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Assessing equity in access to health care provision in the UK: does where you live affect your chances of getting a coronary artery bypass graft?

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Abstract

Study objectives **– Equity should be monitored routinely for all health care services, but ideal studies for each service would be prohibitively expensive and time consuming. A simple, quick, and cheap method for the preliminary exploration of equity in health care provision using routine data was devised. This method was illustrated by examining whether coronary artery bypass graft (CABG) operations reflect socioeconomic differences in ischaemic heart disease (IHD) mortality.**

Design **– Ecological comparison of operation rates was undertaken for CABG for 1991 and IHD mortality for 1981–85 by quartiles of Townsend deprivation score.**

Setting **– North East Thames Regional Health Authority, London, UK.**

Subjects **– All residents of this region aged 35–74 were the denominator population. Numerators were 26 834 IHD deaths and 1041 CABG operations for the defined time periods.**

Main results **– IHD mortality showed a steady, significant increase with increasing area deprivation scores for both men and women. CABG rate ratios increased linearly for women, while for men there was a U shaped pattern, being lowest for the second and third quartiles. This pattern was attenuated, but not abolished, when adjusted for geographical proximity to cardiothoracic surgical units. The ratio of CABG operations to IHD mortality by deprivation was relatively constant in women suggesting equitable provision. In men, this ratio was significantly lower for the third quartile.**

Conclusions **– Inequities may exist in the provision of CABG operations for men in this region and this finding should be the stimulus for further detailed studies. Other health care systems should also examine equity in provision.**

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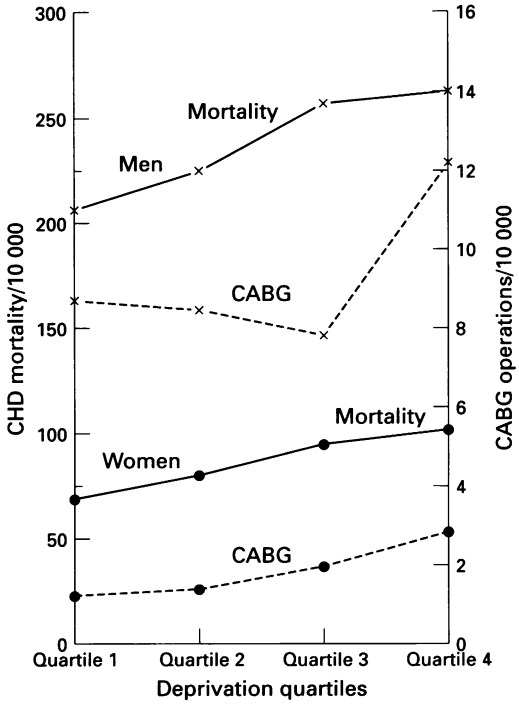
Equity in access to health care services is a pressing concern, both in the US[1] and in the UK.[2] Research from the US has consistently shown that certain groups, such as the poor,[3] women,[4] and ethnic minorities,[5] have less equitable rates of health care provision than other sectors of the population. These inequalities have prompted proposals for health care reforms in the US. One component of these reforms is to widen insurance coverage, as lack of insurance has been a major contributor to inequalities. In contrast, there is little research examining equity in health care provision in the British NHS. This may be attributable to the perception that the universality of the NHS could not result in such inequitable health care distribution. But a recent UK study suggests that such complacency may be dangerous; for a given level of morbidity, women are less likely to receive coronary artery surgery.[6] This highlights the need for regular monitoring of equity in provision for all health care services. Ideally, this monitoring should be performed by collecting population based data on morbidity, or need, for all interventions, and subsequent health care provision. In addition, data on important confounders such as co-morbidity, ethnicity, and social class would need to be collected. Clearly, it would be impossible for each health authority to perform such a study for each health care service even once. What is required is a method which uses readily available data to assess equity and highlight areas where inequality in provision may be occurring. These findings should act as a stimulus for more detailed studies to investigate specific services further. A routine monitoring instrument could quickly evaluate the effect on equity due to any subsequent service changes. We wished to devise a simple method that would provide results quickly and cheaply, and hence could be used repeatedly for monitoring purposes, and could be adapted for use for other services and other disease conditions.

We have used coronary artery bypass graft surgery (CABG) as an example of how equity in provision can be easily and quickly assessed using readily available data. In this instance we examined equity by deprivation. Mortality data for ischaemic heart disease (IHD) provide a fair approximation of the level of morbidity from IHD within the population,[7,8] and show that there is a strong socioeconomic gradient for this condition. CABG is a commonly available operation for IHD, and therefore provision of CABG should reflect need for services and can begin to test whether services are distributed in an equitable fashion.



Age adjusted CHD mortality and CABG operation rates by Townsend quartile of deprivation for North East Thames. Quartile 1, most affluent; quartile 4, most deprived.

Methods

Mortality data (1891–85) from IHD (ICD codes 410–414) and population denominators for men and women aged 35–74 were obtained for the 576 electoral wards in North East Thames Region in London from the Office of Population Censuses and Surveys (OPCS). Five year rather than one year mortality data were used to provide more stable estimates. This region has approximately 3·8 million residents and was chosen as it demonstrated a wide variation in socioeconomic status.

NHS hospitals and trusts routinely collect hospital episode system (HES) data on all inpatients. These data are collated regionally, and data are exchanged to ensure that each region has information on its residents, wherever they were treated. HES data for CABG surgery (OPCS operation codes K40·1–K48·9) for all residents, treated both within and outside the region, for those aged 35–74 were obtained from the North East Thames Regional Information System (IDRIS) for 1991. Operation codes 47·2, 47·3, 47·8, and 47·9 do not reflect IHD morbidity; only one subject in this dataset had one of these codes. Data from private hospitals in the UK are not collected in a systematic fashion and were therefore not available. Routine data on socioeconomic status are also not available, and an area deprivation score for each individual was therefore used. Data on ward socioeconomic variables were obtained from the 1981 census (SASPAC) to derive Townsend deprivation scores.[9] This score is calculated from census data and includes the proportion of unemployed economically active men and women, car ownership by household, overcrowding, and housing tenure. A composite score is produced by standardising and summing all four components. An increasing positive score indicates relative deprivation. Each ward was allocated a deprivation score; for a few wards it was necessary to allocate deprivation scores by using the frozen postcode file, as boundary changes had occurred since the last census. The median number of CABG operations by ward was small; in men two operations were performed per ward, and in women only one. To improve the stability of our estimates of CABG rates, wards were ranked by their deprivation score and divided into quartiles. Quartile one denotes the most affluent 25% of wards.

Living near a cardiothoracic unit may increase the likelihood of receiving an operation. Three of the 15 health districts in North East Thames have hospitals with cardiothoracic surgical facilities within their boundaries. All wards in these three districts were classified as geographically "near", other wards were classified as "far".

Male and female age-specific CABG rates were directly standardised to the total regional population using four ten year age groups. Age adjusted rate ratios and confidence intervals for IHD mortaity and CABG operations were calculated by Poisson regression modelling using *EGRET*.[10] The rates in the most affluent quartile were taken as the baseline group in all analyses. CABG rate ratios were further adjusted for geographic proximity. To compare CABG provision with IHD mortality, we calculated the ratio of CABG operations to IHD mortality by quartile of deprivation. These rates were again adjusted for age group and geographical proximity using Poisson regression modelling. This analysis is akin to that for an SMR; in this case the numerator is the observed CABG operations, while IHD deaths are a proxy for expected operations. As the number of deaths were relatively large compared with the number of CABG operations, the former is assumed to have small sampling error. Deprivation quartiles were modelled both as a dummy variable and as a continuous term to examine whether there was a significant linear trend and were tested using likelihood ratio statistics.

Results

There were 26 834 deaths (19 283 male, 7551 female) for the five year period 1981–85, and 1041 CABG operations in subjects between the ages of 35 and 74 years for the calendar year 1991. Seven cases did not have sex coded, and were therefore excluded: 25 of the remaining 1034 cases (2·4%) could not be allocated to a ward as there was inadequate postcode information. Our analysis was carried out on 1009 CABG operations (814 male, 195 female).

For women, there was a significant steady increase in both mortality and CABG operative rates by quartile of deprivation (figure). Male IHD mortality also showed a similar pattern with deprivation, but operative rates were relatively constant until a significant elevation in the fourth quartile of deprivation. These results

Coronary heart disease (CHD) and coronary artery bypass graft (CABG) rate ratios by Townsend quartile for North East Thames Regional Health Authority (95% CI)*

	Quartiles				χ^2 for trend on 1 df
	1	2	3	4	
Townsend score median value (range)	−3·7 (−7·2, −2·6)	−1·5 (−2·6, 0·1)	2·2 (0·1, 4·4)	6.9 (4·4, 13·0)	
Male:					
CHD mortality rate ratios	1·0	1·10 (1·05, 1·15)	1·26 (1·20, 1·31)	1·29 (1·23, 1·35)	159 p<0·001
CABG rate ratios	1·0	0·97 (0·77, 1·22)	0·90 (0·72, 1·11)	1·42 (1·16, 1·73)	14·6 p<0·001
Adjusted CABG rate ratios†	1·0	0·97 (0·77, 1·22)	0·87 (0·70, 1·08)	1·15 (0·91, 1·44)	0·6 p=0·43
CABG/CHD rate ratios†	1·0	0·86 (0·69, 1·08)	0·68 (0·55, 0·85)	0·82 (0·64, 1·03)	5·6 p=0·02
Female:					
CHD mortality rate ratios	1·0	1·20 (1·11, 1·30)	1·44 (1·34, 1·55)	1·50 (1·39, 1·61)	143 p<0·001
CABG rate ratios	1·0	1·18 (0·68, 2·05)	1·65 (1·00, 2·71)	2·36 (1·46, 3·81)	19·4 p<0·001
Adjusted CABG rate ratios†	1·0	1·18 (0·68, 2·05)	1·56 (0·95, 2·57)	1·75 (1·03, 2·96)	5·70 p<0·017
CABG/CHD rate ratios†	1·0	1·08 (0·62, 1·89)	1·34 (0·81, 2·20)	1·34 (0·77, 2·32)	1·70 p=0·19

* All ratios are age adjusted and relative to rates for the first (most affluent) quartile.
† These models are adjusted for age groups and distance from provider unit dichotomised as "near"/"far".

were almost identical when the analysis was repeated for just saphenous vein bypass grafts (K40·1–K40·9).

None of the "near" wards were in the top two most affluent quartiles of deprivation and "near" wards were therefore significantly more deprived than "far" wards ($\chi^2=186$, 3 df p<0·0001). The ratio of age adjusted CABG operative rates in "far" compared to "near" wards was 0·57 (95% confidence intervals (CI) 0·48, 0·67) in men, and 0·44 (95% CI 0·32, 0·61) in women. After adjusting for deprivation, the rate ratio was 0·65 (95% CI 0·53, 0·79) and 0·55 (95% CI 0·38, 0·81) for men and women respectively.

Adjusting for geographic proximity in both men and women, attenuated the CABG rate ratios for the third and fourth quartile of deprivation, this effect was greatest in the most deprived quartile (table). The ratio of CABG operations to IHD mortality was relatively constant in women. For men however, there was a U shaped pattern with a significantly reduced rate ratio for the third quartile of deprivation.

Discussion

These data cannot assess whether the true level of need is being met, since the true need for CABG operations is not known. They do, however, suggest that there may be inequitable service provision by deprivation for men in this region. The generalisability of these findings to other regions is unclear. In Northern Ireland, access, at least to coronary catheterisation, may not be inequitable,[11] suggesting that equity for a particular service may differ by region, and highlights the need for all regions to perform their own local monitoring. Further studies in North East Thames are obviously required to investigate these findings and determine whether distribution is indeed inequitable, and if so, to identify reasons for this inequity.

For men, there is a U shaped relationship between CABG provision and deprivation which does not reflect the mortality pattern. The observed relationship would certainly be accentuated if private operations could be included.[12] For women, CABG rates follow mortality trends more closely suggesting an equitable provision of health care, but again private operations are excluded. It is not clear why provision seems to be less equitable for men than women. The process by which an individual with angina eventually receives surgery is complex. There may be differences in this process by both sex and socioeconomic status, which merit further investigation.

"Far" wards were observed to have lower operative rates than "near" wards and were also more affluent. Adjustment for deprivation attenuated this ratio, but "far" wards still had lower operative rates than "near" wards. The effect of geographical proximity is also demonstrated in the sex specific CABG rate ratios. After adjustment, rate ratios were attenuated for wards only in the two most deprived quartiles. This confirms that geographical proximity to a centre performing cardiothoracic investigations is an important determinant in health care provision.[13]

CABG/IHD rate ratios should have been unity for both sexes across all quartiles of deprivation, if need was indeed being matched by provision. This was probably true for women, for although this ratio was 1·34 in the two most deprived quartiles, there was no significant trend across the quartiles. But for men, CABG/IHD rate ratios are lower in the three most deprived quartiles, and are significantly lower in the third quartile of deprivation. This suggests that men in the third quartile of deprivation are receiving fewer operations than they need. It could be argued that service provision for men in the most deprived quartile was more equitable as these men lived near a cardiothoracic centre, but this does not explain why the same pattern is not seen in women.

Possible limitations with these data include, (a) out of date data for ward populations and deprivation scores, (b) inaccurate and incomplete hospital inpatient data, (c) missing deprivation scores for some cases, and (d) our crude adjustment for geographic proximity. Recent census data should remedy the first limitation. Because of the wide variation in deprivation scores in this region (table), we believe it is unlikely that many wards would not be reclassified into a different quartile using current census data. Missing hospital and deprivation score data are unlikely to alter our findings, unless they are systematically biased by deprivation. Even our crude adjustments for geographical proximity had some effect, suggesting that it is a valid measure, and may partially account for the observed CABG rate ratio pattern in men. More sophisticated methods could be used to investigate the effect of proximity, and could be the first step in a detailed examination of our findings.

Ideally, CABG operation rates should be examined for a period prior to mortality rates. At a particular point in time, the population cohort used to investigate mortality will be the same as those eligible for a CABG in an earlier

period. However, we chose to examine recent CABG provision as our main aim was to investigate whether current levels of provision are appropriate.

Current mortality data are not available, and although mortality rates for heart disease are falling, it is unlikely that socioeconomic differences in IHD mortality have diminished, if anything they may have increased.[14] A comparison of IHD attack rates and IHD SMRs by region in Great Britain showed that the north-south mortality trend matched that of attack rates, but if anything, was less steep.[8] Our findings may therefore underestimate the degree of inequity in current health care provision. New interventions may have contributed to declining mortality rates, but again, are unlikely to have disproportionately favoured those living in deprived areas.

CABG is but one of the many interventions for angina, but an equal level of morbidity should be met by equal provision. It is unlikely that more affluent areas would have a greater degree of triple vessel disease. On the contrary, morbidity patterns suggest that the reverse is more likely. However, other factors, such as physical fitness, ability to take time off work, and co-morbidity, may well influence the clinical decision of whether a patient will be managed conservatively or surgically. Percutaneous transluminal coronary angioplasty (PTCA) is an alternative surgical intervention to CABG. But it is unlikely that a socioeconomic difference in the choice of intervention would result in a U shaped pattern of provision for men, and a different pattern for women.

Our data are ecological and individuals are classified by an area deprivation score. Other studies have indicated variations in surgical utilisation rates by socioeconomic status.[15] The similarity between IHD mortality differentials for both area deprivation[16] and socioeconomic differentials[17] suggest that the use of area scores may be a useful and valid proxy.

The observation that there is a mismatch between need (as assessed by IHD mortality) and health care provision (as assessed by CABG rates) is not new.[18] Others have examined the relationship between mortality and provision by geographical area, and find no positive association.[13 19] While this approach may highlight outliers which could be investigated further, it does not test a specific hypothesis about inequalities for a specific group. There is considerable socioeconomic heterogenieity even within districts, and the lack of an association may just reflect this. Our analysis enables us to examine whether the socioeconomic status of an area determines provision, over and above the mortality rate for that area. Further, if there is a non-linear relationship between need and provision, as we show for men, such simple correlation plots may fail to detect such an association.

A similar analysis of angiography rates by deprivation in Scotland,[20] showed a steady increase in provision with deprivation in both men and women, but after adjustment for SMR, showed that relatively affluent women have higher rates of angiography than would be expected. The validity of using angiography provision as a marker of need for IHD services is unclear, as a proportion of those who undergo angiography do not have IHD. Although this proportion may not be high in Scotland, in the US, it is thought that as much as 50% of angiography is performed for inappropriate reasons.[21] Population studies show that women report relatively high rates of angina symptoms, in comparison with mortality.[22] While it is unlikely that many women reporting these symptoms will undergo a CABG operation, it is likely that a substantial proportion would be considered for angiography.

While assessing the true need for health care provision in a population is difficult,[23] we have shown a fairly simple method for the preliminary assessment of equity. We show that at least in men, service provision may not be equitably distributed by area deprivation, and that geographical proximity to a provider unit has a marked influence on the likelihood of receiving an operation. This type of analysis could be extended for other services where the epidemiology of the condition is known, for different ethnic groups, and for screening services. Not all services will show a discrepancy, but those that demonstrate either under or over provision should act as a stimulus for further research. In this example, we suggest that inequalities in CABG provision may occur for men. Further studies should be performed to confirm or refute this suggestion, and investigate the role of geographical proximity, choice of intervention, and other co-morbid factors which may account for our observations.

There are demonstrable differences in health in relation to socioeconomic status in many European countries[24 25] and in the US.[26] International comparisons of health care provision by deprivation have also highlighted inequities in health care distribution, and suggest that centrally controlled health care systems, such as Canada, ensure greater equity than the unregulated open competition found in the US.[27] As the largest economy in the western world is to reform its health care system, international comparisons of equity of health provision, using routine markers of deprivation such as unemployment, income, and housing, are vital to inform policy. Since the changes in the NHS, we have moved to a more market orientated health care system. While contracts could explicitly address current inequities in service provision, US research suggests that inequitable provision is not ameliorated by medical care driven by market forces, albeit in an insurance based system.[3-5] In 1971, Tudor Hart observed that, "the market distribution of medical care is a primitive and historically outdated social form, and any return to it would further exaggerate the maldistribution of medical resources".[28] It is vital that this prophecy does not become reality.

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