Policy implications

- Statistical methods were used to devise a new equity based formula for allocating NHS resources to the health authorities
- The models show that in the acute sector standardised mortality rates, self reported morbidity, and a variety of social factors are legitimate indicators of need
- Taking into account the cost of hospital use, including day cases, the effect of age is less important than is currently assumed
- A formula based on this work would redistribute some resources towards poorer areas

current district allocations are likely to be observed. These divergences can be attributed to a number of factors—for example, local policies, clinical practice, efficiency levels, historical supply, local needs factors not captured by the national model, and random variation.

No national formula can possibly capture all the legitimate variations in needs existing in a large number of districts. As a result, although the figures derived from the formulas described here can serve as useful targets, there is always likely to be a need for local discretion. If the regional tier no longer has a role in resource allocation then serious thought must be given to methods by which such local discretion can operate to take into account legitimate local considerations.

Finally, the study has generated an invaluable dataset, which should be of interest to policymakers and researchers. The ward level dataset we have constructed will be released by the Department of Health for general use.

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Relation between socioeconomic deprivation and pathological prognostic factors in women with breast cancer

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Abstract

***Objective*—To investigate the relation between socioeconomic deprivation and pathological prognostic factors in women with breast cancer as a possible explanation for socioeconomic differences in survival.**

***Design*—Retrospective analysis of data from cancer registry and from pathology and biochemistry records.**

***Setting*—Catchment areas of two large teaching hospitals in Glasgow.**

***Subjects*—1361 women aged under 75 who had breast cancer diagnosed between 1980 and 1987.**

***Main outcome measures*—Tumour size, axillary lymph node status, histological grade, and oestrogen receptor concentration in relation to deprivation category of area of residence.**

***Results*—There was no significant relation between socioeconomic deprivation and four pathological prognostic factors: 93 (32%) women in the most affluent group presented with tumours less than 20 mm in size compared with 91 (31%) women in the most deprived group; 152 (48%) of the most affluent group presented with negative nodes compared with 129 (46%) of the most deprived group; 23 (22%) of the most affluent group presented with grade I tumours compared with 12 (17%) of the most deprived group; and 142 (51%) of the most affluent group had a low oestrogen receptor concentration at presentation compared with 148 (52%) of the most deprived group. None of these differences was statistically significant.**

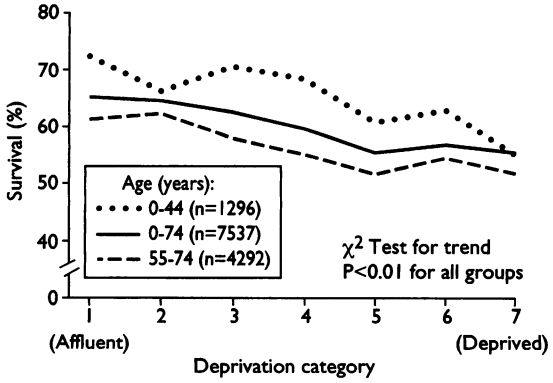
***Conclusions*—Differences in survival from breast cancer by socioeconomic deprivation category could not be accounted for by differences in tumour stage or biology. Other possible explanations, such as differences in treatment or in host response, should be investigated.**

Introduction

Affluent women have a higher incidence of breast cancer than women who are socioeconomically deprived.[1] However, the relation between deprivation and survival from breast cancer is less clear. Six studies published since 1985 have produced conflicting findings: three found that deprived women had poorer survival,[2-4] one that deprived women had better survival,[5] one found no relation between deprivation and survival,[6] and one was equivocal.[7]

Data from the West of Scotland Cancer Registry on 7537 women with breast cancer showed that women from affluent areas (defined with Carstairs' residence based measure of deprivation[8]) had consistently higher five year survival rates than women from more deprived areas. This applied equally to women aged under 45 (mainly premenopausal) and to those aged 55-74 (mainly postmenopausal). For all women aged under 75, five year survival was 66% in the most affluent group compared with 55% in the most deprived group (figure).

Since significant differences in survival were observed across all age groups, they were unlikely to be due to excess deaths from other causes among deprived women. There appeared to be four possible explanations for the differences between socioeconomic groups: differences in tumour stage, tumour biology, treatment factors, or host response. Differences in



Age adjusted five year survival of women aged under 75 in west of Scotland with histologically verified breast cancer diagnosed in 1980-7

tumour stage and biology have been found between ethnic groups in the United States and have been postulated as the reason for ethnic differences in breast cancer survival.[9-12] It therefore seemed that the most likely explanation for the socioeconomic differences in survival would be that women from deprived areas presented on average with more advanced or more malignant tumours. Tumour stage depends largely on two individual prognostic factors (tumour size and axillary lymph node status), while tumour biology includes many factors.[13]

This paper reports a population based investigation of the relation between socioeconomic deprivation and tumour size and axillary node status (the two factors involved in stage) and histological grade and oestrogen receptor concentration (two biological factors).

Methods

STUDY POPULATION

Two hospitals in Glasgow were chosen that served catchment areas with all seven Carstairs' deprivation categories substantially represented (the Western and Victoria Infirmaries). Catchment areas were defined by including postcode sectors where more than 80% of patients with breast cancer were referred to these two hospitals, as opposed to any other. The average population of the two catchment areas over the study period was 467 000. Both hospitals have a specialist interest in breast cancer treatment with high quality recording of pathological material.

Identification data for women with breast cancer were abstracted from the West of Scotland Cancer Registry. Cases registered before 1980 were excluded because pathological data were less complete. Cases registered after 1987 were also excluded because the start of the breast screening programme in Glasgow in 1988 would be expected to alter the stage distribution of tumours.

Patients aged 75 years or over were excluded because in this age group a diagnosis of breast cancer is often followed by hormonal treatment rather than surgery. From the remaining cases, those with a diagnosis made only from a death certificate (33 cases, 2·2%) or those without histological verification (131 cases, 8·6%) were omitted. These exclusions resulted in a total study population of 1361 women, for whom additional data were sought from pathology records (for tumour size, axillary node status, and histological grade) and biochemistry records (for oestrogen receptor concentration).

ANALYSIS

Tumours were grouped into three size bands: 0-19 mm, 20-49 mm, and ⩾50 mm. These bands correspond to the tumour dimensions used in the definitions of clinical stages of breast cancer.[14] Axillary node status was defined as the proportion of axillary nodes sampled which were positive for tumour, grouped into three categories: 0%, 1-50%, and 51-100%. Histological grade of the tumour was coded by modified Bloom and Richardson grades I, II, and III (patients with grade I tumours have the best prognosis).[15] Oestrogen receptor concentration was categorised as low (0-19 fmol/mg cytosol protein), medium (20-99 fmol/mg), or high (⩾100 fmol/mg); low oestrogen receptor concentration is associated with a poorer prognosis. Receptor concentrations were determined by a 10 point competition assay that was subject to regular external quality assurance as part of the quality assurance programme of the European Organisation for Research and Treatment of Cancer.

Deprivation categories were grouped as affluent (Carstairs' categories 1 and 2), middle (categories 3, 4, and 5), and deprived (categories 6 and 7). This ensured adequate numbers in each group. The relation between deprivation and each of the four prognostic factors was examined by means of the χ^2 test.

Results

There was no significant difference between the grouped deprivation categories in the proportions of cases with a diagnosis made only from a death certificate or without histological verification, and there was no significant difference in the categories of information obtainable. Table I shows the information available on tumour size and axillary node status by deprivation group: tumour size was obtained in 969 cases (71%) and axillary lymph node status in 984 (72%).

Table II shows the distribution of tumour size by deprivation group: 93 (32%) of the women in the affluent group presented with a small tumour (<20 mm in diameter), compared with 125 (33%) in the middle group and 91 (31%) in the deprived group. There was no significant difference in tumour size between the deprivation groups (χ^2 (4 df) = 1·62, P = 0·80). The difference in the percentage of small tumours between the affluent and deprived groups was 0·6% (95% confidence interval −6·9% to 8·1%).

TABLE I—*Information available on tumour size and axillary node status in women with breast cancer by deprivation group. Values are numbers (percentages)*

	Deprivation group			
	Affluent (n=416)*	Middle (n=548)†	Deprived (n=397)‡	Total (n=1361)
Tumour size and node status	255 (61·3)	309 (56·4)	234 (58·9)	798 (58·6)
Tumour size only	39 (9·4)	72 (13·1)	60 (15·1)	171 (12·6)
Node status only	61 (14·7)	76 (13·9)	49 (12·3)	186 (13·7)
No usable information	61 (14·7)	91 (16·6)	54 (13·6)	206 (15·1)

*Categories 1 and 2; †categories 3, 4, and 5; ‡categories 6 and 7.

TABLE II—*Relation between tumour size and deprivation in women with breast cancer. Values are numbers (percentages)*

	Deprivation group			
Tumour size (mm)	Affluent (n=294)*	Middle (n=381)†	Deprived (n=294)‡	Total (n=969)
0-19	93 (31·6)	125 (32·8)	91 (31·0)	309
20-49	168 (57·1)	204 (53·5)	162 (55·1)	534
⩾50	33 (11·2)	52 (13·6)	41 (13·9)	126

χ^2 (4 df) = 1·62; P = 0·80.
*Categories 1 and 2; †categories 3, 4, and 5; ‡categories 6 and 7.

Table III shows that no positive nodes were ascertained at presentation in 152 (48%) of the affluent group compared with 179 (46%) of the middle group and 129 (46%) of the deprived group. Again there was no significant difference between the deprivation groups (χ^2 (4 df) = 0·91, P = 0·90). The difference in the percentage with no positive nodes between the affluent and deprived groups was 2·5% (−5·5% to 10·5%). When the definition of lymph node involvement was changed to the absolute numbers of nodes that were

TABLE III—*Relation between axillary lymph node status and deprivation in women with breast cancer. Values are numbers (percentages)*

Lymph node positivity (%)	Deprivation group: Affluent (n=316)*	Middle (n=385)†	Deprived (n=283)‡	Total (n=984)
0	152 (48·1)	179 (46·5)	129 (45·6)	460
1-50	92 (29·1)	108 (28·1)	82 (29·0)	282
51-100	72 (22·8)	98 (25·5)	72 (25·4)	242

χ^2 (4 df) = 0·91; P = 0·90.
*Categories 1 and 2; †categories 3, 4, and 5; ‡categories 6 and 7.

TABLE IV—*Relation between histological grade of tumour and deprivation in women with breast cancer. Values are numbers (percentages)*

Histological grade	Deprivation group: Affluent (n=103)*	Middle (n=110)†	Deprived (n=70)‡	Total (n=283)
I	23 (22·3)	18 (16·4)	12 (17·1)	53
II	41 (39·8)	51 (46·4)	31 (44·3)	123
III	39 (37·9)	41 (37·3)	27 (38·6)	107

χ^2 (4 df) = 1·70; P = 0·79.
*Categories 1 and 2; †categories 3, 4, and 5; ‡categories 6 and 7.

TABLE V—*Relation between oestrogen receptor concentration of tumour and deprivation in women with breast cancer. Values are numbers (percentages)*

Receptor concentration (fmol/mg cytosol protein)	Deprivation group: Affluent (n=278)*	Middle (n=377)†	Deprived (n=287)‡	Total (n=942)
Low (0-19)	142 (51·1)	194 (51·5)	148 (51·6)	484
Medium (20-99)	74 (26·6)	93 (24·7)	72 (25·1)	239
High (≥100)	62 (22·3)	90 (23·9)	67 (23·3)	219

χ^2 (4 df) = 0·43; P = 0·98
*Categories 1 and 2; †categories 3, 4, and 5; ‡categories 6 and 7.

positive, the analysis was restricted to the 807 patients with at least four nodes sampled. There was, however, still no significant difference between the deprivation groups in relation to the number of positive lymph nodes (classified as 0, 1-3, or ≥4) (χ^2 (4 df) = 1·68, P = 0·79).

Routine assessment of histological grade was introduced relatively recently.[16] For the study population, tumour grade was recorded by one hospital from 1984 and by the other from 1986 so that grade was available in 283 cases (54%). Table IV shows that grade I tumours were present in 23 (22%) of the affluent group compared with 18 (16%) of the middle group and 12 (17%) of the deprived group. There was no significant relation between histological grade and deprivation (χ^2 (4 df) = 1·70, P = 0·79). The difference in the percentage of tumours that were grade I between the affluent and deprived groups was 5·2% (−6·7% to 17·1%).

Table V shows the distribution of oestrogen receptor concentration by deprivation group for the 942 cases (69%) in which this factor was recorded. In the affluent group 142 patients (51%) had a low oestrogen receptor concentration compared with 194 (51%) in the middle group and 148 (52%) in the deprived group. There was no significant relation with deprivation (χ^2 (4 df) = 0·43, P = 0·98). The difference in the percentage of patients with a low oestrogen receptor concentration between the affluent and deprived groups was −0·5% (−8·7% to 7·7%).

Discussion

Of the four possible explanations for differences in survival from breast cancer between socioeconomic groups (differences in tumour stage, tumour biology, treatment factors, and host response), only stage of disease has previously been studied. Since definitions of stage used in previous studies have varied,[2 17-21] it may be more informative to look at individual pathological prognostic factors. We believe this to be the first time that pathological prognostic factors have been investigated individually in relation to socioeconomic status in a population based study. In a study population of 1361 women with breast cancer we have shown that none of the four factors investigated was significantly related to socioeconomic deprivation and therefore cannot explain the observed survival differences.

A recent meta-analysis of correlations between pathological prognostic factors identified two anatomical factors (tumour size and axillary node status) that were strongly correlated with each other.[13] It also found eight biological factors to be strongly interrelated. These were tumour grade, oestrogen and progesterone receptor status, thymidine labelling index, DNA ploidy, S phase fraction, epidermal growth factor receptor expression, and erbB2 gene amplification. In this study we investigated the two anatomical factors and two of the eight biological factors (histological grade and oestrogen receptor status). Owing to the strong interrelations it therefore seems unlikely that variations in any of these other biological prognostic factors could explain the socioeconomic differences in survival.

It is unlikely that there was significant bias in the selection of cases for this study. It was population based, and the subjects selected showed similar differences in survival by socioeconomic category to those for the whole of the West of Scotland shown in the figure. The study population contained several hundred women drawn from each of the three deprivation groups (table I). There were no significant differences between the deprivation groups in the proportions of cases with a diagnosis made only from a death certificate or without histological verification, nor in the proportion of cases for which pathological information was unobtainable. There was no significant difference in age structure between the deprivation groups.

COMPARISON WITH OTHER STUDIES

Our results seem to differ from those of five American studies that found more advanced disease on average among "deprived" women compared with "affluent" women.[17-21] Although we investigated the prognostic factors separately in relation to deprivation, it was possible to combine cases of women presenting with a tumour size of less than 20 mm and no axillary node involvement to give an estimate of the proportion of cases with stage I breast cancer. When this was done there was still no significant relation between stage I disease and deprivation group. This disparity may result from the fact that most of the American studies included ethnicity as a possible confounding factor.

According to the 1991 census, only 3·8% of the population of our study catchment areas were non-white. This proportion varied little by deprivation group: 3·9% in the affluent group, 4·2% in the middle group, and 3·1% in the deprived group. The population used in this study therefore allows a socioeconomic effect to be investigated with little risk of confounding by ethnicity.

Our findings appear similar to those of a Finnish study,[2] which found that the proportion of localised tumours decreased from 51% in the highest social class to 47% in the lowest social class. In our study the proportion of cases with no axillary node involvement decreased from 48% in the affluent group to 46% in the deprived group (table III). Such differences in nodal involvement, however, could explain at most only a very minor proportion of the variation in survival related to deprivation.

POSSIBLE EXPLANATIONS

If variations by deprivation category in the

Public health implications

- Women from socioeconomically deprived areas have significantly poorer survival from breast cancer than women from affluent areas
- In this population based study we investigated the relation between socioeconomic deprivation and the prognostic factors tumour size, axillary lymph node status, histological grade, and oestrogen receptor concentration
- Socioeconomic deprivation was not significantly related to tumour stage or biology
- Other possible explanations for survival differences, such as differences in breast cancer treatment or in host response, should be investigated
- If the reasons for socioeconomic differences in survival could be identified and eliminated a greater number of lives could be saved than that expected from the national breast screening programme

prognostic factors we examined cannot explain the differences in survival, other possibilities must be considered. Other biological prognostic factors might differ. Women from deprived areas might be less likely to receive, or to accept, optimal treatment for breast cancer. For example, they might be more likely to withdraw from prolonged chemotherapy regimens. Alternatively, women from deprived areas might have reduced ability to slow down the distant spread of breast cancer because of a differential immune response. This could be due to many possible causes, such as diet, smoking, intercurrent disease, or environmental factors.

These alternative explanations should be investigated since the potential benefit in reducing the inequality in survival between deprivation categories is great. For example, it could result in a greater number of lives saved than that expected from the national breast screening programme. Of the sample of 7537 women from the West of Scotland in whom survival was first studied, there were 1344 deaths within five years among those aged between 50 and 64. Assuming a 25% reduction in mortality from breast cancer, as expected from the national breast screening programme,[22] 336 of those women could be expected to survive. Theoretically, if the survival gradient by deprivation category could be eliminated so that all women had the five year survival rate of the most affluent group, 475 more women in the West of Scotland could be expected to survive for five years. This would also benefit women outside the age group currently invited for screening. Socioeconomic differences in survival from breast cancer therefore have important implications for public health.

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Driving, glaucoma, and the law

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The Road Traffic Act 1988 requires drivers to inform the Driver and Vehicle Licensing Agency of any disability or condition that affects their fitness to drive or which might do so in the future.

Glaucoma clearly falls within this definition and must therefore be reported to the agency regardless of the degree of visual loss. Failure to do so renders the patient liable to prosecution. We assessed the awareness of this legal obligation among patients with glaucoma attending our hospital and among British ophthalmologists.

Subjects, methods, and results

A total of 186 patients (98 men and 88 women) attending routine appointments at the glaucoma department of our hospital during November 1992 were interviewed by the examining clinician. Eighty five were drivers. The mean age of the drivers (65·5 years, age range 24 to 83) was slightly lower than that of those who did not drive (71·5 years, age range 24 to 90 years). Sixty one of the male patients were drivers compared with only 24 of the female patients.

Reassurance was given that the interview was confidential. The clinician recorded the information on a standard form. After the interview patients were advised to inform the Driver and Vehicle Licensing Agency of their diagnosis; if their visual performance did not achieve the minimum legal requirement for driving they were advised to refrain from driving. The table summarises the results.

Multiple choice questionnaires were posted to 450 consultant ophthalmologists in the United Kingdom, their names and addresses having been obtained from the mailing list of an ophthalmological pharmaceutical company. To encourage replies a stamped addressed envelope was included. Of the 450 questionnaires posted in January 1993, 336 (75%) were completed and returned by the 30 April 1993, the end of the study. The replies are summarised in the table.