ORIGINAL ARTICLE

International differences in acute coronary syndrome patients’ baseline characteristics, clinical management and outcomes in Western Europe: the EURHOBOP study

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ABSTRACT

Objective We aimed to describe current characteristics of patients admitted for acute coronary syndrome (ACS) in Western Europe and to analyse whether international in-hospital mortality variations are explained by differences in patients’ baseline characteristics and in clinical management.

Methods We studied a population-based longitudinal cohort conducted in Finland, France, Germany, Greece, Portugal and Spain, and comprising 12 231 consecutive ACS patients admitted in 53 hospitals between 2008 and 2010. Baseline characteristics, clinical management and in-hospital outcomes were recorded. Contextual effect of country on death was analysed through multilevel analysis.

Results Of all patients included, 8221 (67.2%) had NSTEMI (non-ST-elevation myocardial infarction), and 4010 (32.8%) had STEMI (ST-elevation myocardial infarction). In-hospital mortality ranged from 15.1% to 4.9% for German and Spanish STEMI patients, and from 6.8% to 1.9% for Finnish and French NSTEMI patients (p<0.001 for both). These international variations were explained by differences in patients’ baseline characteristics (older patients more likely to have cardiogenic shock in Germany) and in clinical management, with differences in rates of thrombolysis (less performed in Germany) and primary percutaneous coronary intervention (high in Germany, low in Greece). A remaining contextual effect of country was identified after extensive adjustment.

Conclusions In-hospital mortality rates of STEMI and NSTEMI patients were two to three times higher in Finland, Germany and Portugal than in Greece and Spain, with intermediate values for France. Differences in baseline characteristics and clinical management partly explain differences in outcome. Our data also suggest an impact of the healthcare system organisation.

INTRODUCTION

During the past three decades, studies have highlighted differences in acute coronary syndrome (ACS) morbidity and mortality between countries throughout the world.1 Differences were identified between industrialised and developing countries,2 but a north-to-south decreasing gradient of ACS morbidity and mortality was also identified within Western European countries.1,3 Outcome variation was mainly explained by differences in ACS severity,4 therapeutic management,5,6 and national socioeconomic characteristics.8 To reduce these variations, American and European cardiological associations have published international guidelines on ACS management strategies.9,10 Nevertheless, there is no recent international study reporting their effect on national differences in ACS morbidity and mortality.

We carried out a substudy in the EURHOBOP (European Hospital Benchmarking by Outcomes in ACS Processes) project. The objective was to determine whether the north-to-south mortality gradient was maintained in Western Europe. If international variations in mortality were found, we aimed to identify the determinants explaining these differences in risk of death. We especially examined the impact on mortality of ACS patients’ clinical profiles, management strategies and socioeconomic characteristics in the countries included.

METHODS

The analysis was performed within the EURHOBOP study. EURHOBOP is a collaborative study aimed at benchmarking ACS management in Western European hospitals through in-hospital mortality. It was conducted between 2008 and 2010 in seven countries (Finland, France, Greece, Germany, Italy, Portugal and Spain). In each country, 8–10 centres representative of the distribution of university, regional and private hospitals within the country’s healthcare system were selected. Each institution included about 200 consecutive patients with discharge diagnosis of myocardial infarction (MI) or unstable angina (UA) (defined according to the International Classification of Diseases), treated in the last 3 years. This included ACS patients transferred from a primary care centre to a participating hospital.

Data collection

Demographic, risk factor management and severity characteristics were collected (see detailed description of variable collection and definitions at
The income Gini coefficient is used to measure the inequality of income levels among a nation’s residents. A Gini coefficient of zero expresses perfect equality, whereas a value of 1 expresses maximal inequality.

**Statistical analysis**
All analyses were performed using STATA V11.2 (STATA, College Station, Texas, USA). ACS patients’ clinical profiles were summarised for each country as mean and SD for continuous variables and as a proportion for categorical variables. In the same way, the characteristics of the participating institutions, clinical practice and inhospital outcomes were evaluated in each country. One country was then removed from analysis because more than three baseline variables required for multivariate analyses were not available, and five hospitals were excluded because they reported unexplained low mortality rates under 1% for global and ST-elevation myocardial infarction (STEMI) mortality. Sensitivity analysis was performed to ensure these exclusions did not affect the reliability of our findings. Among the six remaining countries, missing data were either imputed by absence when clinically relevant (diabetes) or analysed through a ‘missing data’ class when required (hypertension, chronic renal failure, anterior ST-elevation, troponin elevation, LVEF). Analyses included these categories to avoid excluding patients, which could have biased the sample.

First, international differences in patients’ baseline characteristics, clinical management and inhospital outcomes were identified through bivariate analysis. Proportions were compared using the χ² test (or Fisher’s exact test when necessary). Mean values of quantitative variables were compared by one-way analysis of variance (ANOVA) using Bartlett’s test. When the basic assumptions of the Bartlett test were not met, a non-parametric Kruskal–Wallis test was performed.

Second, the impact of country on ACS mortality was assessed using three-level multivariate logistic regression. We performed a multilevel analysis to take into account potential common characteristics between patients (first level of the hierarchical system) treated in the same hospital (second level) and between hospitals in the same country (third level). Analysis was conducted following the method proposed by Snijders and Bosker; contextual effects of hospital-level and country-level factors on outcomes were assessed by comparing each of the two-level null models (ie, not containing any independent variables) with the three-level null model (patients at the first level and non-patient factors at higher levels) using the log-likelihood ratio test. A contextual effect was retained for a p value <0.05. Thereafter, we developed nested three-level models successively incorporating patients’ baseline characteristics, reperfusion treatments, institutions and the socioeconomic characteristics of the countries in order to test whether the country effect remained significant despite exhaustive adjustment for individual and collective (hospital) factors. For all tests, p<0.05 was considered significant.

**RESULTS**
The analyses were performed on the 12 231 ACS patients enrolled through the 53 private and public hospitals participating in the EURHOBOP study. The majority of patients (94.9%) were treated in a structure equipped with an intensive or coronary care unit, and 5416 (44.3%) were admitted to a university hospital. Most participating centres (54.7%) had a 24 h catheterisation laboratory (table 1).

ACS patients’ clinical profile in Western Europe in 2010
Thirty percent of patients were women (n=3725) and 32.8% (n=4010) of patients were admitted for STEMI. These STEMI patients were younger (age 64±14 vs 69±13 years, p<0.001) and more often current smokers (38.1% vs 22.8%, p<0.001) than NSTEMI patients. Conversely, NSTEMI patients more often had hypertension (65.5% vs 52.5%), diabetes (31.7% vs 22.7%, p<0.001) and a personal history of coronary heart disease (47.1% vs 20.4%, p<0.001) than STEMI patients. With regard to severity of illness, cardiogenic shock was more often recorded at admission in STEMI patients (6.5% vs 2.3%, p<0.001).

**Variations between countries**
As presented in table 2, differences in patients’ clinical profiles were recorded in the six countries participating in the analysis. ACS patients from Northern Europe (Finland and Germany) tended to be older and they more often had a history of coronary heart disease than patients from southern Europe. By contrast, Greek and French ACS patients were the youngest but were also more likely to be current smokers. The highest prevalence of diabetes was recorded in Spain and in Portugal. As regards clinical presentation on admission, reported rates of patients with STEMI were 37.7% in Spain, 35.3% in Greece, 34.7% in Finland, 31.6% in France, 24% in Portugal and 24.8% in Germany (p<0.001), and heart failure symptoms on admission were significantly less among patients from Portugal and Spain.

Management of ACS patients in Western Europe in 2010
High rates of revascularisation were recorded among STEMI patients (table 3). Primary percutaneous coronary intervention (PCI) was performed in 2139 (53.3%) patients, and thrombolysis was administered in 836 (20.8%) patients. All in all, only 746 (18.6%) STEMI patients did not receive any revascularisation during their hospitalisation. Most NSTEMI patients (70.3%) also underwent invasive coronary assessment, but fewer
required percutaneous or surgical revascularisation. Considerable variations between countries were observed in STEMI and NSTEMI management strategies (tables 2 and 3). Thrombolysis was rarely administered in Germany (2.6%), whereas a large proportion of STEMI patients (46.2%) were treated with thrombolysis in Greece. Moreover, thrombolysis was mainly provided before hospital admission in France (84.4%), Germany (53.8%) and Finland (52.4%), whereas, it was generally administered in hospitals in Greece (99.5%), Portugal (98.4%) and Spain (71.1%). The proportion of STEMI patients treated with primary PCI was 84.7% in Germany, 60.4% in France, 57.8% in Spain, 51.5% in Portugal, 41.3% in Finland and 18.4% in Greece (p<0.001). International variations in rates of percutaneous revascularisation were also recorded in NSTEMI patients, who were less often treated during the same hospital stay in Southern European countries: PCI was performed in 66.1% of patients in France, 57.4% of patients in Germany, 44.1% of patients in Finland, 37.3% of patients in Spain, 33.4% of patients in Portugal and 19.6% of patients in Greece (table 4).

### Socioeconomic data

In 2009, according to Eurostat publications, the gross national product per inhabitant in Purchasing Power Standards (PPS) and

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**Table 1** Characteristics of admission hospitals in which ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) patients were admitted

<table>
<thead>
<tr>
<th></th>
<th>Finland n=1813</th>
<th>France n=2424</th>
<th>Germany n=2004</th>
<th>Greece n=1185</th>
<th>Portugal n=3009</th>
<th>Spain n=1796</th>
<th>Total n=12 231</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Hospital</td>
<td>970 (53.5)</td>
<td>847 (34.9)</td>
<td>1201 (59.9)</td>
<td>200 (16.9)</td>
<td>1202 (39.9)</td>
<td>996 (55.5)</td>
<td>5416 (44.3)</td>
</tr>
<tr>
<td>Coronary care unit</td>
<td>1813 (100)</td>
<td>2003 (90.9)</td>
<td>2004 (100)</td>
<td>1185 (100)</td>
<td>3009 (100)</td>
<td>1396 (77.7)</td>
<td>11 610 (94.9)</td>
</tr>
</tbody>
</table>

On site catheterisation laboratory

<p>| | | | | | | | |</p>
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<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Working time or on call 24 h/24</td>
<td>1233 (68)</td>
<td>126 (5.2)</td>
<td>–</td>
<td>199 (16.8)</td>
<td>–</td>
<td>400 (22.3)</td>
<td>1958 (16)</td>
</tr>
</tbody>
</table>

On site cardiac surgery

<p>| | | | | | | | |</p>
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<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Working time or on call 24 h/24</td>
<td>285 (21.2)</td>
<td>–</td>
<td>–</td>
<td>200 (16.9)</td>
<td>902 (30)</td>
<td>796 (44.3)</td>
<td>585 (4.8)</td>
</tr>
</tbody>
</table>

Data are n (%).

**Table 2** STEMI and NSTEMI patient baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Finland n=1813</th>
<th>France n=2424</th>
<th>Germany n=2004</th>
<th>Greece n=1185</th>
<th>Portugal n=3009</th>
<th>Spain n=1796</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (mean)</td>
<td>70.5±12.9</td>
<td>63.8±12.9</td>
<td>68.1±12.7</td>
<td>66.5±12.8</td>
<td>67.6±13.6</td>
<td>68±13.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age &lt;50</td>
<td>132 (7.3)</td>
<td>847 (34.9)</td>
<td>1201 (59.9)</td>
<td>200 (16.9)</td>
<td>1202 (39.9)</td>
<td>996 (55.5)</td>
<td>5416 (44.3)</td>
</tr>
<tr>
<td>51&lt;age&lt;70</td>
<td>704 (38.8)</td>
<td>1162 (47.9)</td>
<td>812 (40.5)</td>
<td>548 (46.2)</td>
<td>1205 (40)</td>
<td>796 (44.3)</td>
<td>5763 (45.2)</td>
</tr>
<tr>
<td>71&lt;age&lt;80</td>
<td>507 (28)</td>
<td>252 (10.4)</td>
<td>512 (25.5)</td>
<td>351 (17.5)</td>
<td>566 (18.5)</td>
<td>796 (44.3)</td>
<td>5763 (45.2)</td>
</tr>
<tr>
<td>81&lt;age&lt;101</td>
<td>470 (25.9)</td>
<td>252 (10.4)</td>
<td>512 (25.5)</td>
<td>351 (17.5)</td>
<td>566 (18.5)</td>
<td>796 (44.3)</td>
<td>5763 (45.2)</td>
</tr>
</tbody>
</table>

Data are n (%) or mean±standard deviation.

BMI, body mass index; CABG, coronary arterial bypass graft surgery; CHD, coronary heart disease; NSTEMI, non ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction; LVEF, left ventricular ejection fraction.

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the income Gini coefficient were estimated at 116 PPS and 0.291 in Germany, 114 PPS and 0.259 in Finland, 107 PPS and 0.299 in Germany, 114 PPS and 0.331 in Spain, 80 PPS and 0.354 in Portugal, respectively. After adjustment, these variables were not related to risk of inhospital death (table 5).

Inhospital outcomes of ACS patients in Western Europe in 2010
During the hospitalisation of STEMI patients, 262 (6.5%) presented with cardiogenic shock, 57 (1.4%) had reinfarction and 339 (8.4%) died. Event rates were slightly lower among NSTEMI patients: cardiogenic shock, 57 (1.4%) had reinfarction and 362 (4.4%) died. Event rates were slightly lower among STEMI patients brought similar results regarding the link between country and mortality. Detailed results are available as web data supplement (see online supplementary tables S1 and S2). The heterogeneity hypothesis was confirmed using a two-level multivariate analysis considering country as a cofactor variable (see online supplementary table S3).

DISCUSSION
The growing number of population-based, registries and of large cardiovascular clinical trials, has highlighted temporal and international differences in ACS epidemiology and outcomes. Our study revealed that large variations persisted in the outcomes of ACS patients in Western Europe. The inhospital mortality rates of STEMI and NSTEMI patients were two to three times higher in Finland, Germany and Portugal than in Greece and Spain, with intermediate values for France. We identified international differences in the baseline characteristics and in the clinical management of ACS patients that could partly explain the difference of risk, but unlike previous series, socioeconomic characteristics did not appear to be associated with differences in ACS mortality.

Table 3 ST-elevation myocardial infarction (STEMI) patients management and inhospital outcomes

<table>
<thead>
<tr>
<th>Country</th>
<th>STEMI Patients</th>
<th>NSTEMI Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>208 (33.1)</td>
<td>116 (18.4)</td>
</tr>
<tr>
<td>France</td>
<td>351 (55.8)</td>
<td>432 (86.7)</td>
</tr>
<tr>
<td>Germany</td>
<td>260 (41.3)</td>
<td>422 (84.7)</td>
</tr>
<tr>
<td>Greece</td>
<td>538 (55.8)</td>
<td>463 (93)</td>
</tr>
<tr>
<td>Portugal</td>
<td>474 (75.4)</td>
<td>440 (88.3)</td>
</tr>
<tr>
<td>Spain</td>
<td>41 (6.5)</td>
<td>8 (1.6)</td>
</tr>
</tbody>
</table>

Table 4 Non-ST-elevation myocardial infarction (NSTEMI) patient management and inhospital outcomes

<table>
<thead>
<tr>
<th>Country</th>
<th>STEMI Patients</th>
<th>NSTEMI Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>758 (34.1)</td>
<td>1267 (84.1)</td>
</tr>
<tr>
<td>France</td>
<td>522 (64.1)</td>
<td>864 (57.4)</td>
</tr>
<tr>
<td>Germany</td>
<td>100 (6.4)</td>
<td>3.2 (3.2)</td>
</tr>
<tr>
<td>Greece</td>
<td>23 (1.9)</td>
<td>29 (1.7)</td>
</tr>
<tr>
<td>Portugal</td>
<td>23 (1.9)</td>
<td>26 (1.6)</td>
</tr>
<tr>
<td>Spain</td>
<td>81 (6.8)</td>
<td>31 (1.9)</td>
</tr>
</tbody>
</table>

Data are n (%).
CABG, coronary arterial bypass graft surgery; PCI, percutaneous coronary intervention.
inhospital mortality are still age, diabetes and MI extension. PCI revascularisation appeared as the strongest predictor of improved prognosis in our results. An apparently protective effect of obesity was also identified. Similar findings have been previously reported and related to a decreased risk of haemorrhage associated with higher Body Mass Indexes and to particular neuro-hormonal impregnation.\textsuperscript{19, 20} Smoking was also apparently associated with a better prognosis in our study, as it has been previously associated with more successful thromboly-
\textsuperscript{21}sis. However, we cannot exclude the possibility of a residual confounding effect, persisting despite adjustment, and due to age, gender or previous history of cardiac disease, which were all related to obesity and smoking.

In sensitivity analysis exploring the impact of missing data, OR for current smoking was equal to 0.69 (95% CI 0.51 to 0.92, p=0.013) when missing data were imputed by absence and 0.83 (95% CI 0.6 to 1.14, p=0.251) when they were not.

### International differences in ACS epidemiology and prognosis

International differences in the clinical profile of ACS patients can be extracted from previous national cardiovascular registries (diabetes was recorded in 32% of German patients in 2000–2002, 23.7% of French patients in 2005 and 31% of Greek patients in 2007), but to the best of our knowledge, there is no recent standardised European study comparing risk factors among ACS patients according to geographic distribution.\textsuperscript{22–24}

These differences between countries could be of interest to national cardiovascular societies. Such knowledge could help to define national priorities for cardiovascular prevention. For instance, our results highlight the need to strengthen campaigns against smoking in France, Greece and Spain, and they suggest that intensive efforts with regard to nutritional prevention programmes should be made in Spain, Portugal and Germany to reduce the prevalence of diabetes.

Our findings also point to differences between countries with regard to initial severity of illness. ACS were 30% more likely to be complicated by cardiogenic shock on admission in Germany than in Finland, Portugal or any other participating country. Similar findings have previously emerged from the MONICA registry. One of the proposed explanations was a recruitment bias due to an urban environment: patients living in towns and cities can reach hospital sooner, whereas isolated patients living in rural areas are less likely to reach hospital alive in the event of life-threatening symptoms.\textsuperscript{4} This hypothesis may explain why we recorded an excess of fatal outcomes in Germany while lower rates of inhospital deaths were recorded in Greece and Spain. Unfortunately, few recent data are available to evaluate prehospital ACS mortality and demonstration that the lower inhospital mortality recorded in Southern European countries is related to higher prehospital mortality is just based on a body of arguments: first, previous results from MONICA support the suggestion that the proportion of prehospital deaths tended to be lower in Germany than in Finland, France and Spain.\textsuperscript{25} More recently, MONICA registry reported that prehospital ACS fatalities represented 74.4% of 28-day ACS mortality in France in 2006 and 69.7% in Germany between 2009 and 2011 (personal communication from the MONICA/KORA registry).\textsuperscript{26} Second, taking into account that only 17% of Greek STEMI patients arrived at the hospital by ambulance\textsuperscript{27} and that broadly 50% of deaths related to ACS occur during the first few hours after symptom onset,\textsuperscript{26} we have to suspect higher prehospital ACS mortality in Greece than in Germany.

Confirmation of this assumption will require further international studies taking into account prehospital ACS mortality. Nevertheless, we know that the main limitation will be the quality of data collection concerning causes of death.

### International differences in ACS clinical management

This European study confirmed recent improvements in STEMI revascularisation: primary reperfusion has risen from 56% in ACS-1 study to 74.1% in the present analysis with increased use of primary PCI, which nowadays appears to be the dominant revascularisation strategy in STEMI.\textsuperscript{17, 27, 28} However, we pointed out that large variations in ACS reperfusion strategies

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Table 5  Multilevel multivariate analysis of factors associated with inhospital mortality in 58 hospitals treating acute coronary syndrome patients in six European countries

<table>
<thead>
<tr>
<th>Multilevel model</th>
<th>Multivariable adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed-effect parameters</td>
<td>OR</td>
</tr>
<tr>
<td><strong>Baseline characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Age vs &lt;50 years</td>
<td>1.13</td>
</tr>
<tr>
<td>51–70</td>
<td>2.58</td>
</tr>
<tr>
<td>71–80</td>
<td>4.18</td>
</tr>
<tr>
<td>81–101</td>
<td>1.07</td>
</tr>
<tr>
<td>Gender F vs M</td>
<td>1.32</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.21</td>
</tr>
<tr>
<td>Not available</td>
<td>2.35</td>
</tr>
<tr>
<td>Obesity (BMI &gt;30 kg/m²)</td>
<td>0.74</td>
</tr>
<tr>
<td>Current smoking</td>
<td>0.69</td>
</tr>
<tr>
<td>History of CABG</td>
<td>0.78</td>
</tr>
<tr>
<td>History of CHD</td>
<td>0.91</td>
</tr>
<tr>
<td>Clinical presentation</td>
<td>2.75</td>
</tr>
<tr>
<td>STEMI vs NSTEMI</td>
<td>35% &lt;LVEF ≤50%</td>
</tr>
<tr>
<td>LVEF ≤50%</td>
<td>7.28</td>
</tr>
<tr>
<td>LVEF &gt;50%</td>
<td>6.57</td>
</tr>
<tr>
<td>Management strategy</td>
<td>0.35</td>
</tr>
<tr>
<td>PCI performed</td>
<td>1.28</td>
</tr>
<tr>
<td>University hospital</td>
<td>1.04</td>
</tr>
<tr>
<td>Coronary care unit</td>
<td>0.99</td>
</tr>
<tr>
<td>Socioeconomic characteristics</td>
<td>0.99</td>
</tr>
<tr>
<td>Gini coefficient (for a 0.001 increase)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

**Random effect parameters**

<table>
<thead>
<tr>
<th>Variance</th>
<th>95% CI</th>
<th>p Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>0.17</td>
<td>0.08 to 0.35</td>
</tr>
<tr>
<td>Country</td>
<td>0.29</td>
<td>0.08 to 1.08</td>
</tr>
</tbody>
</table>

*Computed from log likelihood ratio test.
†Results can also be presented as an OR for death risk, comparing a hospital (or a country) at the 75th percentile of the hospital/country distribution to a hospital (or a country) at the 25th percentile of the hospital/country distribution:
OR hospital (75th vs 25th percentile)=1.74 (95% CI 1.46 to 2.22); OR country (75th vs 25th percentile)=2.07 (95% CI 1.46 to 4.06);
BMI, body mass index; CABG, coronary arterial bypass graft surgery; CHD, coronary heart disease; GNP, gross national product; NSTEMI, non-ST-elevation myocardial infarction; PCI, percutaneous coronary intervention; PPS, purchase power standardized; STEMI, ST-elevation myocardial infarction.
The strengths of the present study include a large number of ACS registered in a real-life setting according to a standardised protocol, which enables comparison between the six countries. The centres included are experienced in participating in such studies, and all investigators underwent collective training, guaranteeing the quality of the data. Moreover, for each country, preliminary analyses were performed to check that included data were consistent with published knowledge. The limitations of this study relate to our deliberate exclusion of Italian data for which many adjustment variables were missing and to the exclusion from the EURHOBOP protocol of all patients who died before admission to hospital. This restricts our conclusions to hospitalised ACS patients: our hypothesis that observed

**Key messages**

**What is already known about this subject?**
Previous population-based registries and large cardiovascular clinical trials highlighted temporal and international differences in acute coronary syndrome (ACS) epidemiology and outcomes. International guidelines have been published to harmonise clinical practice and reduce these variations.

**What this study adds?**
Despite recent improvements, there are still differences between countries in ACS patients’ presentations and in their clinical management. These lead to significant variations in ACS inhospital mortality, which was paradoxically higher in Northern European countries.

**How might this impact on clinical practice?**
These results highlight the heterogeneity in ACS management that persists between countries. Moreover, our findings reinforce the need to take prehospital mortality into account in further studies on healthcare system efficiency.
differences in inhospital mortality are related to differences in prehospital mortality is just based on the analysis of previously published studies confirming this.

CONCLUSION
There are still variations in ACS patients' baseline characteristics and in their clinical management in Western Europe. These differences partly explain the international variations in ACS outcomes. Our findings also suggest that inhospital ACS mortality is highly impacted by differences in prehospital patient management that are directly related to healthcare system organisation.

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Contributors
JM and JF supervised the acquisition of the data. RA, VB, JM, and JF wrote the paper. The other co-authors acquired the data and have critically checked the paper.

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Competing interests
None.

Ethics approval
Each centre has obtained an ethics committee agreement in each country.

Provenance and peer review
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REFERENCES
International differences in acute coronary syndrome patients' baseline characteristics, clinical management and outcomes in Western Europe: the EURHOBOP study

Romain André, Vanina Bongard, Roberto Elosua, Inge Kirchberger, Dimitrios Farmakis, Unto Häkkinen, Danilo Fusco, Marina Torre, Pascal Garel, Carla Araújo, Christa Meisinger, John Lekakis, Antti Malmivaara, Maria Dovali, Marta Pereira, Jaume Marrugat and Jean Ferrières

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