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Short Communication

Effect of participation on the cumulative risk of false-positive recall in a breast cancer screening programme

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One of the major concerns in breast cancer screening programmes is the number of women with mammographic abnormalities requiring further investigation that finally turn out to be negative. It has been reported that, apart from giving rise to anxiety[1] and higher costs,[2] such false-positive mammogram results might also affect subsequent screening attendance.[1]

Several studies have estimated the cumulative risk of false-positive mammograms during a woman's lifespan, and all have found a high cumulative false-positive recall rate, ranging from 20% to 50% after 10 rounds of screening.[3–7] Elmore *et al.*,[3] analysed a cohort of women with irregular programme attendance, while other authors[4–7] analysed cohorts of women participating in all screening rounds. Comparison of their results is difficult not only because of differences between health systems and protocols, but also due to differences in the selection criteria of the target population to estimate the cumulative risk of false-positive recall. It was hypothesized that estimations which only included women who participated in all screening rounds might be biased since, if false-positive results affect attendance at subsequent screening rounds, this might lead to cumulative false-positive rate underestimation in this cohort. To investigate this issue, the cumulative risk of false-positive recall was estimated for two groups of women with different profiles of adhesion to the programme using a cohort of women participating in a population-based breast cancer screening programme. Furthermore, the association between women's characteristics and the cumulative risk of false-positive recall was investigated in both groups to assess whether other variables could be affected by the different participation profiles.

Eligible subjects were 50–69-year-old women invited to participate in the first round of a population-based breast cancer screening programme in Barcelona, Spain in 1996, who had completed four screening rounds by 2003. This programme complied with the European Guidelines for Quality Assurance in Mammographic Screening.[8] Two groups of women were selected from the same database: the first group included 19,458 women who had participated in at least one screening round, and the other group consisted of women who had participated in all four rounds ($n = 8502$).

In the screening programme, mammograms had two possible results: a negative result, in which case 2-year follow-up was recommended; or a positive result, leading to an immediate recall for further assessment to rule out malignancy. A positive mammogram result was considered to be a false-positive if breast cancer was not found after further assessments (non-invasive or invasive procedures).

The following patient information was included in the analysis: age, menopausal status, body mass index (BMI), breast symptoms in the year before the mammogram (lumps, pain, skin changes, nipple retraction, nipple secretion and ulceration), personal history of benign breast disease (including benign biopsies) and family history of breast cancer (mother, sister, daughter, grandmother or aunt). All this information was obtained at each screening round, except for BMI which was only measured at the first screening.

To calculate the risk of false-positive recall and to investigate associated factors, discrete time hazard models were adjusted in both cohorts using the criteria described in detail by Singer and Willett.[9] This methodology applies logit transformation to the hazard of the survival model, and introduces discrete time intervals (screening rounds) as dummy variables in the model. Each woman has as many registers as mammograms until the first false-positive recall. The cumulative risk of false-positive recall was projected forwards for women aged 50–51 years in the first screening round with the possibility of undergoing 10 mammograms in the programme, assuming that the hazard of the fifth to tenth mammograms was similar to the hazard of the fourth mammogram of those women who had four mammograms. The confidence intervals (CI) for the cumulative risk of false-positive recall were calculated using Greenwood's approximation.[9]

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Table 1
Adjusted odds ratios for the risk of false-positive recall in relation to women's characteristics

Characteristics	Cohort of 19,458 women		Subcohort of 8502 women	
	Mammograms	OR[a] (95% CI)	Mammograms	OR[a] (95% CI)
Age (years)				
65–69	10,712	Ref.	5190	Ref.
60–64	19,242	0.96 (0.90–1.03)	11,168	0.92 (0.83–1.01)
55–59	16,518	1.02 (0.96–1.09)	10,002	1.04 (0.95–1.15)
50–54	8132	1.01 (0.93–1.11)	4944	1.03 (0.91–1.17)
Menopause status				
Menopausal	50,006	Ref.	28,789	Ref.
Perimenopausal	3308	1.23 (1.05–1.42)	1990	1.34 (1.09–1.63)
Body mass index				
Normal weight	22,503	Ref.	12,638	Ref.
Overweight or obese	32,117	1.07 (0.99–1.16)	18,682	1.11 (0.99–1.25)
Breast symptoms				
No	52,764	Ref.	30,340	Ref.
Yes	1812	1.07 (0.89–1.29)	967	1.14 (0.87–1.47)
Personal history of breast disease				
No	49,346	Ref.	28,692	Ref.
Yes	5260	2.58 (2.33–2.85)	2625	2.40 (2.05–2.80)
Family history of breast cancer				
No	48,803	Ref.	28,028	Ref.
Yes	5677	1.05 (0.93–1.19)	3221	0.98 (0.81–1.18)

OR, odds ratio; CI, confidence interval.
[a] Both models adjusted for number of screened women.

The risk of false-positive recall in the first screening mammogram was 8.89% (95% CI 8.58–9.19) for the cohort of women participating in at least one screening round, and 8.01% (95% CI 7.59–8.43) for the subcohort participating in all screening rounds. The risk of false-positive recall from the second to the fourth screening was approximately 3% in each screening round and was similar in both groups (data not shown).

The pattern of association between women's characteristics and the false-positive recall risk was similar in both groups (Table 1). The highest significant risk of false-positive recall was observed in women with a personal history of benign breast disease [odds ratio (OR) 2.58 and 2.40 for the cohort of women participating in at least one screening round and the subcohort participating in all screening rounds, respectively]. The risk was also significantly higher for women in their perimenopause (OR 1.23 and 1.34 for the cohort of women participating in at least one screening round and the subcohort participating in all screening rounds, respectively), but was not associated with age, BMI, breast symptoms or a family history of breast cancer.

When taking into account only those women who started the programme at 50–51 years of age, the risk of false-positive recall in the first screening was 10.78% for the cohort of women participating in at least one round (95% CI 10.35–11.22) and 10.56% for the subcohort participating in all screening rounds (95% CI 9.91–11.21). The cumulative risk at the fourth screening was 19.06% (95% CI 18.49–19.63) and 19.03% (95% CI 18.20–19.85), respectively. The projected cumulative risks at the tenth screening were 32.24% (95% CI 31.40–33.07) and 32.20% (95% CI 31.22–33.17) for the cohort of women participating in at least one screening round and the subcohort participating in all screening rounds, respectively. Similar cumulative risks for false-positive recalls were thus obtained and no hazard differences were observed between the cohorts.

A recent European study by Brewer *et al.*,[1] based on a meta-analysis, suggested that false-positive results in screening mammograms could decrease participation. If this applies to the present screening programme, women with false-positive results may have been under-represented in the subcohort, thus leading to underestimation of cumulative false-positive risk. However, this was not observed, and the results remain compatible with the possibility that risk is not affected by total or partial participation in the screening rounds. Although not statistically significant, the greatest difference in the false-positive risk between the two participation profiles was found at the first screening round, where it was 0.88% lower for women attending all screening rounds.

In this analysis, women's characteristics associated with a higher risk of false-positive recall were similar for both participation profiles. As reported previously,[6] the main associated factors were a personal history of benign breast disease and perimenopausal status.

In conclusion, estimation of the cumulative risk of false-positive recall does not seem to vary according to the adhesion profile of women participating in a breast cancer screening programme. However, because of differences in the organizational models of screening programmes and protocol characteristics, one cannot preclude different results if the same analysis was undertaken in different contexts.

Ethical approval

None sought.

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Competing interests

None declared.

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