

Original article

# Validity Assessment of Low-risk SCORE Function and SCORE Function Calibrated to the Spanish Population in the FRESCO Cohorts

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## ABSTRACT

**Introduction and objectives:** To assess the validity of the original low-risk SCORE function without and with high-density lipoprotein cholesterol and SCORE calibrated to the Spanish population.

**Methods:** Pooled analysis with individual data from 12 Spanish population-based cohort studies. We included 30 919 individuals aged 40 to 64 years with no history of cardiovascular disease at baseline, who were followed up for 10 years for the causes of death included in the SCORE project. The validity of the risk functions was analyzed with the area under the ROC curve (discrimination) and the Hosmer-Lemeshow test (calibration), respectively.

**Results:** Follow-up comprised 286 105 persons/y. Ten-year cardiovascular mortality was 0.6%. The ratio between estimated/observed cases ranged from 9.1, 6.5, and 9.1 in men and 3.3, 1.3, and 1.9 in women with original low-risk SCORE risk function without and with high-density lipoprotein cholesterol and calibrated SCORE, respectively; differences were statistically significant with the Hosmer-Lemeshow test between predicted and observed mortality with SCORE ( $P < .001$  in both sexes and with all functions). The area under the ROC curve with the original SCORE was 0.68 in men and 0.69 in women.

**Conclusions:** All versions of the SCORE functions available in Spain significantly overestimate the cardiovascular mortality observed in the Spanish population. Despite the acceptable discrimination

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capacity, prediction of the number of fatal cardiovascular events (calibration) was significantly inaccurate.

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## Evaluación de la validez de las funciones SCORE de bajo riesgo y calibrada para población española en las cohortes FRESCO

### RESUMEN

#### Palabras clave:

Enfermedades cardiovasculares  
Mortalidad cardiovascular  
Funciones de riesgo  
Ictus  
Enfermedad coronaria  
Prevención

**Introducción y objetivos:** Estudiar la validez de la función SCORE original de bajo riesgo sin y con colesterol unido a lipoproteínas de alta densidad y SCORE calibrada en población española.

**Métodos:** Análisis agrupado con datos individuales de 12 estudios de cohorte de base poblacional. Se incluyó a 30.919 participantes de 40-64 años sin enfermedades cardiovasculares en el momento del reclutamiento, que se siguieron durante 10 años para la mortalidad cardiovascular contemplada en el proyecto SCORE. La validez de las funciones se analizó mediante el área bajo la curva ROC (discriminación) y el test de Hosmer-Lemeshow (calibración), respectivamente.

**Resultados:** Se dispuso de 286.105 personas/año. La mortalidad a 10 años por causas cardiovasculares fue del 0,6%. La razón de casos esperados/observados fue de 9,1, 6,5 y 9,1 en varones y de 3,3, 1,3 y 1,9 en mujeres con las funciones SCORE original de bajo riesgo sin y con colesterol unido a lipoproteínas de alta densidad y SCORE calibrada, respectivamente; diferencias estadísticamente significativas con el test de calibración de Hosmer-Lemeshow entre la mortalidad predicha con SCORE y la observada ( $p < 0,001$  en ambos sexos y en todas las funciones). Las áreas bajo la curva ROC con SCORE original fueron 0,68 en varones y 0,69 en mujeres.

**Conclusiones:** Todas las versiones de las funciones SCORE disponibles en España sobreestiman significativamente la mortalidad cardiovascular observada en la población española. A pesar de la aceptable capacidad de discriminación, la predicción del número de acontecimientos cardiovasculares mortales (calibración) fue significativamente imprecisa.

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### Abbreviations

HDL-C: high-density lipoprotein cholesterol  
SCORE-C: calibrated Systematic COronary Risk Evaluation  
SCORE-LOW: original low-risk Systematic COronary Risk Evaluation  
SCORE-LOW-HDL: original low-risk Systematic COronary Risk Evaluation with high-density lipoprotein cholesterol

### INTRODUCTION

Any tool that helps to prevent cardiovascular diseases is welcome because these conditions are still the main cause of death in Spain, with little change in their incidence in the last 30 years.<sup>1,2</sup> Primary prevention identifies populations at high risk of cardiovascular disease to enable at-risk individuals to be treated with intensive measures—both pharmacological and lifestyle—that reduce and delay the incidence of cardiovascular disease.<sup>3</sup> Risk functions have been designed to estimate global coronary risk and have improved upon the simple individual approach of cardiovascular risk factors. These instruments were developed from cohort studies with follow-up durations of 10 or more years and enable estimation of the risk of coronary disease development during this period.<sup>4</sup>

The SCORE (Systematic COronary Risk Evaluation) function, recommended in the European and Spanish guidelines,<sup>3,5-7</sup> calculates the 10-year risk of cardiovascular death. Developed using European cohorts, there is an original version differentiated for high-risk and low-risk countries (SCORE-LOW),<sup>5</sup> another original version that includes the total cholesterol/high-density lipoprotein cholesterol ratio (SCORE-LOW-HDL), and a version calibrated for use in the Spanish population (SCORE-C).<sup>8</sup> The latter

2 versions are available online at HeartScore.<sup>9</sup> The performance of these 3 versions of the SCORE function have not been evaluated in a Spanish population cohort.

The aim of the present study was to analyze the validity of the 3 SCORE functions recommended in Spain by comparing their predictions with the 10-year rate of fatal cardiovascular disease observed in a general Spanish population cohort.

### METHODS

#### Design and Participants

The present study involved pooled analysis of individual data from 12 population-based Spanish cohort studies performed from 1991 onward<sup>10</sup> and with follow-up until 2005 aggregated in the FRESCO study<sup>11</sup> (Table 1 of the supplementary material). All cohort participants were randomly selected, were aged between 35 and 79 years, had no cardiovascular disease at the start of follow-up, and had signed an informed consent form. The FRESCO study was authorized by the Ethics Committee of the *Parc de Salut Mar*, Barcelona (2009/3391/I).

#### Measures

Age, sex, and the other risk factors considered in the SCORE functions (smoking, systolic blood pressure, total cholesterol, and high-density lipoprotein cholesterol [HDL-C]) were known for all cohorts and had been collected using the standardized methodology recommended by the World Health Organization.<sup>10</sup> Participants were classified as smokers (if they were smoking at the time of examination or had quit smoking  $\leq 1$  year previously) or nonsmokers (exsmokers since  $> 1$  year previously or never smoked). Systolic and diastolic blood pressure readings were determined via the mean of 2 determinations obtained at least 5 minutes apart. Analytical determinations were performed after

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