Our position on the NHS Breast Screening Programme

Introduction

This paper discusses breast screening programmes for early detection of breast cancer, focusing on the potential benefits and harms associated with population screening.

Mammography and breast screening

Mammography is an X-ray imaging method used to examine the breast for early detection of cancer and other breast diseases. X-rays of the breasts are called mammograms.

Breast screening (or mammography screening) is when mammograms are taken to check for indications of breast cancer, in the absence of signs or symptoms. Screening can help detect breast cancer at an early stage, when tumours are too small to see or feel.

Diagnostic mammography is used for women (and men) who have symptoms (e.g. a lump, pain or discharge) to help find out whether they have breast cancer. It is also used to evaluate abnormalities detected in a screening mammogram. This paper focuses on breast screening using mammography and does not discuss other types of detection methods containers.

Breast density

Breast tissue is composed of fibrous connective, glandular and fatty tissues. Breast density (or mammographic density) refers to the relative amount of fibrous connective and glandular tissue compared to fatty tissue and is determined from a mammogram (1). Dense breasts have relatively high amounts of glandular tissue and fibrous connective tissue and relatively low amounts of fatty tissue. Women with high breast density are at much higher risk of breast cancer compared to those with average or low breast density; the reasons for this are unclear (2).

As X-rays can pass through fatty tissue, this type of tissue appears dark grey on a mammogram. X-rays do not pass through glandular and connective tissues so these areas appear white (1). (see Figure 1). Abnormal breast changes, including tumours, also appear white. As such, it is often harder to identify tumours in mammograms from women with dense breasts, as they have large areas that appear white (2).

Breast Cancer UK supports the NHS breast screening programme for early detection of breast cancer.

The main benefits of the programme are early detection and reduced breast cancer mortality. One of the most significant harms is overdiagnosis - finding cases of breast cancer with a screening test, that will never cause symptoms.

We also support the NHS providing breast density measurements to women who participate in the breast screening programme, to help towards an understanding of their breast cancer risk.

A woman’s decision to participate in the screening programme is voluntary and should be based on a full understanding of the potential risks and benefits of breast screening. We encourage women to read about the programme and discuss individual options with their GPs.

Figure 1: Mammograms showing breasts with high and low breast densities

<table>
<thead>
<tr>
<th>High breast density</th>
<th>Low breast density</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Mammogram example" /></td>
<td><img src="image2.jpg" alt="Mammogram example" /></td>
</tr>
</tbody>
</table>
Who is eligible for breast screening in the UK?  
The NHS breast screening programme, set up in 1988, invites women registered as female with a GP, between the ages of 50 to 70 (until their 71st birthday), for a mammogram every 3 years. Individuals who are transgender or non-binary may be invited automatically or may need to request an appointment from their GP or local breast screening service. For women 71 years and over, screening every 3 years is available if requested. Women known to be at high risk (e.g. BRCA mutation carriers) may be invited for breast screening before 50, more often than every 3 years; or have magnetic resonance imaging (MRI) scans as well as mammograms.

Men are not included in population-based screening programmes because of the low incidence of breast cancer in men and the lack of studies undertaken that might support a screening programme for men (3). Breast cancer in men is often locally advanced when detected. Screening of asymptomatic high-risk men (e.g. BRCA2 mutation carriers) could result in earlier detection of the disease (3). Research is needed to determine whether a breast screening programme for men is likely to be beneficial.

In some regions of England, the breast screening programme has been inviting women from 47 to 73 years old for a mammogram, as part of the AgeX trial. The trial stopped recruiting women in March 2020 as a result of the Covid-19 pandemic, although participants will continue to be monitored.

Breast Screening during Covid-19
The NHS Breast Screening Programme was paused between March and June 2020, as a consequence of the Covid-19 pandemic (4). During April 2020-March 2021, 525,000 fewer UK women had breast screening compared to the previous year, a 44% decrease. The number of breast cancers detected during April 2020-March 2021 was 10,813, a 39% decrease compared to the previous year (4).

A recent analysis by Duffy et al. (5) of the impact of the pandemic on the UK breast screening programme estimated that between July 2020 and June 2021, 1.5 million women had screening delayed for 2-7 months, resulting in 750,000 outstanding screens. This may result in an estimated 148-687 extra breast cancer deaths in UK woman (5).

Breast screening in other countries
In the UK women are invited for breast screening once every three years. In high socio-economic countries screening usually occurs every two years. The most common age for screening is 50-69 years old (Table 1).

Table 1: Screening age and mammogram interval used in different screening programmes (6-8)

<table>
<thead>
<tr>
<th>Country</th>
<th>Screening age</th>
<th>Mammogram interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>40-75</td>
<td>2</td>
</tr>
<tr>
<td>Korea</td>
<td>40+</td>
<td>2</td>
</tr>
<tr>
<td>Hungary</td>
<td>45-65</td>
<td>2</td>
</tr>
<tr>
<td>Iceland</td>
<td>40-69</td>
<td>2</td>
</tr>
<tr>
<td>Austria, New Zealand, Portugal</td>
<td>45-69</td>
<td>2</td>
</tr>
<tr>
<td>Australia, France, Canada</td>
<td>50-74</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>50-69 (one 40 &amp; 74)</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>50-75</td>
<td>2</td>
</tr>
<tr>
<td>Germany, Poland, Denmark, Latvia, Belgium, Croatia, Cyprus, Finland, Italy, Luxemburg, Norway, Slovenia, Ireland, Singapore, *Switzerland</td>
<td>50-69</td>
<td>2</td>
</tr>
<tr>
<td>Malta</td>
<td>50-69</td>
<td>2.5</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>50-75</td>
<td>2</td>
</tr>
<tr>
<td>Ireland</td>
<td>50-64</td>
<td>2</td>
</tr>
<tr>
<td>Monaco</td>
<td>50-80</td>
<td>2</td>
</tr>
<tr>
<td>Estonia</td>
<td>50-65</td>
<td>2</td>
</tr>
<tr>
<td>UK</td>
<td>50-70 (until 71st birthday)</td>
<td>3</td>
</tr>
<tr>
<td><strong>US</strong></td>
<td>40-75+</td>
<td>1-2</td>
</tr>
<tr>
<td>***WHO recommendations</td>
<td>50-69</td>
<td>2</td>
</tr>
</tbody>
</table>

* The programme runs in only some Swiss cantons.
** There is no centrally organised breast cancer screening programme in the US. Different organisations make different recommendations for screening ages and intervals between mammograms (see here)
*** World Health Organisation (WHO) recommendations apply to “well-resourced settings, where organised programmes can be met by the health-care system and decisions to participate are consistent with values and preferences”. The WHO recommends including 40-49 year olds, only if the programme is conducted in the context of “rigorous research, monitoring and evaluation” and including 70-75 year olds only if the programme is conducted in the context of “rigorous research”.
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Benefits and harms of breast screening

The potential benefits of breast screening include reduced mortality from breast cancer and detection of earlier stage cancer. The potential harms include overdiagnosis; false positives; false negatives; radiation exposure and discomfort.

Benefits

Reduced Mortality from Breast Cancer

The main benefit from participating in breast screening programmes is reduced mortality from breast cancer. A 2012 report commission by the NHS estimated that screening saves one life from breast cancer for every 200 women who are screened (9). In 2019 this was estimated to equate to around 1,700 lives saved from breast cancer in the UK each year (5, 10).

When malignancy is detected early it is easier to treat and cancerous tumours may be removed completely. It is more challenging to manage disease following a late diagnosis when cancer has spread to other parts of the body.

Most studies estimate the risk of dying from breast cancer is reduced by 10-58% in screened populations (8-15). The large variation may be due to different types of studies performed, different methodologies such as variations in follow-up times, and different factors associated with population screening programmes, such as frequency and ages women are invited for mammograms (14).

A 20% reduction of dying from breast cancer would mean ~ 4 breast cancer deaths are prevented for every 1,000 women screened (11). A recent case-control study on breast cancer mortality in England estimated that 9 deaths would be prevented per 1,000 women attending screening (equivalent to 38% reduction) (12).

A systematic review commissioned by the European Commission (EC) (13) concluded “there is high certainty evidence that mammography screening reduces the risk of breast cancer mortality in women between the ages of 50 and 69, with the number of deaths averted between 138 and 483 per 100,000 women invited to screening, depending on the baseline risk assumed”.

Another European systematic review, which included 3 randomised control trials and observational studies, estimated a 12-58% lower mortality was associated with screening (13). It should also be noted that some researchers question whether screening results in any reduction in breast cancer mortality (e.g. 16, 17).

Detection of earlier stage cancer

The EC-commissioned study (13) consistently found that women invited to screening across all age groups showed a lower risk of advanced stages of breast cancer, consistent with other studies. Early stage cancer usually requires less aggressive treatment compared to later stage cancer that presents symptomatically. This may mean lower rates of mastectomy (surgical breast removal), chemotherapy, radiotherapy and also endocrine (hormone) therapy - used to treat hormone receptor positive breast cancers.

Harms

Overdiagnosis

Overdiagnosis refers to breast cancer diagnosed by screening that would not otherwise have come to attention in a woman’s lifetime. Not all breast cancers will spread during a person’s lifetime and often breast cancer does not result in pain. Thus, cancer is present, but would not cause death, pain or otherwise impact a woman’s life.

Overdiagnosis has been consistently associated with breast screening (e.g. 8, 13, 18). It leads to additional mammograms, imaging (e.g. ultrasound, MRI), biopsies (removal of cells or tissues for examination by a pathologist) and treatments, as well as distress and other psychological responses.

The Independent UK Panel on Breast Cancer Screening

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1 Randomised control trials or observational studies
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estimated that 19% of breast cancers diagnosed using screening represent overdiagnosis (9). The panel considered this was the major harm associated with breast screening. A European study found in women aged between 50 and 69, 17% were overdiagnosed (13). A meta-analysis suggests this figure may be closer to 30% (15). Estimates of overdiagnosis vary between 0-55% (18). This large variation is likely to be due to variations in statistical analysis, post-screening follow-up times and the type of study undertaken. The higher figures are more likely to be overestimates as they are based on aggregated data (combined individual data that is averaged), rather than individual data (18, 19).

An independent analysis of the NHS screening programme estimated that for every 100,000 women in England aged 50 invited to screening over the next 20 years, 129 would be overdiagnosed (8).

**False positives**

In the UK an estimated 3.4% of mammograms give false positive results (11). This means women are recalled for further tests which eventually prove negative. Around a third of such cases involve a core biopsy (the removal of a tissue sample with a wide needle for microscopic examination) and around 2% a biopsy under anaesthetic. False positive rates are especially common in younger women, who tend to have denser breasts, making their mammograms more difficult to interpret. In addition to unnecessary tests, false positives lead to anxiety (21).

**False negatives**

False negatives (where no cancer is detected on a mammogram, when it is present) may also occur but are rare. In the UK an estimated 0.02% of mammograms give false negative results (11). These result in false reassurances and delays in treatment. False negatives are more likely to occur in women with high breast density (22).

Breast cancers may develop between screening rounds. These are known as interval cancers. They manifest after a negative screening and before the next routine screening.

**Radiation exposure**

Mammography exposes women to very low doses of ionising radiation that could cause breast cancers. Screening women every 3 years from age 47 to 73 has been estimated to cause 3-6 cancers per 10,000 women screened (23).

Digital mammography, which uses lower radiation doses, is increasingly being used in the NHS English screening programme (11).

**Discomfort and distress**

For some women, mammography is painful; it may also cause anxiety, especially for those requiring further investigations (13).

**All-cause mortality and quality of life years**

Finding breast cancer may lead to treatment and side effects, but in some cases, it may not make a meaningful impact on a woman’s health or prolong her life. (24).

To evaluate Norway’s mammography screening programme, Zahl and colleagues (24) assessed losses in quality of life (false positives, overdiagnosis) and gains in length of life (reduced mortality) using “Quality Adjusted Life Years” measures in two hypothetical cohorts of Norwegian women, one unscreened and another screened. Their analysis indicates that the current mammography screening programme in
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Norway brings more losses than gains. The authors believe these results could be representative for Sweden, Denmark, the UK and US. To date, very few studies examining quality of life effects associated with breast screening programmes have been carried out. Furthermore, studies have not shown breast screening reduces all-cause mortality (24).

Age and frequency of mammograms

Should screening begin below 50?
In 2012, an independent UK panel concluded that while routine breast screening at ages 50-70 confers significant benefit to UK women, the advantages of beginning screening at younger or continuing at a later age were uncertain (9). The AgeX trial was set up to assess whether offering extra screening to older (ages 71-73) and younger women (ages 47-49) would be beneficial. The first report is due to be published in 2026 (25). The UK Age trial was set up to investigate the effects of screening women between ages 40-49 (25).

The main arguments for not routinely screening younger women are that breast cancer incidence and mortality are lower in women under 50, compared to those older (2about 4 out of 5 breast cancers are found in women over 50) and mammograms are more difficult to read in younger women because their breast tissue is denser (13).

Different studies and analyses come to different conclusions as to whether screening should start before 50 years of age. A 2021 systematic review commissioned by the EC (13) concluded that for those under 50 “the evidence is not conclusive” whether screening reduces breast cancer mortality. More recently, in September 2022 the European Health Union published recommendations for cancer screening which included extending the target group for breast cancer screening from women aged 50-69 to include women aged 45-74, and to consider specific diagnostic measures for women with particularly dense breasts (26).

The UK Age Trial, a UK randomised controlled trial, compared yearly screened women aged 40-49 years to women of the same age who were not screened. Yearly mammography before age 50 years, commencing at age 40 or 41 years, was associated with a 25% relative reduction in breast cancer mortality, which was attenuated after 10 years (25). The authors estimated approximately one death was prevented per 1,000 women screened. The trial included 160,000 women with a follow-up of 23 years.

Should screening continue beyond 70?
Several studies have found screening women between ages 70-74 reduces breast cancer mortality and may reduce risk of advanced disease (8, 13, 27). Many screening programmes, such as those in Australia, France and Canada, screen women until 74 years of age (Table 1). Although a 2021 systematic review commissioned by the EC concluded that for those over 69 years of age, evidence that routine screening reduces breast cancer mortality was inconclusive (13), the EC now advises screening should continue until 74 (26). Increasing the screening age increases overdiagnosis (8). The WHO recommends a population-based screening programme for women aged 70−75 years only in a “well-resourced setting” and if it is accompanied by “rigorous research” (8). Current evidence for the benefits of screening mammography for women beyond 75 is not strong (27, 28).

Screening frequency
The NHS screening programme invites women for a mammogram once every 3 years; this differs from all other national screening programmes, most of which invite women every 2 years (Table 1; 6). A WHO report (8) concluded that biennial screening provided the best trade-off between benefits and harm. It estimated that

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biennial screening of women aged 50-69 years old achieved a median 16% reduction in breast cancer deaths compared to no screening. It is unclear why the NHS programme uses triennial rather than biennial screening. Around 34% of breast cancers in the UK are screen detected and screened women are diagnosed with less advanced disease. In countries where breast screening is biennial, screen detected breast cancers are likely to be more common. Less frequent screening may therefore result in detection of later stage illness, which could be more difficult to treat. It would also mean that fewer women are screened, resulting in lower costs associated with running the programme.

The UK has a relatively poor 5 year breast cancer survival rate compared to most developed countries that use biennial screening. Although many factors contribute to breast cancer survival, one factor may be associated with the longer interval between mammograms in the NHS screening programme.

Other considerations for a breast screening programme

Risk-based/stratified screening

In a risk-based (or stratified) screening programme high risk individuals are screened more regularly and lower risk individuals less often. Breast cancer risk can be assessed based on breast density, genomics (studying an individual’s genes) and family history, as well as clinical, environmental and lifestyle risk factors. Individualised risk assessment informs screening interval, starting age, type of imaging or decisions not to screen. High risk individuals (e.g. those with a known genetic predisposition, such as an inherited BRCA mutation, high breast density and a strong family history) could be offered more frequent mammograms (e.g. every 1-2 years) or other types of screening, and medium/low risk individuals invited for screening less frequently (e.g. every 3-5 years).

A 2019 review of the NHS Screening programme concluded “There is widespread consensus that breast screening should become more targeted on the basis of an individual’s risk”.

Breast density measurements

Currently, women who take part in the NHS breast screening programme are not told their breast density measurements. Being informed of this measurement may help women understand their personal risk. This is especially true for women with very high breast density scores, who are at a very high risk of breast cancer. It is also more difficult to detect breast cancers in women with high breast density. The European Breast Imaging Association now recommends women are told breast density measurements. Consistent with this, in a national survey of UK radiologists and breast surgeons, over 75% of radiologists and around half of all breast surgeons interviewed agreed that women should be informed of their breast density scores.

Concluding remarks

Breast Cancer UK supports the NHS breast screening programme for early detection of breast cancer. Most studies conclude the potential benefits of screening mammography outweigh the potential drawbacks. It is an individual’s choice whether to participate in the breast screening programme. In this discussion paper we have outlined the benefits and harms, based on current research, so women can make an informed choice about whether to participate in the programme. Most studies show that screening programmes prevent breast cancer deaths, result in some overdiagnosis and a small level of radiation exposure. An independent evaluation of the NHS breast screening programme found 17,771 breast cancers detected through screening.
concluded that breast screening plays an important role in lowering the risk of dying from breast cancer, especially for women aged 65 or over. It also results in overdiagnosis. These findings highlight the need for further research into improvements to the breast screening programme such as risk-based screening and how it might be implemented, consideration of including high-risk men and women aged 70-75 or those aged 45-49, and informing women of their breast density measurements, to help them understand better their personal risk of breast cancer. Research should also focus on a better understanding about which tumours are likely to remain precancerous, especially those associated with DCIS, to help reduce unnecessary treatment.
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References


Support

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About Breast Cancer UK

Who are we?
Breast Cancer UK aims to prevent breast cancer through scientific research, collaboration, education and policy change. We educate and raise awareness of the risk factors for breast cancer and provide practical information to help people reduce these risks. We campaign to ensure government policies support the prevention of breast cancer. And we fund scientific research that helps to better understand what risk factors contribute to breast cancer, and how to address them.

For further information on breast cancer risk factors please visit our website www.breastcanceruk.org.uk
To view this information in a more accessible format or to provide feedback, please contact us.

Disclaimer
This brief is for information purposes only and does not cover all breast cancer risks. Nor does it constitute medical advice and should not be used as an alternative to professional care. If you detect a lump or have any concerns, seek advice from your GP. Breast Cancer UK has made every effort to ensure the content of this leaflet is correct at the time of publishing but no warranty is given to that effect nor any liability accepted for any loss or damage arising from its use.

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