Ethnic variations in upper gastrointestinal hospitalizations and deaths: the Scottish Health and Ethnicity Linkage Study

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Background: Upper gastrointestinal (GI) diseases are common, but there is a paucity of data describing variations by ethnic group and so a lack of understanding of potential health inequalities. We studied the incidence of specific upper GI hospitalization and death by ethnicity in Scotland. Methods: Using the Scottish Health and Ethnicity Linkage Study, linking NHS hospitalizations and mortality to the Scottish Census 2001, we explored ethnic differences in incidence (2001–10) of oesophagitis, peptic ulcer disease, gallstone disease and pancreatitis. Relative Risks (RRs) and 95% confidence intervals were calculated using Poisson regression, multiplied by 100, stratified by sex and adjusted for age, country of birth (COB) and socio-economic position. The White Scottish population (100) was the reference population. Results: Ethnic variations varied by outcome and sex, e.g. adjusted RRs (95% confidence intervals) for oesophagitis were comparatively higher in Bangladeshi women (209; 124–352) and lower in Chinese men (65; 51–84) and women (69; 55–88). For peptic ulcer disease, RRs were higher in Chinese men (171; 131–223). Pakistani women had higher RRs for gallstone disease (129; 112–148) and pancreatitis (147; 109–199). The risks of upper GI diseases were lower in Other White British and Other White [e.g. for peptic ulcer disease in men, respectively (74; 64–85) and (81; 69–94)]. Conclusion: Risks of common upper GI diseases were comparatively lower in most White ethnic groups in Scotland. In non-White groups, however, risk varied by disease and ethnic group. These results require consideration in health policy, service planning and future research.

Introduction

Gastrointestinal (GI) disease is the most common cause of hospital admission in the UK,¹ and the overall burden of upper GI diseases has increased in past decades, particularly the incidence of pancreatitis, gallstone-related disease and upper GI haemorrhage.¹ Although peptic ulcer disease incidence in most age groups has decreased in the UK, this has increased in elderly people, associated with higher use of ulcerogenic drugs.²,³ Peptic ulcer disease, upper GI haemorrhage and acute pancreatitis are more common in Scotland than in southern England.¹,⁴,⁵ While differences by ethnicity are known to exist for many chronic diseases such as coronary heart disease and common cancers,⁶–⁹ such differences in upper GI diseases are seldom studied in Europe. Previous studies have also been hampered by using COB as a proxy for ethnicity and looking at small hospital-based populations for single disease outcomes.¹⁰,¹¹ We have published our findings on ethnic differences in lower GI diseases,¹² but to date, no known published studies have assessed ethnic variations in a range of upper GI diseases. Using the Scottish health and ethnicity linkage study (SHELS), linking NHS hospitalizations and mortality to the Scottish Census 2001,¹³ we explored ethnic differences in the incidence of specific upper GI hospitalization and death in Scotland from May 2001 to April 2010. We selected specific upper GI diseases with more than 1000 hospitalizations per year to ensure sufficient numbers for an analysis by ethnicity, i.e. oesophagitis, peptic ulcer disease, gallstone disease and pancreatitis (available for gastritis as Supplementary Analysis as it was not primary, i.e. less severe and linked to peptic ulcer disease). We hypothesized ethnic differences in White and non-White minority ethnic groups with a lower incidence in Other White British compared with White Scottish. Hypotheses about the causes of common upper GI disorders exist but are limited, and exploring ethnic variations by upper GI disease outcomes could potentially reduce inequalities and improve causal understanding.

Methods

Linkage

The methods of the SHELS retrospective cohort have been published in detail.⁹,¹³ Using probability matching, 95% of the Census 2001 records were matched to the unique national (Scotland) health identifier, the Community Health Index, allowing linkage to hospitalization and death data for 4.65 million. Following a strict protocol of data security and anonymity, health records for GI diseases up to 2010 were extracted, linked to the Census and made available without identifiers in a safe haven at National Records Scotland (NRS) to named researchers with appropriate clearance and training.
Data
We used self-reported ethnicity (14 categories), COB (categorized as born in the UK and born outside the UK), age, sex and 8 socio-economic indicators (as specified previously) from the 2001 Scottish Census.

To enable sufficient numbers for analysis by ethnicity, we selected four upper GI diseases with more than 1000 hospitalizations per year namely (ICD10 codes): oesophagitis (K20–K23), peptic ulcer diseases (K25–K28), gallstone disease (K80–K83) and pancreatitis (K85–K87). The corresponding ICD-9 codes were used to identify events prior to 1999.

Small numbers and disclosure issues
Analysis and output production followed the NRS Disclosure Control Guidance for SHELS and were reviewed by the Disclosure Committee before being released to researchers. According to the guidance, where the number of events was five and below, data were excluded or aggregated, e.g. for peptic ulcer diseases and gallstone disease, we aggregated Bangladeshi with Other South Asian group and joined Caribbean, African and Other Black into one group named ‘African origin’. For pancreatitis, the only non-White minority ethnic groups with non-disclosive numbers were Indian and Pakistani.

Statistical analysis
We analysed incident events selecting first hospitalization or death (with no event for the same diagnosis in the previous 10 years) between May 2001 and April 2010. Each specific disease was identified if there was a record of hospitalization with at least one relevant diagnosis (up to six recorded) or a record of a relevant cause of death (up to 11 recorded).

We calculated the number of population year (PY) at risk of first event over the period of interest (9 years) and adjusted for any death, transfer out of the NHS Scotland or first event.

We calculated age-adjusted rates per 100,000 PY and relative risks (RRs) of first event with 95% confidence intervals (CIs) using Poisson regression models with robust. We stratified by sex, adjusted for age and subsequently COB. We followed the methods described previously to explore the association between the outcome and eight socio-economic indicators across ethnic group and sex. As it was available widely (0% missing data) and associated consistently with a first upper GI event across ethnic groups and sex (Supplementary appendix table S1), we further adjusted our analysis for the Scottish Index of Multiple Deprivation (SIMD) as a proxy for socioeconomic status. Analysis was restricted to adults (20 years and older). Comparing to White Scottish men and women, we focussed on the results where the 95% CIs did not include the reference value (100).

Data were analysed using SAS V 9.3 (SAS Institute Inc., Cary, NC).

Ethics
The study was approved by the Multicentre Research Ethics Committee for Scotland (reference 11/MRE00/4) and the Privacy Advisory Committee. The ethical and other permissions and related issues have been reported in detail, including an independent assessment by an ethicist.

Results
Hospitalizations and deaths
We identified 313,636 patients with any incident upper GI hospitalization or death linked to the Scottish Census 2001. With 9 years of follow-up and 29 million PY at risk, we found 102,706 incident cases of oesophagitis, 44,612 of peptic ulcer disease, 87,556 of gallstone disease and 17,177 of pancreatitis. Most incident events were hospitalizations; the proportion of incident events identified through death records ranged from 0.3% for oesophagitis to 2.0% for pancreatitis.

Characteristics of the study population
The ethnic distribution of our linked Census 2001 population was similar to the general Census population (Supplementary appendix table S2) with an 89% White Scottish majority, 9% other White ethnic groups and 2% non-White ethnic groups. While most Scottish, Irish and Other British were born in the UK (95–99%) as well as people from any Mixed Background (75%), it was mixed for all other ethnic groups (34–61%). White Scottish, White Irish, Other South Asian and individuals of African origin were more likely to live in more deprived areas in Scotland, whereas the Other White British, Other White, Indian and Chinese ethnicities were more likely to live in the least deprived areas.

Incident upper GI events were identified on average at a younger age for non-White minority ethnic groups (from 48 to 53 years of age) compared with White groups (from 59 to 64 years of age).

Oesophagitis
For oesophagitis in men, the age-adjusted RRs were higher in White Irish, Pakistani, Bangladeshi and Black Scottish or Other Black men (table 1). This excess risk was much diminished on adjustment for COB and SIMD in Irish men. Risks were lower in Chinese and Other White men. Differences diminished on adjustment for Other White men. In women, age-adjusted RRs were higher in Indian, Pakistani and Bangladeshi (2-fold higher) groups and lower in Other White British, Other White, African and Chinese groups. RRs did not change much on adjustment for SIMD and COB.

Peptic ulcer disease and gastritis
For peptic ulcer disease in men, RRs were higher in White Irish, Other South Asian and Chinese and lower in Other White British, Other White, Pakistani and Other South Asian ethnicities and lower in Other White British, Other White and Indian ethnicities with an attenuation of differences for White Irish and Indian women on adjustment for COB and SIMD. In women, age-adjusted RRs were higher in Indian, Pakistani and Bangladeshi (2-fold higher) groups and lower in Other White British, Other White, African and Chinese groups. RRs did not change much on adjustment for SIMD and COB.

Gallstone disease
For gallstone disease in men, RRs were higher in Chinese men and lower in Indian and Other South Asian men, which remained on adjustment for COB and SIMD for Chinese men (table 3). In women, RRs were higher in Pakistani and White Irish groups with little change on adjustment for Pakistani women.

Pancreatitis
For pancreatitis in men, RRs were higher in White Irish men and lower in Other White British men (table 4). The excess risk in Irish men diminished with adjustment for COB and SIMD. In women, RRs were higher in Pakistani group and lower in women of Other White British and Other White ethnicities. Further adjustment for COB and SIMD attenuated the lower risk in Other White British women.
<table>
<thead>
<tr>
<th>Ethnic group</th>
<th>First peptic ulcer event</th>
<th>PY at risk</th>
<th>Age-adjusted rates (for 100 000 PY)</th>
<th>Age-adjusted RR and 95% CI</th>
<th>Age and SIMD adjusted RR and 95% CI</th>
<th>Age and COB-adjusted RR and 95% CI</th>
<th>Age, SIMD and COB-adjusted RR and 95% CI</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Scottish</td>
<td>21 323</td>
<td>1 185 056</td>
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<td>100.0</td>
<td>100.0</td>
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<td>144 277</td>
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<td>113.8 (96.4, 136.8)</td>
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<td>175 994</td>
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<td>17 513</td>
<td>226.4</td>
<td>125.9 (86.2, 183.8)</td>
<td>120.6 (80.2, 181.4)</td>
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<td>32</td>
<td>35 309</td>
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<td>89.1 (63.3, 125.4)</td>
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<td>53</td>
<td>64 202</td>
<td>148.2</td>
<td>82.4 (71.0, 95.6)</td>
<td>81.8 (62.8, 106.5)</td>
<td>87.6 (71.6, 107.3)</td>
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<td>69.3 (54.2, 88.6)</td>
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<td>69.3 (54.5, 88.0)</td>
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<td>100.0</td>
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<td>215 571</td>
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<td>68.2 (37.9, 122.7)</td>
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<td>166.3 (106.1, 265.0)</td>
<td>160.5 (101.8, 252.9)</td>
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<td>African origin</td>
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Because of a lack of reliable ethnicity information, ethnic variations in upper GI diseases have rarely been studied in the UK.\textsuperscript{1,4,5,10,11,16} Because of a lack of reliable ethnicity information, previous studies have used COB as a proxy.\textsuperscript{10} SHELS has enabled us to study those diseases based on the self-reported ethnicity in Scotland. The strengths and weaknesses of SHELS have been considered in detail and published.\textsuperscript{7,13}

Our analysis in the Scottish population has shown interesting variations between ethnic groups for oesophagitis, peptic ulcer disease, gallstone disease, and pancreatitis, seen among both White and non-White minority groups. In White groups, adjustment for socio-economic status and COB diminished the differences observed in White Irish and other white British men mainly, whereas there was less attenuation on adjustment in non-White groups.

### Discussion

#### Principal findings

Our analysis in the Scottish population has shown interesting variations between ethnic groups for oesophagitis, peptic ulcer disease, gallstone disease, and pancreatitis, seen among both White and non-White minority groups. In White groups, adjustment for socio-economic status and COB diminished the differences observed in White Irish and other white British men mainly, whereas there was less attenuation on adjustment in non-White groups.

#### Strengths and limitations

Ethnic variations in upper GI diseases have rarely been studied in the UK.\textsuperscript{1,4,5,10,11,16} Because of a lack of reliable ethnicity information, previous studies have used COB as a proxy.\textsuperscript{10} SHELS has enabled us to study those diseases based on the self-reported ethnicity in Scotland. The strengths and weaknesses of SHELS have been considered in detail and published.\textsuperscript{7,13}

A main strength of SHELS is to provide self-defined ethnicity for the 2001 Census enabled the use of covariates, such as COB and linkage to 9 years of hospitalizations and deaths has given robust power to study variation in specific upper GI diseases in most, but not all, minority ethnic groups in Scotland. Our study has shown varied risks between White Scottish and non-White ethnic groups as well as within the White ethnic groups. Our approach using adjusted PY has reduced the potential bias due to loss to follow-up. Linking to the 2001 Census enabled the use of covariates, such as COB and socioeconomic status. However, data on Helicobacter pylori infection, nonsteroidal anti-inflammatory drugs (NSAIDs), diet,
anthropometrics and other environmental risk factors were not available.

There was incomplete linkage (85–95% for ethnic groups) with the risk that some minority ethnic groups may be under-represented in the SHELS cohort. Furthermore, limited number of events in some groups may lead to wide CIs and type 2 statistical errors. The interpretation requires knowledge of the number of tests done; however, there may be differences that we did not observe or highlight due to small numbers, which in part may counterbalance the risk of type 1 statistical error. Hospitalizations and deaths were combined as per our prior data analysis plan, which specified that stratified analysis would take place if deaths comprise 20% or more of the total outcomes.

There may be a lack of accuracy in the self-reporting of ethnic groups as well as in recording upper GI diagnoses on hospital discharge records and cause of death on mortality records. However, while the incidence of upper GI disease could be underestimated (or overestimated) due to misclassification, it is unlikely to affect one ethnic group more than another. Differences in health-seeking behaviour may exist between ethnic groups, which might be symptom related, e.g. lag time before consulting a doctor about abdominal symptoms or being referred for investigations. If so, we might expect consistency in the patterns, e.g. if the Chinese were low users of health care, they may have low hospitalization risks for all outcomes. This was not, however, the case: peptic ulcer risks were high while other risks were low. Nevertheless, while the variation in patterns by outcome suggests differences in the incidence of disease between different ethnic groups, we acknowledge that differential use of healthcare for diagnosis or treatment in primary care or hospital is an important factor in shaping the patterns.

Findings in relation to the literature

Oesophagitis

Gastro-oesophageal reflux diseases are usually undiagnosed, even in primary care, hence it is less likely to be recorded for hospitalizations. Some of the ethnic differences in oesophagitis may be due to differences in health seeking behaviours, e.g. if certain ethnic groups present more readily with reflux symptoms than others. For example, a time-trends study in the Netherlands found increased rates of reflux oesophagitis in Turkish migrants compared with native Dutch from 1992 to 2009. Systematic reviews showed that gastro-oesophageal reflux disease symptoms and oesophagitis prevalence are higher in western countries compared with eastern countries, which fits with our finding of lower risks in the Chinese population. Several population and hospital-based studies have reported oesophagitis (including pre-malignant Barrett’s oesophagus) as more common in White populations than Asians and Afro-Caribbean in both the UK and USA, which is thought to be related to a protective higher rate of H. pylori in non-White groups. Our finding of higher risk of oesophagitis in the Pakistani and Bangladeshi populations needs to be interpreted cautiously and requires replication in other large multi-ethnic population studies. Moderately lower oesophagitis risks in Other White populations have not previously been published and require further exploration in epidemiological studies.

Peptic ulcer disease and gastritis

Few studies report ethnic differences in peptic ulcer hospitalization and death internationally. Our study adds to observations on the differences in peptic ulcer hospitalization between England and Scotland between 1958 and 1972 and higher peptic ulcer death rates in Scottish and Irish migrants in England and Wales in between 1999 and 2003. Compared with the reference White Scottish group, our data suggest a lower risk of peptic ulcer in Other White British and a similar risk in White Irish, i.e. Scottish and Irish populations appear to have a similar risk after adjustment for socio-economic status and COB. Our study broadly corroborates other international studies, which have assessed ethnic variations in peptic ulcer disease. In the USA, rates of hospitalization for peptic ulcer disease have been reported to be higher in Blacks and minority ethnic groups compared with Whites in 1998. A study in the United Arab Emirates focussing on perforated peptic ulcer found the highest hospitalization rates in Bangladeshi and Indian compared with people of Arab origin. Increased risk of peptic ulcer disease in the Chinese population has been found in cities such as Hong Kong compared with northern Chinese cities. Increased rates of H. pylori have also been reported in Chinese ethnicities compared with reference populations in Malaysia and Singapore. In Scotland, there was a higher risk of peptic ulcer disease in Other South Asians including Bangladeshi populations and in Chinese. However, in contrast, we found the risk of peptic ulcer admission to be lower in men of African origin.

Whether the differences in Scottish, Irish, Other White British and non-White ethnic groups reported are caused by differences in H. pylori seroprevalence or NSAID usage continues to be not well understood and remains an important area of future study.

Gastritis is strongly linked to risk factors for peptic ulcer disease and our Supplementary Analysis show that there are South Asian ethnic groups which appear to be more prone to this. Limited data, from a Malaysian study (H. pylori rates in ulcer, gastritis, duodenitis and non-ulcer dyspepsia at endoscopy were the highest in Bangladesh and then in Indian and Chinese groups compared with Malay) and in the Netherlands (migrants from Asian and African origins had higher rates of H. pylori infection and atrophic gastritis), corroborate our findings of higher risks observed in Indian, Pakistani and Bangladeshi groups.

Gallstone disease and pancreatitis

Gallstone disease is very common and is responsible for many hospitalizations in developed countries. In the USA, the highest prevalence rates were found in Native Indians followed by Hispanic populations. There is, however, a lack of ethnicity data in European populations. The Health Survey for England 2004 on the Health of Minority Ethnic Groups reports 41% and 79% of middle aged (35–54-year old) Pakistani women as, respectively, obese and overweight, which might partly explain the higher risk of gallstone disease admission in this population in Scotland. However, higher risks in Chinese men are more difficult to explain by known risk factors. Our findings require further confirmation in other population studies including risk factors data.

Corresponding with data on gallstone disease, there is a lack of ethnic-specific data in the UK and Europe on pancreatitis. In the USA, the risk of pancreatitis was 2–3-fold higher among Blacks compared with Whites. Our findings of higher risks in Pakistani women in Scotland are novel and, given the high risk of gallstones too, this corroborates the causal links between gallstones and pancreatitis. The prevalence of chronic pancreatitis has been shown to be higher in India and Japan compared with western countries and China, but we were unable to detect such differences in our study due to small numbers. Moderately lower risks in Other White British populations in Scotland could be linked to less alcohol consumption.

Conclusion

We have shown, for the first time in the UK, important ethnic variations in upper GI disorders; health inequalities by ethnic group. The patterns of ethnic variation are seen to be disease dependant, with the moderately sized differences (RRs up to 2-fold) compared with the White Scottish reference. In addition to
variations between non-White minority groups, variations were also seen among White subgroups. These novel data on ethnicity are relevant not only to tackling inequalities, health policy and planning, but also as a mean of developing and refining hypotheses of the causes of upper GI diseases.

**Supplementary data**

Supplementary data are available at EURPUB online.

**Acknowledgements**

ISD and the General Register Office for Scotland both made ‘in-house’ contributions to the work. Arti Nair, Jenny Holmes and Kath Ellis gave secretarial help to prepare the paper and to general administration.

The researchers acted independently of the funding body and the study sponsor (the University of Edinburgh) at all stages of the work. The authorship, the authorship byline, and note of contributions follow SHELS policy on authorship.

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**Contributors from the Scottish health and Ethnicity Linkage Study research team**

These contributors served on the Steering Group and some on other important subgroups of SHELS, so gave general direction that helped this analysis. Colin Fischbacher was a co-applicant with lead responsibility for ISD (Information Services Division) involvement. Chris Povey was a co-applicant and the originator of the idea of linking the Census data to the data held by ISD who performed most of the linkage work including developing linkage methods. Prof. Jamie Pearce (co-applicant) advised especially on socioeconomic adjustment. Duncan Buchanan (co-applicant) chaired the analysis subgroup. Prof. Aziz Sheikh was a co-applicant. Markus Steiner was a research fellow providing support in many aspects of SHELS. Ganka Mueller (part study), Alex Stannard (part study), Stephen Sharp and Kirsty MacLachlan advised particularly in relation to NRS contributions. Anne Douglas coordinated the final phases of this study. These important contributions did not meet ICMJE authorship requirements.

**Conflicts of interest:** None declared.

**Data sharing**

The data are only available in a data safe haven with restricted access at National Records Scotland and governed by strict ethical and other restrictions on access. Individual consent for linking these records was not sought. Access to SHELS is not open (yet), but researchers wishing to utilize the data should write to Prof. Raj Bhopal.

**Key points**

- Ethnic variations in upper GI disorders were found in the Scottish population using a retrospective cohort design combining hospitalization and mortality data with reliable measures of ethnicity from national Census; health inequalities by ethnic group.

- The pattern of upper GI disorders varied for each ethnic group, with some disorders being relatively more common and others less common, e.g. Chinese populations had higher risks of peptic ulcer and lower risks for oesophagitis.

- Ethnic variations were seen both among non-White and among White ethnic subgroups, e.g. low-risk in other White British for peptic ulcer disease compared with White Scottish.

- Future research, policy and planning will be able to draw upon these population-based data on ethnic variations to guide more patient centred, effective and efficient clinical care of upper GI diseases.

**References**


Introduction

Social inequalities in coronary heart disease (CHD) have been witnessed for decades and have shown few signs of narrowing.\(^1\)\(^2\) Despite reductions in overall CHD rates, the disease remains a major contributor to the social inequalities in mortality.\(^3\) Lower socioeconomic position (SEP) is associated with an increased risk of CHD mortality\(^4\)\(^5\) and incidence of myocardial infarction (MI)\(^6\)\(^7\)\(^8\) Disparities have also been demonstrated in post-MI survival.\(^8\)\(^9\)\(^10\)\(^11\)\(^12\)\(^13\)\(^14\)\(^15\)\(^16\)\(^17\) However, different aspects of socioeconomic circumstances are likely to vary in the magnitude of their impact at different stages of the disease. Education, occupational class, income and wealth all tap into a common construct of an individual’s life chances and position in the socioeconomic structure of society, but these dimensions measured by different SEP indicators are conceptually distinct and indicate different types of resources.\(^22\)\(^23\)\(^24\) Even when the SEP measures are correlated, they are likely to have independent effects on health working through different pathways. The four

Disentangling the relative importance of different socioeconomic resources for myocardial infarction incidence and survival: a longitudinal study of over 300 000 Finnish adults

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Background: Lower socioeconomic position (SEP) is associated with an increased risk of myocardial infarction (MI) incidence and mortality, but the relative importance of different socioeconomic resources at different stages of the disease remains unclear. Methods: A nationally representative register-based sample of 40- to 60-year-old Finnish men and women in 1995 (\(n = 302\,885\)) were followed up for MI incidence and mortality in 1996–2007. We compared the effects of education, occupation, income and wealth on first MI incidence, first-day and long-term fatality. Cox’s proportional hazards regression and logistic regression models were estimated adjusting for SEP covariates simultaneously to assess independent effects. Results: Fully adjusted models showed greatest relative inequalities of MI incidence by wealth in both sexes, with an increased risk also associated with manual occupations. Education was a significant predictor of incidence in men. Low income was associated with a greater risk of death on the day of MI incidence [odds ratio (OR) = 1.40 in men and 1.95 in women when comparing lowest and highest income quintiles], and in men, with long-term fatality [hazard ratio (HR) = 1.74]. Wealth contributed to inequalities in first-day fatality in men and in long-term fatality in both sexes. Conclusion: The results show that different socioeconomic resources have diverse effects on the disease process and add new evidence on the significant association of wealth with heart disease onset and fatality. Targeting those with the least resources could improve survival in MI patients and help reduce social inequalities in coronary heart disease mortality.

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References