Using routine data to measure ethnic differentials in access to coronary revascularization

Jennifer Mindell1,2, Ed Klodawski1, Justine Fitzpatrick1
1London Health Observatory, London SW1E 6QT, UK
2Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT, UK

Address correspondence to Jennifer Mindell, E-mail: j Mindell@ucl.ac.uk

ABSTRACT

Background Ethnic inequalities in access to health services are difficult to monitor and address because of limited data. Within the health service, ethnicity data have been poor quality, partly because they are not seen as useful.

Methods The analysis related age- and sex-standardized coronary revascularization procedures to defined measures of need, using proportional ratios derived from Hospital Episode Statistics records for London residents admitted to any hospital nationally in 2002–03 or 2003–04.

Results Although 2001 Ethnicity Categories were mandatory for the NHS from April 2001, by 2003–04 20% of coronary heart disease (CHD) records still had no ethnic category coded. Hospital admission for CHD and revascularization by ethnicity varied widely, following known patterns of CHD incidence and mortality. There is much less variation between ethnic groups when comparing revascularization rate relative with CHD admission rates (whether all or emergencies). However, Bangladeshi patients had only two-thirds [proportional ratio 66.8, 95% confidence interval (CI) 60.7–73.3] and Black Caribbean and Black African patients four-fifths (proportional ratios 80.5, 72.0–89.9 and 80.7, 68.0–95.2, respectively) the revascularization rate in comparison with apparent need as the general population.

Conclusion Even with imperfect data, the analysis of routine data can identify inequalities that warrant further investigation.

Keywords ethnicity, healthcare, inequalities, coronary revascularisation, routine data

Introduction

Ethnic inequalities in health and access to health care are well known, but are hard to monitor and address because of limited data. London is notable for substantial inequalities in health and its determinants both within and between local authority areas. London is also the most ethnically diverse city in the UK. Coronary heart disease (CHD), the commonest cause of death and premature death in England, accounted for 9169 deaths in London in 2004. CHD mortality remains particularly high among Irish and Scottish people and those from South Asian groups, particularly Pakistanis and Bangladeshis. The extent to which access to health care and other factors contribute to this risk is incompletely understood.

Treatments for CHD aim to alleviate symptoms, optimize daily activities, improve quality of life and reduce future complications or death. The National Service Framework set a target rate of 1500 revascularizations per million population across England. The rate increased nationally from 873 per million population in 1988–89 to 1213 per million population in 2002–03, with a rate of 1245 per million population in London in 2002–03.

A recent review reported mixed findings for ethnic inequalities in health and access to health care regarding CHD. South Asians had a lower threshold for seeking medical care for angina symptoms. Patients of general practices with a higher proportion of South Asian patients had higher rates of angiography. Among civil servants, South Asians were more likely to undergo cardiac diagnostic or therapeutic procedures than white colleagues, even after adjustment for clinical need. However, other studies found lower prescription of drugs for and investigation of CHD by general practitioners (GPs), with a longer delay between onset of symptoms and angiography in South Asian patients.
Despite angiographic indications of appropriateness,\textsuperscript{2,21} South Asians in a London study were less likely to receive angioplasty or coronary artery bypass graft (CABG) than white patients, although there was no difference between white and South Asian groups in cardiologists’ recommendations for revascularization. For angioplasty, this applied particularly to Bangladeshi and Pakistani patients, but not to Indian patients.\textsuperscript{21} Adjustment for education and income attenuated, but did not abolish these differences.\textsuperscript{21}

South Asians have relatively higher admission rates for CABG than people from White groups.\textsuperscript{9} This study was undertaken both to explore whether routine hospital data can be used to assess ethnic inequalities in coronary revascularization in relation to need and also to break the cycle in which data have not been collected effectively because they are not used—but are not used due to their poor quality and incompleteness.

Methods

The analysis related revascularization procedures to defined measures of need for London, using records from the Department of Health’s HES (Hospital Episode Statistics) database for 2002–03 and 2003–04. Within the NHS, self-assigned ethnicity should have been collected for all in-patients since 1995, using the 1991 Census ethnic groups. Since April 2001, the 2001 Census ethnic categories were mandatory. The introduction of the Race Relations (Amendment) Act 2000\textsuperscript{22} imposed a positive duty to be proactive in promoting race equality on public bodies. However, ethnicity data within the HES had been poor regarding both completion and the use of valid codes.\textsuperscript{23}

Measure of need

There are no current data on CHD prevalence or mortality in London by ethnic group. We therefore used hospital utilization as a proxy for need for revascularization, against which to compare provision.

Emergency CHD admissions exclude 80% of the revascularizations, as most are performed as elective procedures. All CHD admissions, used elsewhere as a proxy for need for revascularization,\textsuperscript{10} include admissions for revascularization, so could be considered a form of ‘double-counting’ when used as a proxy for need. However, when calculating proportional ratios of interventions in relation to need, it has the advantage that the numerator is a subset of the denominator. It was therefore used as the preferred proxy for need in this study.

CHD admissions rather than episodes were chosen as a better proxy for the number of individuals eligible for surgical intervention as one admission to, or spell in, hospital can include a number of episodes. However, when calculating proportional ratios of interventions in relation to need, CHD episodes were used as the comparator for revascularization EPISODES, so that the same unit of measure was used in the numerator and denominator.

Data

The HES records used for analysis were ‘finished consultant episodes’ within the time period examined, determining admissions by the first episode within a spell. These do not represent the number of patients, as a person may have more than one admission within the year. All records for London residents were included, regardless of where in England they were treated.

A revascularization was defined as an episode containing one or more PTCA operations (OPCS-4 codes K49–K50) or CABG operations (K40–K46). A CHD episode was defined as an HES record containing any ICD-10 codes I20–I25 in the primary diagnosis field.

Analytical methods

Patients’ access to revascularizations was initially analysed using three methods. A technical report, focusing on methodological issues, discussed the methods and made recommendations for analytical approaches using routine hospital data to examine ethnic inequalities in health care.\textsuperscript{24} This article presents analyses using the recommended approach—proportional ratios (Box 1).

Box 1 Proportional ratios

Proportional ratios enable the impact of a disease on a subgroup of a population to be examined. It determines whether the number of episodes that occur in a particular group is higher or lower than the proportion of episodes for that reason in the general population. Proportional ratio is the ratio of the proportion of events from a given cause in a study population to the proportion that would have been expected had overall rates applied.\textsuperscript{25,26}

The general population was the population of London as a whole; all proportional ratios were standardized for age and sex. The population as a whole has a proportional ratio of 100. Values greater than 100 indicate that people from that ethnic group are relatively more likely to be admitted for that cause than for other causes. Values below 100 indicate the opposite. A proportional ratio of 200 (or of 50) means that the proportion of admissions for that reason is twice as high (or half) in that group as in the general population.

Proportional ratios are useful when there are missing denominator data or where it is important that the numerator and denominator data are from the same populations or are coded
in the same way. They are also used when the underlying population at risk (e.g. by ethnic group) cannot be accurately determined. We used proportional admission ratios in this study, despite the existence of population data by ethnic group from the 2001 Census, both because ethnic group remains inadequately recorded on hospital admissions data, so age-standardized rates are a known underestimate, and because ‘other’ groups are coded differently in the 2001 Census and in HES. Proportional ratios also have drawbacks discussed in the Discussion section below. However, the advantages of using proportional ratios outweigh the disadvantages when compared with the disadvantages of other methods for these analyses.

Derivation of proportional ratios

Standard methods for the calculation of proportional ratios and their confidence intervals (CIs) were used. Expected study events were derived for sex and age groups and summed for each ethnic group. Records with missing sex data were omitted (<0.02%). Records with missing age data (≤0.22%) were included as an additional ‘age group’. For each ethnic group, the proportional ratio derived was in terms of ‘all persons’ and ‘all ages’. Further details are given in the technical report.

To explore how proportional ratios vary according to the comparator chosen, the following sets of proportional ratios were derived:

- proportional ratios for CHD emergency admissions based on all admissions, to assess need;
- proportional ratios for revascularizations based on all episodes (i.e. using the most broadly based comparator);
- proportional ratios for revascularizations based on emergency CHD episodes (i.e. using the most restricted comparator);
- proportional ratios for revascularizations based on all CHD episodes (i.e. using a more conservative comparator).

Upper and lower 95% confidence limits were derived for each proportional ratio. Details are given in an appendix to the technical report.

Proportional ratios were derived for all London using 2002/03 data initially. The final ratio, using the preferred comparator of ‘all CHD episodes’, was then calculated using 2 years’ data combined (2002–03 and 2003–04), once HES 2003/04 became available to increase the statistical power. Data were extracted using Access and analysed in Excel.

Results

There were 9176 revascularization episodes in 2002–03 and 10 106 in 2003–04. In 2002–03, there were 37 297 CHD admissions (19 318 emergency) and 46 573 CHD episodes (27 422 emergency) for London residents, with 49 078 such CHD episodes in 2003–04.

Ethnicity codes used in HES were a mixture of 2001 Census ethnic categories and 1991 Census ethnic groups, including codes for ‘not stated’, ‘not given’ or ‘not known’. ‘Known 2001 codes’ were used for only 70% of all episodes in 2002–03 and 79% in 2003–04, with 7% of revascularization episodes and 13% of CHD emergency admissions still being coded using 1991 codes in 2002–03, falling to 5% and 6%, respectively, in 2003–04. Virtually, all London trusts used a mixture of 2001 and 1991 Census codes in 2002–03. Completeness of ethnic coding for 2003–04 data improved, although it was still variable. The proportion of records with a known 2001 code varied widely between trusts, from 27% to >90% in 2002–03 and from 60% to >95% in 2003–04.

Results were examined separately by sex (Table 1). There were no significant differences by sex within ethnic group, so data were amalgamated and results have been presented by ‘persons’ to increase the number of cases and therefore the precision.

The proportional ratio for revascularizations based on all episodes for any cause is shown in Fig. 1. Provision, in general, matched the known ethnic differences in CHD prevalence. For example, revascularization was less common for the Black groups and greater for the Indian, Pakistani and Bangladeshi groups, relative to the London population. However, provision for Irish people was average for London residents, despite their higher prevalence of CHD.

Several ethnic groups experienced relatively more emergency CHD admissions than the London average, using all admissions as the comparator for proportional ratios (Fig. 2). Such admissions were highest among the Bangladeshi community, followed by Pakistani, Mixed White and Asian, Other Asian and Indian groups. Emergency CHD admissions were significantly below the London average in Chinese, Irish, White British and Black groups.

For both revascularization episodes and CHD emergency admissions, those without an ethnicity code had a proportional ratio close to 100.

The proportional ratios for revascularizations based on need as quantified by emergency CHD episodes and in comparison with all CHD episodes (using 2 years’ data) are shown in Figs. 3 and 4, respectively.

The Bangladeshi, Black Caribbean and Black African ethnic groups experienced fewer revascularizations than one would expect. This apparent underprovision appeared greater when emergency, rather than all, CHD episodes were used as the comparator (Fig. 3), but the CIs were smaller when 2 years’ data were used (Fig. 4). Those coded as White
Irish [proportional ratio 118.5 (109.3–128.3)], White other [110.8 (105.4–116.3)] and Indian [106.7 (101.4–112.3)] had significantly raised proportional ratios, relative to the general population.

The proportional ratios for un-coded records again matched the overall population proportional ratios. The proportional ratios for those coded with 1991 codes were low.

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*The numbers are too small to show because of concerns for accuracy and, more importantly, risk of disclosure.

Fig. 1 Proportional admission ratios by ethnicity for London residents: revascularizations/all episodes (HES 2002–03). Source: Hospital Episode Statistics (HES), Department of Health.

Fig. 2 Proportional admission ratios by ethnicity for London residents: emergency CHD admissions/all admissions, HES 2002–03. Source: Hospital Episode Statistics (HES), Department of Health.
in all analyses, except for CHD emergency admissions as a proportion of all admissions. Tertiary centres, where revascularization procedures were performed, were less likely to be using these out-of-date codes.

**Discussion**

**Main findings of this study**

People coded as Bangladeshi had only half to two-thirds the expected number of revascularization procedures when compared with their CHD admissions. Similar results were found in 1997–98 data, with markedly raised CHD admissions but average revascularizations. There were only 37 admissions for revascularization procedures coded as Bangladeshi.8 People coded as Black Caribbean and Black African also had below average revascularizations in relation to their apparent need. These results identify inequalities, but cannot explain them, or define them as inequities, as they can be interpreted in many ways.

**What is already known on this topic**

Material deprivation and ethnic differences in lifestyle29 or other reasons for differential susceptibility to CHD (including physical activity, diet, smoking prevalence and amount of tobacco consumed—or exposure to others’ smoke) affect the incidence and prevalence of CHD in different ethnic groups. Experience of racism may also be associated with increased odds of CHD.30 Some of these factors may also affect the severity or type of CHD.

Material deprivation or differing awareness of CHD can reduce the desire or ability to access care. Bangladeshi patients in East London admitted to hospital for an acute myocardial infarction (AMI) interpreted their symptoms as suggestive of an AMI as often as white patients, although their description of their symptoms were not of classical crushing, central chest pain; they were at least as likely to seek health care. They were more likely to be already taking aspirin and angiotensin-converting enzyme inhibitors,31 suggesting that access to good primary care may not be a problem. Investigation and surgical management of patients admitted to hospital with CHD were related to socioeconomic position in Scotland in the early 1990s32 and inversely related to deprivation.33 The relative contribution of ethnicity and deprivation to inequalities in revascularization could not be explored in our analyses.

There is evidence that South Asian populations access GPs,18 but do not get further along the healthcare pathway,20 so are eventually admitted very late. This could be because their disease is considered unsuitable for referral, or they are not referred for another reason, so are more likely to be admitted as an emergency. If emergency admission is more likely, this increases the denominator. A higher case fatality rate from AMI would also reduce the proportion of people with known CHD, who survive long enough to be referred for revascularization, but recent evidence from Scotland suggests that this is not the case.34 Racism, whether interpersonal or institutional, has been suggested as a possible explanation,30,35 but is difficult to detect.

There may be genuine differences in ability to benefit from revascularization, even for a given prevalence of CHD. As diabetes increases the likelihood of small-vessel disease, a smaller proportion of CHD patients from ethnic groups with above average diabetes prevalence36 may have CHD that is amenable to revascularization procedures. The lack of surgical treatment might also increase the likelihood of emergency admission for exacerbation of symptoms, thereby also increasing the denominator. This could be explored by using patients, rather than episodes or admissions, as the unit for analysis; when these analyses were undertaken, the use of the NHS unique identifier was too incomplete to
allow that approach. However, it has also been found that Bangladeshis in East London were more likely to present with atypical symptoms after myocardial infarction, delaying thrombolysis.30 Heterogeneity of ethnic groups within the ‘South Asian’ group has been highlighted before,14,21,36,37 with Bangladeshis women experiencing the worst mortality from CHD.37

What this study adds
Differences were seen between White Irish and other White groups24 and between Bangladeshi and other South Asian groups. The heterogeneity that exists between different groups could have been missed had certain ethnic categories been grouped together to increase the sample size.

We believe that this is the first time that routine HES data with sufficiently high completion of ethnicity coding have been used to examine inequalities in access to health care by ethnicity. A recent study in Scotland showed that routine databases could also provide information about the health of ethnic minorities.34 We have discussed the strengths and weaknesses of different analytical methods elsewhere24 and have presented the results from the method with the most advantages and fewest disadvantages. However, the results from each of the three methods were very similar.

Limitations of this study
Ethnic coding
Obstacles in assessing ethnic inequalities in access to health care relate both to determining access by ethnic group and to assessing need, to examine whether inequalities (differences) are inequitable (unfair inequalities). Although ethnicity coding in HES had improved since found in the late 1990s,8 incompleteness of ethnicity data was disappointing, as was the persistent use of 1991 Ethnic Groups more than 2 years after the use of 2001 Ethnic Categories became mandatory.

The fact that nearby trusts with similar populations had widely differing ethnic coding rates and that some of the trusts with the worst completion rates previously had almost complete coding in subsequent years demonstrates that complying with requirements for recording ethnic category in NHS inpatients is possible. This study was undertaken to break the cycle in which data are not used because of their poor quality and incomplete nature and are not collected effectively. The proportion of episodes in London with no ethnicity coded or an invalid code has continued to fall, from one in four in 2003–04 to one in six in 2005–06.38

We have no information on the validity of the recorded codes, such as whether the codes were self-assigned, as required. However, results for CHD admissions and revascularization episodes by ethnic group did reflect known ethnic differences in CHD prevalence and mortality. There are Department of Health guidelines for collecting ethnicity information in the NHS in a manner as consistent as possible with collection of ONS Census ethnicity information.39 Section 2.1.2 defines the same 16 Ethnic Categories to be used from April 2001 as in the 2001 Census. It also correctly points out that there is no mapping from the 10 1991 Census Ethnic Groups to the 16 2001 Census Ethnic Categories. Hence, in our analysis, no attempt was made to include any records with ‘1991 Codes’ with any potentially corresponding 2001 Census Ethnic Category. The analysis was based on the ‘2001 Codes’ only, with all ‘1991 Codes’ as one group included for the completeness of data.

The use of 1991 Codes, which should have ceased from April 2001, continued, but has diminished over time and this issue will hopefully be eliminated soon. In the 2002–03 analysis, 1991 Codes accounted for 7.4% of all records for revascularizations and 12.2% for CHD emergency episodes. By 2005–06, the use of the 1991 Codes had fallen to 4.5% and 3.5%.38

Section 6.3 of the Department of Health guidelines describes actual collection of ethnicity information. For outpatients, these recommend issuing a form to the patient prior to admission. During hospital admissions, guidelines recommend collecting the information verbally. In both cases, the intention is for the information to be self-assigned as much as possible. However, the Census and NHS processes of collecting detailed ethnic information and assigning to the 16 2001 Census categories are not identical and may lead to inconsistencies in ethnicity coding between HES and Census data.24 The extent to which ethnicity information is actually self-assigned in the Census could also be considered to be variable.

Difficulty in assessing need
Inequalities are not always inequitable. Significantly different revascularization rates in some groups are inequalities, but if they reflect differing need, they are not inequities. Equal revascularization rates in each ethnic group would reflect inequity, as certain groups have higher incidence of mortality from CHD. The number of CHD admissions and revascularization episodes for Chinese people was particularly low but probably not unduly so, given both that Chinese people comprised only 0.7% of the London population aged 50 and over in the 2001 Census and their known low CHD rates.

Assessing need by ethnic group is difficult because of the lack of reliable data. Death registration does not record
Ethnicity, precluding routine information on disease-specific mortality by ethnicity. Country of birth is now an inadequate proxy for ethnicity, as 50% of the minority ethnic group population in England and Wales in 2001 were born within the UK, including just over half of Pakistani people and just under half of Bangladesh and Indian groups. Ethnic coding of routine healthcare data is imperfect. CHD prevalence at a local level is not routinely available, particularly by ethnic group. Primary care data may in future be a useful source, but information on ethnicity is not captured.

A disadvantage of proportional ratios is their dependence on the presence or absence of competing causes of death or, for revascularization, healthcare utilization, with an observed excess reflecting either a true excess or a deficit of (another) major cause(s). Standardized proportional mortality ratios (PMRs) have been used primarily for analyses of studies of occupational mortality and morbidity. PMRs are an overestimate, where mortality from major diseases is low, and an underestimate when a group's overall mortality rate is high. PMRs have also been used to examine ethnic differences in mortality. Mortality of migrants from the Indian subcontinent showed distinct differences between various South Asian groups for a range of causes of death, but mortality was high for CHD in all groups. When using proportional ratios, one needs to make a judgement about whether the results are likely to be an overestimate or an underestimate. For example, if there is a particular ethnic group that is more likely to be admitted for CHD for a reason other than revascularization, then one can conclude that the PAR is likely to be an underestimate for that group and vice versa. This is a possible explanation for the low PAR for Bangladesh Londoners, as was discussed earlier. The choice of comparator (analogous to a denominator) is crucial for the assessment of inequality by cause of admission, as discussed below. As a broad comparator ('all admissions' or 'all episodes', as the broadest) is particularly liable to bias from the presence or absence of competing causes.

Choice of comparator/denominator

The proportional ratio results for revascularizations using three different comparators show that care needs to be exercised when selecting comparators. The choice of comparator substantially affects the conclusions. When all admissions are used as the base, the PARs for CHD admissions and for revascularization vary considerably but loosely reflect the known prevalence of CHD in different ethnic groups. It is only when revascularization episodes are compared with CHD episodes that the ratios become near to unity for most ethnic groups, suggesting no inequalities between provision and need, with the notable exception of Bangladeshi and Black Caribbean and Black African patients.

Conclusions

Proportional ratios show that the provision of revascularization is on the whole related to need and independent of ethnic group. However, Bangladeshi people underwent around half to two-thirds and Black Caribbean and Black African people around three-quarters to four-fifths the revascularization procedures that would be expected, given the prevalence of CHD in this group (as measured by their rates of emergency hospital care for CHD).

Further analyses, or inclusion of ethnicity in all routine data sources, are required to characterize the inequalities better and to identify the stages at which these appear. It is important that data collection continues to improve in quality and that data are used to monitor healthcare use by ethnicity. This method can be used as part of health equity audit. Inequalities identified need to be explored locally to identify inequities and agree mitigating action. The analysis of routine data can identify potential inequities, but local investigation is required to ascertain why these occur.

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Contributors: All authors designed the study; E.K. extracted the data; E.K. and J.F. analysed the data; all authors interpreted the data; J.M. drafted the manuscript. All authors revised the manuscript and have seen and approved the final version.

Guarantor: Dr Jennifer Mindell

Ethics approval was not required.
The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

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