

# Estimation of the effect of service screening on breast cancer mortality

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# Method

- Establish date of diagnosis for women who died of breast cancer
- Subtract an appropriate lead time to establish an age at which screening may have prevented death from breast cancer
- Apply prevented fraction from screening to this age group

## Standard formula for prevented fraction

If for an intervention occurring at age of diagnosis  $a_i$  the relative reduction in breast cancer mortality (the relative protection) at age  $a_o$  was  $p_i$ , then the number of deaths prevented at age  $a_o$ , given by  $D_o^s$ , is

$$D_o^s = D_o - \sum_{i=0}^n p_i D_o = \sum_{i=0}^n (1 - p_i) D_o$$

and the prevented fraction (PF) for breast cancer mortality at age  $a_o$  from the intervention at age  $a_i$  is dependent on the distribution of the time from diagnosis to death, but not the number of deaths, and is given by

$$PF = 1 - \sum_{i=0}^n p_i$$

# Relative risks and lead times for models

Age group

at screening	Model 1	Model 2	Model 3	Model 4
40-44	0.9	0.9	0.84 <sup>10</sup>	0.84 <sup>5</sup>
45-49	0.9	0.9	0.84 <sup>10</sup>	0.84 <sup>5</sup>
50-54	0.95 <sup>10</sup>	0.76 <sup>5</sup>	0.76 <sup>5</sup>	0.76 <sup>5</sup>
55-59	0.76	0.76	0.76	0.76
60-64	0.68	0.68	0.68	0.68
65-69	0.69	0.69	0.69	0.68

Lead times used

40-49: 1.7 years,

50-59: 3.3 years,

60-69: 3.8 years

# Estimated effect

Estimated screen-detectable ages of women who died of breast cancer when 40 or more years of age from 1995 to 1999.

Mortality age group (years)	Number of deaths 1995-99	Screen-detectable age (years)						Total screen detectable	Per cent screen detectable
		40-44	45-49	50-54	55-59	60-64	65-69		
40-44	168	35						35	20.8%
45-49	273	149	58					207	75.8%
50-54	342	75	174	61				310	90.6%
55-59	335	28	72	191	20			311	92.8%
60-64	279	13	24	93	125	11		266	95.3%
65-69	305	9	15	41	91	132	6	294	96.4%
70-74	354	4	10	22	41	105	44	226	63.8%
75-79	339		8	8	22	57	16	111	32.7%
80-84	279			5	7	17	9	38	13.6%
85+	346			1	2	10	3	16	4.6%
<b>Total</b>	<b>3020</b>	<b>313</b>	<b>361</b>	<b>422</b>	<b>308</b>	<b>332</b>	<b>78</b>	<b>1814</b>	<b>60.1%</b>

# Preventive fraction

The number of deaths from breast cancer in the 65-69 year age group potentially preventable by screening under Model 1 was

$$D_{65-69}^s = (1 - 0.68) \times 132 + (1 - 0.76) \times 91 + (1 - 0.95) \times 41 = 66.1,$$

Therefore, the prevented fraction for breast cancer mortality in the 65-69 year age group was

$$PF = 66.1 / 305 = 0.217, \text{ or } 21.7\%.$$

Age-specific prevented fraction of breast cancer mortality from screening starting at 40 years of age under Models 1 to 4.

Mortality age group* (years)	Prevented fraction (%) for screening 40-69 (95%CI)			
	Model 1	Model 2	Model 3	Model 4
45-49	no effect	no effect	no effect	8.7 (2.9-13.2)
50-54	2.2 (0.2-3.6)	2.2 (0.6-3.8)	3.5 (1.2-5.8)	11.6 (6.5-15.2)
55-59	3.0 (1.4-4.6)	16.7 (9.7-24.1)	18.5 (10.3-23.6)	18.5 (11.5-23.6)
60-64	13.3 (5.9-18.8)	19.6 (14.5-24.9)	20.1 (14.1-25.4)	20.1 (14.4-26.4)
65-69	21.7 (14.6-27.0)	24.2 (19.2-28.9)	24.2 (18.7-30.0)	24.2 (18.1-29.2)
70-74	16.1 (12.5-20.0)	16.1 (12.6-19.6)	16.1 (12.2-19.5)	16.1 (12.2-19.8)
75-79	6.8 (5.0-8.9)	6.8 (5.1-8.9)	6.8 (4.7-8.9)	6.8 (4.7-9.0)
80-84	1.0 (0.5-1.4)	1.0 (0.6-1.3)	1.0 (0.6-1.5)	1.0 (0.6-1.4)
40+	6.7 (4.9-8.3)	9.1 (7.4-10.7)	9.5 (7.7-11.4)	11.2 (8.7-12.8)
All ages	6.4 (4.6-7.8)	8.6 (7.0-10.1)	9.0 (7.3-10.7)	10.6 (8.2-12.1)

Age-specific prevented fraction of breast cancer mortality from screening starting at 45 years of age under Models 1 to 4.

Mortality age group* (years)	Prevented fraction (%) for screening 45-69 (95%CI)			
	Model 1	Model 2	Model 3	Model 4
45-49	no effect	no effect	no effect	no effect
50-54	no effect	no effect	no effect	8.1 (4.4-11.1)
55-59	2.1 (0.8-3.7)	15.8 (8.7-23.5)	17.1 (9.2-22.1)	17.1 (10.3-22.3)
60-64	12.4 (5.0-18.0)	18.8 (13.8-23.7)	18.8 (13.0-23.9)	18.8 (13.3-25.0)
65-69	21.7 (14.6-27.0)	24.2 (19.2-28.9)	24.2 (18.7-30.0)	24.2 (18.1-29.2)
70-74	16.1 (12.5-20.0)	16.1 (12.6-19.6)	16.1 (12.2-19.5)	16.1 (12.2-19.8)
75-79	6.8 (5.0-8.9)	6.8 (5.1-8.9)	6.8 (4.7-8.9)	6.8 (4.7-9.0)
80-84	1.0 (0.5-1.4)	1.0 (0.6-1.3)	1.0 (0.6-1.5)	1.0 (0.6-1.4)
40+	6.3 (4.5-7.8)	8.7 (7.0-10.3)	8.8 (7.1-10.7)	9.8 (7.6-11.4)
All ages	6.0 (4.3-7.3)	8.2 (6.6-9.7)	8.3 (6.7-10.1)	9.2 (7.2-10.8)



Age-specific prevented fraction of breast cancer mortality from screening starting at 50 years of age under Models 1 to 4.

Mortality age group* (years)	Prevented fraction (%) for screening 50-69 (95%CI)	
	Model 1	Models 2, 3 & 4
45-49	no effect	no effect
50-54	no effect	no effect
55-59	no effect	13.7 (7.2-20.6)
60-64	12.4 (5.0-18.0)	18.8 (13.8-23.7)
65-69	21.7 (14.6-27.0)	24.2 (19.2-28.9)
70-74	16.1 (12.5-20.0)	16.1 (12.6-19.6)
75-79	6.8 (5.0-8.9)	6.8 (5.1-8.9)
80-84	1.0 (0.5-1.4)	1.0 (0.6-1.3)
40+	6.1 (4.3-7.5)	8.4 (6.8-10.0)
All ages	5.7 (4.0-7.1)	8.0 (6.4-9.5)

# Country comparisons: percentage change in crude BC mortality rates age 60-69 years, 1993-2002 (WHO database)

