CHAPTER 9

AN EQUITY AUDIT IN CORONARY CARE

EXEMPLAR Payne, Nick and Saul, Carol (1997) 'Variations in use of cardiology services in a health authority: comparison of coronary artery revascularisation rates with prevalence of angina and coronary mortality', *British Medical Journal*, 314: 257–61

What you need to understand in order to understand the exemplar
The term 'prevalence'. Here this means the number/proportion of people in an area suffering from a condition (angina) at a point in time or over a given time period.
The idea of representativeness and ways of selecting representative samples. *See Chapter 10, section 1*
The importance of an adequate sample size for a survey and how to read the confidence intervals given. *See Chapter 10, sections 6 and 7*
Age standardisation. *See Chapter 11, sections 1 and 2*
Standardised Mortality Ratios. *See Chapter 11, section 3*
Deprivation Indices. *See Chapter 11, section 4*
Correlation, correlation co-efficients, regression and scatterplots. *See Chapter 10, section 10*
For any terms which are unfamiliar, try the index.

Introduction

The inverse care law was formulated by Tudor Hart in 1971, stating that there is an inverse relationship between the need for care and the availability of care: the people who need care most are those least likely to get it. In the exemplar reading for this chapter, Nick Payne and Carol Saul demonstrate this for cardiology services in Sheffield in the late 1990s. Their research involved:

- A community sample survey using a postal questionnaire charting the prevalence and social distribution of symptoms of heart disease.
- The use of a deprivation index to rank electoral wards in Sheffield on a scale of deprivation and affluence.
- The use of a standardised mortality ratio for deaths from coronary heart disease to show the relationship between death from this cause and area deprivation, after discounting for the effects of different wards having different age profiles.
- The correlation of deprivation, severally with early death, coronary symptoms and treatments provided, analysed by regression analysis expressed in terms of a correlation co-efficient (Pearson's Product Moment) and scatterplots.
- The validation of data collected by service agencies against data collected by a survey.
- The comparison of the pattern of 'need' as established by the research, as against the pattern of services actually delivered, which showed that poorer areas had more people in need of cardiology services, but fewer people in these areas received them.

Payne and Saul describe their study as an 'equity audit', as indeed it is, since the research evaluates whether services are being delivered on an equitable basis. However, much of what they did could equally well be used in an exercise of epidemiologically based needs assessment designed to prioritise different areas of an authority for additional resourcing or for special exercises to improve access to services.

VARIATIONS IN USE OF CARDIOLOGY SERVICES IN A HEALTH AUTHORITY: COMPARISON OF CORONARY ARTERY REVASCULARISATION RATES WITH PREVALENCE OF ANGINA AND CORONARY MORTALITY

Nick Payne and Carol Saul

Abstract

Objective: To explore the relation between rates of coronary artery revascularisation and prevalence of angina to assess whether use of health services reflects need.

Design: Prevalence of angina symptoms determined by postal questionnaire on 16,750 subjects (18 to 94 years). Comparison of data on use of coronary artery revascularisation with prevalence of symptoms and mortality from coronary heart disease.

Setting: Health authority with population of 530,000.

Subjects: Patients admitted to hospital for coronary heart disease; patients who died; and patients undergoing angiography, angioplasty, or coronary artery bypass graft. Cohort of 491 people with symptoms from survey.

Main outcome measures: Pearson's product moment correlation coefficients for relation between variables.

Results: Overall, 4.0% (95% confidence interval 3.7% to 4.4%) of subjects had symptoms. Prevalences varied widely between electoral wards and were positively associated with Townsend score ($r = 0.79$; $P < 0.001$), as was mortality, but the correlation between admission rates and Townsend score was less clear ($r = 0.47$; $P < 0.01$). Revascularisation rate and Townsend score were not associated. The ratio of revascularisation to number experiencing symptoms was inversely related to Townsend score ($r = -0.67$; $P < 0.001$). The most deprived wards had only about half the number of revascularisations per head of population with angina than did the more affluent wards. In affluent wards 11% (13/116) of those with symptoms had coronary angiograms compared with only 4% (9/216) in poorer wards ($\chi^2 = 4.96$; $P = 0.026$). Townsend score also inversely correlated with revascularisations per premature death from coronary heart disease ($r = -0.55$; $P < 0.01$) and revascularisations per admission for myocardial infarction ($r = -0.47$; $P < 0.01$).

Conclusion: The use of interventional cardiology services is not commensurate with need, thus exhibiting the inverse care law.

Introduction

Tudor Hart enunciated the sad fact that 'the availability of good medical care tends to vary inversely with the need for it in the population served'; often summarised as the inverse care law.[1] More recent work has suggested health authorities should carry out 'equity audits' to determine whether health care resources are being utilised in accordance with need.[2]

In the treatment of angina, increased availability of coronary artery revascularisation, such as coronary artery bypass graft and angioplasty, has been recommended.[3] There is, however, distinct national and local variation in rates of treatment.[4,5] While some have shown poor access to services among residents of deprived areas[6] others have found no such relation.[7]

In general, utilisation of revascularisation treatment for angina will be influenced by the following: firstly, need – epidemiology of disease that, even after differences in age and structure are considered, varies substantially from place to place, at both national and local levels;[8] secondly, supply – the availability of cardiologists and centres carrying out revascularisation procedures has been shown to be a substantially important predictor of utilisation;[4,9] thirdly, demand – in turn affected by patients' consultation thresholds, general practitioners' referral thresholds, and cardiologists' referral and intervention thresholds.

We examined the prevalence of symptoms of angina at small area level within a city, Sheffield, no part of which is more than 20 km from a major cardiological centre.

Methods

Sheffield has a population of 530,000, living in both rural and urban areas. It has 29 electoral wards ranging in size from 12,400 to 31,800 residents. Specialist cardiological investigation and treatment is carried out at the Northern General Hospital, which is located closest to some of the wards with the highest standardised mortality ratios for coronary heart disease. This hospital also provides specialist cardiological services to the surrounding districts in South Yorkshire and North Derbyshire, thus serving a population of around 1.5 million.

Determining prevalence of angina

After we obtained ethical approval we used the health authority's population register to generate a random sample, stratified for age and sex, of residents registered with general practitioners. The stratification was by six age and sex bands: men or women and ages 18–34, 35–54 and 55–94 years. A postal questionnaire to determine the prevalence of a range of common symptoms was sent to this sample of 16,750 residents in March 1994.

The sample was also stratified at the electoral ward level, such that the prevalence of the various conditions studied could be estimated with reasonable confidence limits for each of the 29 electoral wards.

We used a slightly simplified form of the World Health Organisation (Rose) angina questionnaire[10] to assess the prevalence of angina symptoms (D. Cook, personal communication). To improve the specificity only those with more severe symptoms were included. Up to two reminders (one full questionnaire and one postcard) were sent to those who failed to respond. By preserving a unique patient number we directly linked questionnaire data from individual respondents with health event data such as hospital admissions and procedures.

Health event and census data

The health authority's database was used to examine hospital admission activity at electoral ward level – all these data were based on hospital admissions not consultant episodes, which can be multiple within a single admission. We calculated overall admission rates (emergency and elective) for coronary heart disease (ICD-9 (International Classification of Diseases, ninth revision) codes 410–414), myocardial infarction (code 410), coronary artery bypass graft (codes K40–K47 in the fourth revision of Office of Population Censuses and Surveys classification of operations[11]), and angioplasty (codes K49–K50.1). At individual level, particular attention was paid to admissions for angiography (codes K63–K65), coronary artery bypass graft, and angioplasty from 1 April 1991 to 31 December 1995, the time period just before and after the survey. For survey respondents, linked activity data were examined at the individual patient level, thus multiple admissions of the same patient were counted only once.

We used the 1991 census to calculate the Townsend score[12] for each electoral ward. This score is designed to be high in areas of increased deprivation.

Data handling and analysis

Survey data were analysed with EpiInfo.[13] When appropriate we standardised individual ward data directly by using the England and Wales population as the reference. Data were plotted as scatter plots, and Pearson's product moment correlation coefficients were calculated.

Results

Of the 16,750 questionnaires sent out, 12,240 (73%) were completed and returned. After we excluded a further 1160 that were returned without reaching the person for whom they were intended, the response rate was 79%. Table 1 shows the prevalence of symptoms of angina by age and sex for Sheffield as a whole.

Overall, 4.0% (95% confidence interval, 3.7% to 4.4%) experienced symptoms of pain or discomfort in the chest when walking at an ordinary pace on the level. The proportion was 4.6% (4.0% to 5.2%) in men compared with 3.6% (3.2% to 4.0%) in women and was substantially higher in older age groups.

Table 1 Prevalence of symptoms of angina[10] by sex and age band

Sex and age (yr)	No. (%) of patients
Men:	
18–34	32/1711 (1.9)
35–54	45/1758 (2.6)
55–94	172/1975 (8.7)
18–94	249/5444 (4.6)
Women:	
18–34	22/2027 (1.1)
35–54	48/2079 (2.3)
55–94	172/2689 (6.4)
18–94	242/6795 (3.6)

Prevalence of symptoms and mortality from coronary heart disease compared with deprivation

There was wide variation in the age standardised prevalence of symptoms of angina between electoral wards; it ranged from under 2% in some to over 6% in others. Figure 1 shows that there was a strong positive relation ($r = 0.79$; $P < 0.001$) between the Townsend score of the electoral ward and the prevalence of symptoms.

Figure 2 shows a similar relation when we plotted premature mortality (<65 years) from coronary heart disease against Townsend score. Again, there was wide variation in the mortality between electoral wards, and mortality was strongly and significantly correlated with Townsend score ($r = 0.78$; $P < 0.001$).

Unlike symptoms of angina or mortality from coronary heart disease, admission rates for coronary heart disease varied only twofold between the highest and lowest electoral wards. There was still a significant correlation between admission rates and Townsend score ($r = 0.47$; $P < 0.01$), but it was now smaller than for prevalence of angina symptoms or mortality from coronary heart disease. There was, however, no relation at all between the rates of coronary artery revascularisation (angioplasty and coronary artery bypass graft) and Townsend score.

To determine whether utilisation of coronary artery revascularisation was uniformly related to need we calculated the ratio of revascularisations to the number in the electoral ward estimated to have symptoms of angina. Figure 3 shows

Figure 1 Prevalence of angina symptoms compared with Townsend deprivation score

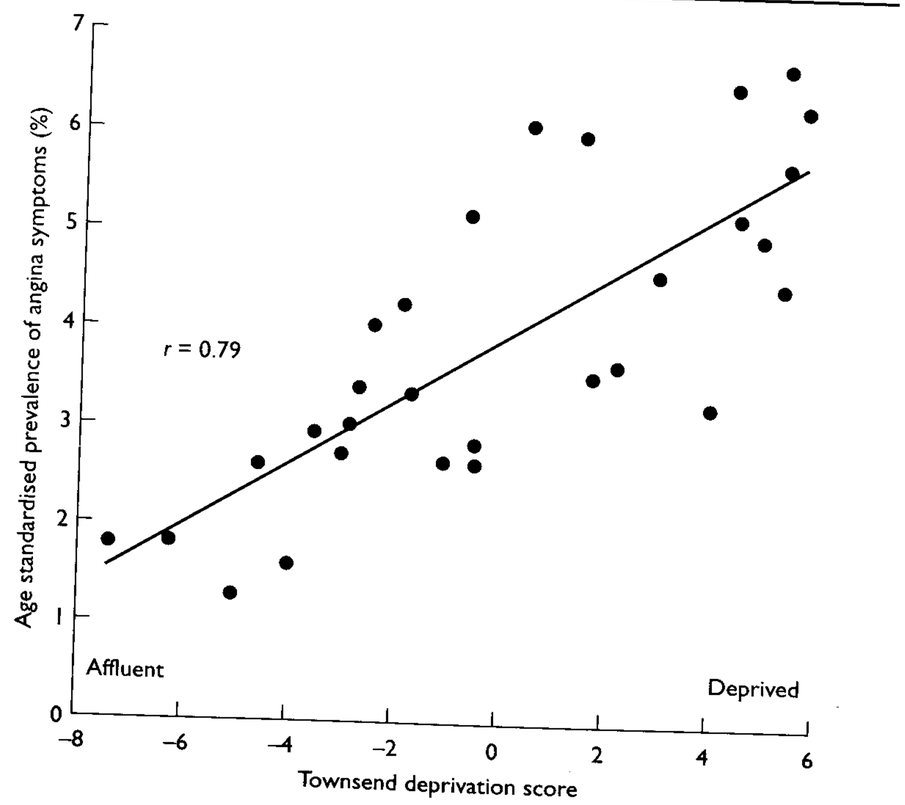
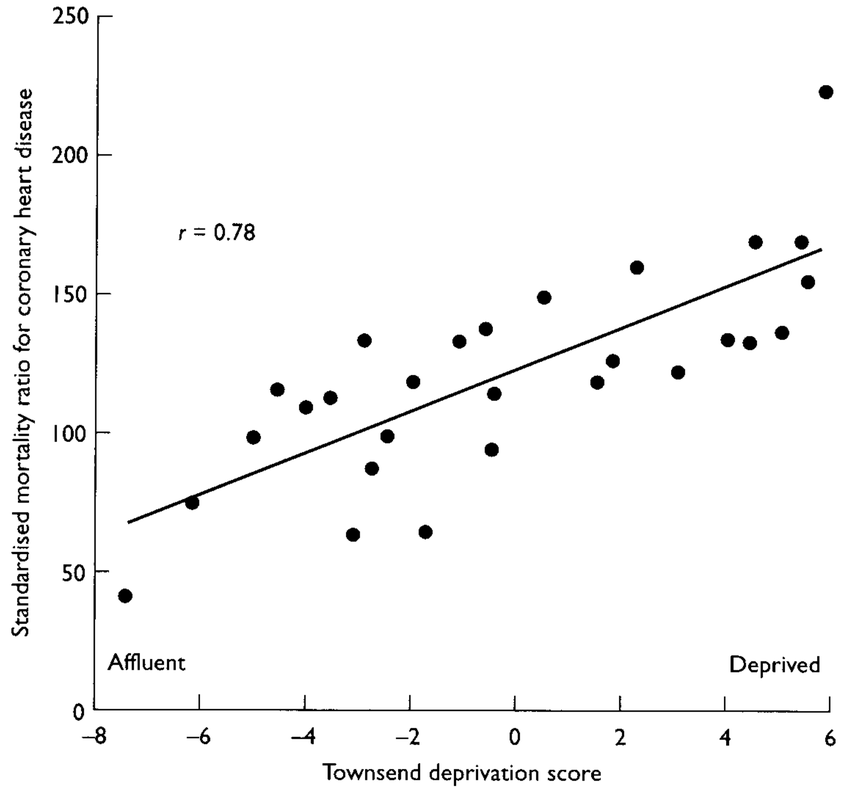


Figure 2 Mortality from coronary heart disease (standardised mortality ratio 1988–92 for ages 35–64) compared with Townsend deprivation score



this index plotted against Townsend score. There was a clear variation between electoral wards in these ratios: deprived wards had only about half the numbers of revascularisations per head of population estimated to have angina symptoms than did affluent wards ($r = -0.67$; $P < 0.001$).

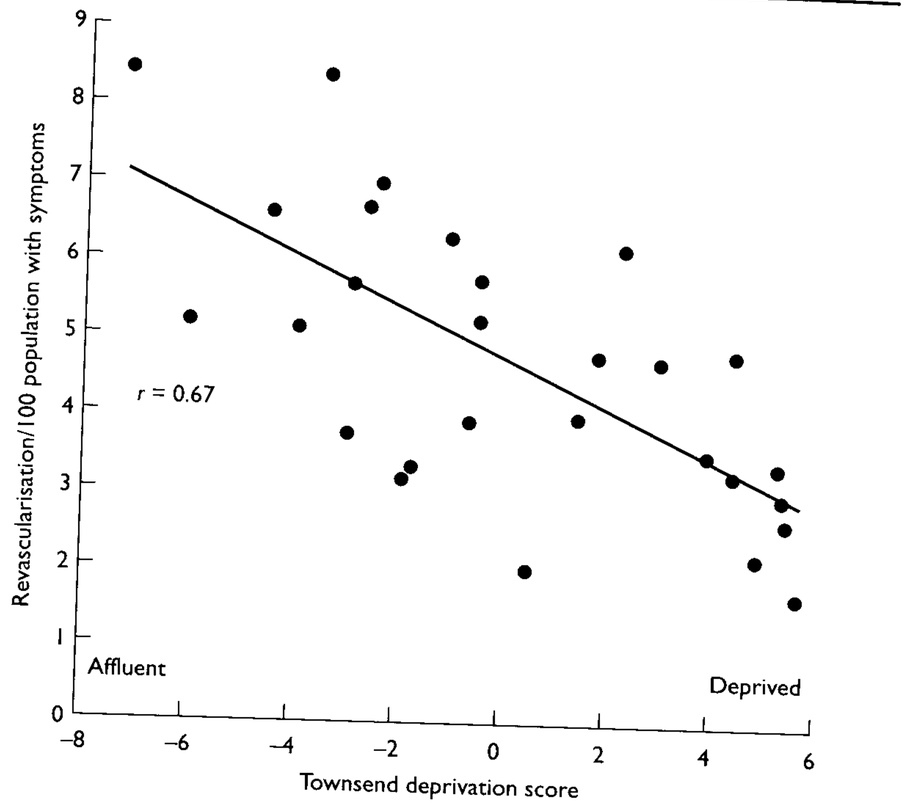
Proxy measures of prevalence of angina

As health symptom surveys may overestimate the true prevalence of angina, two proxy measures were compared with the coronary artery revascularisation rate. Figure 4 shows a similar inverse relation between revascularisations per premature death (<65 years) from coronary heart disease and Townsend score ($r = -0.55$; $P < 0.01$). Figure 5 shows that the same was true when revascularisations per myocardial infarction were compared with Townsend score ($r = -0.47$; $P < 0.01$).

Linkage data for survey and service utilisation

It may not be valid to assume that relations found at small area level exist at the level of the individuals who make up those areas (the 'ecological fallacy'). We also considered, therefore, data at both small area and individual level.

Figure 3 Coronary artery revascularisations per number with symptoms of angina compared with Townsend deprivation score

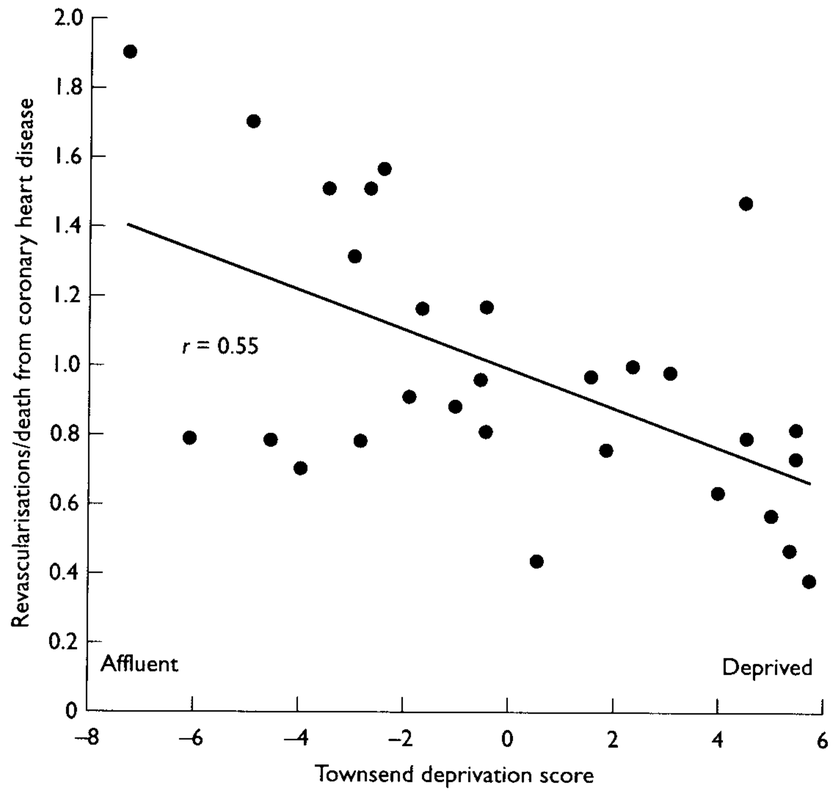


Individual survey results from respondents who had angina symptoms were linked to health event data to determine whether they had been admitted to hospital for angiography in the three years before and 21 months after the survey. Validation showed 100% linkage accuracy – that is, no relevant records were lost in this process. The angiography rate was found to be 20 times higher in those with angina identified through the survey (19.7/1000 population) compared with the rate in the general population (1.0/1000 population). Table 2, however, shows that there was substantial difference between more affluent and less affluent electoral wards: in the 10 most affluent wards 11.2% (13/116; 95% confidence interval 5.5% to 16.9%) had had angiography compared with 4.2% (9/216; 1.5% to 6.9%) in the 10 most deprived electoral wards ($\chi^2 = 4.96$; $P = 0.026$). Finally, 6.9% (22/321) of those aged under 70 years with angina symptoms had had an angiogram compared with only 1.2% (2/170) of those aged 70 and over ($\chi^2 = 6.53$; $P = 0.01$).

Discussion

Our results show a large local variation in both mortality from coronary heart disease and prevalence of angina as determined by a population survey. Both mortality and prevalence of symptoms were strongly correlated with material deprivation, as estimated by the Townsend score, at electoral ward level. We found that the ratio of rates of coronary artery revascularisation to the prevalence of

Figure 4 Coronary artery revascularisations per death from coronary artery disease compared with Townsend deprivation score



angina symptom varied substantially across the city and was inversely proportional to deprivation. Thus, use of services was not commensurate with need and seemed to exhibit the inverse care law,[1] even though the availability of care is the same.

The data on rates of coronary artery revascularisation refer only to procedures undertaken within the NHS, and private sector activity may add another 10–20% to this.[14] Given that private sector activity is likely to be higher for more affluent wards, however, and indeed that private insurance coverage in professional groups is much higher than in unskilled manual groups (23% compared with 2%[15]), the differences in use in relation to need for these services between the affluent and deprived populations may be even greater than described.

Response rates to the electoral ward survey varied between 63% and 88%, with affluent wards tending to have highest response, and this might have influenced the results. All but five of the 29 wards, however, had a response rate of over 70%. Moreover, the lower response rates in deprived electoral wards are only of concern if they result in deprived respondents being less representative of the deprived population than affluent respondents are of the affluent population; there is no evidence that such response bias exists.

Problems have been identified regarding the utility of the angina questionnaire,[10] particularly regarding its specificity in women.[16,17] The health survey for England,[18] which used similar questionnaire and survey methodology, gave an overall prevalence of 3.1% (95% confidence interval 2.7% to 3.6%) in an equivalent age group.

Figure 5 Coronary artery revascularisations per admission for myocardial infarction compared with Townsend deprivation score

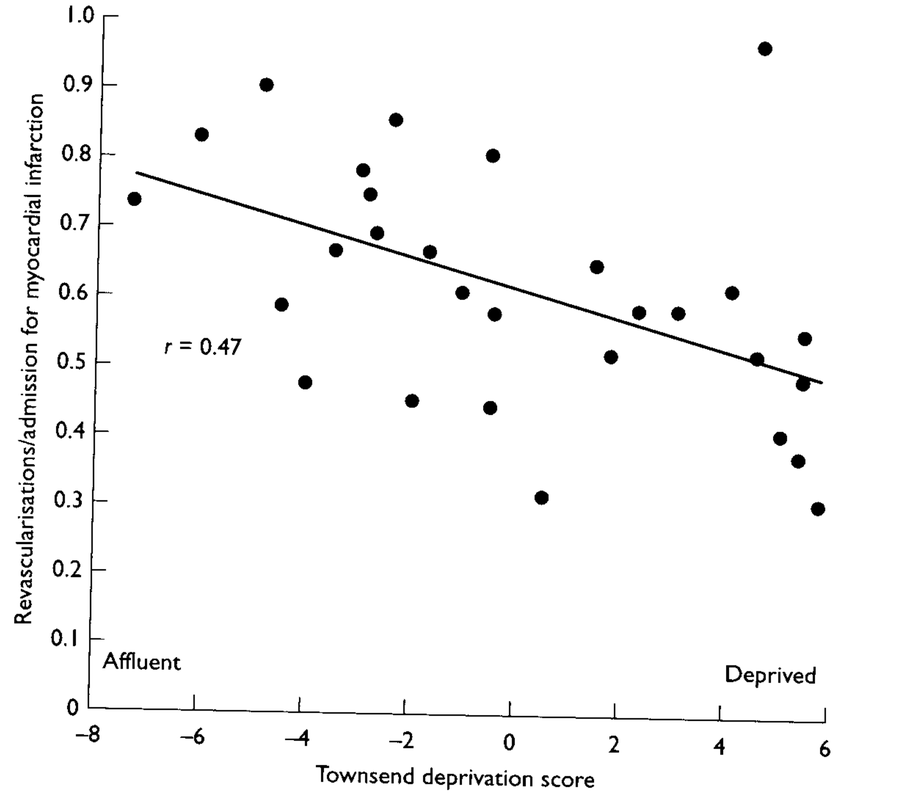


Table 2 Proportions of subjects who reported symptoms of angina and had undergone angiography

Wards	No. of subjects	Proportion (%) (95% CI)
Ten most affluent	13/116	11.2 (5.5 to 16.9)
Ten most deprived	9/216	4.2 (1.5 to 6.9)

Even in their 18–34 year group the estimated prevalence was about 1%. The same survey, by using diagnosis as reported by patients, produced estimates of 4.3% in men and 3.4% in women; broadly similar to our results. Other estimates are lower, at 1.6% in men and 1.2% in women, but these are derived only from numbers of patients consulting general practitioners in a single year.[19] Although these methodological problems may have implications for the absolute values of symptoms of angina, however, there is no evidence that specificity and sensitivity rates are likely to vary according to level of deprivation, so any impact on the comparison between affluent and deprived populations is probably insignificant. Prevalence of other symptoms (for example, hip pain) examined in our survey and elsewhere[20] showed little or no relation to deprivation, thus failing to support the notion that people in lower socioeconomic groups complain more about symptoms. Moreover, the relation shown between mortality from coronary heart disease and deprivation strongly reinforces our finding with respect to the distribution of angina symptoms.

The hospital data on admissions, like other routine data, have limitations,[21] but the data used for this study have been subject to local validation between provider and purchaser and suffer from these problems much less than most hospital episode statistics datasets.

Patients who smoke are known to have poorer results after revascularisation procedures,[22-24] and though this has led to considerable debate, many clinicians are reluctant to perform these procedures unless patients have stopped smoking.[25] One possible explanation for the findings reported here is that they are related to the prevalence of smoking, which is higher among less affluent groups. If we assumed that prevalence of smoking among angina sufferers is twice as high in the more deprived parts of Sheffield, however, this would explain only half of the observed difference in the difference of the revascularisation to prevalence ratio between electoral wards. To illustrate, the angiography rate in those with angina identified through the survey was found to be 11% (13/116) in the 10 most affluent wards and 4% (9/216) in the 10 most deprived wards. National and local data suggest that about 83% of affluent populations are likely to be non-smokers but only 65% of deprived populations.[26 27] Even if the smokers had been excluded from treatment (that is, from the numerator) and if the denominator was adjusted to reflect the likely number of non-smokers, the angiography rate in affluent wards would still be twice that in deprived wards – that is, 13% ($13/(116 \times 0.83)$) *v* 6% ($9/(216 \times 0.65)$), respectively. In future studies, however, smoking prevalence and measures of comorbidity from hospital activity datasets could be controlled for directly. This would also be important in the investigation of our finding of differential revascularisation rates between older and younger patients as age alone should not be a determining factor in selection of patients for this treatment. Selection of elderly patients for angiography is more complex than for younger patients, but it has been argued that symptomatic benefit is similar for younger and older patients and that earlier referral and investigation might yield a population with lower operative risk.[28]

Recommendations for action

We recommend an audit of referral of angina patients, particularly seeking to redress this apparent inequity. If consultation thresholds are higher in the less affluent areas it should be determined whether education of patients is required to encourage consultation by those with symptoms suggestive of angina. General practitioners should be aware of referral recommendations and potential benefits of treatment for those with angina. Detailed discussion of these results with cardiologists suggests that once patients have been referred for angiography those needing revascularisation are prioritised only on the basis of the severity of their disease. Finally, if cardiology services are expanded, steps should be taken to ensure that those in less affluent parts of the city receive a fairer share of these health services.

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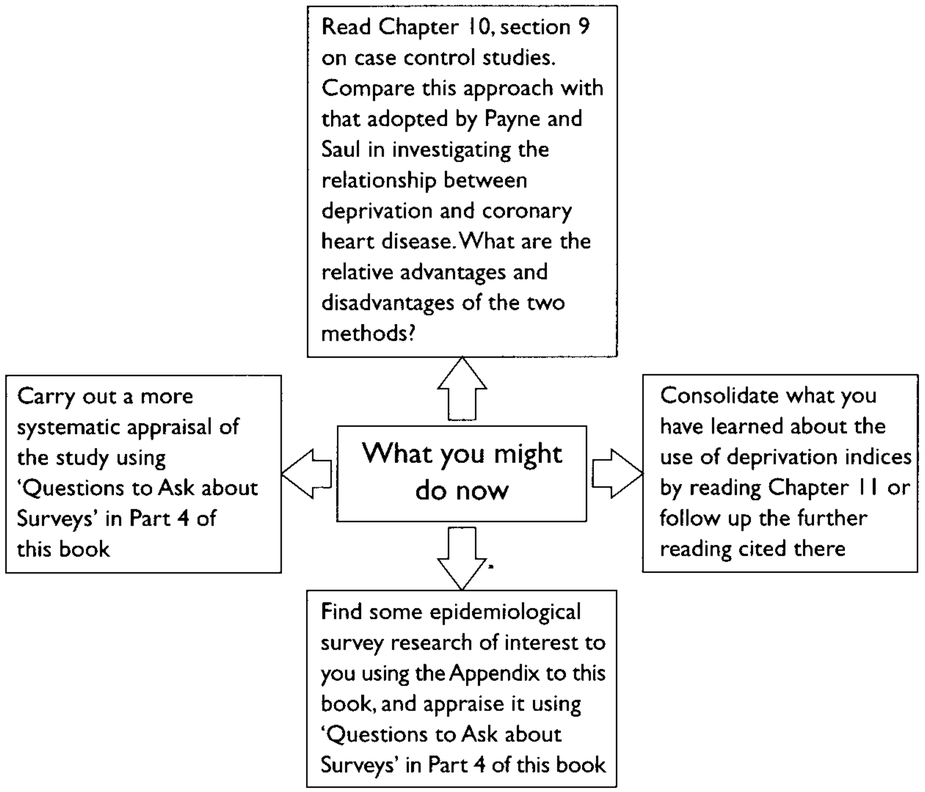
What you might do now



RESOURCE CHAPTERS

CHAPTER 10

SURVEYS AND CASE CONTROL STUDIES

Introduction — 1 Sampling and representativeness — 2 Sampling frames — 3 Stratified (or non-proportional) samples — 4 Cluster sampling — 5 Staged sampling and phased sampling — 6 Confidence intervals and surveys — 7 Selecting a stratified sample of adequate size: an example — 8 Under- and over-representation and their management — 9 Case control (or case comparison) studies — 10 Correlation, co-efficients, regression and scatterplots — 11 Correlation, causes and statistical control — 12 Contemporaneous and longitudinal surveys — 13 The ecological fallacy in interpreting survey results — 14 Questionnaires, reliability and meaningfulness — 15 Questions to ask about surveys — 16 Further reading on surveys and case control studies — References and further reading

Introduction

This volume contains two exemplar studies with surveys as important components. Chapter 8 offers an exercise by Geoff Cohen and his colleagues in validating the sampling procedures and the instruments (questionnaires) used in Scottish surveys of consumer satisfaction with the NHS. General remarks about the validation of instruments are made in Chapter 6. Chapter 9 presents an exemplar of service evaluation by Nick Payne and Carol Saul using, among other research techniques, a survey to chart the social distribution of angina symptoms. This chapter now provides some general comments about survey technique and how to read the results of surveys.

The purpose of a survey is to chart frequency distributions in a population. These might be the percentages of people in the population of the UK of different ages with limiting and long-standing disabilities or perhaps the numbers of people of different types who are satisfied with the primary care they receive (Chapter 8). Such data may be put to use in:

- Planning services, for example, how many people of what different types would benefit from and appreciate this kind of care?
- Evaluating policies and interventions, for example, how many people of what types engaged in health-damaging behaviours before the health promotion campaign and how many afterwards