Cumulative attendance, assessment and cancer detection rate over four screening rounds in five English breast-screening programmes: a retrospective study

Matthew Wallis1, Fergus Neilson2, Helen Hogarth2, Caroline Whitaker2, Keith Faulkner2

1Breast Screening Unit, University Hospitals Coventry and Warwickshire, Clifford Bridge Road, Coventry, CV2 2DX, United Kingdom
2North East, Yorkshire and the Humber Quality Assurance Reference Centre, 9 Kings way, Silverlink Business Park, Wallsend, Newcastle upon Tyne, NE28 9ND, United Kingdom

Address correspondence to Matthew Wallis, E-mail: mgwallis12@aol.com

ABSTRACT

Background Data collection in the National Health Service Breast Screening Programme monitors performance in a different cohort of women each year.

Methods This paper follows a single cohort study of 57 425 women (aged 50–53, when first invited) over four screening rounds to find: how many women attend screening and how often; how many were assessed; how many times they were assessed; and the number of cancers detected at each round.

Results Average attendance in each round was 76.9% and has remained constant. Only 62% of women have attended all four rounds, but 89.9% have been screened at least once, the average number of attendances being 3.5. Average assessment rate decreased from 7.3 to 3.5%. A total of 11.3% of women were assessed once, 0.91% twice and 0.06% three times. Cancer detection rates have more than doubled from 3.3 per 1000 screened to 6.9.

Conclusions Current monitoring shows constant uptake over time, but when looking at a cohort of individual woman, a much larger percentage have ‘ever’ attended and a smaller number have attended all invitations. The chance of a woman being assessed at all, if she attends all four rounds, is 12.3%, which can be calculated by summatting the recall rates in each round.

Keywords public health, screening

Introduction

In the United Kingdom National Health Service Breast Screening Programme (NHSBSP), women aged between 50 and 70 years are invited for X-ray mammography every 3 years. Originally, mammography comprised of a single view of the breast. Subsequently, women attending the programme for the first time have taken two views at their first visit. Since 2004, it is NHSBSP’s policy for women to have two views at each screening round.

After the initial screening stage, some women are re-invited for mammography and other possible investigations. This is referred to as the assessment stage. Breast cancer may be detected at this stage, or women may be referred for a diagnostic, surgical biopsy.

Every year, the NHSBSP monitors the number of women who attend the breast-screening programme, the number of women who are assessed, the number of fine needle aspiration cytology/small bore biopsy examinations and the number of cancers detected. These women are grouped according to their screening history, i.e. first time invitees, previously invited but never attended, attended <5 years before and attended in the past, but >5 years ago. Additionally, ‘coverage’, i.e. the proportion of the eligible population screened in the last 3 years, is monitored. All of the measures are based on the cohort of women with first offered appointments in the year April to March. This will change annually as new women become 50 and join the programme and women reach 70 and leave.

Matthew Wallis, Consultant Radiologist
Fergus Neilson, QA Co-ordinator
Helen Hogarth, Research assistant
Caroline Whitaker, Audit Officer
Keith Faulkner, QA Director

© The Author 2007, Published by Oxford University Press on behalf of Faculty of Public Health. All rights reserved.
There have always been concerns about how to achieve and maintain a high level of attendance in the screening programme, because this, together with cancer detection, is the key to reduce the mortality. The breast-screening trials have all shown a decline in overall attendance with time and age. The best results are from the Swedish ‘W-E’ trial, when the attendance, women aged between 50 and 69 years, at entry, fell from 90% in their first round to 82% in the third and final round.

There have been a number of studies investigating the attendance at a breast-screening unit. Earldey and Elkind investigated the reactions of women who attended a breast-screening unit. Attenders and non-attenders for breast screening were compared in a study by French et al. Non-attenders were concerned about the disruption in their lives if cancer were detected. Other researchers have done studies on approaches to improve the attendance by persuading non-attenders to attend. An Australian study discovered that women who were more health conscious were more likely to attend screening. In addition, women who knew that mammography reduced the risk of developing severe breast cancer were more likely to attend. A Scottish study found that older women who lived farthest away from the screening site were less likely to attend, whereas a Canadian study concluded that low socio-economic status women in urban areas were less likely to re-attend the screening programme.

Van de Pol and Marjon attempted to predict attendance for breast screening using routinely collected data such as screening history, deprivation score, the screening setting (mobile or static) and time of year. A Dutch study concluded that negative experiences were not a reason for drop out from a screening programme. One of the main detrimental side effects of screening is false positive recall. The effect on re-attendance is unclear with contradictory messages from the literature. The significant discrepancy between the recall rates in USA and UK has been highlighted by Smith-Bindman who calculated that, >10 years, the chances of recall in the USA was as high as 49.4% compared with the UK at 13.3%. These calculations were based on the assumption that the recall in each round of screening was independent of the outcome of the previous round. The validity of this assumption has recently been tested by Xu.

Scaf-Klomp followed up a cohort of 6898 women in Nejmegen for nine biennial screening rounds from 1975, but did not look at the cumulative risks of recall. However, there have been no studies by the NHSBSP that has followed up a cohort of women and monitored their pathway through the programme over a number of screening rounds to answer some key questions about this programme.

Therefore, the objectives of this study were

1. To follow a cohort of women who were invited to one of five screening programmes over four screening rounds.
2. To discover how many times an individual attend the programme.
3. To determine how many individuals were assessed and how many times.
4. To establish how many cancers were detected in this single cohort over four screening rounds.

Methods

The screening history of each woman over four screening rounds was analysed. Data from five breast-screening programmes were used to select 57,425 women for the study. The screening programmes were North Yorkshire, Leeds and Wakefield, Humberside, Pennine and Warwickshire, Solihull and Coventry (WSC), and these programmes have been anonymized for the purpose of this paper.

Women were selected using a standard report on the National Breast Screening Computer Systems held in each screening office, which was designed for this project. Cases were selected on the basis of being between the ages of 50 and 53 years at the start of each NHSBSP (between 1989 and 1992). This allowed for four full 3-year rounds of data for each woman to be obtained.

The data obtained for each woman was pseudonymized by the numeric screening identification number. Assessment of the screening history of a woman was based on ‘Episode Close Date’ (date on which the woman’s computer records were closed for that screening episode) and ‘Episode Endpoint’ (a summary of the actions and outcomes at various stages of the screening and assessment process). The assessment of the outcome for each screening round for each woman involved assigning a simple Outcome code. Each round for each woman was assigned one of the following categories:

1. Cancer
2. Assessed
3. Screened
4. Did not attend
5. No further records on the NBSS.

The assignment was made by the evidence contained in the woman’s Episode Endpoint and so, for example, although there was no Episode Endpoint, there was an Episode Close Date, the woman ‘Did not attend’. If the Episode Endpoint showed that the woman had been screened and the outcome was negative, with no further evidence of
assessment or cancer, then the woman was assigned a code of 'Screened'. The women assigned to the 'No further records on the NBSS' were those for whom there was neither Episode Close Date nor Episode Endpoint. This assignment was done by means of an Excel Spreadsheet, within which these decision criteria were programmed.

Once the outcome for each round was assigned, data were summarised further onto spreadsheets, which calculated the probability of each of the possible pathways using the four screening rounds. There were \( \binom{4}{2} \times \binom{5}{2} = 500 \) possible pathways. Despite the use of spreadsheets, the process of gathering, manipulating, checking and then analysing the pathways was substantial and took several weeks.

Now, owing to the use of spreadsheets, the process is quicker, but still time consuming.

Issues that arose during the assessment of the outcome of each screening round, which should be noted, are:

1. Women do not follow an exact 3-year screening round pattern (because either the programme has not invited them on time or they have changed their location or self-referred into the programme); hence, we took a reasoned position on this when assigning a category for all cases. This was that the ‘screening round’ could not be \(<2\) years and could not be \(>4\) years.

2. Some women had screening episodes in quick succession (for early recall to the programme, because they have moved or because they have self-referred). If the woman had more than one screening episode within the first 2-year period, the outcomes for these were summarized, and the ‘worst case’ were taken in the order as stated above.

### Results

Uptake is defined as the proportion of women who attend the screening programme in response to an invitation. In our data set, it was not possible to differentiate between women who were invited and those who either self-referred or referred by their General Practitioner. As a consequence, we have used a simple attendance rate, which is justified on the grounds that this describes the actual impact of the NHSBSP on the population, given that there is more than one route of entry to the programme. Table 1 gives the numbers of women invited, the numbers of women attending the screening programme and the attendance rate for the five screening programmes, in percentage terms, for the four rounds. In all instances, the attendance rate was above the NHSBSP minimum standard of 70%. There is a small increase in the attendance rate over the four rounds of the programme. Despite the differences in the

### Table 1 Attendance rates (%) for the five screening programmes

<table>
<thead>
<tr>
<th>Screening programme</th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
<th>Round 4</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5951</td>
<td>7645</td>
<td>78</td>
<td>5667</td>
<td>7136</td>
</tr>
<tr>
<td>B</td>
<td>9511</td>
<td>12,204</td>
<td>78</td>
<td>9272</td>
<td>11,908</td>
</tr>
<tr>
<td>C</td>
<td>9450</td>
<td>13,140</td>
<td>72</td>
<td>9117</td>
<td>12,524</td>
</tr>
<tr>
<td>D</td>
<td>10,569</td>
<td>14,526</td>
<td>73</td>
<td>10,349</td>
<td>13,944</td>
</tr>
<tr>
<td>E</td>
<td>7788</td>
<td>9910</td>
<td>79</td>
<td>7474</td>
<td>9215</td>
</tr>
<tr>
<td>All units</td>
<td>43,269</td>
<td>57,423</td>
<td>75</td>
<td>41,879</td>
<td>54,627</td>
</tr>
</tbody>
</table>

### Table 2 Assessment rate (%) for the five screening programmes

<table>
<thead>
<tr>
<th>Screening programme</th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
<th>Round 4</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.8</td>
<td>3.2</td>
<td>2.7</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>4.2</td>
<td>2.0</td>
<td>3.4</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>8.4</td>
<td>4.3</td>
<td>4.2</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>11.5</td>
<td>5.0</td>
<td>4.5</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>6.0</td>
<td>3.3</td>
<td>3.3</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>All units</td>
<td>7.3</td>
<td>3.6</td>
<td>3.7</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

Range 4.2–11.5 2.0–5.0 2.7–4.5 2.8–4.1
underlying screening populations, the range in uptake for these programmes is relatively small.

Table 1 also shows that by the four rounds, 10 810 (19%) of the 57 423 women were `lost' to the individual programmes.

Assessment rates for the five programmes at each of the four rounds are given in Table 2. The average across all five programmes and the range are also given in Table 2.

Cancer detection rates for the five programmes are given in Table 3. While there is a spread in detection rates, the overall rate of cancers detected has increased in each consecutive round. Table 4 gives the numbers of cancers detected, which are divided into invasive (81%), non-invasive (18%) (range 14–23%). The proportion of non-invasive cancers did not vary among rounds.

Table 5 gives information on the average number of attendances for the five screening programmes. Over half the women (62%) attend all four times, with a significant number (10.1%) never attending at all. The average number of attendances to the screening programme over four rounds was 3.5.

As may be deduced from Table 6, most women are not assessed over the four screening rounds. Approximately one in eight women will be assessed at least once, with a small fraction (0–0.12%) being assessed three times. Assessment rates do vary between programmes by a small amount.

### Discussion

**Main findings of this study**

There are variations in attendance rates among the five screening programmes, with Screening Programme C having the lowest attendance rate and E having the highest rate. These variations tend to be consistent with variations in health deprivation. However, it is interesting to see that the
average attendance rate for any of the five screening programmes has remained similar over four rounds, and it has not fallen off with time as the cohort ages. The global attendance figure clearly hides the behaviour of the individual woman. Over half (62%) attend all four rounds, with 77.2% attending at least three rounds. The average number of times a woman attends screening is 3.5. More importantly, only 10% (range 7.9–12.1%) has never attended.

The assessment rate for all five screening programmes was highest for a woman at the first attendance. The assessment rate is higher because there are no previous films for comparison at the first visit. Although the range of assessment rates has decreased, the average assessment rate has remained reasonably constant over rounds 2, 3 and 4.

Over four rounds (12 years), the vast majority of women are never assessed (87.7%). Of those women who are assessed, only a small fraction is assessed more than once (just under 1% in total). The probability of being assessed is 12.3%, with a typical woman who is assessed having on average 1.08 assessments over four screening rounds.

A pragmatic method of calculating cumulative recall by summing the recall rate of each round (used by Smith-Bindman in her comparison for transatlantic data) is reasonable based upon the findings presented here.

Cancer detection rates have doubled from 3.3 per 1000 screened to 6.9 in line with the rest of the NHSBSPs, as a result of improvements to the programme such as increasing film density and offering two views.

What is already known on this topic?
This is in direct conflict to the previously published screening trials where uptake has fallen over time and with age. Although it is not possible to explain this on the basis of our study, the clear difference is that we are providing service screening as part of a national programme subject to considerable national publicity. This contention could be supported by the Nijmegen data where attendance in the 50–53 cohort stabilized after round 4 when the trial could be considered to be well imbedded in the population.

These findings are generally in line with Scaf-Klomp, who found that 63% of women were ‘very or rather regular’ attenders and only 7% never attended.

What this study adds
This paper is the first to track a cohort of younger women individually in various breast-screening programmes. Average attendance has remained stable unlike screening-based trials, and we presume that this is due to the fact that screening is heavily publicised and made freely available to the whole population. Thus, when planning future screening programmes, it would be prudent for planning to be based on a stable attendance. The global attendance of 90% having attended at least one screening cannot be obtained from routine annual cohort data returns.

The fact that only a very small proportion of the population (0.9%) is assessed more than once can again only be derived from this type of study tracking individual women. As a result, we can reasonably suggest that one can calculate the cumulative burden of assessment by summing the assessment rates from each individual round. This burden might not be a particular problem in the well-established northern European service screening programmes, but in the North America where screening is annual, the recall rates can be as high as 14%; this can mean that an individual woman could have as much as a 50% chance of recall after 10 years.

### Table 5 Number of attendances to screening by unit

<table>
<thead>
<tr>
<th>Screening programme</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9.7</td>
<td>6.5</td>
<td>9.0</td>
<td>16.3</td>
<td>58.5</td>
</tr>
<tr>
<td>B</td>
<td>10.1</td>
<td>6.7</td>
<td>10.6</td>
<td>23.8</td>
<td>48.8</td>
</tr>
<tr>
<td>C</td>
<td>13.4</td>
<td>8.2</td>
<td>10.6</td>
<td>17.9</td>
<td>49.9</td>
</tr>
<tr>
<td>D</td>
<td>12.2</td>
<td>8.2</td>
<td>10.9</td>
<td>18.3</td>
<td>50.4</td>
</tr>
<tr>
<td>E</td>
<td>9.2</td>
<td>5.5</td>
<td>8.6</td>
<td>14.7</td>
<td>62.1</td>
</tr>
<tr>
<td>All units</td>
<td>10.1</td>
<td>5.6</td>
<td>7.2</td>
<td>15.2</td>
<td>62</td>
</tr>
<tr>
<td>Range</td>
<td>9.2–13.4</td>
<td>5.5–8.2</td>
<td>8.6–10.9</td>
<td>14.7–23.8</td>
<td>48.8–62.1</td>
</tr>
</tbody>
</table>

Average number of attendances = 3.5.

### Table 6 Chance of a woman being assessed

<table>
<thead>
<tr>
<th>Screening programme</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>89.9</td>
<td>9.5</td>
<td>0.76</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>91.4</td>
<td>8.0</td>
<td>0.55</td>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>86.5</td>
<td>12.3</td>
<td>1.1</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>83.3</td>
<td>15.2</td>
<td>1.45</td>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>88.5</td>
<td>10.8</td>
<td>0.65</td>
<td>0.05</td>
<td>0</td>
</tr>
<tr>
<td>All units</td>
<td>87.7</td>
<td>11.3</td>
<td>0.91</td>
<td>0.06</td>
<td>0</td>
</tr>
</tbody>
</table>

(Downloaded from https://academic.oup.com/jpubhealth/article/29/3/275/1589868 by guest on 23 October 2023)
Limitations of this study

The five screening programmes analysed in this paper are reasonably representative of those in the UK, but all are somewhat larger than a Forrest Unit (target population 45,000)\(^2\) and larger than most screening units.\(^2\) However, the 3-year programme is unique and, with more frequent invitations/screens, these findings may not hold true.

These data are also from the early years of the screening programme, and we know that global attendance in the UK has risen and recall rates fallen;\(^2\) hence, for women being invited for the first time today (2006), the cumulative attendance could well be higher and cumulative recall could be lower.

Finally, there are limitations in the methodology used to track women. This is a retrospective study in which we have pragmatically assumed a screening round could not be tracked women. This is a retrospective study in which we have invited for the first time today (2006), the cumulative attendance could well be higher and cumulative recall could be lower.

Some of these are likely to have been invited, screened and even assessed, out with our boundaries, potentially deflating our ‘ever-screened’ and ‘ever-assessed rates’.

References