Socio-economic inequalities in survival from screen-detected breast cancer in South West England: population-based cohort study

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Background: Socio-economic inequalities in breast cancer survival have been reported worldwide, but whether these exist in screen detected as well as symptomatic women has not been established. Making this distinction will allow inferences about the relative contributions of pre- and post-diagnostic delay to these inequalities. Methods: Screening-eligible women diagnosed with breast cancer in South West England (2002–06) were followed-up to 2007. Five-year relative survival ratios (RSRs) were calculated for each deprivation quintile, using deprivation-specific life-tables and a period approach. The deprivation gap in survival was calculated as the slope index of inequality between least and most deprived women. Results: The study included 11 018 women, of whom 1176 died during follow-up. Screening status of 54% of women was missing. A clear gradient in survival across deprivation groups ranged from 83.6% [95% confidence interval (CI) 80.0,
Introduction

The UK’s Cancer Reform Strategy\(^1\) highlights the importance of reducing inequalities in cancer incidence and outcome. Two important developments in a first step to achieve this have been the launch of the National Cancer Equality Initiative,\(^2\) and the National Awareness and Early Diagnosis Initiative. Both initiatives acknowledge the paucity of evidence on which recommendations to reduce cancer inequalities can be based.

Socio-economic inequalities in cancer survival have been reported in different countries and are a global concern.\(^3–9\) An analysis of cancer survival in England and Wales has shown that survival from breast cancer is lower in women of lower socio-economic position (SEP).\(^10\) A similar pattern of survival has also been described specifically in the South West region of England.\(^11\) A key factor in explaining poorer breast cancer survival for less affluent women is likely to be related to screening coverage. Women from low socio-economic groups are less likely to access mammography services than their more affluent counterparts,\(^12,13\) and therefore may receive delayed diagnosis and treatment.

If inequalities in breast cancer survival are limited to only those women who do not attend screening, then the efforts to reduce inequalities should be more focussed on improving screening and uptake among the most deprived women. One previous report found that inequalities in survival that are seen for all women diagnosed with breast cancer, are also evident, though attenuated, in women with screen-detected breast cancer. That study, which included women in the UK diagnosed with breast cancer over a one year period found a 12.2 percentage point difference in 5-year relative survival between the most affluent and most deprived quintiles of women diagnosed symptomatically, compared to a 6.6 percentage point difference for screen-detected women.\(^14\) To conduct a more detailed analysis and interpretation than was available in the All Breast Cancer Report\(^14\) we have included data for women diagnosed over a greater time period to estimate 5-year relative survival from breast cancer by screening status and deprivation quintile.

Methods

All women diagnosed with invasive breast cancer between January 2002 and December 2006 registered on the South West Cancer Registry were included in our study. Age was restricted to only include women within the screening age range of 50–70 years. Depription was measured using the income domain of the 2007 Index of Multiple Deprivation (IMD)\(^15\) an area-based measure of SEP, derived from a woman’s place of residence at time of diagnosis, and calculated at the lower super output area (LSOA) level. Income scores were categorized into quintiles of the English population. Follow-up was to the end of 2007.

Screening status was classified into five categories. The ‘screen-detected’ category included women who were diagnosed through the breast screening programme. The ‘interval cancer’ category included women who belonged to the screening programme but who were diagnosed symptomatically between screens. The ‘non-/lapsed attenders’ category included women who have never been invited to the screening programme but are not current participants. The ‘uninvited’ category includes women who do not belong to a screening programme, such as those registered with a general practitioner. The ‘unknown’ category included women whose screening status was not recorded on the cancer registry.

Results

A total of 11 018 women with breast cancer were included in the study, all of whom were diagnosed between 2002 and 2006 and registered on the South West Cancer Registry. During the follow-up period, a total of 1176 deaths were recorded. The median age at diagnosis in the whole cohort was 60 years [inter-quartile range (IQR): 55–65 years], which did not differ by deprivation categories (table 1). From the available data, fewer than half the women (45%) were detected at screening, although for 54% of women, screening status was unknown. Among those with missing data on screening, the median age at diagnosis across deprivation categories was similar. The distribution of women across deprivation
Table 2 Five-year relative survival for all breast cancer cases in the South West region by screening status

<table>
<thead>
<tr>
<th>Screening status</th>
<th>Women</th>
<th>Deaths</th>
<th>5-year RSR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen-detected cancers</td>
<td>4965</td>
<td>164</td>
<td>96.88 (95.97–97.58)</td>
</tr>
<tr>
<td>Interval cancers</td>
<td>45</td>
<td>9</td>
<td>84.94 (75.09–91.12)</td>
</tr>
<tr>
<td>Cancers in non-attenders</td>
<td>12</td>
<td>2</td>
<td>84.39 (64.14–93.89)</td>
</tr>
<tr>
<td>Cancers in uninvited</td>
<td>39</td>
<td>5</td>
<td>90.05 (79.23–95.39)</td>
</tr>
<tr>
<td>Unknown status</td>
<td>5957</td>
<td>996</td>
<td>80.43 (79.24–81.56)</td>
</tr>
</tbody>
</table>

Table 3 Five-year relative survival for all breast cancer cases in the South West region by deprivation quintile

<table>
<thead>
<tr>
<th>Deprivation</th>
<th>Women</th>
<th>Deaths</th>
<th>5-year RSR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (least deprived)</td>
<td>2098</td>
<td>187</td>
<td>90.79 (88.97–92.32)</td>
</tr>
<tr>
<td>2</td>
<td>3077</td>
<td>313</td>
<td>89.45 (87.97–90.75)</td>
</tr>
<tr>
<td>3</td>
<td>3099</td>
<td>357</td>
<td>86.04 (84.50–87.45)</td>
</tr>
<tr>
<td>4</td>
<td>2039</td>
<td>227</td>
<td>85.07 (83.03–86.89)</td>
</tr>
<tr>
<td>5 (most deprived)</td>
<td>705</td>
<td>92</td>
<td>83.56 (79.98–86.55)</td>
</tr>
</tbody>
</table>

Table 4 Five-year relative survival for screen-detected breast cancer cases in the South West region by deprivation quintile

<table>
<thead>
<tr>
<th>Deprivation</th>
<th>Women</th>
<th>Deaths</th>
<th>5-year RSR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (least deprived)</td>
<td>880</td>
<td>33</td>
<td>98.16 (95.88–99.18)</td>
</tr>
<tr>
<td>2</td>
<td>1435</td>
<td>51</td>
<td>97.53 (95.66–98.60)</td>
</tr>
<tr>
<td>3</td>
<td>1420</td>
<td>44</td>
<td>95.91 (93.93–97.25)</td>
</tr>
<tr>
<td>4</td>
<td>922</td>
<td>24</td>
<td>96.05 (93.48–97.62)</td>
</tr>
<tr>
<td>5 (most deprived)</td>
<td>308</td>
<td>12</td>
<td>95.60 (90.63–97.96)</td>
</tr>
</tbody>
</table>

a: All women.
b: Women with missing screening data.

Discussion

In this study of breast cancer registrations in the South West we have shown that deprivation survival disparities are evident for the complete cohort of women diagnosed. They are also evident, albeit attenuated, for women diagnosed within the screening programme, indicating that lack of earlier detection could account for much of the inequality within the general population. However as there was still a clear gradient of deprivation survival disparity within the screen-detected population, there are also other factors affecting inequalities in breast cancer outcomes between women of different SEPs.

The strengths of this study lie in the population-based nature of the cancer registry and the complete outcome (death) ascertainment through record linkage. One of the biggest limitations of the study is the large degree of missing screening data in the cancer registry. Following our analysis, this was investigated. It appears likely that we are, to some extent, under-ascertaining screen-detected cancers; in the South West, we would expect ~1200 screen-detected invasive breast cancers per year, whereas in the 5-year period of our study, we identified 5000; the remaining 1000 women could be included in the 6000 for whom we had missing screening data. From a detailed analysis of the figures, it appears most likely that a substantial proportion of the women with unknown screening status in this analysis had an interval cancer (C Rocha, South West Cancer Intelligence Service, personal communication 2009). This also fits with the rather low 5-year survival reported among these women.

The primary concern regarding the degree of missing data is whether it is randomly missing or not; if so, it has the potential to bias the association between deprivation and relative survival, when stratified by screening status. The lack of an association between deprivation group and missing screening data is reassuring. However, it is still possible that the relative survival in the people with missing data does not follow the same pattern by deprivation category as does the screen-detected data, although it is hard to conceive why this might be so. Cancer registries in the UK are continuing efforts to improve linkage between data sources, and it is likely that the proportion of missing data in key variables such as diagnosis route will be lower in future.

A second limitation of the analysis is the use of an area-based deprivation index to measure SEP. This does not capture individual SEP as well
as an individual marker would. However, Woods et al. have previously shown that the income domain of the IMD index, calculated at the LSOA level, is more strongly associated with breast cancer survival than those measures based on larger geographic areas, which are commonly used in the UK. Measurement error could only have attenuated, rather than artificially created, the observed inequalities. We may therefore have underestimated the deprivation gap to some degree but this is likely to have occurred equally in the screened and unscreened populations, and therefore unlikely to have affected our conclusions. Research in the USA has highlighted the importance of considering social context when examining health outcomes. Specifically investigating non-adherence to mammography screening, Dailey et al. found that neighbourhood-level socio-economic factors were associated with regular screening, independent of individual level factors. Ideally, we would use both individual and area-based measures to characterize SEP, the latter capturing broader context of neighbourhoods which is not measured with individual level exposures.

Systematic reviews of interventions to increase mammography uptake arrive at different conclusions to those specifically assessing interventions for women with low rates of screening. The latter find that approaches which include access-enhancing interventions produce the greatest increase in mammography uptake. However, the majority of the evidence is US-based, and the interventions are not necessarily applicable to the UK. Within the National Health Service (NHS), local efforts have been made to increase mammography uptake in women with low rates of screening, but are not always evidence-based, nor do they have their effectiveness evaluated. The acceptability of interventions needs to be assessed in the diverse populations in the UK, and cost-effectiveness should be considered before interventions can be recommended.

Of importance is to consider reasons for the remaining survival disparity that we observed in screen-detected women. Within our dataset, we could not investigate this further. One possibility is that this could be due to higher co-morbidity among lower SEP women. Previous research has found that women from lower socio-economic groups diagnosed with breast cancer are more likely to have at least one other chronic condition (hypertension, diabetes, previous myocardial infarction and chronic obstructive pulmonary disease) than their counterparts from higher socio-economic groups. Although neither of these studies specifically investigated screen-detected breast cancers, it is likely that similar patterns may be evident in that group of women. The excess mortality we observed in the women from more deprived areas cannot be directly attributed to the effects of higher co-morbidities, since we have effectively controlled for this using deprivation-specific life tables in our analyses. However, it is possible that co-morbidities could affect treatment options in a woman’s cancer care, and thus indirectly affect her survival. Clearly, further work, perhaps using prospectively collected data rather than routinely collected data, is required to investigate this further.

The possibility that there are inequalities in the treatment of women from different socio-economic groups should also be considered. It has been proposed that higher educated and affluent women are more adept at navigating through the secondary care system. Again, further research is needed to investigate this, and if substantiated, to identify strategies to improve access for all women through the system.

Screening programmes are usually attended more regularly by affluent people; therefore, while they may improve survival overall, they can also increase disparities between deprived and affluent people due to differential uptake; a phenomenon referred to as intervention-generated inequalities. Although there was a considerable amount of missing data in this study, a large proportion of the observed deprivation gap in breast cancer survival appeared to be accounted for by lack of early detection. Therefore efforts to eliminate inequalities in breast cancer among 50- to 70-year-old women should focus on increasing breast screening participation for women of lower SEP. However, efforts should also be made to ensure equal access through the secondary care system to address the attenuated survival inequalities that remained even among screen-detected women with breast cancer.

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Conflicts of interest: None declared.

Key points

- Socio-economic inequalities in survival were detected in the whole cohort of women with breast cancer, and were also evident for screen-detected women.
- The persisting gradient of deprivation within the screened population indicates there are factors other than those relating to early detection which determine inequalities in breast cancer outcomes between women of different SEPs.
- Efforts to eliminate inequalities in breast cancer should consider both increasing attendance at breast screening and ensuring equal access through the secondary care system for women of lower SEP.

References

Breast cancer among women over 75 years: an important public health problem?

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Women aged >75 years are not invited for mammographic screening; if diagnosed with breast cancer, due to their anticipated short-life expectancy, they are expected to die of other causes. To describe the breast cancer health problem in women aged >75 years, we estimated breast cancer incidence in this age group and the risk of breast cancer death in patients diagnosed after 75 years of age in Nijmegen, the Netherlands. Our findings demonstrate that in this age group, 3.3% of the women will be diagnosed with breast cancer, and that one in three of these incident cases die of this disease. These patients could have benefited from continued screening.

On the other hand, currently a large number of 75-year-old women still have a favourable life expectancy. A part of this group will be diagnosed with breast cancer and may ultimately die from this disease. These women could have benefited from screening.