Clinical research

Increasing trends of acute myocardial infarction in Spain: the MONICA-Catalonia Study

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Aims To assess coronary mortality and morbidity secular trends in Spain.

Methods and results Acute coronary events occurring in both sexes at ages 35–74 years between 1985 and 1997, were monitored in a geographical area of Catalonia, through a population-based registry. Information was collected from annual discharge lists of 78 hospitals and from death certificates, and validated following the methods and quality control of the World Health Organization MONItoring Trends and Determinants in CArdiovascular Disease Project (MONICA). Registration included 19 119 valid events (14 221 in men, 4898 in women) of which 30% were fatal and 41% were definite acute myocardial infarctions. Average attack rates were 315 per 100 000 (95% CI 300–329) and 80 (75 –86) in men and women, respectively. Incidence (first-ever event) rates were 209 (194 –224) and 56 (52 –60) per 100 000. Attack rates increased annually by 2.1% (0.3 –4.1) and 1.8% (−0.9 to +4.6). Average 28-day case fatality was 46% (44 –47) in men decreasing significantly by 1.4 and 53% (51 –55) in women with no change. Fatal trends remained stable. Nationwide morbidity statistics showed similar trends.

Conclusion Acute coronary syndromes are rising in Spanish men.

KEYWORDS
Acute myocardial infarction; Incidence; Mortality; Trends; Women; MONICA

Introduction

Spain has the second lowest coronary mortality in Europe after France.1 Crude mortality rates from coronary heart disease (CHD) were 119 per 100 000 population in men and 86 per 100 000 in women of all ages in 1998.2 This low coronary mortality contributes to the favourable life expectancy of the Spanish population, the second longest in Europe after Sweden, and one of the longest in the world. CHD mortality declined in most developed countries between 1970 and 1992, but increased in European countries of former centralized economies and Greece while it remained unchanged in Spain.3 Much is being postulated about the possible influence of the ongoing social changes in eastern Europe upon its unfavourable mortality patterns.3 However, less has been published about the impending loss of the favourable cardiovascular situation in southern European countries that experienced important socio-economic changes in the last quarter century.4

The MONICA-Catalonia Project was launched in 1984 to monitor temporal trends in CHD mortality, morbidity, acute coronary care, and risk factors as part of the World Health Organization Monitoring Trends and Determinants in Cardiovascular Disease (WHO-MONICA Project)5 covering ages 35–64 years. The MONICA-Catalonia Study was the only participating centre from Spain and it additionally included ages 65–74 years. The aim of this paper is to report secular trends of attack, incidence, and 28-day case fatality rates of acute coronary events in men and women for

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a longer range of age (35–74 years) and period of registration (1985–1997) than the WHO-MONICA collaborative analysis. We also compare the trends with those of routine nationwide statistics.

**Methods**

**Study area**

The study population was the 35- to 74-year-old residents (233,940 men, 246,047 women) of a geographical and administrative area (MONICA-Catalonia) near the city of Barcelona in Catalonia, in north-eastern Spain, the characteristics of which were previously described. The study was approved by the Board of the Department of Health and Social Security of Catalonia and followed the principles of the Helsinki Declaration and the requirements of the Spanish Data Protection Act.

**Registration procedures**

WHO-MONICA protocol and methods were applied. Acute coronary events were identified by cold pursuit, i.e. after patient hospital discharge or death. Hospital discharges coded 410–414 by the International Classification of Diseases, 9th revision, clinical modification (ICD-9 CM) were identified from annual discharge lists. Monitoring involved 78 hospitals from within and outside the study area. Death certificates coded with ICD-9 codes 401–447, 250, 272, 278, 797–799, for any of the causes of death were obtained monthly from the mortality registry of the Catalan Department of Health. Eligibility was based on age at date of onset or death, municipality of residence, and diagnosis codes.

Each event was investigated by abstracting and reviewing patients’ medical records and medicolegal necropsy reports by a central peripatetic team of three nurses and one physician. This team was trained and certified locally and internationally by the MONICA Quality Control Centre for event registration in Dundee, Scotland and the Quality Control Centre for ECG coding in Budapest, Hungary. Validation of acute myocardial infarction (AMI) or coronary death diagnosis was based on symptoms, enzymes, Minnesota coding of serial electrocardiograms and, in fatal cases, past coronary history and necropsy findings. Events were classified into five WHO-MONICA diagnostic categories: (i) definite, (ii) possible, or (iii) no AMI or coronary death, (iv) ischaemic cardiac arrest, and (v) fatal coronary events with insufficient information to qualify for any of the four above. Valid coronary events were combined into two main groups: (i) MONICA definition 1 (non-fatal definite, fatal definite, fatal possible, and fatal with insufficient data, and (ii) MONICA definition 3 (definition 1 plus non-fatal possible). We also analysed the events according to their place of treatment, i.e. in or out of hospital. Deaths in emergency rooms, on arrival at hospital, and community deaths were considered out-of-hospital deaths for which additional information was obtained by telephone from certifying physicians, coroners, and, if necessary, next of kin. Completeness of registration of coronary deaths was checked annually by linkage with the regional mortality registry.

Data were sent each year to the MONICA Data Centre at the National Public Health Institute in Helsinki for quality checking and international comparison. Events in the age range 65–74 years were also sent there and checked ad hoc by applying the same quality control programme.

Data on official hospital discharge diagnosis of AMI and CHD rates (ICD-9-CM, 410, 410–414) for the whole of Spain, were obtained from the Hospital Morbidity Survey. CHD mortality rates (underlying cause of death ICD-9, 410–414) were taken from vital statistics. Equivalent information for Catalonia was taken from the Department of Health, although in the case of routine hospital discharge data, it was available only from 1994. All these data were analysed as for the MONICA registry.

**Demographic and statistical methods**

MONICA-area population counts for rate denominators were obtained from the Catalan Institute of Statistics from the 1981, 1986, 1991, and 1996 censuses. Denominators for inter-census years were estimated by interpolation methods described elsewhere. All rates were directly age-adjusted by five-year age groups to the old European standard population. Case fatality was age-adjusted using the distribution of coronary events of the whole WHO-MONICA Project with weights of 1, 3, 7, and 12 for age groups of 35–44, 45–54, 55–64, and 65–74 years, respectively. Confidence intervals (95% CI) were calculated in the conventional manner using the normal approximation of the binomial distribution.

Annual attack rates were defined as incidence plus recurrent events plus those without information on recurrence divided by the annually estimated MONICA-area population. Incidence rates were calculated by counting first events only, defined as if no previous history of AMI was factually recorded in the medical record or based on information given by physicians and/or relatives. Differentiation of multiple events in the same subject was ensured through strict algorithms defined in the WHO-MONICA protocol. An event was considered recurrent if symptom onset was at least 28 days after the date of onset of the preceding event. An event was fatal if death occurred within 28 days of symptom onset. Fatal event rates were calculated as all fatal events divided by the estimated population for a given year. Case fatality was calculated as the number of fatal events divided by the sum of fatal and non-fatal events for each corresponding MONICA diagnostic category. Attack and incidence rates both include fatal and non-fatal events.

Average rates were calculated as the mean of the annual age-adjusted rates between 1985 and 1997. Differences in proportions were tested by and differences in means by the Student’s t-test. Trends of age-adjusted rates and case fatality were calculated separately by sex, using a linear regression model of the natural logarithm of age-adjusted annual rates on the calendar year taken as a continuous variable. The annual and relative changes in event rates are expressed as percentages and were calculated as

\[
100\left(\frac{e^{\beta t} - 1}{\beta t}\right)
\]

where \(\beta\) is the linear regression coefficient and \(t\) is the number of years (\(t = 1\) or \(t = 12\) for the period 1985–1997). A sensitivity analysis excluding years 1985 (first year), or years 1985 and 1997 (first and last years) was also carried out.

The analysis was repeated using a bootstrap simulation method, to account for the potential effects of lack of independence of observations due to the time dependence of the data or the inclusion of recurrent infarctions. CIs in this case were calculated by the percentile method as no bias of beta estimates was detected. Linearity was tested by plotting the residuals as well as by graphic inspection of the trends. A polynomial quadratic model was also fitted to assess non-linearity.

All significance tests were two-sided with the significance level set at 0.05. When no gender differences were observed,
Results

In total, 24 458 events (first and recurrent) with date of onset between 1985 and 1997 were registered and validated (Figure 1). Of these, 5339 (21.8%) did not fulfil WHO-MONICA criteria to be qualified as AMI or coronary death. The remaining 19 119 events were used for the present analysis, of which 26% occurred in women, 33% were recurrent, and 41% were classified as definite AMI. Events admitted to hospital, whether fatal or non-fatal, accounted for 79% while 20% of events were out-of-hospital deaths. Almost half (48%) of the events appeared after the age of 64 (43% in men, 64% in women). The average age at onset was 61(±9.3) years in men and 65(±7.6) in women (t = 32.57, P < 0.0001).

Attack rates

Thirteen-year average crude acute coronary attack rates including all types of events (definition 3) were 457 and 151 per 100 000 in men and in women, respectively. Table 1 gives average annual rates and percentage change for selected diagnostic categories and their combinations into MONICA definitions, as well as for official statistics. In men, attack rates of non-fatal definite AMI significantly increased by 2.1% annually. In contrast, attack rates of fatal coronary events remained stable in both sexes. Similar but non-significant changes were observed in women. In contrast, attack rates of fatal coronary events remained stable in both sexes. Non-fatal possible AMI also augmented significantly. When combined in one single group (MONICA definition 3), the annual increase in attack rates was 3.2% in men and 4.2% in women. Attack rates of hospital (fatal and non-fatal) definite AMI rose significantly by almost 2% in men while it remained undetermined in women. The rise was similar for nationwide official AMI hospital discharge rates. When all clinical manifestations, including chronic CHD, were considered, Spanish hospital discharge rates increased by more than 4% in both sexes (Table 1).

Linear analysis by bootstrap methods gave very similar results and did not alter the conclusions. Likewise, the use of a quadratic, instead of a linear, model did not change the conclusions for fatal events or for trends.
Table 1  Average age-adjusted attack rates (and 95% CI), annual linear percentage change (and 95% CI) in acute coronary events by WHO-MONICA classification in men and women aged 35–74 years in MONICA-Catalonia and in official statistics between 1985 and 1997

<table>
<thead>
<tr>
<th>Type of event</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average attack rates (%)</td>
<td>Annual change (%)</td>
</tr>
<tr>
<td>MONICA registry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MÓNICA definition 1</td>
<td>315 (300–329)</td>
<td>1.0 (−0.2 to 2.3)</td>
</tr>
<tr>
<td>Non-fatal definite AMI</td>
<td>180 (167–192)</td>
<td>2.1 (0.3 to 4.1)</td>
</tr>
<tr>
<td>All fatal coronary events</td>
<td>135 (131–139)</td>
<td>−0.4 (−1.3 to 0.6)</td>
</tr>
<tr>
<td>MONICA definition 3</td>
<td>457 (425–489)</td>
<td>3.2 (2.0 to 4.3)</td>
</tr>
<tr>
<td>Non-fatal possible AMI</td>
<td>142 (119–165)</td>
<td>8.0 (6.4 to 9.5)</td>
</tr>
<tr>
<td>MONICA hospital definite AMI</td>
<td>196 (183–209)</td>
<td>1.8 (0.1 to 3.7)</td>
</tr>
<tr>
<td>Official statistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain AMI hospital discharges³</td>
<td>205 (193–217)</td>
<td>2.1 (1.1 to 3.2)</td>
</tr>
<tr>
<td>Spain CHD hospital discharges³</td>
<td>580 (523–637)</td>
<td>4.4 (3.7 to 5.2)</td>
</tr>
<tr>
<td>Spain CHD mortality²</td>
<td>133 (129–138)</td>
<td>−1.6 (−1.9 to −1.3)</td>
</tr>
<tr>
<td>Catalonia CHD mortality²</td>
<td>118 (112–124)</td>
<td>−2.3 (−2.6 to −2.0)</td>
</tr>
<tr>
<td>MONICA area CHD mortality²</td>
<td>111 (105–117)</td>
<td>−2.4 (−3.2 to −1.6)</td>
</tr>
</tbody>
</table>

|                                            | Average attack rates (%)                       | Annual change (%)                              | Change over period (%) |
|                                            | 80 (75–86)                                     | 0.8 (−1.3 to 2.9)                              | +10                   |
|                                            | 37 (33–40)                                     | 1.8 (−0.9 to 4.6)                              | +24                   |
|                                            | 43 (40–46)                                     | 0.0 (−2.1 to 2.2)                              | 0                    |
|                                            | 133 (121–146)                                  | 4.2 (2.4 to 5.9)                               | +64                   |
|                                            | 53 (43–63)                                     | 10.1 (6.3 to 13.7)                             | +216                  |
|                                            | 43 (40–47)                                     | 1.1 (−1.2 to 3.5)                              | +14                   |

³Rates per 100 000 population.  
⁴ICD-9CM, 410–414.

in definition 3. However, the polynomial model for definition 1 trends pointed towards non-linearity, as there was a significant increase until the year 1991 when it started to decline, both in men [β(t) = +28.61 ± 4.8684, β(t²) = −0.0072 ± 0.001222], and in women [β(t) = +35.56 ± 10.725, β(t²) = −0.0089 ± 0.0027].

To check for any departures from the event classification with time, we looked at trends in major diagnostic criteria for non-fatal definite AMI and fatal events (Figure 2). Trends were rather constant over the time period; only abnormal enzymes (t = 2.41, P = 0.035) and definite electrocardiogram (t = −2.89, P = 0.015) in non-fatal definite AMI among men and necropsies in fatal events showed a slight temporal trend due to outlying values in the extreme years. As expected, the proportion of deaths with typical diagnostic criteria was lower than for non-fatal definite events (Figure 2B).

Finally, the sensitivity analysis did not change the main conclusions.

Recurrent AMI

Information on previous AMI was available in 92.7% of the events and previous history was present in 25% (men 27%, women 19%) (χ² = 103.9, P < 0.001). This type of information was unobtainable mainly in out-of-hospital deaths, especially during the first 5 years of the registry (13.2%) although it later remained stable (4%). Figure 3 shows the average annual change for first and recurrent event attack rates separately. Non-fatal recurrent AMI tended to increase more than incident AMI, but the differences were non-significant. Fatal events increased similarly in both first and recurrent events.

28-day case fatality

A third of the events were fatal. The ratio of non-fatal definite to fatal coronary incident events was 2.1 in men and 1.2 in women, and 3.4 and 2.7, respectively, if possible events were also included. Place of death was out-of-hospital in 67% of cases, 16% in coronary care units, 15% in other hospital wards, and unknown in 2%. The proportion of out-of-hospital deaths remained stable throughout the period, but was always higher in men than in women (69 vs. 61%, χ² = 35.1, P < 0.0001). Necropsy was available in 11% of deaths (11% men, 8% women, χ² = 11.3, P < 0.001). Table 2 shows data for 28-day case fatality. Average, annual, overall 28-day case fatality for definite AMI was nearly 50%. Case fatality rates of definite events in women were systematically (average 15%) higher than in men. This gender difference was mainly due to hospitalized events (36% significantly higher in women), rather than to out-of-hospital fatality for which no gender significant differences were observed. Case fatality decreased significantly in men, even when excluding the unusually high value for 1985 (β = −0.011 ± 0.004). Remarkably, the decrease was significant for out-of-hospital deaths but only of borderline significance for events admitted to hospital (Table 2). There were no significant changes in 28-day fatality for definition 1 events in women. Gender differences disappeared when non-fatal possible events were added (definition 3). For this definition,
Figure 2  Trends in the proportion of typical diagnostic criteria amongst (A) non-fatal definite AMI and (B) fatal coronary events in MONICA-Catalonia, 1985–97.
total, hospital, and out-of-hospital case fatality decreased significantly in both sexes (Table 2). Figure 4 shows the stable evolution of fatal event trends as a result of trends in attack rates and case fatality.

Comparison with official statistics

Trends of MONICA hospital definite AMI exhibited a similar pattern to nationwide AMI hospital discharge rates until 1994, when the trends for men started to decline in MONICA-Catalonia, but they continued to rise in Spain and were flat in Catalonia (Figure 5A). Comparison of trends including possible events was not feasible as routine hospital statistics included ICD-9 code 411 (other acute coronary syndromes) together with the chronic CHD codes (412–414).

Average rates of MONICA fatal events in men were 22% significantly higher than the corresponding MONICA area mortality rates, but similar to the CHD mortality rates for the whole of Spain. In women, fatal event rates were higher than the mortality statistics both for the MONICA area and for the whole of Spain (39 and 20%, respectively) (Table 1). This comparison also revealed that temporal trends of MONICA fatal rates were stable rather than the favourable decline obtained when using routine statistics for the area and the region (Figure 5B).

Discussion

Trends

This paper shows a 29% significant increase in attack rates in non-fatal definite AMI in Spanish men between 1985 and 1997. The increase did not reach statistical significance in women, probably due to lack of power. A significant rise in possible AMI was also observed in both sexes, but the category of possible AMI is more subject to different sources of variation. Given the important public health implications of this finding, before attributing this rise to a growth of the CHD epidemic in our population, it is necessary to take several issues into account.

Modifications in the Catalan hospital organization took place just before, and at the beginning of, the MONICA-Catalonia period. Although an influence of these changes cannot be completely ruled out, several facts indicate that the increase might be due to a real change in incidence. First, while the growth in non-fatal possible events could respond, like everywhere...
else, to non-explicit lowering of the threshold for acute chest pain hospital admission, it is unlikely that such clinical practice would affect the admission of cases presenting with overt AMI manifestations. The stability of the proportion of the three main AMI diagnostic components, namely symptoms, enzymes, and electrocardiogram, fulfilling typical criteria throughout the period would support this view. Another less likely possibility would be a change in patient awareness in seeking medical care for pre-cordial pain. There are no indications that the latter might have had an influence, as no related public education campaigns took place during that period and the public’s knowledge that acute chest pain is amenable to hospital admission was widespread since the advent of coronary care units in the 1960s. Secondly, a rise in recurrent events could be a consequence of an increase in the at-risk population due to longer survival after the first AMI in the last two decades. Or they could be more liable to changes in hospital admission or primary care practices. Yet the increase was also observed in incident (first-ever) events, and, more importantly, in out-of-hospital incident deaths. Thirdly, the rise in definite AMI was observed in men but not in women. The probability that secular changes in the threshold for hospital admissions would be responsible for the rise of definite AMI in men but not in women seems very remote, but not impossible. If this were the case, it would be of high social concern. On the contrary, it seems more plausible that rapid changes in aetiological determinants are affecting men in particular and, perhaps incipiently, women too given the increase in incident out-of-hospital deaths among them. Finally, Spanish countrywide hospital discharge routine statistics show remarkable increases too, both for AMI and for all CHD.

**Case fatality**

Short-term case fatality of definite AMI in men decreased modestly, in spite of notable changes of within-hospital treatments. Major evidence-based therapeutic improvements, such as thrombolysis or ACE-inhibitors, were common practice in most hospitals but they were introduced later and their use was lower than in other northern European MONICA centres. Thus, for example, the proportion of definite AMIs receiving thrombolysis changed from 13 to 39% during the period, a proportion of treatment still too small to produce a large enough impact to diminish population case fatality.

Apart from Catalonia, other MONICA centres in central and eastern Europe and Beijing showed increasing coronary rates for ages 35–64, but case fatality was also increasing in these centres. The findings for Catalonia are unique inasmuch as attack rates are increasing but case fatality is decreasing, something not surprising given the universal coverage of life-saving and other drugs by the national health system, an essential differential feature with these other centres. Attack and case-fatality rates were declining or stable in all other western European centres.

Of special concern, is the differential 28-day case fatality gender pattern of definite AMI. In women, case fatality was higher (53%) than men to the expense of hospital cases, similar for in- and out-of-hospital events and with no sign of improvement. The high case fatality in women was comparable to Spanish, and other studies. Although co-morbidity characteristics could partially account for this gap, the lack of gender differences in out-of-hospital case fatality rather suggests the existence of gender disparities in hospital care.

**Mortality**

The result of opposing forces of almost equal magnitude in the increase in attack (+3.2%) and decrease in case fatality (−3.7%) rates led to stable fatality events.

Except for a short period between 1968 and 1977, when CHD mortality rose slightly, CHD rates in Spain had remained mostly unchanged and have only started to decline recently, i.e. 17% in men and 21% in women between 1985 and 1997. CHD mortality also decreased in the MONICA area and in the region (Table 1). However, fatal coronary event rates in

### Table 2: Average, age-adjusted 28-day case fatality (and 95% CI) and annual linear percentage change (and 95% CI) of acute coronary events by WHO-MONICA definitions in men and women aged 35–74 years in MONICA-Catalonia between 1985 and 1997

<table>
<thead>
<tr>
<th>Type of event</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average case fatality (%)</td>
<td>Annual change (%)</td>
</tr>
<tr>
<td><strong>MONICA definition 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-of-hospital</td>
<td>46 (44–47)</td>
<td>-1.4 (-2.3 to -0.6)</td>
</tr>
<tr>
<td>In-hospital</td>
<td>31 (29–33)</td>
<td>-2.0 (-3.2 to -0.8)</td>
</tr>
<tr>
<td><strong>MONICA definition 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-of-hospital</td>
<td>32 (30–35)</td>
<td>-3.7 (-4.6 to -2.9)</td>
</tr>
<tr>
<td>In-hospital</td>
<td>22 (20–24)</td>
<td>-4.4 (-5.7 to -3.1)</td>
</tr>
</tbody>
</table>

**Type of event**

- Out-of-hospital
- In-hospital

**Average case fatality (%)**

- Male: 46 (44–47)
- Female: 53 (51–55)

**Annual change (%)**

- Male: -1.4 (-2.3 to -0.6)
- Female: -0.7 (-1.8 to 0.5)

**Average case fatality (%)**

- Male: 31 (29–33)
- Female: 33 (31–35)

**Annual change (%)**

- Male: -2.0 (-3.2 to -0.8)
- Female: -0.6 (-2.4 to 1.2)
MONICA-Catalonia remained stable and were higher than mortality statistics. This might also appear to be in contradiction with the significant declines of total cardiovascular mortality. While the decline in total cardiovascular mortality (−1.8% annually), is explained mainly by the steep decline in stroke (−2.3%) and other non-coronary heart mortality (−2.2%), the apparent contradiction between MONICA and CHD mortality statistics is explained by the contribution of false negative death certificates not officially coded to CHD as the underlying cause of death, but counted as MONICA fatal events after their validation. Precisely one of the original purposes of the WHO-MONICA Project was to validate vital mortality statistics by looking not only to the diagnostic validity of CHD, but also to false negative AMIs concealed under other certified causes of death. Even though the diagnosis of AMI as a cause of death is difficult to validate, it was feasible to do it in 65% of eligible deaths (Figure 1) with a reasonable stability of the main three diagnostic criteria (Figure 2B). Even with increasing availability of necropsies, if this had any impact, it would have been an increase, not a decrease in fatal events. Therefore, the trend estimates of MONICA fatal coronary events are more, not less reliable than the vital statistics.

**Attack rates**

The average attack rates of definite coronary events in MONICA-Catalonia are lower than those found in similar north American studies and in other northern European MONICA centres, i.e. Scotland or Finland-Kuopio (777 and 835 per 100,000), even taking into account that the latter two did not include the ages 65–74 years. Spanish CHD rates are therefore low, even including ages beyond 65. Our rates are in accordance with the predictions estimated in the European Multi-factorial Trial years before MONICA started. In that trial, the age-adjusted attack rate of 360 per 100,000 men aged 40–59 was predicted for the following 10 years, on the basis of the risk factor distribution of occupational cohorts of Catalan men in 1974–77 and the longitudinal coefficients of the European cohorts of the Seven Countries study. A decade later, the average annual age-adjusted attack rate for men of the same age range in our registry was 317 per 100,000 (definition 3). MONICA-Catalonia average rates and trends for hospital definite AMI also resembled routine AMI hospital discharge rates for the whole of Spain and Catalonia.

Three-year average coronary attack rates were published previously from the REGICOR study, but they...
found lower attack rates of definite AMI than ours (194 and 44 per 100 000 in men and women aged 25–74, respectively). The sole inclusion of events admitted to a hospital within that area and the different economic characteristics of those counties close to the MONICA-Catalonia area might account for the difference. On the other hand, strict comparison with that registry is intricate, as it was not subject to WHO-MONICA international quality control.

Some scepticism occurred recently about the external validity for whole countries of small-area studies like MONICA. But even in the USA, valid reliable information exists only for limited areas. Our study shows that the MONICA-Catalonia experience reflects the Spanish situation well, hence its value as a sentinel region.

In terms of assessing the burden of CHD and planning for health services, the sole use of routine hospital morbidity statistics to monitor general trends of CHD might be of some value if disease registers are unfeasible, provided that some sort of validation is carried out. This is especially relevant after the introduction of new disease definitions following new diagnostic techniques. but if routine mortality statistics alone are used, without linking or taking morbidity into account, our data show that the wrong conclusions could be drawn. Concerning prevention, we wish to emphasize that incidence events accounted for 78% of all events and that, although half of those who died from CHD had suffered a previous AMI, the contribution made by the change in incident deaths to the change in CHD mortality was 70%. This indicates that primary prevention matters most. Cardiovascular prevention strategies in Spain obviously need to include organized secondary prevention to avoid individual deaths and re-infarctions. But the adoption of strong primary prevention policies addressed to maintain a balanced diet, to the daily practice of physical activity and against smoking is of the utmost importance if the rising CHD epidemic is to be controlled. Otherwise, the costs of acute medical care will be endlessly escalating without any meaningful impact upon the population’s health.

In conclusion, acute coronary syndromes are increasing in Spanish men whilst short-term case fatality diminished only slightly. The rise in events is most probably due to a genuine increase of the AMI incidence, although changes in hospital admission practice cannot be totally excluded.
The situation in women is less clear, but also of concern. The case fatality gender differences observed should lead to prompt actions to reduce this gap.

Acknowledgements

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