ORIGINAL ARTICLE

The Estimated Incidence and Case Fatality Rate of Ischemic and Hemorrhagic Cerebrovascular Disease in 2002 in Catalonia

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Introduction and objectives. The aim of this study was to obtain an estimate of the incidence of cerebrovascular disease (CVD) in the Spanish population in 2002.

Methods. The study involved data on patients aged over 24 years for the year 2002 contained in both the death register and the Minimum Basic Data Set from 65 of the 84 Catalan general hospitals (i.e., 90.7% of all acute hospital beds in Catalonia). Total and age-adjusted mortality rates, cumulative incidence, and hospitalization rates, and the 28-day case fatality rate for CVD in the Catalan population were calculated after cases of traumatic and transient disease had been excluded.

Results. The unadjusted CVD mortality rate per 100,000 population aged over 24 years in Catalonia was 92 in men and 119 in women. The age-adjusted rates were 58 (95% confidence interval [CI], 56-61) and 43 (95% CI, 41-44), respectively. The cumulative incidence of CVD per 100,000 population was 218 (95% CI, 214-221) in men and 127 (95% CI, 125-128) in women. The unadjusted 28-day case fatality rate in the population was 36.2%: 30.3% in men and 42.0% in women. Some 62.5% of patients (57.2% of men and 66.4% of women) died from CVD outside hospital.

Conclusions. These findings indicate that CVD mortality and incidence rates in Catalonia are among the lowest in developed countries. More than half of the deaths that took place within 28 days after the onset of symptoms occurred outside hospital.

Key words: *Cerebrovascular diseases. Stroke. Epidemiology.*

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Estimación de la incidencia poblacional y la mortalidad de la enfermedad cerebrovascular establecida isquémica y hemorrágica en 2002

Introducción y objetivos. Se pretende obtener una aproximación a la incidencia poblacional de las enfermedades cerebrovasculares (ECV) en el año 2002.

Métodos. Se han combinado los datos del Registro de Mortalidad y el Registro del Conjunto Mínimo Básico de Datos de 65 de los 84 hospitales generales catalanes durante el año 2002 (el 90,7% de las camas de hospitalización aguda), de los pacientes de más de 24 años. Se han estimado las tasas poblacionales de mortalidad, incidencia acumulada y hospitalización, brutas y estandarizadas por edad, y la mortalidad a los 28 días por ECV, excluidas las traumáticas y la transitoria, en Cataluña.

Resultados. La tasa bruta de mortalidad por 100.000 de ECV en Cataluña en mayores de 24 años fue de 92 en varones y 119 en mujeres, y la estandarizada por edad, 58 (intervalo de confianza [IC] del 95%, 56-61) y 43 (IC del 95%, 41-44), respectivamente. Las tasas de incidencia acumulada de ECV fueron 218 (IC del 95%, 214-221) en varones y 127 (IC del 95%, 125-128) en mujeres. La letalidad poblacional cruda a 28 días fue del 36,2% (el 30,3% en varones y el 42,0% en mujeres). El 62,5% de los pacientes (el 57,2% de los varones y el 66,4% de las mujeres) murió por ECV fuera de los hospitales.

Conclusiones. Los resultados indican que la mortalidad y la incidencia de ECV en Cataluña se sitúan entre las más bajas de los países desarrollados. Más de la mitad de las muertes ocurridas en los 28 días siguientes al inicio de los síntomas se produce fuera de los hospitales.

Palabras clave: *Enfermedades cerebrovasculares. Accidente cerebrovascular. Epidemiología.*

ABBREVIATIONS

TIA: transient ischemic attack
MBDS: Minimum Basic Data Set
CVD: cerebrovascular disease
CI: confidence interval

INTRODUCTION

In 2002, cerebrovascular disease (CVD) affected over 15 million people in the world; 5.5 million died with 35 000 deaths occurring in Spain.[1] Despite specific initiatives undertaken in different parts of the country, annual CVD incidence remains the great unknown.[2-11] This contrasts with our detailed knowledge of the epidemiology of coronary heart disease.[12]

In the last 30 years, CVD mortality has fallen steadily — more noticeably than that mortality from ischemic heart diseases — to the point where respective trend rates having crossed and, in men, the former are currently lower than the letter all over Spain.[13] Local data indicate Catalonia is no exception to this rule.[14] No data are available on the evolution of estimated CVD incidence, either nationally or by autonomous region, to suggest the extent to which improvements in acute phase care and possible modifications in incidence contribute to the observed reduction in mortality. In the last decade, the Minimum Basic Data Set (MBDS) has demonstrated its reliability as a source of healthcare information derived from hospital activity.[15]

The objective of the present analysis is to estimate CVD incidence from mortality data and data from the MBDS for 2002, to permit easy access to information about the evolution of CVD.

METHODS

In Catalonia, we enrolled patients presenting established stroke (>24 hours with symptoms). We only included patients aged >24 as CVD frequency is negligible in younger people.[15-18] We made estimations for other subgroups by age (25-74 and 45-84 years) to facilitate comparisons with other studies.

To select CVD entities in principal diagnosis we used International Classification of Disease codes[9] 430, 431, 432 for patients with hemorrhagic disease; 433.#, 434.# for ischemic disease; and 436, 437, 437.1, 437.2, 437.4, 437.5, 437.6, 437.8, and 437.9 for patients incorrectly defined (hash, #, following a 3-digit code indicates we included any fourth or fifth digit in the code). We also selected patients with CVD entities as a secondary diagnosis who underwent thrombolysis, vascular surgery of any type or coronary angiography, and those with a principal diagnosis of atrial fibrillation, myocardial infarction, carotid stenosis or intermittent claudication.

In 2002, data from MBDS covering 90.7% of acute hospital beds in general hospitals in Catalonia indicate only 19 of the 84 general hospitals submitted no figures. Most of these 19 are small, privately-managed hospitals.[15]

To estimate cumulative incidence or rate of attack (incidents and recurrent cases) of CVD in the population aged >24 years in Catalonia we used population projections for 2002 from the regional government´s Mortality Registry. We had no access to indicators of either registry and consequently included the number of admissions discharged alive as recorded in the MBDS, and the number of deaths in the Mortality Registry. We considered recurrent events in the 28 days after the onset of symptoms of the first event as complications of the index case. We eliminated patients repeated because of inter-hospital transfers, but not the diagnostic data and procedures followed at the last hospital they were admitted to. This was possible thanks to an internal MBDS indicator that, unfortunately, cannot be cross-referenced with the Mortality Registry database.

We calculated mortality (number of deaths per 100 000 population and year for the disease studied) as follows:

$$\text{Mortality rate} = \frac{\text{Death from CVD in the Mortality Registry}}{\text{Population year}} \times 100\,000$$

Cumulative incidence is expressed as:

$$\text{Incidence Rete} = \frac{\text{Patients discharged from hospital in MBDS with CVD} + \text{deaths from CVD in the Registry of Deaths}}{\text{Population + year}} \times 100\,000$$

We estimated 28-day case fatality (the percentage of patients presenting the disease and dying in the acute phase, accepting by convention that this lasts 28 days), with all deaths in the Mortality Registry, as follows:

$$\text{Mortality} = \frac{\text{Death from CVD in Mortality Registry}}{\text{Patients discharged from hospital in MBDS with CVD} + \text{Deaths from CVD in the Mortality Registry}} \times 100\,000$$

We calculated outside hospital mortality as:

$$\text{Outside hospital mortality} = \frac{\text{Death from CVD in the Mortality Registry} - \text{Deaths from CVD according to MBDS}}{\text{Patients discharged from hospital in the MBDS with CVD} + \text{Deaths from CVD in the Mortality Registry}} \times 100$$

We calculated hospitalization as follows:

$$\text{Hospitalization rate} = \frac{\text{Patients discharged from hospital with CVD in the MBDS}}{\text{Population}} \times 100\,000$$

We excluded transient ischemic attack (TIA) from all calculations. Percentages are given as specified by age and adjusted for the world population using the direct method of standardization with the following weightings for men and women: 25-34 years, 14; 35-44 years, 12; 45-54 years, 11; 55-64 years, 8; 65-74 years, 5; 75-84 years, 1.5; and >84 years, 0.5. Essentially, the adjustment eliminated the effect of age group distribution in the populations studied so figures obtained thus are directly comparable.

RESULTS

Table 1 shows the distribution by age group, gender and diagnostic entities of hospital admissions diagnosed with CVD in Catalonia in 2002.

Unadjusted mortality per 100 000 population for the set of diagnoses considered as CVD, excluding TIA, in patients aged >24 years was 92 in men and 119 in women. Figure 1 shows specific and age-adjusted rates, again excluding TIA. Adjusted mortality for the world population aged >24 years was 50 (95% confidence interval [CI], 49-51); in the 25-74 age group, it was 19 (95% CI, 18-20) and in the 45-84 age group, 62 (95% CI, 61-63). Figure 1B presents the same rates by gender.

Death certificate diagnoses record causes of death as 22.8% hemorrhagic CVD; 14.1% ischemic CVD; 0.3% TIA, and 62.8% undetermined.

Cumulative incidence of age-adjusted CVD by age group was 45-84 years, 268 per 100 000 (95% CI, 265-270); 25-74 years, 106 (95% CI, 105-107); >24 years, 206 (95% CI, 204-208). Specific (unadjusted) and age-adjusted cumulative incidence appear by gender in Table 2.

The 28-day case fatality rate in patients aged >24 was 36.2%: 30.3% in men and 42.0% in women. Adjusted mortality for this age group was 18.2% (95% CI, 17.1-17.7): 15.5% (95% CI, 14.3-15.3) in men and 21.6% (95% CI, 19.7-21.0) in women. Mortality adjusted for the world population aged 25-74 years was 16.4% (95% CI, 15.4-17.5): 13.9% (95% CI, 12.7-15.0) in men and 19.9% (95% CI, 18.0-21.8) in women.

Deaths from CVD outside general hospitals was 62.5% (57.2% in men and 66.4% in women).

Unadjusted hospitalization for CVD (without TIA) was 252 per 100 000 men and 205 per 100 000 women aged >24; and 157 per 100 000 men and 79 per 100 000 women aged 25-74 years.

In the MBDS, Admissions for hemorrhagic CVD were 18.0%; ischemic CVD, 54.6%; TIA (code 435), 16.4%; and incorrectly defined, 11.0%.

TABLE 1. **Distribution of the Number of Patients Aged >24 Years Admitted With a Diagnosis of Cerebrovascular Disease by Age Group, Gender, and Diagnostic Entities. Catalonia 2002***

	25-34	35-44	45-54	55-64	65-74	75-84	>84	All
Hemorrhagic								
430, 431, 432								
Men	30	80	127	237	366	389	106	1335
Women	39	39	84	83	230	340	162	977
Both	69	119	211	320	596	729	268	2312
Ischemic								
433.#, 434.#								
Men	20	65	281	594	1171	1209	368	3708
Women	14	42	101	206	672	1419	846	3300
Both	34	107	382	800	1843	2628	1214	7008
Incorrectly defined								
436, 437, 437.1, 437.2, 437.4, 437.5, 437.6, 437.8, 437.9								
Men	5	13	28	81	187	262	118	694
Women	1	5	16	31	123	319	237	732
Both	6	18	44	112	310	581	355	1426
Total								
Men	55	158	436	912	1724	1860	592	5737
Women	54	86	201	320	1025	2078	1245	5009
Both	109	244	637	1232	2749	3938	1837	10 746

*The hash symbol # following a 3 digit code indicates that we included any fourth or fifth digit.

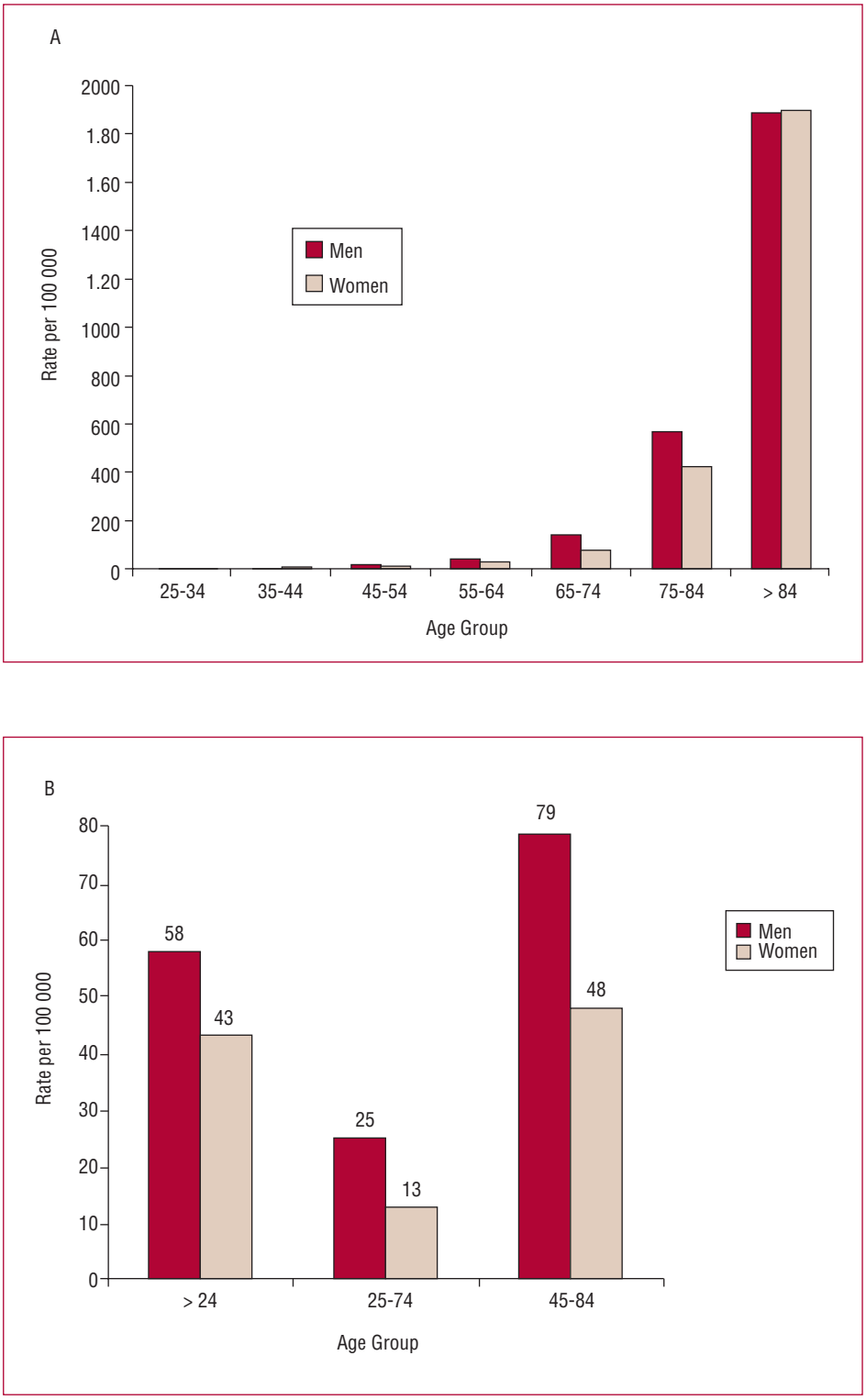

Figure 1. Specific (A) and adjusted (B) mortality rates by age-group and gender, per 100 000 inhabitants, of cerebrovascular disease in patients aged >24 years. Catalonia 2002.

DISCUSSION

Combined Mortality Registry and MBDS data indicate that in 2002 Catalonia was among the regions with the lowest incidence of CVD in the developed world. Nonetheless, 28-day case fatality was high as more than one third of patients aged >24 years, and >20% of the 25-74 year-old population died in the 28 days; and figures are always higher for women. Case fatality is <10%, so more than half of the deaths occur outside general hospitals although we cannot

TABLE 2. **Rates of Cumulative Incidence per 100 000 of Cerebrovascular Disease in Catalonia in 2002, Specific and Adjusted by Age Group and Gender***

Age	Men	Women
25-34	10	10
35-44	32	18
45-54	106	48
55-64	289	97
65-74	679	335
75-84	1564	1164
>84	3135	2965
Adjusted rates		
>24	218 (95% CI, 214-221)	127 (125-128)
25-74	148 (95% CI, 146-150)	67 (95% CI, 66-68)
45-84	362 (95% CI, 358-367)	186 (95% CI, 183-189)

*CI indicates confidence interval.

establish how many of these die prior to reaching hospital and how many die in other healthcare contexts.

Incidence of Cerebrovascular Disease in Spain

Table 3 presents a comparative summary of data available on incidence and prevalence of different forms of CVD in different parts of Spain.

Some hospital registries have a dubious reference population base[16-18] and we considered it inappropriate to calculate hospitalization or incidence rates; data should be interpreted with great care. However, related in-hospital activity does indicate the number of CVD-related admissions to Spanish hospitals.[15-19] Diagnostic precision has not been verified nor does it guarantee the exclusion of patients transferred or readmitted. The few cohort studies available have no clear population base.[6,20] Despite this, data on prevalence of different forms of CVD in Spain seem quite consistent[3,8,10,21] (Table 3).

Adjusted cumulative incidence among 45-84 year-olds in Catalonia (268 per 100 000) is only slightly above that observed in the mid-1980s in France (238 per 100 000) and far below that of countries from the former Soviet Union.[22]

An extrapolation of these incidence estimates to Spain as a whole in 2002 points to some 79 000 cases of CVD in the population, with 29 000 resulting in death.

In one hospital registry, total in-hospital mortality was 9.5%: 8.3% in men and 10.7% in women. Mortality from hemorrhagic CVD was 25.0% (22.4% in men and 28.0% in women), and from ischemic CVD, 9.9% (8.4% in men and 11.3% in women).[23-32] These data contrast with the high mortality in the population observed in the present study, perhaps partly because some patients who die in the 28 days following the onset of symptoms do so after discharge from healthcare centers other than general hospitals receiving acute cases.

Characteristics and Limitations of the Estimates Calculated

Our estimates of cumulative incidence (rate of attack) in the CVD population in Spain are previously unpublished and precision depends on: the exactitude of statements on patients admitted for CVD in the MBDS; the diagnostic accuracy of death certificates; the fact that CVD is a little known entity and; the exclusion of data on the healthcare activity of 19, albeit small, general hospitals (9.3% of beds in Catalonia). Given that MBDS data for 2002 covered 90.7% of acute beds in general hospitals in Catalonia, the figures presented may at most represent an underestimation of approximately 10%. Moreover, we could not determine whether patients with CVD included in the study were resident in Catalonia nor did we include non-fatal cases of Catalan residents occurring outside the autonomous community. This factor may have little impact on the estimate but we have no means of quantifying it.

Historic data on mortality from CVD indicate the trend in Catalonia parallels that in the rest of Spain, so rates of cumulative incidence presented here probably differ little from those in the other autonomous communities.[13,14,32,33]

However, even after excluding readmissions in the 28 days following the onset of symptoms (date of previous admission when this happens), we cannot say whether mortality outside hospitals (approximately two thirds) is before or after admission. Deaths prior to reaching hospital can mainly be explained by the clinically characteristic onset of some subarachnoid hemorrhages or of massive intracerebral hemorrhages that can lead to sudden death or a rapidly progressing neurologic focus and death.[27] Following admission, this could partly be explained by the discharge of terminal patients who subsequently die at home, in an institution for chronic patients, or in palliative care. Furthermore, the natural evolution of the stroke itself may partly explain this, given that mean hospital stay of patients with stroke is 8-10 days. Causes of death in stroke, during the first month, are neurologic in 50% of patients (due to cerebral

TABLE 3. **Review of Annual Cumulative Incidence Data (Rate of Attack) and Prevalence of Cerebrovascular Disease in Spain***

	Age	Men	Women	Both	Author and Bibliographic Reference
Quasi population-based incidence of CVD per 100 000					
Girona, 1990	All	364	169		López-Pousa et al[3]
Asturias, 1990-1991	All			132	Caicoya et al[4]
Pamplona, 1991	>70 years	2371	1493		Di Carlo et al[21]
Related in-hospital activity					
MBDS Catalonia, 2002	>24 years	6832 discharged	5992 discharged		The present authors
State-wide EMH, 2000	All	52 788 discharged	47 409 discharged		CNE[19]
Annual incidence in cohort studies per 100 000					
Manresa, work force cohort 1968-1996	30-59 years	183	–		Abadal et al[6]
DRECE, state-wide primary care, 1992-1997	5-60 years				Gutiérrez Fuentes et al[20]
	With CV risk			120	
	Without CV risk			350	
Annual population-based incidence CVD per 100 000					
Segovia, 1992-1994: only TIA/MII	All	98	63		Sempere et al[7]
MBDS-mortality Catalonia 2002	25-74 years	148	67		The present authors
Adjusted rate		(95% CI, 146-150)	(95% CI, 66-68)		
MBDS-mortality Catalonia 2002	>24 years	304	284		The present authors
Adjusted rate					
Population-based prevalence of CVD					
Arévalo, 1990	>65 years	6.1%	7.9%		Bermejo et al[8]
Madrid, 1990	>65 years	11.5%	6.4%		
Pamplona, 1991	>65 years	8.3%	5.8%		Di Carlo et al[21]
Zaragoza, 1980	>65 years	8.3%	5.7%		
Girona, 1990	>65 years	4.6%	4.9%		López-Pousa et al[9]
Alcoy, 1992	>20 years			2.1%	Matías-Guiu[10]
Population-based prevalence of TIA					
Madrid, 1990	>65 years	3.6%	1%		Bermejo et al[8]
Girona, 1990	>69 years	1.1%	0.4%		López-Pousa et al[9]
Alcoy, 1992	>20 years			1.3%	Matías-Guiu[10]

*TIA indicates transitory ischemic attack; CNE, Spain´s national epidemiology center; MBDS, Minimum Basic Data Set; CV, cardiovascular; CVD, cerebrovascular disease; EMH, survey of in-hospital mortality; MII, minor ischemic ictus.
All rates are non-adjusted unless specified.

remaining 50% of patients present at any time but favored by the patient immobility and are more frequent at >10-15 days, when the patient may already have been discharged from the reference hospital.[33]

In 2002, the estimated 29 000 deaths in the Spanish population is lower than the World Health Organization estimate of 35 000 for the same year.[1] This is probably because we excluded fatalities labeled with 6 traumatic CVD codes and non-specific diagnoses such as "cerebral arteriosclerosis."

Although the number of terminal patient transfers is unlikely to be high, we have no data to indicate the scale of this possible bias that would lead to these patients being counted twice: once, when recorded in the MBDS as discharged and, again, in the Mortality Registry. Given that CVD often presents in the form of sudden death, it is more likely that a substantial number of deaths outside hospital may really be pre-hospital. These biases could be partly neutralized if we had access to the identity of admissions and deaths.

Since the 1950s, mortality from CVD in the population in Catalonia and in Spain has fallen more rapidly than for ischemic heart disease, which has put Spain among the countries with the lowest rates in the

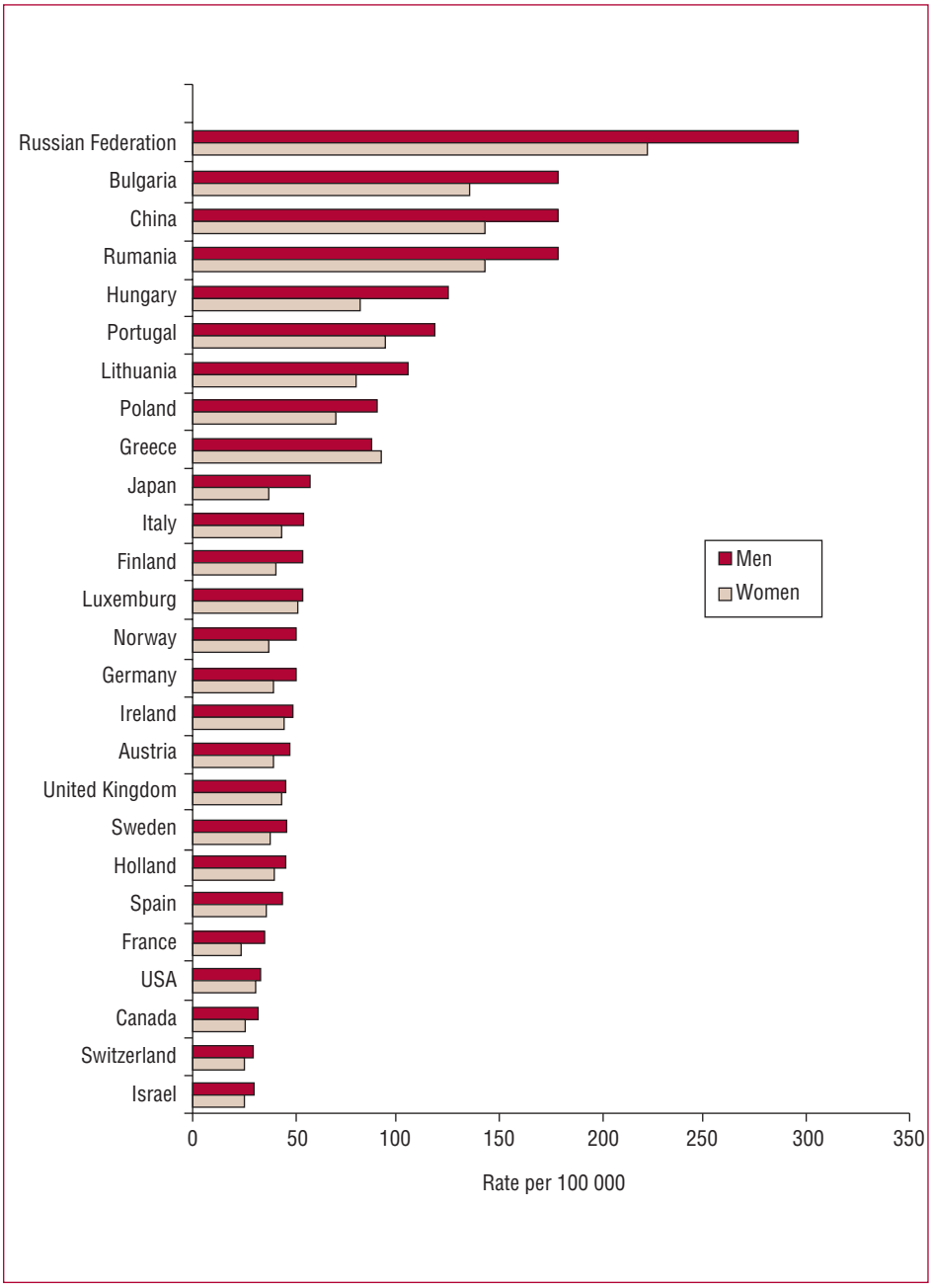

Figure 2. Comparative rates of age-adjusted mortality from cerebrovascular disease in several industrialized countries in men and women, in 2002.

industrialized world (Figure 2). Even though they refer to specific age groups, figures obtained by the present study come from the same source, ie, death certificates, as official figures published by the Mortality Registry of Catalonia and by the Spanish National Center of Epidemiology.[1,19,32]

All general hospitals would need to code and submit data from the MBDS to improve this procedure and stabilize its reliability and applicability across Spain. Studies to validate the methodology proposed would enable us to quantify the magnitude of possible biases through a population-based registry.

CONCLUSIONS

The data presented indicate that incidence of CVD is relatively low in Spain but mortality is considerable. More than half of the deaths occurring in the 28 days following the onset of symptoms happened outside hospitals.

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