 Associations of area based deprivation status and individual educational attainment with incidence, treatment, and prognosis of first coronary event in Rome, Italy

Sally Picciotto, Francesco Forastiere, Massimo Stafoggia, Daniela D’Ippoliti, Carla Ancona, Carlo A Perucci

Background: Socioeconomic gradients in the occurrence of myocardial infarction are well known, but few studies have examined socioeconomic disparities in post-infarction outcomes. The objective of this study was to explore relations of socioeconomic status with the incidence, treatment, and outcome of first coronary event in Rome, Italy, during the period 1998–2000, examining effect modification by gender.

Methods: Subjects were Rome residents aged 35–84 years who died from first acute coronary event before reaching the hospital (n = 3470) or were hospitalised for first acute myocardial infarction (n = 8467). Area based deprivation status and patients’ educational attainment were the exposure variables. The outcomes were: incidence of coronary event; recanalisation at the index hospitalisation and fatality within 28 days of hospitalisation; cardiac readmissions and fatality between 28 days and one year of index hospitalisation.

Results: Incidence rates increased as area based deprivation status increased; the effect was stronger among women than among men (men RR = 1.40, 95%CI:1.30, 1.50, women RR = 1.78, 95%CI:1.60, 1.98, most compared with least deprived). Rates of recanalisation were significantly lower in the most deprived patients than in the least deprived (OR = 0.77, 95%CI:0.59, 0.99) and in the less educated than in the highly educated (OR = 0.73, 95%CI:0.58, 0.90). Associations of short term fatality with area based deprivation status and educational attainment were weak and inconsistent. However, neither deprivation status nor education was associated with one year outcomes.

Conclusions: Area based deprivation status is strongly related to incidence of coronary events, and more so among women than among men. Deprivation status and educational attainment are weakly and inconsistently associated with short term fatality but seem not to influence one year prognosis of acute myocardial infarction. Deprived and less educated patients experience limited access to recanalisation procedures.
are present (or calculable from data present) in all government records including the aforementioned registries.

Residents of Rome aged 35–84 who died from acute coronary events before reaching a hospital (out of hospital deaths) were selected as follows: deaths during 1998–2000 with causes ICD-9 = 410–414 were found in the regional cause of death registry and linked with the regional hospital discharge registry. We excluded subjects who died out of hospital within 28 days after hospitalisation for either acute myocardial infarction (AMI) (ICD-9: 410), to avoid duplicating hospitalised subjects, or ischaemic diseases (ICD-9: 411–414), to exclude people who probably did not suffer an AMI. All deaths occurring in a hospital or immediately preceded by a hospitalisation from causes other than ischaemic heart disease were excluded, as AMI was considered a complication.

Hospitalised AMI cases, retrieved from the regional hospital discharge registry, were all residents of Rome aged 35–84 years who were admitted to hospitals during the years 1998–2000 with principal diagnosis of AMI (ICD-9 = 410). Patients were excluded if they were discharged alive after fewer than three days, an indication that AMI was ruled out.

Our goal was to study “first” coronary events. We therefore excluded all hospitalisations that included a secondary diagnosis of previous infarction (ICD-9 = 412) and all subjects with a prior hospitalisation for AMI or previous infarction in the calendar year of the index event or in the three preceding years.

Follow up data on vital status and cardiac readmissions to the end of 2001 for hospitalised patients were obtained by linking the respective aforementioned registries.

For each person, comorbidities in the three years before the event were identified via record linkage. Hospitalisations with any of the following principal or secondary diagnoses were flagged: diabetes (ICD-9 = 250), hypertension (ICD-9 = 401–405), chronic obstructive pulmonary disease (COPD) (ICD-9 = 490–496), peripheral vascular disease (ICD-9 = 440.2), angina/other chronic ischaemic heart disease (ICD-9 = 413–414), conduction disorders (ICD-9 = 426), arrhythmia (ICD-9 = 427), or heart failure (ICD-9 = 428). At the index event for hospitalised patients, presence of these illnesses as secondary diagnoses was noted, as was recourse to recanalisation procedures (ICD-9 procedure = 36.0), hereafter abbreviated PTCA (percutaneous transluminal coronary angioplasty, ICD-9 procedure = 36.01, 36.02, 36.05, representing 95% of recanalisations performed on the cohort). Bypass surgery rates were too low to be examined.

Rome has a total population of 2 576 866 residents living in 5550 census blocks. The population aged 35–84 years, used as the denominator in this study, is 1 602 468. Each subject’s area based deprivation status was derived from an index based on multiple characteristics of the census block of residence from 1991 census data: distribution of educational level, occupational categories, working age male unemployment rate, family size, crowding, and proportion of dwellings rented/owned. The city distribution of this index was divided into four categories by the 20th, 50th, and 80th centiles; these categories (1 = least deprived, 4 = most deprived) comprised the deprivation status variable used in this study. Area based deprivation status is available for 97.3% of Rome’s total population.

For hospitalised cases only, discharge records included patients’ individual levels of education, which were aggregated into three categories: fewer than eight years of education (no middle school diploma), 8–12 years (middle school diploma), and at least 13 years (high school diploma or more).

The administrative nature of the data rendered ethics committee approval unnecessary.

**Data analysis**

Incidence rates (out of hospital deaths, hospitalisations, total events) in the Rome population aged 35–84 years were calculated by area based deprivation status, stratified by gender, standardised for age (direct method, five-year age classes, world standard population), and reported as annual rates per 100 000 persons. Age adjusted relative risks (RR) and 95% confidence intervals (CI) were estimated using Poisson models.

Within the hospitalised cohort, separate associations of area based deprivation status and educational attainment level with several outcomes were examined. Patients whose deprivation status or educational attainment was missing were excluded from the respective analysis. Crude rates were calculated before modelling. Short term outcomes studied were receipt of PTCA at index hospitalisation and fatality.

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**Figure 1** First coronary events and their outcomes in the population of Rome, age 35–84 years, 1998–2000.
within 28 days of hospital admission. Logistic regression analyses yielded adjusted odds ratios (OR) for deprivation status and educational attainment, respectively, using the most privileged category as the reference. Those surviving at least 28 days were followed up until 365 days after the index event; outcomes studied were fatality, hospital readmission for new AMI, and hospital readmission for other cardiac causes: angina/other acute ischaemic heart disease (ICD-9 = 411, 413), arrhythmia (ICD-9 = 427), or congestive heart failure (ICD-9 = 428). For these outcomes, Cox multivariate models yielded hazard ratios (HR) by deprivation status and educational attainment.

For all analyses, several baseline characteristics were considered a priori as potential confounders. We constructed sex specific models as follows. A linear term for age was always considered. Sensitivity analyses showed that a squared age term was not significant in most models; where it was, the results did not substantially change. Next, comorbidities diagnosed at the index event or in the previous three years were considered in the model for angioplasty use.

Table 1  Descriptive characteristics of residents of Rome (aged 35–84 years) who had a first coronary event during the period 1998–2000

<table>
<thead>
<tr>
<th></th>
<th>Total incidence</th>
<th>Out of hospital deaths</th>
<th>Hospitalised cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td><strong>Gender:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>8367</td>
<td>68.5</td>
<td>2381</td>
</tr>
<tr>
<td>Women</td>
<td>3840</td>
<td>31.5</td>
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</tr>
<tr>
<td><strong>Age (years):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>397</td>
<td>3.3</td>
<td>48</td>
</tr>
<tr>
<td>45–54</td>
<td>1391</td>
<td>11.4</td>
<td>227</td>
</tr>
<tr>
<td>55–64</td>
<td>2713</td>
<td>22.2</td>
<td>554</td>
</tr>
<tr>
<td>65–74</td>
<td>3767</td>
<td>30.9</td>
<td>1145</td>
</tr>
<tr>
<td>75–84</td>
<td>3939</td>
<td>32.3</td>
<td>1766</td>
</tr>
<tr>
<td><strong>Area based deprivation status:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (privileged)</td>
<td>1928</td>
<td>15.8</td>
<td>686</td>
</tr>
<tr>
<td>2</td>
<td>3617</td>
<td>29.6</td>
<td>1169</td>
</tr>
<tr>
<td>3</td>
<td>3560</td>
<td>29.2</td>
<td>1075</td>
</tr>
<tr>
<td>4 (deprived)</td>
<td>2579</td>
<td>21.1</td>
<td>754</td>
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<tr>
<td>Missing</td>
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<td>4.3</td>
<td>56</td>
</tr>
<tr>
<td><strong>Educational attainment:</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>13+ years (high school diploma)</td>
<td>1793</td>
<td>21.2</td>
<td></td>
</tr>
<tr>
<td>8–12 years</td>
<td>2377</td>
<td>30.4</td>
<td>2864</td>
</tr>
<tr>
<td>&lt;8 years</td>
<td></td>
<td></td>
<td>1233</td>
</tr>
<tr>
<td><strong>Comorbidities (diagnoses in the three years before the event):</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>863</td>
<td>7.1</td>
<td>268</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1403</td>
<td>11.5</td>
<td>502</td>
</tr>
<tr>
<td>COPD</td>
<td>562</td>
<td>4.6</td>
<td>260</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>189</td>
<td>1.5</td>
<td>63</td>
</tr>
<tr>
<td>Angina</td>
<td>226</td>
<td>1.9</td>
<td>73</td>
</tr>
<tr>
<td>Other ischaemic heart disease</td>
<td>839</td>
<td>6.9</td>
<td>393</td>
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<tr>
<td>Conduction disorders</td>
<td>171</td>
<td>1.4</td>
<td>101</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>479</td>
<td>3.9</td>
<td>246</td>
</tr>
<tr>
<td>Heart failure</td>
<td>406</td>
<td>3.3</td>
<td>236</td>
</tr>
</tbody>
</table>

Total incidence includes out of hospital deaths and hospitalised cases.

Table 2  Area based deprivation status and incidence of first coronary events in Rome, 1998–2000: age standardised annual rates (per 100000 residents), age adjusted relative risks and confidence intervals (95% CI)

<table>
<thead>
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<th>Area based deprivation status*</th>
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<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of cases</td>
<td>Adjusted rate†</td>
</tr>
<tr>
<td>Out of hospital deaths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (privileged)</td>
<td>428</td>
<td>69.1</td>
</tr>
<tr>
<td>2</td>
<td>719</td>
<td>71.2</td>
</tr>
<tr>
<td>3</td>
<td>692</td>
<td>81.2</td>
</tr>
<tr>
<td>4 (deprived)</td>
<td>505</td>
<td>97.8</td>
</tr>
<tr>
<td>Hospitalisations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (privileged)</td>
<td>888</td>
<td>181.3</td>
</tr>
<tr>
<td>2</td>
<td>1728</td>
<td>203.7</td>
</tr>
<tr>
<td>3</td>
<td>1793</td>
<td>234.3</td>
</tr>
<tr>
<td>4 (deprived)</td>
<td>1257</td>
<td>261.8</td>
</tr>
<tr>
<td>Total coronary events</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (privileged)</td>
<td>1316</td>
<td>250.4</td>
</tr>
<tr>
<td>2</td>
<td>2447</td>
<td>274.9</td>
</tr>
<tr>
<td>3</td>
<td>2485</td>
<td>315.5</td>
</tr>
<tr>
<td>4 (deprived)</td>
<td>1762</td>
<td>359.6</td>
</tr>
</tbody>
</table>

*Deprivation status was missing for 37 male and 19 female out of hospital deaths, and 320 male and 147 female hospitalised cases, not included in this table.
†Age standardised rates, using the direct method with five-year age classes, and the world standard population. Relative risks are age adjusted, using the Poisson model with five-year age classes and the population of Rome aged 35–84 years. Low rates of out of hospital deaths among younger women necessitated the use of 10-year age classes instead.
However, when examining short term mortality, only comorbidities diagnosed in prior hospitalisations were included. This approach served to avoid coding bias, namely the apparent “protective effect” of certain less severe diagnoses (for example, hypertension) because of the tendency to omit these diagnoses for severely ill patients. For longer term outcomes (fatality, hospital readmissions for AMI or for other cardiac causes within one year) all comorbidities diagnosed either at the index event or previously were considered, as was PTCA at the index hospitalisation. All models were reduced to exclude comorbidities not associated with the outcome (p > 0.20). In subsequent overall analyses of both sexes, interaction terms between sexes and comorbidities were included when relevant.

### RESULTS

In all, 12,207 coronary events (3740 out of hospital deaths and 8467 hospitalisations) were found in the Rome population between 35 and 84 years old over the three year period. Figure 1 summarises the short term and one year outcomes. Ischaemic heart disease (ICD-9: 410–414) accounted for slightly more than half of the deaths of the 589 (8.0%) 28 day survivors who died within a year of their first coronary event.

Table 1 shows the distribution of total cases, out of hospital deaths, and hospitalised cases according to gender, age, area based deprivation status, and comorbidities diagnosed in the three preceding years, and, for the hospitalised patients, educational attainment. People who died out of hospital were more likely to be older and female than those hospitalised for AMI. Area based deprivation status was available for 94.5% of hospitalised patients.

Table 2 displays crude absolute risks, adjusted odds ratios for the outcomes in the hospitalised group, and adjusted hazard ratios for one year follow up outcomes in the 28 day survivors. In total, 789 hospitalised patients (9.3%) received PTCA at their index hospitalisation. As area based deprivation increased, the likelihood of receiving PTCA decreased (p for trend 0.02). The trend was clearer for men than for women, but significantly lower PTCA rates were seen for women than for men (OR = 0.53, 95% CI: 0.40, 0.72).

Overall, area based deprivation status was not significantly associated with other outcomes, although a tendency of higher short term mortality for more deprived groups was suggested for women (p for trend 0.05). No effect modification by sex was found for the one year outcomes.

Agreement between area based deprivation status and individual educational attainment was high. The proportions of patients with at least a high school diploma were 32.3% and 16.2% in the most and least affluent census blocks, respectively, while 25.4% and 38.1%, respectively, had not completed middle school (p for trend < 0.01).

Table 3 gives results of analyses using individual educational attainment as the exposure variable. The least educated patients were least likely to receive PTCA (p for trend, 0.004), especially among men. Crude fatality rates (both short term and first year) seem to show disparities, but strong confounding by age was present. Indeed, educational attainment was strongly correlated with age (p for trend < 0.01): 15% of patients aged 75–84 years had at least a high school diploma, compared with 53% of those aged 35–44. Hence, the age adjusted odds ratios for short term mortality were smaller than expected and not statistically significant in the gender stratified analyses. Overall, however, a small effect of educational attainment on short term, but not first year, mortality remained (OR = 1.24, p for trend 0.04). No other educational

| Table 3 | Frequency distribution (%) of comorbidities diagnosed in the preceding three years, and secondary diagnoses at the index AMI hospitalisation, by area based deprivation status among hospitalised patients aged 35–84 years in Rome, 1998–2000 |
|-----------------|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Comorbidities diagnosed in preceding three years** | **Area based deprivation status** | 1 | 2 | 3 | 4 | missing | Overall | p Value for trend |
| Diabetes | 5.9 | 6.5 | 7.4 | 8.3 | 5.6 | 7.0 | <0.01 |
| Hypertension | 9.4 | 10.6 | 10.3 | 12.7 | 8.1 | 10.6 | 0.01 |
| COPD | 2.5 | 2.7 | 4.1 | 4.8 | 3.4 | 3.6 | <0.01 |
| Peripheral vascular disease | 1.3 | 1.2 | 1.6 | 1.9 | 1.3 | 1.5 | 0.06 |
| Angina or other ischaemic heart disease | 6.4 | 5.7 | 6.1 | 6.7 | 4.5 | 6.1 | 0.52 |
| Conduction disorders | 1.0 | 0.6 | 0.9 | 1.0 | 0.4 | 0.8 | 0.51 |
| Arrhythmia | 3.1 | 2.2 | 2.7 | 3.4 | 2.1 | 2.8 | 0.18 |
| Heart failure | 1.7 | 1.5 | 2.3 | 2.5 | 2.1 | 2.0 | 0.02 |
| **Secondary diagnoses at time of index event** | | | | | | | | |
| Diabetes | 13.2 | 15.8 | 16.2 | 16.9 | 17.1 | 15.8 | 0.01 |
| Hypertension | 29.6 | 30.7 | 28.5 | 29.2 | 25.3 | 29.3 | 0.39 |
| COPD | 4.5 | 4.5 | 5.2 | 7.0 | 6.2 | 5.3 | <0.01 |
| Peripheral vascular disease | 1.0 | 2.0 | 1.2 | 1.5 | 1.5 | 1.5 | 0.99 |
| Angina or other ischaemic heart disease | 12.1 | 10.2 | 11.1 | 11.5 | 10.1 | 11.0 | 0.88 |
| Conduction disorders | 7.2 | 5.9 | 6.7 | 6.8 | 5.8 | 6.5 | 0.82 |
| Arrhythmia | 20.1 | 22.1 | 23.7 | 25.2 | 24.8 | 23.1 | <0.01 |
| Heart failure | 13.5 | 14.4 | 12.6 | 13.2 | 17.8 | 13.7 | 0.31 |

N = 8467. “Deprivation status 1 is the most privileged and deprivation status 4 the most deprived category.”
disparities reached statistical significance, and gender did not modify the effect except in the case of PTCA.

DISCUSSION

Three MONICA studies found rates of out of hospital deaths among lower SES strata16: one included only men; one found equal effects of SES among women and men; and one found weaker effects of SES among women,1 but all examined a restricted age range where women rarely suffer coronary events. A Scottish study found that the social deprivation gradient was less steep among women than among men.3 In Rome, the relative risk (most compared with least deprived areas) of out of hospital death was about equal for men and for women.

However, the socioeconomic gradient in the hospitalisation rate for AMI in the Rome population was much steeper for women than for men. Previous results on this outcome are sparse, but total incidence has been studied. In Finland, those of lower income or education level had higher total incidence rates among both sexes, with effect modification by gender depending on which measure was used.1 In Scotland, as in Rome, overall incidence had a strong socioeconomic gradient that was steeper for women than for men.3 In the USA, the steeper educational gradient for women than for men in total incidence of coronary heart disease was mainly attributable to body mass index.31 However, in all cases, SES accounted for more coronary events among men than among women because women’s absolute risk was much lower.

Our negative findings for one year outcomes are consistent with a London study, where only short term mortality rates were higher among more deprived patients.18 This latter disparity was inconsistently evidenced in Rome: only among women when using area based deprivation status and only overall when using educational attainment to measure SES. The London study did not present gender stratified results, and in Glasgow, where short term mortality was not associated with SES, no difference was found between the sexes.1 However, in Finland both short and long term mortality were associated with low SES, with greater effects seen among men than among women.1

In Rome the only post-hospitalisation outcome showing a clear socioeconomic gradient was PTCA. Access to PTCA depends on illness severity and comorbidities.22 Diabetes, COPD, and arrhythmia were more prevalent in the most disadvantaged Roman patients, consistent with many studies showing more severe clinical findings in patients of lower SES.23, 24, 25 However, this did not explain differential access to PTCA: recanalisation procedures were less likely to be performed on those living in deprived areas, on those with lower educational attainment, and on women, even after adjusting for comorbidities. As PTCA was only just becoming widespread during the years studied, social disparities in receiving this surgery might no longer exist. However, our results are consistent with findings from the USA,23 Canada,26 and Scotland.27 In Canada, geographical proximity to a hospital offering the service did not fully account for differential access to angiography by SES.25 As in Rome, North American women were significantly less likely than men to undergo recanalisation26; in Scotland gender differences depended on the procedure.24 In the former Yorkshire Region (UK), socioeconomic inequities in access to revascularisation procedures varied geographically.27 In Finland, such sex and socioeconomic inequities in access decreased from 1988 to 1996, but were not eliminated completely.24 Finally, in Rome, living in a deprived area (same

### Table 4 Association between neighbourhood based SES and outcome of first AMI hospitalisation in Rome, 1998–2000

<table>
<thead>
<tr>
<th>Area based deprivation status</th>
<th>Men</th>
<th>Women</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk (%)</td>
<td>Adjusted OR/HR</td>
<td>95% CI</td>
</tr>
<tr>
<td>PTCAT†‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (privileged)</td>
<td>11.0</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10.9</td>
<td>0.97</td>
<td>0.75 1.27</td>
</tr>
<tr>
<td>3</td>
<td>11.1</td>
<td>0.94</td>
<td>0.73 1.22</td>
</tr>
<tr>
<td>4 (deprived)</td>
<td>9.0</td>
<td>0.75</td>
<td>0.56 1.01</td>
</tr>
<tr>
<td>p value trend</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short term fatality†‡</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1 (privileged)</td>
<td>13.7</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>11.3</td>
<td>0.86</td>
<td>0.67 1.10</td>
</tr>
<tr>
<td>3</td>
<td>10.5</td>
<td>0.86</td>
<td>0.67 1.11</td>
</tr>
<tr>
<td>4 (deprived)</td>
<td>10.8</td>
<td>0.91</td>
<td>0.69 1.19</td>
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<tr>
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<td></td>
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<td>6.9</td>
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<tr>
<td>Rehospitalisation for AMI (1 year)†‡</td>
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<td>1.00</td>
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</tr>
<tr>
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<td>0.83 2.13</td>
</tr>
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<td>0.63 1.78</td>
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<td>p value trend</td>
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<tr>
<td>Rehospitalisation for other cardiac cause (1 year)†‡</td>
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<td>1.00</td>
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<td>17.1</td>
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<td>0.84 1.29</td>
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<td>0.93</td>
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</tbody>
</table>

N = 8000. The reference category is deprivation status 1. Risks are crude absolute risks. Odds ratios and hazard ratios are adjusted for gender, age (as a continuous variable), and selected comorbidities (diabetes, hypertension, COPD, peripheral vascular disease, arrhythmia, conduction disorders, heart failure, anemia/other ischemic heart disease). Adjusted for comorbidities diagnosed at the index event or in the preceding three years. Adjusted for comorbidities diagnosed in the preceding three years. Adjusted for PTCA. Crude absolute risks, adjusted odds ratios (OR)/hazard ratios (HR) and 95% confidence intervals (95% CI).
indicator used as in this study) was associated with reduced access to coronary care units.14 Hence, many locations show evidence of treatment disparities, although publication bias may exaggerate such inequality and the causes may not be the same for different treatments and locations.

Some limitations of the study should be mentioned. Deprivation status was area based and may not accurately represent the person’s true SES. However, several studies found that neighbourhood socioeconomic environment had significant effects on coronary heart disease hospitalisations and mortality, even after adjustment for individual level SES measures.29–31 Although the urban structure of Rome is different from that of northern European cities, where segregation by SES is more pronounced, the census blocks used in defining deprivation status were small enough (average population 466) to capture disparities: this indicator is associated to many health outcomes previously studied.14 17 32 33

We selected the subjects under study based on linkage between various registries and following examples from other countries.14 34 Our definition of out of hospital death for coronary event is consistent with a restricted version of the definition of “possible fatal coronary heart disease” in a 2003 Scientific Statement of the American Heart Association.35 Hospitalisation for AMI was defined as having primary diagnosis ICD-9 = 410, whose accuracy in hospital discharge records in Rome has been previously validated.37 38 As only the first event was considered, our results may not hold for repeated events. When an AMI patient suffers serious complications, these may be reported as the principal diagnosis while AMI is reported as a secondary diagnosis; such patients are more likely to experience adverse short and long term outcomes. Because we excluded these subjects, if they lived in more deprived areas then a bias towards the null could have occurred.

A selection bias based on severity could be responsible for the weak and negative post-hospitalisation findings. If emergency health services were provided disproportionately to wealthier neighbourhoods, then those from deprived areas who reached the hospital would be the ones with less severe AMI. They would therefore have a better prognosis than those from wealthy areas, who would arrive at the hospital sooner. Consequently, differences in treatment or prognosis, favouring higher SES strata, would

### Table 5

**Association between level of education attained and outcome of first AMI hospitalisation in Rome, 1998–2000**

<table>
<thead>
<tr>
<th>Educational attainment</th>
<th>Risk (%)</th>
<th>Adjusted OR/HR</th>
<th>95% CI</th>
<th>Risk (%)</th>
<th>Adjusted OR/HR</th>
<th>95% CI</th>
<th>Risk (%)</th>
<th>Adjusted OR/HR</th>
<th>95% CI</th>
</tr>
</thead>
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<tr>
<td><strong>PTCA</strong></td>
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</tr>
<tr>
<td>≥13 years</td>
<td>14.0</td>
<td>1.00</td>
<td></td>
<td>8.0</td>
<td>1.00</td>
<td></td>
<td>12.9</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>8–12 years</td>
<td>11.3</td>
<td>0.86</td>
<td>0.70</td>
<td>1.06</td>
<td>8.0</td>
<td>1.06</td>
<td>0.64</td>
<td>1.76</td>
<td></td>
</tr>
<tr>
<td>≤8 years</td>
<td>7.7</td>
<td>0.70</td>
<td>0.55</td>
<td>0.90</td>
<td>5.3</td>
<td>0.88</td>
<td>0.52</td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td>p value for trend</td>
<td>0.01</td>
<td></td>
<td></td>
<td>0.50</td>
<td></td>
<td></td>
<td>0.004</td>
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<tr>
<td><strong>Short term fatality</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥13 years</td>
<td>7.8</td>
<td>1.00</td>
<td></td>
<td>13.4</td>
<td>1.00</td>
<td></td>
<td>8.8</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>8–12 years</td>
<td>9.6</td>
<td>1.13</td>
<td>0.88</td>
<td>1.45</td>
<td>15.4</td>
<td>1.16</td>
<td>0.78</td>
<td>1.73</td>
<td></td>
</tr>
<tr>
<td>≤8 years</td>
<td>14.6</td>
<td>1.22</td>
<td>0.95</td>
<td>1.56</td>
<td>21.7</td>
<td>1.31</td>
<td>0.91</td>
<td>1.88</td>
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<tr>
<td>p value for trend</td>
<td>0.12</td>
<td>0.13</td>
<td></td>
<td></td>
<td>0.04</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>First year fatality</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥13 years</td>
<td>4.7</td>
<td>1.00</td>
<td></td>
<td>8.1</td>
<td>1.00</td>
<td></td>
<td>5.3</td>
<td>1.00</td>
<td></td>
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<tr>
<td>8–12 years</td>
<td>6.1</td>
<td>1.12</td>
<td>0.82</td>
<td>1.53</td>
<td>11.2</td>
<td>1.21</td>
<td>0.74</td>
<td>1.97</td>
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<tr>
<td>≤8 years</td>
<td>9.8</td>
<td>1.02</td>
<td>0.75</td>
<td>1.38</td>
<td>13.0</td>
<td>1.02</td>
<td>0.64</td>
<td>1.62</td>
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<tr>
<td>p value for trend</td>
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<td>0.70</td>
<td></td>
<td></td>
<td>0.80</td>
<td></td>
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</tr>
<tr>
<td><strong>Rehospitalisation for AMI (1 year)</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥13 years</td>
<td>3.6</td>
<td>1.00</td>
<td></td>
<td>2.6</td>
<td>1.00</td>
<td></td>
<td>3.4</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>8–12 years</td>
<td>3.3</td>
<td>0.84</td>
<td>0.57</td>
<td>1.24</td>
<td>4.6</td>
<td>1.74</td>
<td>0.75</td>
<td>4.01</td>
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<tr>
<td>≤8 years</td>
<td>3.9</td>
<td>0.83</td>
<td>0.56</td>
<td>1.25</td>
<td>4.0</td>
<td>1.39</td>
<td>0.61</td>
<td>3.18</td>
<td></td>
</tr>
<tr>
<td>p value for trend</td>
<td>0.38</td>
<td>0.76</td>
<td></td>
<td></td>
<td>0.55</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Rehospitalisation for other cardiac cause (1 year)</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥13 years</td>
<td>16.2</td>
<td>1.00</td>
<td></td>
<td>15.8</td>
<td>1.00</td>
<td></td>
<td>16.2</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>8–12 years</td>
<td>17.2</td>
<td>1.04</td>
<td>0.87</td>
<td>1.24</td>
<td>17.1</td>
<td>1.07</td>
<td>0.75</td>
<td>1.54</td>
<td></td>
</tr>
<tr>
<td>≤8 years</td>
<td>16.7</td>
<td>0.98</td>
<td>0.81</td>
<td>1.19</td>
<td>17.2</td>
<td>1.03</td>
<td>0.73</td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td>p value for trend</td>
<td>0.83</td>
<td>0.96</td>
<td></td>
<td></td>
<td>0.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = 7234. The reference category is at least 13 years of education. Risks are crude absolute risks. Odds ratios and hazard ratios are adjusted for gender, age (as a continuous variable), and selected comorbidities (diabetes, hypertension, COPD, peripheral vascular disease, arrhythmia, conduction disorders, heart failure, angina/other ischaemic heart disease). *Odds ratio reported from logistic regression. †Adjusted for comorbidities diagnosed either at the index event or in the preceding three years. ‡Adjusted for comorbidities diagnosed in the preceding three years. ‖Hazard ratio reported from Cox multivariate analysis of survival time.

*Adjusted for PTCA. Crude absolute risks, adjusted odds ratios/hazard ratios and 95% confidence intervals (CI).

What this paper adds

The socioeconomic gradient in total incidence of coronary events was steeper among women than among men in Rome, but this was attributable to hospitalisations rather than out of hospital deaths. Area based deprivation status and individual educational attainment seemed not to influence one year prognosis, but were significant predictors of access to PTCA.

Policy implications

People involved in health care should be aware of the socioeconomic differences in the occurrence of coronary events. Efforts should be made to offer equal access to PTCA treatment in different socioeconomic groups.
be underestimated. To evaluate the presence of such a selection bias, we examined the relative proportion of total first coronary events that were out of hospital deaths for each deprivation category (see table 2). Among men, the age adjusted proportion of total first coronary events that were out of hospital deaths was roughly constant across deprivation categories (between 25.9 and 27.7%). However, among women this proportion decreased substantially from 37.3% in the most privileged category to 27.3% in the least. Hence, somewhat counterintuitively, privileged women who suffered severe coronary events were more likely to die before reaching a hospital than deprived women. These findings render an effect of selection bias unlikely.

Although we were able to consider several baseline morbidity factors, both recorded before the AMI and during the actual hospitalisation, the main limitation of using administrative data is the impossibility of considering actual AMI severity, lifestyle risk factors, and treatment adherence.

In conclusion, between 1998 and 2000 the population incidence of first coronary events in Rome was higher among the most deprived groups, and the gradient was more pronounced among women. There is evidence that access to effective invasive treatments (PTCA) was not egalitarian with respect to SES based deprivation status and especially educational attainment and gender. Short term mortality results were inconclusive. Overall, SES seemed not to influence socioecologic factors in the treatment and outcomes of acute myocardial infarction.

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