Research article

Impact of false-positive mammography on subsequent screening attendance and risk of cancer

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Abstract

Background: One area of concern within the largely successful UK National Health Service breast screening programme is the relatively high proportion of women showing mammographic abnormalities who undergo further diagnostic tests that prove negative. Previous studies suggest that, in addition to increasing anxiety, such false-positive mammography is associated with increased risk of subsequent interval cancer. In the present article, we quantify this increased risk, investigate whether it extends to cancers detected at rescreening, and determine whether cancers differ between women who have, and have not, experienced false-positive mammography.

Methods: This was a retrospective cohort study of 140,387 women aged 49–63 years routinely invited for first screening by the East Anglian National Health Service breast screening programme. Proportions reattending, and subsequent risk and pathological attributes of cancer were compared between women who underwent further (negative) assessment following false-positive mammography and women mammographically normal at first screen.

Results: At first screen, 108,617 (91.9%) of the screened women were mammographically normal, 4278 (3.6%) were assessed and then judged normal, and 514 (0.4%) underwent benign biopsy. Compared with nonassessed normal women, reattendance was lower among assessed women: 83.1% (95% confidence interval [CI], 82.0–84.1) versus 85.7% (95% CI, 85.5–85.9) (odds ratio [OR], 0.82; 95% CI, 0.76–0.89). Assessed women were at greater risk of interval cancer (rate per 1000 women screened, 9.6 [95% CI, 6.8–12.4] versus 3.0 [95% CI, 2.7–3.4]; OR, 3.19 [95% CI, 2.34–4.35]), and also of cancer detected at second screen (rate per 1000, 8.4 [95% CI, 5.8–10.9] versus 3.9 [95% CI, 3.5–4.3]; OR, 2.15 [95% CI, 1.55–2.98]). More cancers in assessed women measured ≥20 mm (OR, 1.59; 95% CI, 0.99–2.55).

Conclusions: Women undergoing false-positive mammography at first screen were less likely to reattend for subsequent screens than were nonassessed women, yet they were more likely to develop interval cancers or cancers at second screen, and their cancers were larger. Factors predisposing for false-positive mammography require investigation. Women should be encouraged to continue with screening.

Keywords: breast screening, false-positive mammography, interval cancer, screen-detected cancer, screening attendance

Introduction

Effective population-based screening requires adequate compliance among the target population [1]. The goal of the UK breast screening programme, a 25% reduction in mortality, required first-screen compliance to be 70% [2,3]. This target was exceeded in many areas throughout

CI = confidence interval; HRT = hormone replacement therapy; OR = odds ratio.

the UK [4]. Another key prerequisite to maintaining a successful screening programme is acceptability, and the ≥90% reattendance rate among previous screenees indicated high acceptability in UK women [4].

Despite meeting most of the targets set, however, breast screening in the UK has not been an unmitigated success story. When screening was introduced there were reports of increased anxiety among the large numbers of women undergoing assessment following positive screening mammography [5]. Although most women do not show abnormalities on their screening mammograms and are simply asked to return for rescreening in 3 years, the mammograms of 5–9% of all women indicate possible malignancy. These women must undergo a second 'assessment' phase of the screening process, which involves further procedures such as ultrasound, needle biopsy and, possibly, open biopsy to establish a definitive diagnosis. As expected, malignancy is ruled out for the majority of women assessed, indicating that the result of their mammography was falsely positive. In the current study, the term 'false positive' is thus applied to any woman who is recalled for assessment on the basis of mammographic findings and in whom cancer is not diagnosed. Other studies may limit use of the term only to those women who have undergone open biopsy with no resultant diagnosis of cancer.

Although some studies have indicated that false-positive mammography does not deter women from reattending [6–8], it clearly has associated financial and psychological costs. Furthermore, ourselves [9] and other workers [10] have found that women judged false positive at first screen are more likely to develop an interval cancer before the second screening is due. To assess the impact of false-positive mammography on screening effectiveness, we investigate whether false-positive mammography affects subsequent reattendance in East Anglia. We quantify the magnitude of the increased risk of interval cancer, and extend these investigations to determine whether false-positive mammography at first screen increases the risk of cancer detected at second screen. Finally, we compare the pathology of cancers presenting in women who have undergone false-positive mammography with that of cancers in women judged normal at the preceding screening.

Methods

Screening was introduced in East Anglia over the period 1989–1991. Women were invited by year of birth, in 5-year age groups [11]. The first round of screening occurred in 1989–1995, and the second occurred 3 years later (1992–1998). All women invited to the first round, and eligible for reinvitation to the second, were identified on the breast screening computer system. The majority was aged 50–62 years. Those aged 63–64 years were beyond the invited age range at the time of the second screen and were excluded. We only included women invited on schedule (i.e. within 24 months of commencing invitation of the relevant birth cohort) in order to exclude women who failed to respond at first invitation but who attended for the first time on reinvitation 3 years later [12].

Women were followed up from the date of first invitation until invitation to the second screening if within 3.5 years (i.e. 1277 days), or for the mean interscreen interval for the screening unit if no screen occurred within this time (mean ± standard error interscreen interval for all regional screening units, 1106 ± 7.6 days). Interval and screen-detected cancers were identified by matching screening unit and Cancer Registry databases as described previously [12]. Women not attending within 6 months of the first invitation were deemed to have refused screening. With the exception of women attending for the first invitation within 6 months but placed on early recall, only those women whose second screening episode (either accepted or refused) was completed within 3.5 years of the first invitation are considered in the present analysis.

Information on prognostic characteristics size (maximum diameter of invasive component), grade [13], node status and histological subtype [14] was obtained from the Cancer Registry, from screening units and from medical records. Cancers were assigned a prognostic risk group [9], based on histological type and malignancy grade [15–17]. Differences in distribution of these attributes, and of the risk of cancer, among study groups were expressed as ORs [18].

Study groups

Table 1 presents the relationship of the study groups to the total population of 203,194 women eligible for invitation to the first screening round. Of these women, 140,387 (69.1%) were identified as first-round invitees who were invited within schedule and were eligible for reinvitation to rescreening.

Of these 140,387 women, 118,216 (84.2%) completed a satisfactory first screen within 6 months of the first appointment. At first appointment, 108,617 (77.4%) were judged normal on the basis of mammography alone (the 'non-assessed normal' group). Of 6460 (4.6%) women who underwent further assessment to establish definitive diagnosis, 6337 were investigated immediately; the remainder underwent further appointments for technical reasons or through failure to respond to invitations. Of those assessed immediately, 4278 women were judged normal at assessment ('assessed normal' group), and 514 proceeded to open biopsy, the result of which was benign ('assessed benign' group). Women in assessed normal and assessed benign groups returned directly to routine screening. Overall, there were 113,409 women in the

Table 1

Relationship of study groups to total population of women eligible for and invited to the first screening round in East Anglia

Group	Number	Percent
All women eligible for screening in the first round	203,194	100.0
Those not aged 49–63 years and hence ineligible for reinvitation to the second round	337,668	16.6
Those not invited as routine first screen	7272	3.6
Those not invited within schedule (see Methods)	21,769	10.7
Those eligible for reinvitation, invited as routine first screen, within schedule	140,387	69.1
Those eligible for reinvitation, invited as routine first screen, within schedule	140,387	100.0
Those judged normal at first screen (nonassessed normal group)[a]	108,617	77.4
Nonresponders to first invitation	24,048	17.0
Technical (and clinical) recalls	1385	1.0
Those assessed immediately after first screen and judged normal (assessed normal group)[a]	4278	3.0
Those assessed immediately after first screen then undergoing benign biopsy (assessed benign group)[a]	514	0.4
Those assessed immediately after first screen then diagnosed with cancer	680	0.5
Those assessed immediately after first screen and put on early recall	753	0.5
Those assessed immediately after first screen then undergoing delayed episode completion (includes nonresponders, delayed responders, those who moved or died, etc.)	112	0.1

[a] Total in study groups (nonassessed normal + assessed normal + assessed benign) = 113,409 (80.8% of total study population).

nonassessed normal, assessed normal and assessed benign study groups, comprising 80.8% of all women who were invited for a routine first screen within schedule and were eligible for reinvitation to the second round.

The mean ± standard deviation age of women was similar in all study groups: 56.0 ± 3.5 years in the entire invited cohort eligible for reinvitation, 55.8 ± 3.5 years in the nonassessed normal group, 56.1 ± 3.5 years in the assessed normal group, and 56.4 ± 3.6 years in the assessed benign group.

Of the 6337 women assessed immediately following the first screen, 680 were initially diagnosed with cancer. A further 11 women were diagnosed following initial nonattendance at assessment, and 22 at early recall. This produced a total of 713 women. Of the 680 women diagnosed at initial assessment, 676 were registered at the Cancer Registry. The remaining four women were either recurrences of earlier breast primaries or other malignancies not classified as primary breast cancer (e.g. cytosarcoma phyllodes) [19,20].

Results

Numbers of cases, rates per 1000 screened, and odds of presenting with interval cancer or having a cancer detected at second screen are presented by study group in Table 2. In all study groups combined, 375 interval cancers presented and 463 cancers were detected at second screen. The risk of subsequent interval cancer, or cancer detected at second screen, was higher in women assessed at the preceding screen. The OR among all assessed women for an interval cancer arising was 3.19 (95% CI, 2.34–4.35) compared with the nonassessed normal group, and that for detecting a cancer at second screen was 2.15 (95% CI, 1.55–2.98). Compared with the nonassessed normal group, the OR of a second round screen-detected cancer in the assessed benign group was lower, but the difference was not significant, possibly due to the small size of the assessed benign group (OR, 0.50; 95% CI, 0.07–3.55).

Numbers and proportions of women with appointments for, and attending, the second screen are presented, by study group and interval cancer status, in Table 3, which also presents the ORs for the likelihood of recorded appointments and reattendance. Explanations for a lack of recorded reinvitation appointment include deletion of appointments cancelled in advance, and removal of women from the invitation list following moving house, bilateral mastectomy or death. Overall, 90.6% of women had recorded appointments for a second screen within 3.5 years, and 85.6% reattended. Compared with the nonassessed normal group, the proportion with recorded appointments was slightly lower among the assessed normal group (OR, 0.78; 95% CI, 0.71–0.86) and was lower still among the assessed benign group (OR, 0.51; 95% CI, 0.41–0.65) (see Table 3). Reattendance was similarly slightly lower among women in the assessed normal group (OR, 0.84; 95% CI, 0.78–0.92) compared

Table 2

Likelihood of presentation of interval cancer following an initial screen, and of detection of cancer by screening at the second screening round, by assessment status

Study group	Total (*n*)	Women with/without cancer		Rate with per 1000 screened (95% CI)	Odds ratio (95% CI)
		With (*n*)	Without (*n*)		
Women with/without interval cancer					
All groups	113,409	375	113,034	3.31 (2.97–3.64)	–
Nonassessed normal	108,617	329	108,288	3.03 (2.70–3.35)	1.00
Assessed normal	4278	42	4236	9.82 (6.86–12.77)	3.26 (2.36–4.51)
Assessed benign	514	4	510	7.78 (0.19–15.38)	2.58 (0.96–6.95)
All assessed	4792	46	4746	9.60 (6.83–12.36)	3.19 (2.34–4.35)
Women with/without second round screen-detected cancer					
All groups	113,409	463	112,946	4.08 (3.71–4.45)	–
Nonassessed normal	108,617	423	108,194	3.89 (3.52–4.26)	1.00
Assessed normal	4278	39	4239	9.12 (6.27–11.96)	2.35 (1.69–3.27)
Assessed benign	514	1	513	1.95 (0–5.75)	0.50 (0.07–3.55)
All assessed	4792	40	4752	8.35 (5.77–10.92)	2.15 (1.55–2.98)

with the nonassessed normal group, and was lower still among the assessed benign group (OR, 0.65; 95% CI, 0.52–0.81). Reattendance among women with recorded reinvitation appointments was similar in all groups (94–95%, calculated from data in Table 3).

Reattendance was much lower among women presenting with interval cancer following the first screen. Combining assessed and nonassessed women, 90.8% of women without interval cancer had reinvitation appointments recorded, and 85.8% actually reattended, whereas only 27.2% of women with interval cancer had reinvitation appointments, and 19.2% reattended (see Table 3). Among the 680 women diagnosed with cancer immediately following first screen, similarly low proportions with reinvitation appointments (250 of 680 women [36.8%]) and reattending (224 of 680 women [32.9%]) were observed (data not shown).

The effects of the study group on pathological attributes of interval cancers and second round screen-detected cancers are presented in Table 4. Interval cancers and cancers detected at second screen in assessed women were larger compared with cancers in nonassessed women, with more measuring at least 20 mm (OR, 1.59; 95% CI, 0.99–2.55). This effect reached statistical significance in the assessed normal group (OR, 1.63; 95% CI, 1.01–2.64). There were no significant differences between assessed and nonassessed women in risk of high grade (grade 3) cancers. Compared with the nonassessed normal group, there were some indications of fewer high grade interval cancers among those assessed (OR, 0.47; 95% CI, 0.17–1.28), but this was not statistically significant. Cancers detected at second screen in women who were assessed at first screen showed some indication of increased risk of positive nodes (OR, 1.51; 95% CI, 0.67–3.39). There was a non-significant increase in numbers of advanced stage (stage 2+) interval and second round screen-detected cancers in assessed women (OR, 1.32; 95% CI, 0.83–2.11). Interval cancers in the assessed normal group showed a slightly increased tendency to present in the left breast (OR, 1.51; 95% CI, 0.77–2.95). For interval cancers, the likelihood of a cancer being of high prognostic risk (group 3) was significantly lower in the assessed normal group than in the nonassessed group (OR, 0.34; 95% CI, 0.12–0.99).

Discussion

False-positive mammography is a relatively frequent occurrence within breast screening programmes. It was calculated that, during 10 years in New England, USA, one-third of women screened by mammography and clinical examination underwent false-positive screening [21]. Last year in the UK there were around 11 unnecessary recalls for every cancer detected within the National Health Service breast screening programme (8.3% of women assessed at first screen, 6.7 cancers detected per 1000 screened; 7.6% false-positive at first mammography) [4]. This figure fell to around six recalls for every cancer detected at repeat screening (3.9% of women assessed, 5.5 cancers detected per 1000 screened; 3.4% false-positive at subsequent mammography) [4]. For a woman attending all five

Table 3

Numbers and proportions of cases of interval cancer and second round screen-detected cancer, and likelihood of presentation, by study group and interval cancer status

		Reinvited				Reattending			
		Women (*n*)				Women (*n*)			
Study group	Total (100%)	Yes	No	% Yes (95% CI)	Odds ratio[a] (95% CI)	Yes	No	% Yes (95% CI)	Odds ratio[a] (95% CI)
All groups									
All	113,409	102,772	10,637	90.6 (90.5–90.8)		97,062	16,347	85.6 (85.4–85.8)	
With interval cancer	375	102	273	27.2 (22.7–31.7)		72	303	19.2 (15.2–23.2)	
Without interval cancer	113,034	102,670	10,364	90.8 (90.7–91.0)		96,990	16,044	85.8 (85.6–86.0)	
Nonassessed normal									
All	108,617	98,561	10,056	90.7 (90.6–90.9)	1.00	93,081	15,536	85.7 (85.5–85.9)	1.00
With interval cancer	329	97	232	29.5 (24.6–34.4)		69	260	21.0 (16.6–25.4)	
Without interval cancer	108,288	98,464	9824	90.9 (90.8–91.1)		93,012	9824	85.9 (85.7–86.1)	
Assessed normal									
All	4278	3782	496	88.4 (87.4–89.4)	0.78 (0.71–0.86)	3572	706	83.5 (82.4–84.6)	0.84 (0.78–0.92)
With interval cancer	42	5	37	11.9 (2.1–21.7)		3	39	7.1 (0–14.9)	
Without interval cancer	4236	3777	459	89.2 (88.2–90.1)		3569	667	84.3 (83.2–85.4)	
Assessed benign									
All	514	429	85	83.5 (80.3–86.7)	0.51 (0.41–0.65)	409	105	79.6 (76.1–83.1)	0.65 (0.52–0.81)
With interval cancer	4	0	4	0		0	4	0	
Without interval cancer	510	429	81	84.1 (81.0–87.3)		409	101	80.2 (76.7–83.7)	
All assessed									
All	4792	4211	581	87.9 (87.0–88.8)	0.74 (0.68–0.81)	3981	811	83.1 (82.0–84.1)	0.82 (0.76–0.89)
With interval cancer	46	5	41	10.9 (1.9–19.9)		3	43	6.5 (0–13.7)	
Without interval cancer	4746	4206	540	88.6 (87.7–89.5)		3978	768	83.8 (82.8–84.9)	

[a] Odds ratios of the likelihood of reinvitation or reattendance among assessed normal, assessed benign or all assessed women versus that in the nonassessed normal group.

screens to which she is currently invited, assuming the result of each screening is independent of any previous result, her cumulative probability of at least one false-positive screening is therefore around 19% {1 – (*P* [No. false positives on first screen] × *P* [No. false positives on subsequent screen]^4)}, i.e. {1 – ([1 – 0.0763] × [1 – 0.0335]^4)}.

In East Anglia, 4.1% of women screened in the first screening round and eligible for a second screen underwent false-positive mammography at first screen. These women were more than three times as likely as nonassessed normal women to present with an interval cancer before the second screen was due, and more than

Table 4

Effect of study group on pathological attributes of interval cancers and second round screen-detected cancers

	Size (mm)			Grade			Node status			Stage			Laterality			Tumour risk group		
	20+	< 20	Odds ratio[a]	3	1+2	Odds ratio[b]	+ve	–ve	Odds ratio[c]	2+	1	Odds ratio[d]	Left	Right	Odds ratio[e]	3	1 + 2	Odds ratio[f]
Interval cancer																		
Nonassessed	160	124	1.00	72	148	1.00	101	133	1.00	179	131	1.00	139	162	1.00	75	216	1.00
Assessed normal	26	14	1.44 (0.72–2.87)	5	22	0.47 (0.17–1.28)	13	18	0.95 (0.45–2.03)	25	15	1.22 (0.62–2.40)	22	17	1.51 (0.77–2.95)	4	34	0.34 (0.12–0.99)
Assessed benign	1	1	0.78 (0.05–12.51)	1	0	–	1	2	0.66 (0.06–7.36)	1	2	0.37 (0.03–4.08)	2	2	1.17 (0.16–8.38)	2	2	2.88 (0.40–20.81)
All assessed	27	15	1.40 (0.71–2.74)	6	22	0.56 (0.22–1.44)	14	20	0.92 (0.44–1.91)	26	17	1.12 (0.58–2.15)	24	19	1.47 (0.77–2.80)	6	36	0.48 (0.19–1.18)
Second screen cancer																		
Nonassessed	78	275	1.00	57	256	1.00	72	206	1.00	104	253	1.00	180	172	1.00	54	294	1.00
Assessed normal	11	24	1.62 (0.76–3.44)	5	23	0.98 (0.36–2.68)	10	19	1.51 (0.67–3.39)	13	22	1.44 (0.70–2.96)	16	16	0.96 (0.46–1.97)	4	30	0.73 (0.25–2.14)
Assessed benign	0	1	–	0	1	–	0	1	–	0	1	–	0	1	–	0	1	–
All assessed	11	25	1.55 (0.73–3.29)	5	24	0.94 (0.34–2.56)	10	20	1.43 (0.64–3.20)	13	23	1.37 (0.67–2.82)	16	17	0.90 (0.44–1.84)	4	31	0.70 (0.24–2.07)
All cancers																		
Nonassessed	238	399	1.00	129	404	1.00	173	339	1.00	283	384	1.00	319	334	1.00	129	510	1.00
Assessed normal	37	38	1.63 (1.01–2.64)	10	45	0.70 (0.34–1.42)	23	37	1.22 (0.70–2.11)	38	37	1.39 (0.86–2.25)	38	33	1.21 (0.74–1.97)	8	64	0.49 (0.23–1.06)
Assessed benign	1	2	0.84 (0.08–9.29)	1	2	1.57 (0.14–17.41)	1	3	0.65 (0.07–6.33)	1	3	0.45 (0.05–4.37)	2	3	0.70 (0.12–4.21)	2	3	2.64 (0.44–15.94)
All assessed	38	40	1.59 (0.99–2.55)	11	47	0.73 (0.37–1.46)	24	40	1.18 (0.69–2.01)	39	40	1.32 (0.83–2.11)	40	36	1.16 (0.72–1.87)	10	67	0.59 (0.30–1.18)

[a] Odds ratio of cancer measuring 20 mm and above versus < 20 mm. [b] Odds ratio of cancer of grade 3 versus grades 1 or 2. [c] Odds ratio of node positive cancer versus node negative. [d] Odds ratio of cancer of stage 2 or above versus stage 1. [e] Odds ratio of cancer in the left breast versus in the right breast. [f] Odds ratio of cancer of risk group 3 versus risk groups 1 or 2 [9].

twice as likely to have a cancer detected at second screening. If the followup period of the current study had been extended beyond the interscreen interval, these women might have continued to show increased risk of cancer beyond the due date for second screen. The rate in lapsed attenders who were false positive at first screen is thus also likely to have been high.

For women who undergo false-positive mammography and then present with cancer, the validity of the negative assessment comes into question. Among women in the current study, 12.3% of those presenting with interval cancer after the first screen, and 8.6% of those with cancer detected at second screen, had previously been assessed compared with the 4.2% of women assessed of those not diagnosed with cancer. A review of the original screening films of women with interval cancers has shown that around one-fifth of all East Anglian cases might potentially be prevented through earlier diagnosis at the previous screening [9]. However, quantification of the extent to which failure of diagnosis at assessment has contributed to the interval cancer rate requires detailed comparison of the site and nature of relevant lesions at assessment and diagnosis, which was beyond the scope of the current study.

Another possible explanation for the increased risk of cancer in women following false-positive mammography might be that a characteristic of women's breasts which makes them difficult to interpret mammographically and predisposes them to the risk of a false-positive result is actually itself a risk factor for breast cancer. Such a link between risk of false-positive mammography and risk of cancer might be hormone replacement therapy (HRT). Laya *et al*. in 1996 [22], and others since [23], demonstrated that current use of HRT by women aged 50+ years is associated both with decreased screening sensitivity (increased interval cancers) and decreased specificity (increased false positives). Furthermore, long-term use of HRT has been shown to increase breast cancer risk [24]. It has been proposed that these effects of HRT are mediated through high risk (i.e. dense) mammographic patterns [25], which themselves have been shown to be associated both with reduced screening specificity [22,26,27] and with increased risk of breast cancer [28,29]. Unfortunately, information on HRT use among women in the current study was not available to test this hypothesis. If found relevant, however, consideration of a woman's individual risk profile might prove helpful in deciding a strategy for subsequent rescreening.

In addition to being at increased risk of cancer, women who experienced false-positive mammography were 18% less likely than those who were genuinely screen normal to reattend for a second screening. Women who underwent benign biopsy were even less likely (35%) to return. This finding was in contrast with reports from previous studies when false-positive mammography either had no effect on subsequent attendance [6–8] or, alternatively, actually increased by 20% the likelihood of future reattendance [30], even in those who underwent a negative biopsy [31]. As previously suggested [7,32], however, regional variations in handling of assessment procedures and false-positive cases may explain differences in uptake of screening reinvitations. Such findings suggest that the figures may be amenable to improvement through a change in practice.

The reduced reattendance among women with false-positive mammography was accompanied by a reduced likelihood of reinvitation appointments recorded on the screening computer system. Followup of the 85 assessed benign women who did not have reinvitation appointments recorded on the computer system (Table 2) revealed that at least 35 of them (41%) had been offered reinvitation appointments, which they had cancelled in advance. The reduced reattendance among assessed women would not have been apparent had the analysis investigated the proportions of women *with recorded reinvitation appointments* who returned, since reattendance among those with recorded reinvitation appointments was similarly high in all women (around 94%), regardless of assessment history. Furthermore, such analysis would have failed to reveal the correct magnitude of the increased risk of cancer among women undergoing false-positive mammography, since the OR for an interval cancer arising in all assessed women versus that in nonassessed women was 3.19 (95% CI, 2.34–4.35). This OR fell to 1.21 (95% CI, 0.49–2.97) when only those women with recorded reinvitation appointments within 3.5 years were considered (data not shown). Regardless of whether the lack of recorded reinvitation appointments is due to an active choice on the part of women not to attend or due to a failure of the system to reinvite them, the fact that they are not being rescreened yet they are at increased risk of cancer is clearly of great concern.

False-positive mammography, leading to unnecessary assessment of disease-free women, has associated costs. First, there are the psychological costs of inconvenience and increased anxiety in women unnecessarily recalled [5,33,34]. Second, there are the direct financial costs to the health service of unnecessary procedures [35,36]. Third, there are the overall costs to the invited population of the reduced effectiveness of screening [11]. East Anglian women undergoing false-positive first mammography were more likely to present with cancer and less likely to reattend for a second screen. The impact of nonreattendance on potential subsequent mortality reduction is not insignificant since, for those who do not reattend, the stage of any subsequently diagnosed cancers will be shifted from earlier, when detected by screening, to later, when presenting symptomatically in lapsed attenders.

For women who experienced false-positive mammography and then presented with an interval or screen-detected cancer, the current study indicated that these cancers were more likely to measure 20+ mm and to be of a higher stage than those in nonassessed women, and second screen-detected cancers were more likely to be node positive. This indicates a poorer prognosis for women who presented with cancer having undergone false-positive mammography, although when assessed by histological subtype and grade such cancers were apparently of lower prognostic risk than those in nonassessed women. The reasons for this inconsistency are unclear.

The current findings relate to women assessed at first screen within the East Anglia screening programme, carried out over the period 1989–1995. With technical improvements to the programme and women's increased familiarity with it, reduced reattendance and increased risk of cancer may be less associated with false-positive mammography at first screen. Furthermore, the impact of false-positive mammography may be lower after a second or subsequent screening. Fewer women are assessed at second and subsequent screens [37,38], possibly due to the increase in specificity associated with the availability of previous films for comparison [39]. Finally, it should be noted that, while there was increased risk of subsequent cancer associated with women assessed at first screen, such women contributed only a modest proportion of all interval and second round screen-detected cancers.

Conclusions

False-positive mammography in the first screening round in East Anglia was associated both with increased risk of interval cancers and cancer detected at second screening, and with reduced reattendance at subsequent screens. If these associations persist within the screening programme, then efforts must be made to identify the factors predisposing certain women to false-positive mammography, to encourage continued participation, and to detect any subsequent cancers at the earliest possible opportunity.

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