Social deprivation and breast cancer
Aliki Taylor and K. K. Cheng

Abstract
Background This cross-sectional study was carried out in a population-based setting in Worcestershire to investigate the relationship between social deprivation and other potential prognostic factors.

Methods A total of 762 female patients diagnosed with primary breast cancer between 1 January 1998 and 31 December 1999 were selected. Breast cancer included all new cases of primary invasive breast cancer and ductal carcinoma in situ. A total of 753 patients were matched by their postcode of residence to enumeration district Townsend score and then divided into three groups based on Townsend quintiles (affluent n = 478; middle n = 157; deprived n = 118). Main outcome measures were relationships between social deprivation and tumour type, stage at presentation, oestrogen receptor status, tumour grade and treatment type.

Results Compared with the most deprived women, affluent women were less likely to present with invasive ductal tumours (70.8 per cent versus 85.9 per cent, χ² linear trend = 6.757, p = 0.009), tumours of higher grade (36.0 per cent versus 44.7 per cent, χ² linear trend = 4.201, p = 0.043), and oestrogen receptor negative tumours (22.4 per cent versus 33.3 per cent, χ² linear trend = 3.501, p = 0.061). There was no significant difference in stage or tumour size at presentation between deprivation groups. More deprived women with invasive tumours of less than 20 mm maximum diameter were significantly more likely to have mastectomies than affluent women (47.8 per cent versus 32.1 per cent, χ² linear trend = 4.091, p = 0.043).

Conclusions This study suggests that level of social deprivation is associated with increased risk of potentially unnecessary mastectomies.

Keywords: breast cancer, social deprivation, ductal tumours

Introduction
There are 39500 new cases of breast cancer diagnosed each year in the United Kingdom and breast cancer is now the commonest cancer.1 It is one of the few cancers that is more common in affluent women; however, deprived women with breast cancer have poor relative survival compared with affluent women.2,5

Five year survival in the United Kingdom is currently 75 per cent,3 and improved survival in the last 10 years is largely due to better treatment including the increased use of chemotherapy and Tamoxifen and the introduction of the national breast screening programme.3,9

One recent study concluded that deprived women were likely to have 10 per cent poorer 10 year relative survival compared with affluent women,3 and this figure is similar to that given in other studies.2,5 Research into the causes of poor relative survival from breast cancer in deprived women indicates that it is likely that the differences in survival are multi-factorial. Possible explanations include health service factors,10,11 later stage at diagnosis,1,12 differing tumour biology,13,14 and higher levels of co-morbidity.14 It is also known that deprived women have had higher rates of mastectomies in the past.1,15

Research by Thomson et al.3 showed that approximately a third of the difference in survival from breast cancer between affluent and deprived women was explained by differences in oestrogen receptor (ER) status. Negative ER status is associated with poorer survival and has also been found to be more common in deprived women in other studies.13,16 Grade of invasive breast tumour and variation by social class has also been studied.12,17 There have been no studies that we could find that have examined differences in histopathological type of breast cancer between social classes.

This population-based cross-sectional study included female patients diagnosed with breast cancer in Worcestershire, and was designed to collect detailed information on histopathology (tumour type, grade, ER status), lymph node status, tumour size, stage and treatment (surgery, chemotherapy, radiotherapy, hormone therapy, oophorectomy): information not usually recorded in most Cancer Registries. Recent years were chosen for inclusion in the study (1998–1999), and survival could not be measured. These years were chosen because sufficient time would have passed since the publication of the Calman/Hine report on cancer18 in 1995 and the BASO19 and COG20 guidelines in 1995 and 1996 respectively on breast cancer to create universally high-quality care for patients treated by specialists in Cancer Units and Centres.
Methods

A protocol of the study description was submitted to the Local Research and Ethics Committee and approved in January 2000. All multidisciplinary breast teams (MBTs) were informed of the study and permission to access case notes was obtained from Worcestershire breast surgeons.

West Midlands Cancer Intelligence Unit (WMCIU) initially identified 897 residents in one district of the West Midlands Region with breast cancer diagnosed between 1 January 1998 and 31 December 1999.

Information from histopathological records and casenotes from the three Cancer Units was obtained as well as patient details noted on a British Association of Surgical Oncologists (BASO) proforma held by one of the breast surgeons. From the original 897 patients, the following were excluded: 46 Death Certificate Only patients, 11 recurrences or benign lumps, 23 with a different date of diagnosis from that obtained from the casenotes. Five new patients were added to the total, having been identified from the BASO proforma. This brought the total to 822 patients. Of these, 60 patients treated outside the district were excluded (7.3 per cent).

This left a total of 762 patients. For these, 617 casenotes were located over a 10 month time period (81 per cent). For 145 patients (19 per cent), casenotes were not in the medical records libraries during any of this time period. This included 63 patients (8.3 per cent) treated exclusively or partially in the private sector. Some details from most of these patients were obtained from the BASO proformas and histopathology records.

Breast cancer included ductal carcinoma in situ (DCIS) and all new cases of primary invasive breast tumours, but not Paget’s disease of the nipple or lobular carcinoma in situ (LCIS). Invasive ductal carcinoma is the commonest form of breast cancer, making up nearly 80 per cent of invasive breast cancers. Other invasive types (including lobular, medullary, mucinous and tubular) are grouped as ‘other’ in the analysis.

Missing data were most common for elderly patients who did not have surgical treatment – these patients could not be staged accurately (see Tables 3 and 4).

Statistical methods

Data were collected in EXCEL and converted into SPSS version 10.1. Each patient with a postcode was matched by the Public Health Department of Worcestershire Authority Health to 1991 Census Enumeration District (ED) of residence and then to 1991 Census ED based Townsend score. Townsend quintiles were calculated from the West Midlands female population and patients allocated to quintiles on the basis of Townsend scores \( n = 753, 98.8 \) per cent). West Midlands quintiles were used as Worcestershire is an affluent district, and locally based quintiles would allocate more than the expected numbers into the deprived quintiles, therefore not reflecting true deprivation. Quintiles were used as an approximation to social classes groupings, with quintile 1 the most affluent and quintile 5 the most deprived. Because of the small number of patients in the more deprived quintiles, quintiles 4 and 5 were merged. Quintiles 1 and 2 were also merged so that the two most affluent quintiles could be compared with the two most deprived quintiles:

- group 1 (affluent): Townsend range –8.5 to –1.3 \( n = 478 \)
- group 2 (middle): Townsend range –1.2 to +1.1 \( n = 157 \)
- group 3 (deprived): Townsend range +1.2 to +8.8 \( n = 118 \)

\( \chi^2 \) tests for heterogeneity (h) and trend (t) and were carried out.

Staging of patients

The following staging of breast cancer was used:

- Stage 0. Ductal carcinoma in situ (DCIS) only.
- Stage I. Invasive tumour <2 cm maximum diameter, and has not spread outside of the breast.
- Stage II. Invasive tumour 2–5 cm maximum diameter, and/or has spread to axillary nodes of the same side as the breast tumour.
- Stage III. Invasive tumour either >5 cm maximum diameter, or regardless of size, has spread to axillary nodes that are stuck together or the surrounding tissue or are on the opposite side to the breast tumour. This stage also includes breast tumours, regardless of size, that have spread to the skin, chest wall or the internal mammary lymph nodes.
- Stage IV. The cancer, regardless of size, has metastasized to distant organs or lymph nodes not near the breast.

Results

Stage and tumour biology

Stage at diagnosis did not differ significantly between deprivation groups (Table 1). Of the total of 154 women who were unstaged, 64 (41.6 per cent) had no breast surgery and could therefore not be staged; 56 (36.4 per cent) were unstaged because of insufficient axillary nodes removed during surgery (0–3 nodes) for invasive cancer; 34 (22.1 per cent) were not staged because of inadequate information obtained from available records.

The proportion of women with invasive ductal tumours increased with increasing level of deprivation (70.8 per cent versus 85.9 per cent, \( \chi^2 \) linear trend = 6.757, \( p = 0.009 \)). The proportion of women with high-grade tumours increased with increasing levels of deprivation (36.0 per cent versus 44.7 per cent, \( \chi^2 \) linear trend = 4.201, \( p = 0.040 \)). There was very suggestive evidence, given the small numbers, that women with a greater level of deprivation presented with a higher level of ER negative tumours (22.4 per cent versus 33.3 per cent, \( \chi^2 \) linear trend = 3.501, \( p = 0.061 \)) (Table 1).

Screening and tumour size

Affluent women of 50 years and over were significantly more likely to be referred from the NHS Breast Screening Programme (NHSBSP) than deprived women (28.6 per cent versus 18.7 per...
There was no significant difference in size at presentation between affluent and deprived women aged 50 years and over when sizes of less than 20 mm or 20 mm or more were compared ($\chi^2$ linear trend 0.917, $p = 0.338$) (Table 1).

### Treatment characteristics

Among women who presented with invasive ductal tumours of less than 20 mm maximum diameter (Table 2), the proportion who had mastectomies rather than breast-conserving surgery increased with increasing level of deprivation (32.1 per cent versus 47.8 per cent, $\chi^2$ linear trend = 4.091, $p = 0.043$). A tumour size of less than 20 mm was taken as a ‘cut-off’ point as this was previously shown to have similar outcomes for mastectomy or breast-conserving surgery. However, there is now evidence that tumours up to 50 mm can be treated by breast-conserving surgery plus radiotherapy.21 There was also a significant difference in the proportion of mastectomies by social class for invasive tumours of less than 50 mm (47.6 per cent versus 60 per cent, $\chi^2$ linear trend = 4.417, $p = 0.036$). (Table 2).

Chemotherapy given to women over 50 years of age with invasive breast cancer (stages I–III) by nodal status is shown in Table 2. Among women with positive nodes, the proportion who received chemotherapy was highest in affluent women (53.5 per cent versus 31.3 per cent, $\chi^2$ linear trend = 6.378, $p = 0.012$). There was no significant difference in the proportions of women given hormonal therapy by ER status (86 per cent versus 70 per cent, $\chi^2$ linear trend 1.938, $p = 0.164$ for ER positive tumours and linear trend; 97.7 per cent versus 100 per cent, $\chi^2$ linear trend 0.686, $p = 0.407$ for ER negative tumours). However, the small numbers in this category make interpretation of the results difficult (Table 2).

### Table 1 Pre-treatment characteristics for breast tumours by deprivation group; values are numbers unless specified, with percentages given in parentheses

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1 (affluent)</th>
<th>2 (middle)</th>
<th>3 (deprived)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (all) (years)a</td>
<td>59.09</td>
<td>62.80</td>
<td>62.24</td>
<td>60.39</td>
</tr>
<tr>
<td>&lt;50 yearsb</td>
<td>118 (24.7)</td>
<td>24 (15.3)</td>
<td>27 (22.9)</td>
<td>169 (22.4)</td>
</tr>
<tr>
<td>&gt;50 years</td>
<td>360 (75.3)</td>
<td>133 (84.7)</td>
<td>91 (77.1)</td>
<td>584 (77.6)</td>
</tr>
<tr>
<td><strong>Referral (≥50 years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NHSBSp</td>
<td>103 (28.6)</td>
<td>22 (16.5)</td>
<td>17 (18.7)</td>
<td>142 (243.0)</td>
</tr>
<tr>
<td>Other</td>
<td>257 (71.4)</td>
<td>111 (83.5)</td>
<td>74 (81.3)</td>
<td>442 (75.7)</td>
</tr>
<tr>
<td>**Tumour size (≥50 years)**a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–19 mm</td>
<td>147 (47.4)</td>
<td>56 (50.0)</td>
<td>39 (53.4)</td>
<td>242 (48.9)</td>
</tr>
<tr>
<td>≥20 mm</td>
<td>163 (52.6)</td>
<td>56 (50.0)</td>
<td>34 (46.6)</td>
<td>253 (51.1)</td>
</tr>
<tr>
<td><strong>Stagee</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0f</td>
<td>30 (7.1)</td>
<td>13 (11.1)</td>
<td>9 (9.6)</td>
<td>52 (8.7)</td>
</tr>
<tr>
<td>I</td>
<td>129 (33.2)</td>
<td>42 (35.9)</td>
<td>38 (40.4)</td>
<td>209 (34.8)</td>
</tr>
<tr>
<td>II</td>
<td>193 (49.6)</td>
<td>52 (44.4)</td>
<td>40 (42.6)</td>
<td>285 (47.5)</td>
</tr>
<tr>
<td>III</td>
<td>26 (6.7)</td>
<td>9 (7.7)</td>
<td>4 (4.3)</td>
<td>39 (6.5)</td>
</tr>
<tr>
<td>IV</td>
<td>11 (2.8)</td>
<td>1 (0.9)</td>
<td>3 (3.2)</td>
<td>15 (2.5)</td>
</tr>
<tr>
<td><strong>Typeg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ductalg</td>
<td>260 (70.8)</td>
<td>89 (73.0)</td>
<td>73 (85.9)</td>
<td>422 (73.5)</td>
</tr>
<tr>
<td>Otherh</td>
<td>107 (29.2)</td>
<td>33 (27.0)</td>
<td>12 (14.1)</td>
<td>152 (26.5)</td>
</tr>
<tr>
<td><strong>ER statusi</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>56 (22.4)</td>
<td>22 (28.2)</td>
<td>20 (33.3)</td>
<td>98 (25.3)</td>
</tr>
<tr>
<td>Positive</td>
<td>194 (77.6)</td>
<td>56 (71.8)</td>
<td>40 (66.7)</td>
<td>290 (74.7)</td>
</tr>
<tr>
<td><strong>Gradej</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I and II</td>
<td>231 (64.0)</td>
<td>63 (52.5)</td>
<td>47 (55.3)</td>
<td>341 (60.2)</td>
</tr>
<tr>
<td>III</td>
<td>130 (36.0)</td>
<td>57 (47.5)</td>
<td>38 (44.7)</td>
<td>226 (39.8)</td>
</tr>
</tbody>
</table>

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aInvasive tumours and DCIS.
b$\chi^2$ heterogeneity: 6.014; 2df; $p = 0.049$; $\chi^2$ linear trend: 1.409; 1df; $p = 0.235$.
c$\chi^2$ heterogeneity: 9.547; 2df; $p = 0.008$; $\chi^2$ linear trend: 7.033; 1df; $p = 0.008$.
d$\chi^2$ heterogeneity: 0.924; 2df; $p = 0.630$; $\chi^2$ linear trend: 0.917; 1df; $p = 0.338$.
eInvasive tumours only.
f$\chi^2$ heterogeneity: 6.198; 2df; $p = 0.625$; $\chi^2$ linear trend: 2.651; 1df; $p = 0.103$.
g$\chi^2$ heterogeneity: 8.042; 2df; $p = 0.018$; $\chi^2$ linear trend: 6.757; 1df; $p = 0.009$.
hIncludes lobular, mucinous, medullary, tubular and mixed types of invasive cancers.
i$\chi^2$ heterogeneity: 3.513; 2df; $p = 0.173$; $\chi^2$ linear trend: 3.501; 1df; $p = 0.061$.
j$\chi^2$ heterogeneity: 5.988; 2df; $p = 0.050$; $\chi^2$ linear trend: 4.201; 1df; $p = 0.040$. 

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21 There was also a significant difference in the proportion of mastectomies by social class for invasive tumours of less than 50 mm (47.6 per cent versus 60 per cent, $\chi^2$ linear trend = 4.417, $p = 0.036$). (Table 2).

Chemotherapy given to women over 50 years of age with invasive breast cancer (stages I–III) by nodal status is shown in Table 2. Among women with positive nodes, the proportion who received chemotherapy was highest in affluent women (53.5 per cent versus 31.3 per cent, $\chi^2$ linear trend = 6.378, $p = 0.012$).

There was no significant difference in the proportions of women given hormonal therapy by ER status (86 per cent versus 70 per cent, $\chi^2$ linear trend 1.938, $p = 0.164$ for ER positive tumours and linear trend; 97.7 per cent versus 100 per cent, $\chi^2$ linear trend 0.686, $p = 0.407$ for ER negative tumours). However, the small numbers in this category make interpretation of the results difficult (Table 2).
Discussion

Results from this study show that deprived women were more likely to present with invasive ductal breast carcinoma and high-grade tumours. To the best of our knowledge, the association between histological type and deprivation has not been previously reported. The association found in this study was highly statistically significant. Diagnostic bias was unlikely as histopathologists were unaware of women’s deprivation status. However, the role of chance cannot be ruled out because of multiple comparisons.

There was also a suggestion of an association between increasing deprivation and negative ER status, although in this category there were many missing numbers. This association could be partly explained by the smaller proportion of lobular carcinoma and other special types (including mucinous, tubular, medullary, and mixed) and the higher proportion of high-grade tumours in the deprived group. The special types together make up approximately 20 per cent of invasive breast cancers, are more likely to be of low grade and ER positive, and tend to have a better response to treatment. There is evidence that invasive ductal breast tumours tend to be associated with poorer survival than most of the special types.22,23

Two UK studies have examined the effect of tumour grade and social class but found no significant association.12,17 Studies in the USA have found higher incidence of invasive ductal carcinoma compared with invasive lobular carcinoma in African American women, Hispanics and Asians compared with Caucasians.24 In the USA, it has been difficult to dissociate race from social class. There is biological plausibility that differences in survival between social classes could be partly explained by differences in tumour biology, including tumour type and ER status.3,13 This also raises possible questions concerning the aetiology of different types of invasive breast cancer.

There was no significant difference in stage at presentation between affluent and deprived women. Some UK studies have not found a difference in stage at presentation between deprivation groups3,17 whereas others have.12

Deprived women were less likely to have breast-conserving surgery than affluent women, a finding mirrored by other studies.3,15 Older deprived women with positive nodes were significantly less likely to be offered adjuvant chemotherapy; however, small numbers make interpretation of these results difficult. An alternative explanation is the higher probability of co-morbidity in deprived older women.

What are the limitations of this study?

The main potential for bias is missing data; this was most common for patients over 65 years who did not have surgery (n = 80), private patients on whom incomplete information was obtained (n = 63), and patients whose casenotes were inaccessible (n = 145). Tables 3 and 4 summarize characteristics of missing data, and
show that there was no wide variation between deprivation and proportions of missing data.

Confounding issues relate to differences in co-morbidity, which were not recorded in this study, as well as variations in the reporting of tumours by the different histopathology departments. The most significant inter-observer differences were for reporting of grade and vascular invasion. There were no significant differences in reporting of tumour type by different histopathologists.

Worcestershire is a relatively affluent rural county, and has a small number of women in deprived groups. This makes interpretation of some results difficult because of small numbers.

What are the implications for further research?

There are some factors highlighted by this study (including tumour type, grade and ER status) that might explain poor relative survival from breast cancer in deprived women. Presentation with more aggressive tumours and smaller likelihood of chemotherapy in postmenopausal women will contribute to poorer relative survival. This cohort of women will now be followed up in collaboration with WMCIU to determine whether differences in treatment or tumour biology can lead to poor relative survival in deprived women.

**Acknowledgements**

We are very grateful to the following for their help: Dr Cheryl Livings of the West Midlands Cancer Intelligence Unit; the breast surgeons, histopathologists and medical records departments at the present Worcestershire Acute Hospitals NHS Trust for providing original data and for help with extracting local patient data; Hereford and Worcestershire NHS Breast Screening department for providing details of patients in the local screening programme; Dr Mike Hawkins of the University of Birmingham for statistical advice and comments on the draft; Dr Lillian Somervaille of the West Midlands Public Health Observatory and Dr Rob Cooper of the University of Birmingham for advice in the original study design; Mrs Elizabeth Davies of Worcestershire Health Authority for matching postcodes to Townsend scores.

**Contributors**

A.T. designed the study, extracted information from local patient records, and carried out the statistical analysis. K.C. provided advice on the original study design and analysis. Both contributed to writing up. A.T. is the guarantor.

**References**


**Table 3** Characteristics of missing data by mean age and tumour size; values are numbers

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean age at diagnosis</th>
<th>Mean tumour size</th>
<th>Total missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage*</td>
<td>71.9</td>
<td>22.10</td>
<td>154</td>
</tr>
<tr>
<td>Treatment†</td>
<td>58.7</td>
<td>22.00</td>
<td>101</td>
</tr>
<tr>
<td>ER status†</td>
<td>67.7</td>
<td>24.13</td>
<td>314</td>
</tr>
<tr>
<td>Tumour grade†</td>
<td>72.7</td>
<td>27.58</td>
<td>135</td>
</tr>
<tr>
<td>Tumour type†</td>
<td>72.2</td>
<td>28.30</td>
<td>129</td>
</tr>
<tr>
<td>All tumours*</td>
<td>60.4</td>
<td>21.98</td>
<td>762</td>
</tr>
</tbody>
</table>

*Invasive tumours and DCIS.
†Invasive tumours only.

**Table 4** Characteristics of missing data by deprivation group; values are numbers with percentages given in parentheses

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1 (affluent)</th>
<th>2 (middle)</th>
<th>3 (deprived)</th>
<th>Missing deprivation score</th>
<th>Total missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage*</td>
<td>89 (18.6)</td>
<td>40 (25.5)</td>
<td>24 (20.3)</td>
<td>1</td>
<td>154</td>
</tr>
<tr>
<td>Treatment†</td>
<td>65 (13.6)</td>
<td>20 (12.7)</td>
<td>14 (11.9)</td>
<td>2</td>
<td>101</td>
</tr>
<tr>
<td>ER status†</td>
<td>198 (41.4)</td>
<td>65 (41.4)</td>
<td>49 (41.5)</td>
<td>2</td>
<td>314</td>
</tr>
<tr>
<td>Tumour grade†</td>
<td>87 (18.2)</td>
<td>23 (14.6)</td>
<td>24 (20.3)</td>
<td>1</td>
<td>136</td>
</tr>
<tr>
<td>Tumour type†</td>
<td>81 (16.9)</td>
<td>22 (14.0)</td>
<td>24 (20.3)</td>
<td>2</td>
<td>129</td>
</tr>
<tr>
<td>Total</td>
<td>478 (100)</td>
<td>157 (100)</td>
<td>118 (100)</td>
<td>9</td>
<td>762</td>
</tr>
</tbody>
</table>

*Invasive tumours and DCIS.
†Invasive tumours only.


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