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Review

How effective are breast cancer screening programmes by mammography? Review of the current evidence

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ABSTRACT

Randomised controlled trials showed that breast cancer screening by mammography reduces breast cancer mortality in women over age 50 by 25–30%. However, it was not clear if this effect would persist outside the controlled trial environment or even could be enhanced.

We review the current evidence of the impact of long-standing breast cancer screening programmes (Australia, Canada, Denmark, Finland, Iceland, Italy, the Netherlands, Spain, Sweden and the United Kingdom) on breast cancer mortality.

The decrease observed in women invited to screening ranges from 16% to 36%. Breast cancer mortality reductions range from 24% to 48% in women having attended at least one screen after correcting for selection bias. Although evaluation design, time period studied, participation rates achieved differ, the trend in mortality reduction is consistent. Adjuvant therapy is estimated to contribute about one third to this decrease. We conclude that mammography screening programmes implemented for at least 10 years achieve a similar, but not greater mortality reduction as the randomised controlled trials. However, it may take some more years before the full impact of these mammography screening programmes can be assessed.

1. Introduction

Based on the results of eight randomised controlled trials studying the efficacy of mammography screening to reduce breast cancer mortality and numerous meta-analyses, showing a 25–30% decrease in breast cancer deaths, several industrialised countries started implementing national mammography screening programmes in the 1980s and 1990s. A Cochrane review published in 2001[1–3] challenged the results of some of the randomised controlled trials leading to a major controversy on the benefits of mammography screening.[c] Several extensive reviews then re-asserted that randomised controlled trials had shown that breast cancer screening by mammography in women age 50–69 at regular intervals can reduce breast cancer mortality.[5–8] Furthermore many papers were published in 2002 and 2003 that countered specific issues raised in the Cochrane review.[9–17]

However, it was not clear how much of this effect would persist outside the controlled trial environment. A first review of the effectiveness of mammography screening programmes was done at an international level by IARC in 2002.[18] Analysing studies on the impact of service screening mammography

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[c] An update of the Cochrane review on breast cancer screening was published in 2006.[4] The trials included in the analysis are identical to those in the initial review, but the conclusions differ indicating that screening likely reduces breast cancer mortality by 15–20%.

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fpublished between 1990 and 2004, another review concluded that breast cancer mortality reductions observed were consistent with those observed in the randomised trials.[19] In 2006, the Advisory Committee on Breast Cancer Screening in England considered efficacy of mammography screening to be underestimated in the randomised controlled trials.[20] In the same year, a health technology assessment requested by the Quebec Ministry of Health (Canada) re-examined the scientific evidence on which screening mammography programmes are based.[21] This extensive review also concluded that modern breast cancer screening programmes may achieve greater reduction in breast cancer mortality than was found in the screening trials, without providing conclusive evidence.

This paper reviews the recent evidence on the impact of breast cancer screening programmes on breast cancer mortality. We focus on programmes evaluated after at least 10 years of implementation, as statistically significant results of breast cancer screening can be expected 10–15 years after the introduction of the screening.

2. Methods

A Medline search on the effectiveness and breast cancer mortality reduction linked to mammography screening (programmes) was carried out and complemented by a search of references in the relevant articles. Only materials published in English language between 2000 and end of 2008 were included. Details of the search strategy are available with the authors. Evaluation reports of long-standing national programmes done by accredited national institutes were searched and complemented by information on mammography screening from national websites.

3. Results

Breast cancer screening programmes by mammography have been operating for more than 10 years in Australia, Belgium, Canada, Denmark, Finland, France, Iceland, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. Some of these programmes were progressively geared towards national coverage, whereas other programmes remained limited to one or several regions of the country. Published materials assessing the impact of a mammography screening programme on breast cancer mortality were identified for nine countries. For each of these (in alphabetic order) the history of the national or regional screening programme is briefly summarised followed by evidence on their possible role in reducing breast cancer mortality.

3.1. *Australia*

The National Programme for the Early Detection of Breast Cancer, now known as BreastScreen Australia, was established by the Commonwealth and the States and Territories in 1991. It is targeted at women without symptoms aged 50–69, although women aged 40–49 and 70 years and older are able to attend screening. BreastScreen Australia operates in over 500 locations nationwide, via fixed, semi-mobile and mobile screening units. The Programme's aim is to achieve a participation rate of 70% among women aged 50–69 years. In 2002–2003, the programme screened 56.1% of women in the target group.

The 2006 progress report of Australia[22] shows that the 5-year relative breast cancer survival has increased from 70.9% in the period 1982–1986 to 86.6% in 1998–2002. There was no change in breast cancer survival in men during the same period. The age-standardised breast cancer mortality rate for women aged 40–85 was fairly steady until the early 1990s, but since then has fallen from 31.0 deaths per 100,000 women in 1990 to 23.4 deaths per 100,000 in 2004 corresponding with a 24.5% mortality reduction. Furthermore the median age of death due to breast cancer for women increased from 64 years in 1983 to 67 years in 2004. A recently published case–control study supports these findings.[23] The relative odds to die of breast cancer were 0.59 in screening participants compared with non-participants. After correcting for the screening self-selection bias as observed in the randomised trials,[d] the breast cancer mortality reduction approximated 30% (odds ratio 0.70).

3.2. *Canada*

Organised breast cancer screening began in British Columbia in 1988 and has since expanded to include all 10 provinces plus the Yukon, Nunavot and Northwest Territories. The last province, Prince Edward Island, started screening in 1999. The average national participation was 34% in 2003. Nationally the target population is defined as asymptomatic women between the ages 50 and 69 years with no prior diagnosis of breast cancer. However, each province may also propose screening to women outside this target age group. British Columbia has the longest standing screening programme, and by 2003 more than 50% of women aged 40–79 had received at least one screening mammography through the programme. Women under the age of 50 are screened annually and those over 50 are screened every 2 years.

To assess the impact of this screening programme on breast cancer mortality a cohort of women aged 40–79 having had their first screen in the period 1988–2003 was identified.[26] Observed breast cancer deaths were compared to those that would have been expected in the same cohort without screening. The calculation of expected deaths was derived from incidence and survival rates of non-participants during the same time period. It was assumed that women participating in screening had the same risk of developing breast cancer as those who did not. The breast cancer mortality ratio, calculated by dividing observed by expected breast cancer deaths, was estimated at 0.60 (95% CI (confidence interval) 0.55–0.65) for all ages combined. There were no significant

[d] Self-selection or healthy-volunteer bias refers to the notion that women who choose to attend screening tend to have a higher socioeconomic status, which by itself is associated with a higher incidence of the disease, but a lower case fatality. The net effect is that women who attend have generally better health status and are less likely to die of breast cancer regardless of screening. If not addressed this confers a bias in favour of screening. Methods exist to adjust for self-selection in the analysis of randomized trials[24] and case–control studies.[25]

differences between age groups. Corrected for self-selection bias using estimates from the literature the mortality ratio was 0.76 corresponding to a 24% decrease in the breast cancer mortality in women over age 40 undergoing screening.

3.3. *Denmark*

In Denmark, mammography screening was introduced between 1991 and 1994 in three of 16 administrative regions. In Copenhagen the screening programme started in 1991 offering screening to women aged 50–69 years. Participation rate in the initial round was 71%. In 2005 a study was carried out to compare breast cancer mortality in women invited for screening in Copenhagen between 1991 and 2001 (five rounds) and a national control group (regions without a mammography screening programme), a historical Copenhagen control group and a historical national control group (1981–1991).[27] It should be noted that opportunistic mammography screening has remained very limited in Denmark. The study showed a significant reduction in breast cancer mortality during the 10-year screening period of 25% (RR 0.75, 95% CI 0.63–0.89) compared with what would be expected in the absence of screening. For women actually participating in screening, breast cancer mortality was reduced by 40% (RR 0.60, 95% CI 0.49–0.74). After adjusting for self-selection bias, the relative risk was 0.63.

3.4. *Finland*

In Finland, nationwide population-based breast cancer screening was initiated in 1987. In 1992 all women aged 50–59 years were invited for screening every 2 years. Screening remained optional for women aged 60–69 leading to wide variations of coverage at the municipal level. Since 2007 all women until 69 years of age were invited (progressive implementation).

A non-randomised study was carried out in Helsinki, where breast cancer screening started from 1986 onwards progressively including birth cohorts of women aged 50–59. Breast cancer mortality among the birth cohorts invited for screening and having completed all screening rounds (1935–1939) and the last birth cohorts not included in the screening programme (1930–1934) were compared in the period 1986–1997. A statistically non-significant 19% decrease in refined mortality was found (RR 0.81, 95% CI 0.62–1.05).[28]

Another study analysed time trends in breast cancer incidence and mortality in three cities with different screening histories: screening offered to women in birth cohorts 1918–1932 (age 55–69) since 1987 in Turku, screening offered to women in birth cohorts 1928–1932 (age 55–59) since 1987 in Tampere, no screening in these birth cohorts in Helsinki.[29] The incidence of breast cancer during the 11-year screening period 1987–1997 in women born in 1918–1932 was compared with incidence during the pre-screening period 1976–1986 in women born in 1907–1921 in each city. The follow-up for breast cancer mortality was 4 years longer. The incidence of breast cancer increased by 31–38% in all study cities irrespective of screening. No statistically significant changes in breast cancer mortality were seen in Tampere (non-significant 14% mortality reduction) or Helsinki (non-significant 11% mortality increase). In Turku, a significant 36% mortality reduction (RR 0.64; 95% CI 0.47–0.88) was found in the whole study population. Although a consistent mortality reduction was found in all age groups screened, it was statistically significant only in women aged 65–69 at entry (RR 0.53; 95% CI 0.28–0.99).

Very recently the impact of the nation-wide mammography screening programme has been examined.[19,30] Women invited at least once by a screening centre of the Cancer Society of Finland, covering about half of the population, and living in a municipality with a screening programme functioning for at least 9 years were included. This cohort of 361,848 women was followed during the period 1992–2003. Expected breast cancer deaths without screening were estimated based on population data in the same municipalities from 1974 to 1985. The reduction in breast cancer mortality was 22% (RR 0.78; 95% CI 0.70–0.87) in all women aged 50–69. Among women having participated in screening the relative risk was 0.66 (95% CI 0.58–0.75), and 0.72 (95% CI 0.56–0.88) after adjusting for self-selection bias.

Finland has been the only country initially inviting only women aged 50–59. One could expect that such a programme would have a lower impact on breast cancer mortality than if the full age range 50–69 was invited. To examine the effect on breast cancer mortality at age 60–79 years of inviting different age groups, Finish municipalities were divided into three categories: inviting women aged 50–59 only, inviting all women aged 50–69, and inviting women aged 50–59 regularly and women aged 60–69 irregularly.[31] Methods to measure the observed and expected deaths were the same as above.[30] The reduction in breast cancer mortality after age 60 was the strongest (RR0.72; 95% CI 0.51–0.97) in municipalities inviting the full age range and no effect was found with invitations restricted to women aged 50–59 years (RR 1.04; 95% CI 0.81–1.31).

3.5. *Iceland*

The Icelandic mammography screening programme started in 1987 and achieved national coverage in 1989. All women aged 40–69 are invited biennially. The impact of this programme was recently assessed using the case–control method.[32] Breast cancer deaths from 1990 to December 2002 were defined as cases ($n = 226$). Controls were age- and screening-area-matched women invited to screening and were alive at the time their case had died ($n = 902$). The odds ratio for the risk of death due to breast cancer in women attending at least one screen compared to those who were never screened was 0.59 (95% CI 0.41–0.84). After adjusting for self-selection bias, the odds ratio was 0.65 (95% CI 0.39–1.09). This indicates a 35% statistically non-significant mortality decline.

3.6. *Italy*

Pilot breast cancer screening programmes started in Florence and Turin in the early 1990s. Since 1995 nine areas have implemented a screening programme. To evaluate the impact of these screening programmes, all breast cancers diagnosed from the year before the start of the local programmes up to the year 2001 were followed up until the end of 2005 or for 10 years.[33] Only invasive breast cancer cases ($n = 12,987$) were considered for survival analysis, for a total of 1921 breast

cancer deaths. Median follow-up time was 6.6 years. Women were grouped as invited to screening or non-invited. Only those women who had not yet been invited during the implementation phase of the programmes were considered as non-invited. All other women, including those who never responded to an invitation were considered as invited. The 10-year survival rates were 85.3% for the invited group against 75.6% for the non-invited. The authors acknowledge that the length of the follow-up is possibly too short to give a lead time free estimate of the benefit. The estimated breast cancer mortality reduction was 36% at 5–10 years after diagnosis.

3.7. *The Netherlands*

The Dutch national breast screening programme started in 1989 and invited women aged 50–69 years. National coverage was reached in 1997. In 1998, it was extended to include women aged 70–75 years old. Screening is organised regionally and involves mobile units. The participation rate has been stable around 80%.

In 2001 the national breast screening evaluation team reported a 19.9% statistically significant breast cancer mortality reduction in the age group 55–74 as compared to death rates in 1986–1988.[34] Adjuvant systemic therapy seemed unlikely to explain this reduction, as mortality rates continued to rise in municipalities where screening began after 1995. The trend in mortality decline continued and reached 25.5% in 2004, 14 years after the start of the national programme.[35,36] The observed decline in breast cancer mortality is very similar to the decrease that had been predicted by a microsimulation model as shown in Fig. 1.[35]

3.8. *Spain*

A breast cancer screening programme was set up in the province of Navarra in 1990 targeting women aged 45–65 years. A participation rate of more than 85% was rapidly achieved and maintained. Breast cancer mortality during the pre-screening period (1987–1989) was compared to the last screening periods (2002–2004). Overall breast cancer mortality declined by 36% (95% CI 21–48%) with the largest reduction in the age group 50–69 (52%; 95% CI 33–65%). Furthermore, based on breast cancer incidence trends 1975–1990, breast cancer deaths without screening were estimated for the period 1990–2004 (extrapolating the pre-screening trend) and were compared to observed breast cancer mortality after the introduction of screening. The estimated decrease in breast cancer mortality was 62% in the screened age group, but was only 22% in the unscreened age groups (30–44 and $\geqslant$75 years).[37]

3.9. *Sweden*

In 1986, the National Board of Health in Sweden recommended mammography screening for women aged 40–74, leaving implementation decisions to the county level. The first counties started screening in 1986 followed progressively by other counties. National coverage was achieved in 1997. Opportunistic screening exists in the large cities but is rare elsewhere. Attendance rates have been around 70–75%.

A recent study examined the time trend in incidence-based breast cancer mortality among women aged 40–69 years screened in 13 large areas within nine counties over a period of follow-up of 20–44 years.[38,39] Only counties with at least 10 years of follow-up after the initiation of screening were included. This represents approximately 45% of Swedish women and includes information about age at diagnosis, age at death, and screening history for 542,187 women in the pre-screening and 566,423 women in the screening epochs. The pre-screening epoch examined varies by county from 1958–1979 to 1979–1989. The screening epochs vary in length from 8 (one county) to 15 years covering the period 1980–2001. Each screening epoch had an additional follow-up of 5 years for mortality. Attendance of screening was uniformly high, averaging 75%. After adjusting for self-selection bias, there was a significant 43% reduction in incidence-based breast cancer mortality associated with screening (RR 0.57; 95% CI 0.53–0.62).

Another analysis compared counties which started inviting women to mammography screening in 1986–1987 (intervention group) to those which started in 1993 or later

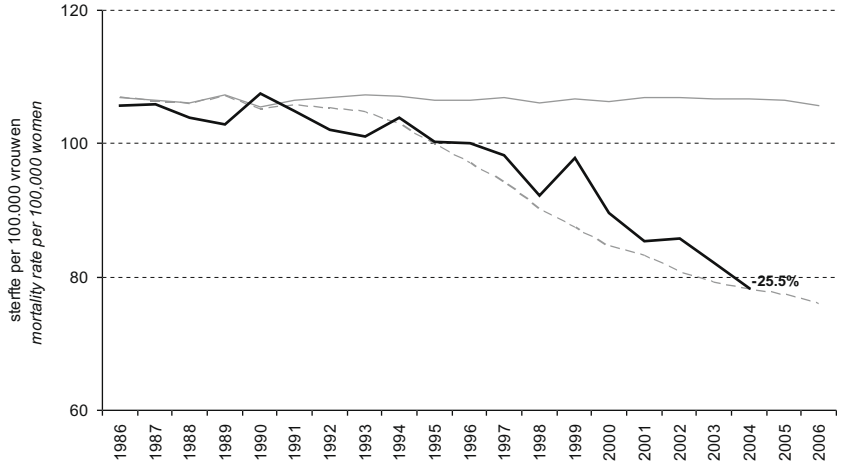

Fig. 1 – Age-standardised breast cancer mortality rates as observed (bold line) in the Netherlands and predicted for the situation with (dotted line) and without screening (thin solid line) programme in women aged 55–74 years in the period 1986–2004 (from Ref. [35]).

(control group).[40] After a mean follow-up of 10.6 years, a statistically non-significant 16% reduction in mortality due to breast cancer was found (RR 0.84; 95% CI 0.76–1.05). After adjustment for inclusion and lead time biases the reduction was 20%.

The breast cancer mortality decline associated with mammography screening was examined in the two Swedish counties where one of the randomised controlled trials had taken place.[41] Comparing the period when no screening was available (1968–1977) to the period when screening was made widely available (after the trials; 1988–1996), a reduction in mortality corrected for selection bias of 48% was found in women 40–69 undergoing screening (RR 0.52, 95% CI 0.43–0.63). No significant change in breast cancer mortality was found in these time periods for women who did not undergo screening. However, in the latter category, women aged 20–39 years were included.

In Northern Sweden, breast cancer mortality in women aged 40–74 was compared between two counties which started screening in 1989/1990 and two counties that started 5–7 years later. Study and control populations were followed up for 11 years.[42] The relative rate of breast cancer death for women invited to screening was 0.70 (95% CI 0.56–0.87) with the largest effect seen in women aged 40–49 years. After adjusting for a slight difference in breast cancer mortality between the two groups in the 10 years preceding the study period, the estimated breast cancer mortality reduction was 26% (RR 0.74; 95% CI 0.70–0.94).

3.10. *United Kingdom*

In 1986 an expert committee recommended the introduction of a national breast screening programme for women 50–64 which started in 1989. The NHS Breast Screening Programme (NHSBSP) reached national coverage in 1994. Since April 2001 the screening programme was expanded to routinely include women aged 65–70. Screening interval is 3 years (not two as in all other programmes) and participation rates are around 75%.

In England and Wales, death rates due to breast cancer were fairly constant during the 1980s, but since around 1990 they have fallen in all age groups by about 25%.[20] Recent data from the Office for National Statistics show a decline of 39% in women aged 50–64 over the period 1989–2006.[43] The rapid decline in mortality is believed to be partly the result of earlier diagnosis of breast cancer, which is associated with screening and increased breast awareness, and partly the result of increased use of adjuvant therapies. In the UK, several methods have been used to estimate the contribution of the national screening programme to the reduction in mortality. Estimates of the decrease in breast cancer mortality attributable to screening vary between 6% and 15% depending on the number of screening rounds, and the use of one- or two-view mammography.[44,45]

A recently published case–control study examines the impact of mammography screening in the East Anglia region of the UK.[46] Since 1989 women aged 50–70 have been invited to screening every 3 years. Cases were deaths of breast cancer diagnosed from 1995 to 2004 ($n = 284$). Controls were women alive at the time of death of the case and matched by age and geographic region ($n = 568$). The odds ratio for risk of death due to breast cancer in women who attended at least one routine screen compared to those who did not attend was 0.35 (95% CI 0.24–0.50). Adjusting for self-selection bias the estimated mortality reduction was 48% (0.52; 95% CI 0.0.32–0.84) in women being screened and was 35% in women invited to screening. Restricting the analysis to breast cancer deaths before 1999 the estimate of the impact of screening was a 59% breast cancer mortality reduction for women ever screened and a self-selection bias corrected 37% reduction. This more conservative estimate still indicates that screening reduces breast cancer mortality by one-third.

4. Discussion

The evidence emerging from long-standing breast cancer screening programmes shows a clear, albeit variable impact on breast cancer mortality. This variation is partly due to different assessment methods used as shown in Table 1. Some studies compare breast cancer mortality in screened women to non-screened women. This means 100% compliance rate in the screened group and reflects the effectiveness (or one could say, efficacy) of mammography screening per se (hereafter 'screening effectiveness'). Other studies examine the mortality trends in a population invited to screening versus those not offered screening. In the invited group only a certain percentage will participate. The impact of the programme will thus depend on the effectiveness of mammography screening *and* on the participation rate (hereafter 'programme effectiveness'). A third method to examine the impact of a nation-wide mammography screening programme has been to assess breast cancer mortality over time in the screened age group (hereafter 'time trend'). In this instance there is no comparison between two groups as in the previous two methods. However, in someways it is comparable to studies comparing women screened or invited to be screened to a historical control group (not screened/not invited to be screened).

The initial randomised controlled trials compared breast cancer mortality rates among women who were invited to screening to those who were not invited. Their estimates of a 25–30% reduction in breast cancer mortality are similar to the programme effectiveness estimates presented in Table 1 ranging from 16% to 36%. In two Finish studies and in one Swedish study the decrease is not statistically significant. In Finland this may be partially due to the restricted age range of women offered screening (50–59 years). Programme effectiveness is also highly dependent on the participation rate in a screening programme, which was high to very high (70–85%) in the programmes included here. As one would expect, screening effectiveness (100% compliance) is higher than programme effectiveness, ranging from 24% to 48% after correction for selection bias. Although research methods, time period studied and the approach to correct for self-selection bias differ, the trend in mortality reduction is consistent.

An important question is to what extent the observed mortality reductions are due to screening mammography or to other factors such as earlier response to self-detected breast symptoms and better management of breast cancer,

Table 1 – Estimates of breast cancer mortality reduction according to method used.

	Breast cancer mortality reduction (%)	Corrected for selection bias (%)	Study period of screening programme (years of programme follow-up)	Comment
Screening effectiveness estimates (comparing women actually screened to women not screened)				
Australia[23]	59	30	1994–2005 (11)	Case–control study
British Columbia[26]	40	24	1988–2003 (15)	Geographical comparison Women ⩾ 40
Copenhagen[27]	40	37	1991–2001 (10)	Geographical and historical comparison
Finland[30]	34	28	1992–2003 (11)	Historical comparison; partial coverage women 60–69
Iceland[32]	61	35 (n.s.)	1987/1990–2002 (15)	Case–control study
Sweden Nine counties[38,39]	45/42	43/39	1980–2001 (8–15) Five years additional follow-up	Historical comparison
Sweden Two counties[41]	63	48	1988–1996 (13)	Historical comparison
East Anglia, UK[46]	65	48	1995–2004 (10)	Case–control study Programme since 1989
Programme effectiveness estimates (comparing women invited to screening to non-invited)				
Copenhagen[27]	25		1991–2001 (10)	Geographical and historical comparison
Finland[30]	22		1992–2003 (11)	Historical comparison; partial coverage women 60–69
Helsinki[28]	19 (n.s.)		1986–1997 (10.5)	Only women 50–59 at screening
Turku[29]	36		1987–1997 (10) Follow-up until 2001	Historical comparison, women 55–69 at screening
Italy[33]	36		1995–2001 (median 6.6) Follow-up until 2005	Indirect BC mortality estimate by 10-year survival analysis
Sweden[40]	16 (n.s.)		1986–1997 (median 10.6)	Geographical comparison
Sweden Nine counties[38,39]	27		1980–2001 (8–15) Five years additional follow-up	Historical comparison
Northern Sweden[42]	26		1989–1998 (11) Follow-up until 2001	Geographical comparison
Time trend in breast cancer mortality (in age groups benefiting from screening)				
Australia[22]	24.5		1990–2004	Women age 40–85
Navarra, Spain[37]	36 52		1990–2004	Women all ages Women age 50–69
Netherlands[34]	19.9		1988–1999	Women age 55–74
[35,36]	25.5		1988–2004	Women age 55–74
UK[43]	39		1989–2006	Women age 50–64

in particular adjuvant treatment. This is relevant when using historical control groups or analysing time trends in breast cancer mortality as evidence for the impact of screening. Further analysis of the Swedish two-county study showed a 44% reduction (RR 0.56, 95% CI 0.49–0.64) in breast cancer mortality between 1978 and 1997 in the 40–69 years age group for those who were screened and a 16% reduction (0.84, 95% CI 0.71–0.99) in those who were not exposed to screening.[47] This mortality reduction is estimated to be caused by improved management of breast cancer and higher awareness, while the additional 28% mortality reduction in screened women is attributed to the impact of screening. This is corroborated by the data from Navarra, Spain where the estimated decrease in mortality from 1975 to 2004 was 62% in the screened age group, but was only 22% in the unscreened age groups.[37] The relative and absolute contributions of screening mammography and adjuvant treatment to the reduction in breast cancer mortality have been estimated in the Netherlands in 2004.[48] The reduction in breast cancer mortality due to adjuvant therapy was estimated at 7% in women aged 55–74 years, while the reduction due to screening (implemented in women aged 50–69 years since 1990–1997) would be 28–30% in 2007. These results indicate that a quarter to a third of breast cancer mortality reduction could be attributed to adjuvant systemic therapy in the presence of a mammography screening programme with a high participation rate. As shown by a study in the United States the estimated contributions of screening mammography and adjuvant treatment may differ in the absence of an organised screening programme.[42,49] From 1975 to 2000 the reduction of breast cancer mortality due to screening was estimated at 7–23% across seven models used, with a median of 15%. Adjuvant therapy was estimated to reduce mortality by 12–21%, with a median of 19%.

This paper does not intend to discuss the validity of different methodological approaches and to examine in detail how these may influence estimates of breast cancer mortality reduction. We examined the evidence from screening programmes after at least 10 years of activity to see if a trend

would emerge regardless of the assessment method chosen. We conclude that mammography screening programmes implemented for at least 10 years achieve a similar, but not a greater mortality reduction as the randomised controlled trials. However, this may not yet represent the maximum cumulative effect of screening programmes on breast cancer mortality. A screening programme covers a period of 20 years, involving 10 screens between age 50 and 69, and a 5-year follow-up thereafter to assess survival after diagnosis. None of the programmes reviewed has had a follow-up period of 25 years after onset of the screening. It may thus take some more years before the full impact of these mammography screening programmes can be assessed.

Conflict of interest statement

None declared.

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