide S, et al. Estimación del riesgo cardiovascular en España según la guía europea sobre prevención de la enfermedad cardiovascular en la práctica clínica. *Rev Esp Cardiol* 2015;68(5):417–25.
  - [23] Martínez—Linares JM, Guisado—Barrilao R, Ocaña—Peinado F, Salgado—Parreño FJ. Artículo de revisión: modelos de estimación de riesgo cardiovascular y papel de enfermería en la prevención. *Rev Enferm Cardiol* 2014;21(63):33–9.
  - [24] Buffone IR, Benozzi SF, Lombán VI. Revisión sobre instrumentos de estimación de riesgo de enfermedad cardiovascular. *Arch Med Fam Gen* 2014;11(1):21–30.
  - [25] Muñoz O, Rodríguez N, Ruiz A, Rondón M. Validación de los modelos de predicción de Framingham y PROCAM como estimadores del riesgo cardiovascular en una población colombiana. *Rev Colomb Cardiol* 2014;21(4):202–12.
  - [26] García—Agudo S, Riera—Routon K, Gambí—Pisonero N, Siquier—Cantallops A, Díaz MP, Campos—González I. Riesgo cardiovascular determinado mediante el modelo REGICOR y edad del corazón en trabajadores de diferentes sectores productivos. *Med Balear* 2015;30(2):17–26.
  - [27] Armas—Rojas NB, de la Noval—García R, Dueñas—Herrera A, Castillo—Núñez, Suárez—Medina R, Castillo—Guzmán A. Estimación del riesgo cardiovascular mediante tablas de la Organización Mundial de la Salud, área de salud “Héroes del Moncada”. *Rev Cubana Cardiol Cir Cardiovasc* 2014;20(1).
  - [28] Veliz—Rojas L, Mendoza—Parra S, Barriga OA. Adherencia terapéutica y control de los factores de riesgo cardiovasculares en usuarios de atención primaria. *Enferm Univ* 2015;12(1):3–11.
  - [29] Valdés S, García—Torres F, Maldonado—Araque C, Goday A, Calle—Pascual A, Soriguer F. Prevalence of obesity, diabetes and other cardiovascular risk factors in Andalusia (Southern Spain). Comparison with national prevalence data. The Di@bet.es study. *Rev Esp Cardiol* 2014;67(6):442–8.
  - [30] Mejía C, Espejo R, Zevallos K, Castro T, Vargas A, Millan G. Factores asociados al riesgo cardiovascular según Framingham en taxistas de una empresa de Huancayo, Perú. *Rev Asoc Esp Med Trab* 2016;25(1):1–49.
  - [31] Sandonis—Ruiz LM, Nava—Criado JM, Ayus—Sánchez L, Junguitu I, Gómez—Gómez Y, Martín—Montero R, et al. Calcula tu riesgo cardiovascular. *Enfer en Cardiol* 2011;3(51–52):82–4.
  - [32] Vega—Abascal J, Guimara—Mozqueda M, Vega—Abascal L. Riesgo cardiovascular, una herramienta útil para la prevención de las enfermedades cardiovasculares. *Rev Cub Med Int* 2011;27(1):91–7.
  - [33] León—Latre M, Moreno—Franco B, Andrés—Estepan EM, Ledesma M, Laclaustra M, Alcalde V, et al. Sedentary lifestyle and its relation to cardiovascular risk factors, insulin resistance and inflammatory profile. *Rev Esp Cardiol* 2014;67(6):449–55.
  - [34] Badimón JJ, Santos—Gallego CG, Torres F, Castillo J, Kaski JC. Nuevas herramientas en la estratificación del riesgo cardiovascular. *Rev Esp Cardiol Supl* 2011;11:21–8.
  - [35] Bimbela—Serrano MT, Vidal—Peracho C, Bernúes—Vázquez L. Estrategias de educación terapéutica en el tratamiento de la obesidad del adulto con riesgo cardiovascular en la consulta de enfermería comunitaria. *Bibliot LAscasas* 2014;10(3).
  - [36] López—Jiménez F, Cortés—Bergoderi M. Obesidad y corazón. *Rev Esp Cardiol* 2011;64(2):140–9.
  - [37] Lobos—Bejarano JM, Brotons—Cuixart C. Factores de riesgo cardiovascular y atención primaria: evaluación e intervención. *Aten Prim* 2011;43(12):668–77.
  - [38] Fernández—Bergés D, Cabrera de León A, Sanz H, Elosua R, Guembre MJ, Alzamora M, et al. Síndrome metabólico en España: prevalencia y riesgo coronario asociado a la definición armonizada y a la propuesta por la OMS. *Estudio DARIOS Rev Esp Cardiol* 2012;65(3):241–8.
  - [39] Fernández—Bergés D, Félix—Redondo J, Lozano L, Pérez—Castán JF, Sanz H, Cabrera de León A, et al. Prevalencia de síndrome metabólico según las nuevas recomendaciones de la OMS. *Estudio HERMES Gac Sanit* 2011;25(6):519–52.
  - [40] Moreno P, Rodríguez—Álvarez C, Santiago M, Rijo MC, Aguirre—Jaime A, Abreu R, et al. Síndrome metabólico y mortalidad en población mayor de 65 años de la isla de Tenerife. *Nutri Clín Diet Hosp* 2014;34(2):63–70.
  - [41] Reinoso—Barbero L, Capapé—Aguilar A, Díaz—Garrido R, Santiago—Dorrego C, Gómez—Gallego F, Bamdrés—Moya F. Predicción del riesgo cardiovascular y su relación con el síndrome metabólico y los niveles de marcadores serológicos emergentes en vigilancia de la salud de los trabajadores. *Arch Prev Riesgos Labor* 2014;17(2):91–6.
  - [42] Zubeldia—Luzurica L, Quiles—Izquierdo J, Mañas—Vinuesa J, Redón—Más J. Prevalencia de hipertensión arterial y de sus factores asociados en población de 16 a 90 años de edad en la comunitat Valenciana. *Rev Esp Salud Publ* 2016;90(1).
  - [43] Lobos—Bejarano JM, Galve E, Royo—Bordonada MA, Alegría—Ezquerria E, Armario P, Brotons—Cuixart C, et al. Posicionamiento del comité español interdisciplinario de prevención cardiovascular y la sociedad española de cardiología en el tratamiento de las dislipemias. Divergencia entre las guías europeas y estadounidenses. *Rev Esp Salud Publ* 2015;89:15–26.
  - [44] Abu Assi E, López—López A, González—Salvado V, Redondo—Diéguez A, Peña—Gil C, Bouzas—Cruz N, et al. El riesgo de eventos cardiovasculares tras un evento coronario agudo persiste elevado a pesar de la revascularización, especialmente durante el primer año. *Rev Esp Cardiol* 2016;69(1):1–8.
  - [45] Mazón—Ramos P. Riesgo cardiovascular en el siglo XXI. Cómo detectarlo en prevención primaria. Cómo controlarlo en prevención secundaria. *Rev Esp Cardiol* 2012;65(2):3–9.
  - [46] Baena—Díez JM, Alzamora Sas MT, Forés—Raurell R, Pera G, Torán—Monserrat P, Sorribes—Capdevila M. El índice tobillo – brazo mejora la clasificación del riesgo cardiovascular: estudio ARTPER/PERART. *Rev Esp Cardiol* 2011;64(3):186–92.
  - [47] Marrugat J, Vila J, Baena—Díez JM, Grau M, Sala J, Ramos R, et al. Relative validity of the 10 – year cardiovascular risk estimate in a population cohort of the REGICOR study. *Rev Esp Cardiol* 2011;64(5):385–94.
  - [48] Alegría—Ezquerria E, Alegría—Barrero A, Alegría—Barrero E. Cardiovascular risk assessment: relevance and usefulness. *Rev Esp Cardiol Supl* 2012;12:8–11.
  - [49] Gil—Guillén VF, Orozco—Beltrán D, Pita—Fernández S, Carratalá—Manuera MC, Redón—Más J, Navarro J, et al. En la identificación del riesgo cardiovascular con el modelo SCORE, ¿se puede recomendar su cálculo indistintamente con colesterol total o índice aterogénico? Concordancia entre el colesterol total y el índice aterogénico en la tabla SCORE. *Rev Esp Cardiol* 2011;64(5):421–3.
  - [50] Gabriel R, Brotons C, Tormo MJ, Segura A, Rigo F, Elosua R, et al. The ERICE score: the New Native Cardiovascular Score for the low – risk and aged Mediterranean population of Spain. *Rev Esp Cardiol* 2015;68(3):205–15.
  - [51] Martínez—Linares JM, Medina—García J. Comparación de las calculadoras online de riesgo cardiovascular. *Enferm Cardiol* 2016;23(67):66–70.
  - [52] Matheny M, McPheeters ML, Glasser A, Mercaldo N, Weaver RB, Jerome RN, et al. Systematic review of cardiovascular disease risk assessment tools. Evidence synthesis no. 85. AHRQ publication no. 11-05155-EF-1. Rockville: Agency for Healthcare Research and Quality; 2011.
  - [53] Cooney MT, Dudina AL, Graham IM. Value and limitations of existing scores for the assessment of cardiovascular risk: a review for clinicians. *JACC* 2009;54(14):1209–27.
  - [54] Chamnan P, Simmons RK, Sharp SJ, Griffin SJ, Wareham NJ. Cardiovascular risk assessment scores for people with diabetes: a systematic review. *Diabetologia* 2009;52:2001–14.
  - [55] Pell JP. Scores of riesgo cardiovascular. *Rev Urug Cardiol* 2012;27:326–34.
  - [56] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8(1):19–32.
  - [57] Berra S, Elorza—Ricart JM, Estrada MD, Sánchez E. Instrumentos para lectura crítica y la evaluación de estudios epidemiológicos transversales. *Gac Sanit* 2008;22(5):492–7.
  - [58] Harbour R, Miller J, for the Scottish Intercollegiate Guidelines Network Grading Review Group. A new system for grading recommendations in evidence based guidelines. *BMJ* 2001;323:334–6.
  - [59] Marrugat J, Elosua R, Covas MI, Fitó M, Schröder H. Registre Gironí del Cor. Estudio REGICOR en las comarcas de Girona 1978–2008. Barcelona: Instituto Municipal de Investigación Médica; 2008.
  - [60] Brotons C, Moral I, Soriano N, Cuixart L, Osorio D, Botarro D, et al. Impacto de la utilización de las diferentes tablas SCORE en el cálculo del riesgo cardiovascular. *Rev Esp Cardiol* 2014;67(2):94–100.
  - [61] Vargas—Velázquez JMA, Escobar—Salinas JS. Probabilidad de evento coronario en los próximos 10 años en paciente diabéticos según la escala de Framingham REGICOR. *Rev Vir Soc Par Med Int* 2016;3(1):53–9.
  - [62] Alcocer LA, Lozada O, Fanghanel G, Sánchez—Reyes L, Campos—Franco E. Estratificación del riesgo cardiovascular global. Comparación de los métodos Framingham y SCORE en población mexicana del estudio PRIT. *Cir Cir* 2011;79(2):168–74.
  - [63] Lister Del Pino P, León—Amenero G, Leiva—Montejo A, Segura ER. Concordancia entre las escalas de riesgo cardiovascular PROCAM y Framingham en varones que reciben tratamiento antirretroviral en un hospital nacional de Lima, Perú 2013. *Rev Peru Med Exp Salud Públ* 2015;32(4):731–8.
  - [64] Benozzi S, Álvarez C, Gómez—Echevarría G, Perruzza F, Pennacchiotti G. Can the SCORE and NCEP function charts be applied in primary prevention to estimate cardiovascular risk in the Argentine population? *Rev Argent Cardiol* 2010;78(4):346–9.
  - [65] Muñoz OM, Ruiz—Morales AJ, Mariño—Correa A, Bustos MM. Concordancia entre los modelos de SCORE y Framingham y las ecuaciones AHA/ACC como evaluadores del riesgo cardiovascular. *Rev Colomb Cardiol* 2017;24(2):110–6.
  - [66] Versteyleen MO, Joosen IA, Shaw LJ, Narula J, Hofstra L. Comparison of Framingham, PROCAM, SCORE, and Diamond Forrester to predict coronary atherosclerosis and cardiovascular events. *J Nucl Cardiol* 2011;18(5):904–11.

- [68] Castro–Sansores C, Guerrero–Flores A, Santos–Rivero A, Sarmiento–Coutiño C, Valencia–Serrano N, Bolaños–Caldelas E. Comparación de tres métodos para la estimación del riesgo cardiovascular en una población de pacientes con infección por VIH. *Med Int Mex* 2011;27(5):439–45.
- [69] Platek AE, Szymanski FM, Filipiak KJ, Dudzik–Plocica A, Krzowski B, Karpinski G. Stratification of cardiovascular risk in patients with atrial fibrillation and obstructive sleep apnea-validity of the 2MACE score. 2017.
- [70] Pastori D, Farcomeni A, Poli D, Antonucci E, Angelico F, Del Ben M, et al. Cardiovascular risk stratification in patients with non – valvular atrial fibrillation: the 2MACE score. *Intern Emerg Med* 2016;11:199–204.
- [71] Pena–Álvarez V. Factores de riesgo cardiovascular y el índice tobillo-brazo. *Metas Enferm* 2015;18(7):20–3.
- [73] Khambhati J, Allard–Ratick M, Dhindsa D, Lee S, Chen J, Sandesara PB, et al. The art of cardiovascular risk assessment. *Clin Cardiol* 2018;41:677–84.