

## Breast Cancer Screening—for health professionals (PDQ®)

### Overview

- [Screening With Mammography](#)
  - [Benefits](#)
  - [Harms](#)
- [Clinical Breast Examination](#)
  - [Benefits](#)
  - [Harms](#)
- [Breast Self-examination](#)
  - [Benefits](#)
  - [Harms](#)

Note: Separate PDQ summaries on [Breast Cancer Prevention](#), [Breast Cancer Treatment](#), [Male Breast Cancer Treatment](#), and [Breast Cancer Treatment and Pregnancy](#) are also available.

This summary covers the topic of breast cancer screening and includes information about breast cancer incidence and mortality, risk factors for breast cancer, the process of breast cancer diagnosis, and the benefits and harms of various breast cancer screening modalities. This summary also includes information about screening among special populations.

Mammography is the most widely used screening modality, with solid evidence of benefit for women aged 40 to 74 years. Clinical breast examination and breast self-exam have also been evaluated but are of uncertain benefit. Technologies such as ultrasound, magnetic resonance imaging, tomosynthesis, and molecular breast imaging are being evaluated, usually as adjuncts to mammography.

### Screening With Mammography

#### Benefits

Based on solid evidence, screening mammography may lead to the following benefit:

- **Decrease in breast cancer mortality**
  - **Magnitude of Effect:** In the randomized controlled trials (RCTs), for women aged 40 to 74 years, screening with mammography has been associated with a 15% to 20% relative reduction in mortality due to breast cancer.[1] Absolute mortality benefit for women screened annually for 10 years is approximately 1% overall, ranging from 4 per 10,000 women who start screening at age 40 years to 50 per 10,000 women who start at age 50 years.[2] Based on the 25-year follow-up from the Canadian National Breast Screening Study (CNBSS), an RCT of breast cancer screening,[3] there is some uncertainty about the magnitude of benefit of mammography in the present day.
  - **Study Design:** RCTs, population-based evidence.
  - **Internal Validity:** Variable, but meta-analysis of RCTs good.
  - **Consistency:** Fair.
  - **External Validity:** Good.

## Harms

Based on solid evidence, screening mammography may lead to the following harms:

- **Overdiagnosis and Resulting Treatment of Insignificant Cancers:** Diagnosis of cancers that would otherwise never have caused symptoms or death in a woman's lifetime can expose a woman to the immediate risks of therapy (surgical deformity or toxicities from radiation therapy, hormone therapy, or chemotherapy), late sequelae (lymphedema), and late effects of therapeutic radiation (new cancers, scarring, or cardiac toxicity). Although the specific plan of recommended treatment is typically tailored to individual tumor characteristics, at this time there is no reliable way to distinguish which cancer would never progress in an individual patient; therefore, some treatment is nearly always recommended.
  - **Magnitude of Effect:** Varies with patient age, life expectancy, and tumor type (ductal carcinoma *in situ* and/or invasive).[4,5] Of all breast cancers detected by screening mammograms, up to 54% are estimated to be results of overdiagnosis.[6] The best estimations of overdiagnosis come from either long-term follow-up of RCTs of screening or the calculation of excess incidence in large screening programs. Although there are uncertainties with each approach, follow-up of the long-term CNBSS and well-conducted excess incidence studies in the United States [7] and Scandinavia [8,9] found that at least 20% of screen-detected breast cancers are overdiagnosed.
  - **Study Design:** Descriptive population-based comparisons, autopsy series, and series of mammary reduction specimens.
- **False-Positives with Additional Testing and Anxiety.**
  - **Magnitude of Effect:** On average, 10% of women will be recalled from each screening examination for further testing, and only 5 of the 100 women recalled will have cancer.[10] Approximately 50% of women screened annually for 10 years in the United States will experience a false-positive, of whom 7% to 17% will have biopsies.[11,12] Additional testing is less likely when prior mammograms are available for comparison.
  - **Study Design:** Descriptive population-based.
- **False-Negatives with False Sense of Security and Potential Delay in Cancer Diagnosis.**
  - **Magnitude of Effect:** 6% to 46% of women with invasive cancer will have negative mammograms, especially if they are young, have dense breasts,[13,14] or have mucinous, lobular, or rapidly growing cancers.[15]
  - **Study design:** Descriptive population-based.
- **Radiation-Induced Breast Cancer:** Radiation-induced mutations can cause breast cancer, especially if exposure occurs before age 30 years and is at high doses, such as from mantle radiation therapy for Hodgkin disease. The breast dose associated with a typical two-view mammogram is approximately 4 mSv and extremely unlikely to cause cancer. One Sv is equivalent to 200 mammograms. Latency is at least 8 years, and the increased risk is lifelong.[16,17]
  - **Magnitude of Effect:** Theoretically, annual mammograms in women aged 40 to 80 years may cause up to one breast cancer per 1,000 women.[16,17]
  - **Study design:** Descriptive population-based.

For all these potential harms of screening mammography, internal validity, consistency and external validity are good.

## Clinical Breast Examination

### Benefits

Clinical breast examination (CBE) has not been tested independently; it was used in conjunction with mammography in one Canadian trial, and was the comparator modality versus mammography in another trial. Thus, it is not possible to assess the efficacy of CBE as a screening modality when it is used alone versus usual care (no screening activity).

- **Magnitude of Effect:** The current evidence is insufficient to assess the additional benefits and harms of CBE. The single RCT comparing high-quality CBE to screening mammography showed equivalent benefit for both modalities. Accuracy in the community setting might be lower than in the RCT.
- **Study Design:** Single RCT, population cohort studies.

- **Internal Validity:** Good.
- **Consistency and External Validity:** Poor.

## Harms

Screening by CBE may lead to the following harms:

- **False-Positives with Additional Testing and Anxiety.**
  - **Magnitude of effect:** Specificity in women aged 50 to 59 years was 88% to 99%, yielding a false-positive rate of 1% to 12%.[\[18\]](#)
  - **Study Design:** Descriptive population-based.
  - **Internal Validity, Consistency and External Validity:** Good.
- **False-Negatives with Potential False Reassurance and Delay in Cancer Diagnosis.**
  - **Magnitude of Effect:** Of women with cancer, 17% to 43% have a negative CBE. Sensitivity is higher with longer duration and higher quality of the examination by trained personnel.
  - **Study Design:** Descriptive population-based.
  - **Internal and External Validity:** Good.
  - **Consistency:** Fair.

## Breast Self-examination

### Benefits

Breast self-examination (BSE) has been compared to usual care (no screening activity) and has not been shown to reduce breast cancer mortality.

- **Magnitude of Effect:** No effect.[\[19,20\]](#)
- **Study Design:** Two RCTs.
- **Internal Validity and Consistency:** Fair.
- **External Validity:** Poor.

### Harms

Based on solid evidence, formal instruction and encouragement to perform BSE leads to more breast biopsies and diagnosis of more benign breast lesions.

- **Magnitude of Effects on Health Outcomes:** Biopsy rate was 1.8% among the study population compared with 1.0% among the control group.[\[19\]](#)
- **Study Design:** Two RCTs, cohort studies.
- **Internal Validity:** Good.
- **Consistency:** Fair.
- **External Validity:** Poor.

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