**The Framingham Function Overestimates Stroke Risk for Diabetes and Metabolic Syndrome Among Spanish Population**

B. Costa, J.J. Cabré, F. Martín, J.L. Piñol, J. Basora, and J. Bladé, on behalf of the ITG Research Group

**Objective.** To estimate stroke risk for diabetes, isolated or associated to metabolic syndrome (MS) according WHO and National Cholesterol Education Program (NCEP) criteria.

**Design.** Multicentre and prospective cohort study.

**Setting.** Primary health care.

**Participants.** Subjects between 55-85 years-old without any evidence of stroke, included from 1998 in a random population sample for MS follow-up during routine practice in Reus (Tarragona, Spain).

**Main measurements.** Stroke risk was achieved using Framingham function by means of a computerized algorithm using a diagnostic factorial design (diabetes and/or MS). Theoretical stroke risk and cumulated incidence of stroke events (1998-2003) were compared.

**Results.** Among 728 subjects (412 women, mean age=66 years old, body mass index =29 kg/m²), 457 (62.8%) did not have diabetes, nor MS, 93 (12.8%) had MS without diabetes, 72 (9.9%) diabetes without MS, and 106 (14.5%) presented both conditions (WHO rules). According NCEP criteria were 60.7%, 14.8%, 7.8% and 16.7%, respectively.

Ten-year estimated stroke risk accounted for WHO/NCEP 8.4/9.1, 10.8/10.5, 18.17/3%, and 18.8/19.1%. Cumulated incidence for stroke events were: 2.18%, 1.4% and 3.8% (WHO), and 2.5%, 2.8%, 3.5%, and 5.8%, respectively (NCEP).

**Conclusions.** Stroke risk scores were extremely increased among diabetic subjects irrespective to MS diagnose. The Framingham function probably overestimates stroke risk among Spanish individuals.

**Key words:** Diabetes. Metabolic syndrome. X-syndrome. Stroke. Stroke risk.
Introduction

Stroke is one of the main causes of mortality, hospitalization, disability, and excess health costs in most developed countries. In reality, its social impact results from its motor and cognitive sequelae and associated comorbidity. Although valid preventive strategies are available, their use in routine clinical practice is inconsistent.1,2 It has now been shown beyond question that type 2 diabetes and metabolic syndrome (MS) increase cardiovascular risk; however, a parallel increase in the risk of stroke is less evident.3 In Spain, this risk has yet to be evaluated in detail on the basis of a careful comparison of different sources of information specifically for diabetes either with or without SM. Aside from the problems with long-term follow-up of a cohort and the establishment of minimum diagnostic criteria for stroke, three main obstacles may also account for the absence of information. First, there is no standard profile for measuring the risk of stroke. Although mathematical models are available, the risk contributed by diabetes varies between different modes of stroke injury (lacunar infarct, atherothrombosis, cardioembolism, hemorrhage), making it difficult to estimate risk under different circumstances.4 In addition, formulas obtained for other populations are not often used because they do not reflect the Mediterranean lifestyle, although they might be used in the absence of other more appropriate sources of information. Second, conjectures regarding classification have led to the appearance of at least 4 definitions of MS in recent years.5-10 Third, confirmation of an episode of stroke, especially if transitory or asymptomatic, is complex in older persons, especially within the setting of primary care. Diabetes is usually assumed to be a risk factor for stroke, but it is not known whether considering diabetes as part of MS increases the risk or whether the influence of diabetes is independent of MS. In view of these limitations, the aim of this study was to provide a preliminary estimate of overall stroke risk, calculated with the Framingham Stroke Risk Profile, associated with type 2 diabetes in the presence or absence of MS. A further aim was to compare theoretical risk estimates with the actual incidence of stroke in a cohort followed at primary care centers for 5 years, from 1998 to 2003.

Patients and Methods

In 1998 a prospective multicenter cohort study was begun in an urban area with a population of close to 100 000, with an age structure similar to that of the population of the region of Catalonia (northeastern Spain) as a whole. A random sample representative of the population over 14 years of age was studied. The aims were to estimate the prevalence of MS, the associated risk of vascular events, and the incidence of vascular events, and to identify the factors with the greatest influence on risk that were amenable to preventive measures. The population sample needed for a theoretical prevalence of MS of 17% with ±2% precision and an alpha risk of .05 was estimated as 1500, assuming a 20% drop-out rate.

The study was approved by our institution’s ethics committee, and participants gave their informed consent to take part in the study. All participants were advised that a database would be created and that information from their primary care medical record would be entered about their age, sex and address, basic health status (familial and personal antecedents, toxic habits, height, and weight), and results of laboratory tests in blood (biochemical profile, hemogram, lipid profile, oral glucose tolerance of
test if one or more risk factors for diabetes were present, hemo-
globin A1c, and fasting insulin level) and urine (microalbuminu-
ria and 24-hour urinalysis as needed). The database also recorded
cardiovascular risk factors (hypertension, diabetes, dyslipidemia,
and obesity), relevant electrocardiographic findings (atrial fibrilla-
tion, left ventricular hypertrophy, and ischemic heart disease),
and an associated record of vascular events and treatments.
Diabetes was diagnosed on the basis of the recommendations of
the World Health Organization (WHO) as fasting venous blood
glucemia 7 mmol/L (126 mg/dL) or higher, glucemia 2 hours af-
after oral glucose overload (75 g) of 11.1 mmol/L (200 mg/dL) or
higher, with appropriate measures to confirm the diagnosis in
patients who were asymptomatic. The criteria used in this
study to diagnose MS (Table 1) were based on recommendations
of WHO5 and the National Cholesterol Education Program
(NCEP).6 Heart disease was assumed to be present when there was a clin-
ical history of ischemic heart disease or heart failure, and when
the available results of complementary tests (electrocardiogram,
exercise test, and scintigraphy) were suggestive. Cerebrovascular
disease was assumed if there was a clinical history suggestive of
transitory ischemic accident, transitory cerebrovascular accident,
or positive imaging tests. All subjects with no record of cerebro-
vascular complications underwent basic neurological examina-
tion intended to rule out silent processes. If there was a reasona-
ble suspicion, the participant was asked to complete a ques-
tionnaire (Mini Mental Status Exam) and to undergo an imag-
ing test (computed tomography). Peripheral vasculopathy
was diagnosed if there was no peripheral pulse or if vasculopathy
was demonstrated with Doppler echography. Left ventricular hy-
pertrophy was diagnosed on the basis of conventional electrocar-
diographic findings, when available.
For this study we selected adults aged between 55 and 85 years
(the range used for risk calculation in the Framingham profile)
without antecedents of stroke. To calculate risk we used the scale
developed by D’Agostino and colleagues based on data from
the Framingham study, and the recent revision by Straus et al.12–14
This system places particular importance on age, sex and mean
systolic blood pressure (taking into consideration the use of an-
thypertensive medication). The initial score was recalibrated on
the basis of the presence of any of the following risk factors for
stroke: smoking, diabetes, established cardiovascular disease
(congestive heart failure, myocardial infarction or other forms of
coronary ischemia, intermittent claudication, or peripheral artery
ischemia), atrial fibrillation, and left ventricular hypertrophy. The
scores for 10-year stroke risk ranged from 1% to 80%. All data
for stroke risk were processed with specially-designed software
developed for this study.
The statistical analysis was done with conventional software
(SPPS version 11.0) running on a personal computer. Descrip-
tive statistics were obtained first; then factorial analysis of the da-
ta for each diagnosis (MS/diabetes × Yes/no) was done for 4
groups (neither, either diagnosis separately, or both). Qualitative
data are reported here as frequencies followed by percentages in
parentheses. Quantitative data are expressed as the arithmetic
mean followed by the standard deviation in parentheses. The χ2
test was used for inferential bivariate qualitative statistics. Quan-
titative analyses were done with Student’s t-test or analysis of va-
riance after normal distribution was verified with the Kolmog-
rov-Smirnov test. The stroke risk profile was calculated for each
group as mean probability with a 95% confidence interval (95% CI).

### Results

The sample consisted of 728 subjects (412 women, 56.6%). Mean age was 66.4 (7.3) years, mean body mass
index (BMI) was 29.3 (4.9) kg/m², and mean systolic blood
pressure was 14.01 (18.5) mm Hg. Treatment with antihyp-
tensive medication was recorded for 335 persons (46%). According to WHO parameters, 199 individuals
(27.3%) fulfilled the criteria for MS, and 178 (24.4%) ful-
filled the criteria for type 2 diabetes. The diagnosis of dia-
betes was based on fasting blood glucose levels in 103 per-
sons (57.9%) and on glucemia 2 hours after oral glucose
overload in 75 (42.1%) persons.
More than half of the sample (457 persons, 62.8%) had
neither diabetes nor MS, 93 (12.8%) has MS but not dia-
betes, 72 (9.9%) had diabetes but not MS, and 106
(14.5%) had both (WHO criteria). According to NCEP
criteria, the corresponding figures were 60.7%, 14.8%,
7.8%, and 16.7%. Table 2 shows how the sample was dis-
tributed according to WHO criteria for diabetes and MS,
as a function of the parameters used to calculate stroke
risk. We found no statistically significant differences be-
tween the 4 groups in sex, age, or smoking habit, although
differences appeared for the rest of the variables. Indivi-

### Table 1

<table>
<thead>
<tr>
<th>Parameters Used to Diagnose Metabolic Syndrome</th>
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<tbody>
<tr>
<td><strong>World Health Organization (WHO) criteria</strong></td>
</tr>
<tr>
<td>Altered glucose metabolism/diabetes mellitus and/or</td>
</tr>
<tr>
<td>Blood pressure 140/90 mm Hg or higher</td>
</tr>
<tr>
<td>Elevated triglycerides (1.7 mmol/l⁻¹ or 150 mg·dl⁻¹ or higher) and/or decreased HDL-cholesterol (&lt;0.9 mmol·l⁻¹ or 35 mg·dl⁻¹ in men; &lt;1.0 mmol·l⁻¹ or 39 mg·dl⁻¹ in women)</td>
</tr>
<tr>
<td>Central obesity (men: waist-hip ratio &gt;0.90; women: waist-hip ratio &gt;0.85) and/or BMI&gt;30 kg·m⁻²</td>
</tr>
<tr>
<td>Microalbuminuria (urinary excretion of albumin 20 µg·min-1 or higher, or albumin/creatinine ratio 20 mg·g⁻¹ or higher)</td>
</tr>
<tr>
<td>At least one invariable component and 2 or more variable components required</td>
</tr>
<tr>
<td><strong>National Cholesterol Education Program (NCEP) criteria</strong></td>
</tr>
<tr>
<td>3 or more of the following conditions</td>
</tr>
<tr>
<td>Elevated triglycerides (1.7 mmol·l⁻¹ or 150 mg·dl⁻¹)</td>
</tr>
<tr>
<td>HDL-cholesterol fraction less than 1.03 mmol·l⁻¹ or 40 mg·dl⁻¹ in men, or less than 1.29 mmol·l⁻¹ or 50 mg·dl⁻¹ in women</td>
</tr>
<tr>
<td>Blood pressure 130/85 mm Hg or higher</td>
</tr>
<tr>
<td>Fasting glucose 6.1 mmol·l⁻¹ or 110 mg·dl⁻¹ or higher</td>
</tr>
</tbody>
</table>

### Notes

- The Framingham Function Overestimates Stroke Risk for Diabetes and Metabolic Syndrome Among Spanish Population
- Costa B, et al.
- ORIgINAL ARTICLE
The Framingham Function Overestimates Stroke Risk for Diabetes and Metabolic Syndrome Among Spanish Population

Costa B, et al.

TABLE 2

Distribution of Subjects According to Parameters in the Framingham Profile for Calculating Stroke Risk*

<table>
<thead>
<tr>
<th>WHO Diagnostic Group</th>
<th>MS (–) DM (–)</th>
<th>MS (+) DM (–)</th>
<th>MS (–) DM (+)</th>
<th>MS (+) DM (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>n=457</td>
<td>n=93</td>
<td>n=72</td>
<td>n=106</td>
</tr>
</tbody>
</table>

Qualitative parameter

- Sex, women: 256 (56.0%) 55 (59.1%) 38 (52.8%) 63 (59.4%)
- Pharmacological antihypertensive treatment: 184 (40.3%) 49 (52.7%) 29 (40.3%) 73 (68.9%)
- Smoking habit: 57 (12.5%) 13 (14.0%) 10 (13.9%) 15 (14.2%)
- Coronary artery disease: 36 (7.9%) 12 (12.9%) 17 (23.6%) 26 (24.5%)
- LVH: 7 (1.5%) 0 (0%) 8 (11.1%) 5 (4.7%)

Quantitative parameter

- Age, years: 66 (7.5%) 66.7 (7.2%) 67.6 (8%) 67.1 (6.6%)
- BMI, kg.m²: 28.4 (4.6%) 31.7 (4.4%) 27.8 (4%) 32.3 (5%)
- Systolic blood pressure, mm Hg: 137.1 (17.8%) 150.1 (19.6%) 137.6 (18.4%) 146.4 (16.3%)

*WHO indicates World Health Organization; MS, metabolic syndrome; DM, diabetes mellitus; LVH, left ventricular hypertrophy; BMI, body mass index; SS, statistical significance. Qualitative parameters are expressed as the number of cases with percentages in parentheses. Quantitative parameters are expressed as the mean with standard deviation in parentheses.

TABLE 3

10-Year Stroke Risk in Each Group *

<table>
<thead>
<tr>
<th>Metabolic Syndrome</th>
<th>Diabetes Mellitus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
</tr>
<tr>
<td>MS (–) (WHO)</td>
<td>457</td>
</tr>
<tr>
<td>MS (–) (NCEP)</td>
<td>442</td>
</tr>
<tr>
<td>MS (+) (WHO)</td>
<td>72</td>
</tr>
<tr>
<td>MS (+) (NCEP)</td>
<td>108</td>
</tr>
</tbody>
</table>

*WHO indicates World Health Organization; NCEP, National Cholesterol Education Program; MS, metabolic syndrome; DM, diabetes mellitus. Mean percentage probability of having a stroke episode is shown with 95% confidence interval and number of cases in each category.

Using as the reference value the 8.4% stroke risk in persons with neither diabetes nor MS, a diagnosis of MS was associated with a 28.6% increase in stroke risk. However, a diagnosis of diabetes was associated with a 114.3% increase, and when both diagnoses appeared together, this was associated with a 123.8% increase in mean estimated stroke risk. When risks were estimated for diagnoses based on the NCEP criteria, the figures were very similar.

Figure 1 shows the differences in stroke risk for men and women in each age group according to diagnoses based on the WHO criteria. Figure 2 illustrates the risks in both sexes as calculated according to the NCEP criteria for diabetes and MS. The highest probability of stroke in men was found for the 75 to 79-year-old group. In women, the highest risk was found for the 80 to 84-year-old group; this was the only age group in which the estimated risk for women was higher than the risk for men. The two sets of plots overlapped to a considerable degree.

During the study period 47 patients (6.4%) were lost to follow-up because they moved to a new address served by a different health center (30), for reasons that were not stated (6), or because of death. Of the 11 subjects who died, 6 of the deaths were attributed to a cardiovascular problem. Table 4 summarizes the distribution of cerebrovascular episodes recorded in each of the 4 groups (diagnosis based on WHO or NCEP criteria) during the first 5 years of follow-up.
Type 2 diabetes, hypertension (especially high systolic blood pressure), obesity, dyslipidemia, and microalbuminuria are frequently associated with, and can lead to, increased stroke risk, particularly for ischemic stroke. These mutual influences of different risk factors make it difficult to discern the risk due to diabetes alone against the overall risk associated with MS. Because the available epidemiological data are scarce, the present study aims to provide a preliminary estimate for the Spanish population.

Notwithstanding the modest size of our sample, the results indicate that the overall estimated stroke risk was higher among individuals with diabetes or MS than in the population with neither of these entities. The profile used here was derived from the Framingham study on the basis of results for the population in the USA and has not yet been validated in Spain or other countries in this area. Although the stroke risk estimates obtained for our population may thus be inaccurate, it is also likely that influential environmental and genetic factors were distributed randomly across the 4 groups compared here. Thus the trends seen in the between-group comparisons are likely to reflect relative differences between groups.

Our research group is specialized in diabetes and MS prevention, so the routine use of the oral glucose tolerance test provided information on the diagnosis of our patients’ glucemia status. A recent, thorough review of the available scientific evidence examined the main stroke risk factors in detail, and noted the relevant role of hypertension in raising the relative risk of stroke 3-fold to 5-fold. In contrast, the same review suggested that the risk associated with diabetes was lower, but left the issue unresolved as the level of scientific evidence was considered to be lower. In fact, the role of hyperglycemia as a modifiable stroke risk factor has always been controversial: some studies openly support this source of risk, whereas others dismiss the relevance of this factor.

Conflicting results have also been reported in the Spanish literature. For example, a study in the Manresa area (eastern Spain) found an association between stroke and hyperglycemia after 28 years of follow-up. Along similar lines, another prospective study in the city of Barcelona found an association between diabetes and a worse prognosis for intracerebral hemorrhage. In contrast, other research found age- and sex-related differences in the incidence that were independent of glucemia values. The results reported here cannot resolve all these contradictions, nor are they intended to defend a glucocentric position. They simply insinuate that the risk of stroke posed by diabetes might be independent of the influence diabetes exerts when considered part of MS, at least when the latter is defined according to WHO or NCEP criteria and risk is evaluated with the Framingham Stroke Risk Profile. In fact, diabetes alone leads to a notable increase in basal stroke risk, whereas the presence of MS together with diabetes leads only to a small additional increase. To explain these values, it should be considered that according to the definition used to develop the Framingham Stroke Risk Profile, diabetes receives a high direct score and raises the level of stroke risk in all patients with this diagnosis. Moreover, the higher incidence of electrocardiographic
Cerebrovascular disease involves evident excess health costs resulting from its associated mortality and morbidity.

A method to calculate stroke risk, based on the Framingham functions derived for the US population, is available but is rarely used in Spain.

The actual incidence of cerebrovascular events observed in the present study was clearly lower than the risk calculated with the Framingham functions, suggesting that they overestimate risk.

Considering diabetes as part of metabolic syndrome according to WHO or NCEP criteria clearly amplifies stroke risk.

Stroke risk calculated with the Framingham functions is high.

Risk Profile offers multiple possibilities for overestimating risk depending on the variable in question. The most controversial issue for primary care is whether diabetes (or MS) should be considered a risk equivalent or simply a risk factor. It is revealing that the incidence of thromboembolic stroke in men who participated in the Framingham study was 40% higher than in men in Honolulu, whereas episodes of hemorrhagic stroke were almost identical. These epidemiological data emphasize the fact that the Framingham Stroke Risk Profile offers multiple possibilities for overestimating risk depending on the variable in question.

In contrast, the increased stroke risk cannot be attributed to the prolonged duration of diabetes because nearly half of our subjects were diagnosed with the oral glucose tolerance test, i.e., in the initial stages of the disease. Naturally, the prevalence of diabetes we assumed for our study population is available but is rarely used in Spain.

The differences in the incidence of stroke episodes between the 4 diagnostic groups seem negligible considering their low impact, and attempts to explain them would be little more than conjecture. However, they suggest that the NCEP definition of MS provides estimates of risks that are closer to the actual incidence, which is apparently lower than the impact that can be inferred from the Framingham stroke risk scale.

It has often been noted that published studies on the Spanish population are scarce, and this limitation is especially evident for the population of older persons. Although it would appear to make little sense to study older patients in terms of prevention, many such patients are not hospitalized or do not undergo CT scans even though the prognosis for life expectancy and cerebrovascular function are known to be worse in this age group. Moreover, differences in health care have been found in relation to gender, ethnic group and other factors. It is revealing that the incidence of thromboembolic stroke in men who participated in the Framingham study was 40% higher than in men in Honolulu, whereas episodes of hemorrhagic stroke were almost identical. These epidemiological data emphasize the fact that the Framingham Stroke Risk Profile offers multiple possibilities for overestimating risk depending on the variable in question.

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risk. For now the Framingham functions can be used with due caution, although the data from the present study suggest that they should not be recommended for systematic use in population screening.

Acknowledgments
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References
The last 10 years have been witness to an important change in the orientation of cardiovascular risk prevention activities, which have moved away from one-off interventions aimed at modifiable risk factors toward a model of more integrated intervention strategies based on prior quantification and risk stratification for disease. Atherosclerosis, the main physiological substrate of cardiovascular disease (CVD), is a chronic process of multifactorial origin in which different risk factors (RF) interact synergically. Assuming that the main objective of CVD prevention is to reduce the probability of becoming ill, it would not make much sense to “standardize” the value of different RF; rather, it makes more sense to act on them in a coordinated manner, using more stringent measures according to the risk of disease.

One of the circumstances that has made this approach possible is the increasing availability of tools able to quantify, or at least stratify, the risk of a CVD episode from certain individual characteristics that are easy to determine, i.e., from RF. Currently about 20 different risk scales are available in a large variety of versions and formats, from tables and scoring systems to sophisticated computer-based programs that calculate risk rapidly. These scales are based on probabilistic mathematical models obtained by applying multivariate analysis techniques to data from long-term follow-up studies of cohorts of individuals. The paradigm for such studies is the Framingham study, in which the incidence of CVD has been related to a number of identified RF. Use of resulting model for other persons has made it possible to estimate cardiovascular risk, i.e., the probability of having a CVD episode during a given period (usually 10 years).

Although mathematical functions have been developed to calculate coronary disease risk, stroke risk, or both simultaneously, the former are much more widespread and more popular than the latter. This seems surprising given that the burden of stroke is similar to that associated with coronary disease in terms of morbidity, mortality, complications, and sequelae. The study by Costa et al published in this issue of ATENCIÓN PRIMARIA estimates the risk of stroke with the Framingham scale in a population sample from the city of Reus (Tarragona, Spain), with the aim of determining the risk associated with type 2 diabetes with and without associated metabolic syndrome (MS). The estimated risk of stroke was higher in persons with MS or diabetes than in other persons, but the association of MS with diabetes did not significantly increase the risk in comparison to diabetes alone. The findings were foreseeable in light of the higher relative score for diabetes compared to the scores for components of MS according to the Framingham scale. Unfortunately, the low number of cerebrovascular episodes during the period of follow-up was insufficient to validate the estimates. However, the results are consistent with those of a recent prospective study of persons in Aragon with type 2 diabetes seen in endocrinology outpatient clinics. This study found that when all four components of MS were present (according to the WHO criteria), there was no increase in stroke risk, although the risk for coronary disease did increase.

**Key Points**

- Estimation and stratification of cardiovascular risk are fundamental steps before cardiovascular risk prevention activities can be carried out effectively.
- Scales derived from the Framingham study used to calculate stroke risk are little used and have not been validated for use in Spain.
- While we await long-term prospective studies that are sufficiently powered to validate the Framingham risk functions and the SCORE project functions for the Spanish population, it seems reasonable to use the latter based on the most recent consensus recommendations.
- Regardless of the risk scale used, accurate ways to estimate risk need to be made available and improved upon for use in daily primary care practice.
Subsequent comparisons of the theoretical risk and the cerebrovascular episodes observed during the 5-year follow-up period in the cohort studied by Costa et al\(^1\) showed this approach to be a useful way to study the validity and applicability of the Framingham functions for the Spanish population—features that had not been studied previously. Both for the whole cohort and for subgroups with diabetes, MS, or both, the actual incidence of stroke was lower than the risk estimated with the Framingham functions. Similar results were obtained when the coronary disease risk function was applied for populations in the Mediterranean area and even populations in northern Europe,\(^3\) and these findings have been interpreted as a logical consequence of the differences in basal characteristics and risks between the populations being compared. It was therefore proposed that correction factors be used\(^3,4\) to minimize the problem.

Although the findings reported by Costa et al\(^1\) suggest that the Framingham model also overestimates the risk of stroke for the Spanish population, this conclusion should be qualified. First, it is likely that the theoretical risk was underestimated because of the high prevalence of diabetes in the Reus cohort (24.5%, as compared to 6% in the Framingham cohort). This marked difference in prevalence can be explained in part by differences in the diagnostic criteria, particularly as more than 40% of the persons with diabetes in the Reus cohort were diagnosed with an oral glucose tolerance test. Second, the large proportion of diabetics with the oral glucose tolerance test implies a shorter duration of the disease, and thus a lower baseline risk of CVD. Finally, the total number of cerebrovascular episodes recorded during the study period for the Reus cohort was small and clearly insufficient, as the authors noted,\(^1\) to hazard an interpretation of the differences between the four subgroups. Additional prospective studies with larger numbers of participants and a longer follow-up period will be needed before the Framingham model for stroke risk can be completely banished from use for the Spanish population.

However, other options are available meanwhile. Risk functions from the SCORE project\(^5\) recently became available. These functions were developed from data for more than 200,000 participants in several European countries, including Spain. This model provides estimates separately or jointly for the risk of death from stroke and coronary disease, and different versions have been devised for areas with a high and a low incidence of CVD. For diabetes specifically—and leaving aside for now the issue of whether it should be considered a risk equivalent for CVD—use of the Framingham functions has been questioned because of the low number of patients with diabetes who were followed in the original cohort (237 of a total of 5573). Regrettably, the SCORE project did not include diabetes among the RF in the model, although it did recommend using a constant to double the estimated risk in men and quadruple the estimated risk in women for any combination of RF. As an alternative, specific equations for coronary disease and stroke risk\(^6\) have been developed for the population with type 2 diabetes, based on the cohort of the UK Prospective Diabetes Study (UKPDS). In addition to overcoming the limitations of the Framingham and SCORE risk functions, the diabetes-specific equations included RF characteristic of diabetes (years or duration of the disease) or known to be related with stroke risk (atrial fibrillation); however, they also await validation for the Spanish population.

In daily practice, primary care physicians are often overwhelmed by the profusion of risk scales and the multitude of guidelines for prevention, which change, are inconsistent, or have been developed in other regional, national, European or international settings. This panorama is, to a large extent, a reflection of the lack of a genuinely Spanish model for predicting cardiovascular risk, or prospective studies that are able to ensure the validity and applicability of other models that are being imported for use with the Spanish population. National- and regional-level projects are now underway\(^7\) and should, in the near future, provide the hoped-for results. Meanwhile, interdisciplinary initiatives based on consensus are to be welcomed. One such initiative is the recent publication and widespread dissemination of the Spanish version of the European Guidelines on Cardiovascular Disease Prevention (Comité Español Interdisciplinario para la Prevención Cardiovascular),\(^8\) under the auspices of the relevant national health authorities and 11 participating scientific societies.

We should note that CVD prevention does not begin or end with risk calculation. Risk models, while important, can only be considered aids to decision-making with regard to the choice of appropriate preventive interventions aimed at enhancing cardiovascular health in the population. Integration (eventually) of these tools into computer-based medical records, as a clear example of the potential of technology at the service of health professionals, is one possible strategy that might facilitate and improve the identification of risk and recording of RF. In addition, risk stratification and setting intervention and follow-up targets for preventive activities are further strategies for improving cardiovascular health. Framingham, after all, is too remote, and the risk profile functions developed from that study should probably be eschewed. But first we need to close the huge gap that separates the guidelines from the reality of daily practice.

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