original article

Annals of Oncology 20: 1199–1202, 2009
doi:10.1093/annonc/mdn770
Published online 12 March 2009

Effectiveness of organised versus opportunistic mammography screening

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Received 7 November 2008; accepted 1 December 2008

Background: Detailed comparison of effectiveness between organised and opportunistic mammography screening operating in the same country has seldom been carried out.
Patients and methods: Prognostic indicators, as defined in the European Guidelines, were used to evaluate screening effectiveness in Switzerland. Matching of screening programmes' records with population-based cancer registries enabled to compare indicators of effectiveness by screening and detection modality (organised versus opportunistic screening, unscreened, interval cancers). Comparisons of prognostic profile were also drawn with two Swiss regions uncovered by service screening of low and high prevalence of opportunistic screening, respectively.
Results: Opportunistic and organised screening yielded overall little difference in prognostic profile. Both screening types led to substantial stage shifting. Breast cancer prognostic indicators were systematically more favourable in Swiss regions covered by a programme. In regions without a screening programme, the higher the prevalence of opportunistic screening, the better was the prognostic profile.
Conclusions: Organised screening appeared as effective as opportunistic screening. Mammography screening has strongly influenced the stage distribution of breast cancer in Switzerland, and a favourable impact on mortality is anticipated. Extension of organised mammography screening to the whole of Switzerland can be expected to further improve breast cancer prognosis in a cost-effective way.
Key words: breast cancer, effectiveness, mammography screening, Switzerland

introduction

Since effectiveness of high-quality mammography screening for women aged 50 and over was proved in randomised controlled trials, organised (service) and opportunistic (individual) screening have become widespread throughout Europe [1, 2]. If breast cancer mortality reductions reported in service screening programmes have been consistent with those found in randomised trials [3], no direct evidence yet supports the effectiveness of opportunistic screening.

In most European countries, opportunistic and organised screening coexist. Lower service screening attendance has been observed in countries with simultaneous presence of substantial opportunistic screening [4–7]. Apart from different attendance rates, short-term performance indicators of quality and early effectiveness reached similar levels in programmes that operated in centralised and decentralised health care systems [8]. Thus, mortality reductions expected at a population level from programmes' attendance and performances only would be underestimated if participation to, and effectiveness of, opportunistic screening is not considered in those settings where both screening modalities coexist.

The decentralised nature and lack of systematic and reliable reporting of opportunistic mammography screening activity have strongly limited the evaluation of its effectiveness. Indeed, many series could not differentiate mammography into diagnostic versus *de facto* opportunistic screening [9, 10]. Thus, accurate comparison of effectiveness between organised and opportunistic screening has seldom been carried out.

This study was set up in Switzerland where the modality of cancer diagnosis is reliably ascertained by registries [11] and the distribution of organised versus opportunistic screening varies substantially across regions. The two objectives were (i) to compare breast cancer screening effectiveness in organised versus opportunistic screening for different patterns of screening attendance and (ii) to study the prognostic profile of breast cancer in presence of low and high prevalence of opportunistic screening.

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patients and methods

Five mammography screening programmes are operating in Switzerland, covering all six French-speaking cantons (Swiss administrative units) and ~25% of the Swiss female resident population aged 50–69 years. These regional programmes have similar quality control and screening procedures (eligibility, invitation) that include double reading with arbitration and two-view mammography. Opportunistic screening is available throughout the country, but mammography screening is only reimbursed when carried out biennially from age 50 within an organised, quality-controlled programme.

This study focussed primarily on the three Swiss cantons (Geneva, Vaud and Valais) with the longest operating screening programmes. They all were launched in the wake of the Swiss pilot project (1993–1998) [12], and data on the first 8 years of operation were available for these analyses (1999–2006). While self-reported use of mammography (screening and diagnostic) among females aged 50–69 years was overall similar, ~90%, in the three cantons during this time period, participation widely differed across programmes (Geneva: 26%, Vaud: 49%, Valais: 66%) [13]. This mainly reflected a higher prevalence of opportunistic screening in cantons with a lower programme's participation.

Screening programmes' records could be matched with cancer registries' databases in Vaud and Valais only. However, all three cancer registries included details on the modality of diagnosis (i.e. screening, symptoms). Four categories of breast cancers were considered according to screening and detection method: (i) screen-detected cancer by organised screening (registry-ascertained cancer detected by mammography screening programme), (ii) screen-detected cancer by opportunistic screening (registry-ascertained, screen-detected cancer with no organised mammography in the last 2 years), (iii) interval cancer (registry-ascertained cancer with a screen-negative organised mammography in the last 2 years) and (iv) unscreened cases (cancer diagnosed via symptoms among nonparticipants in the last 2 years of the programme).

Performance and prognostic indicators as defined in the European Guidelines [14] were used to assess screening effectiveness. Prognostic indicators were computed for each screening/detection modality (intracantonal comparisons for Vaud and Valais), as well as for the whole cantons (intercantonal comparisons). Comparisons across cantons included two additional regions covered by a Cancer Registry with low (St Gallen, ~30%) and high (Ticino, ~70%) prevalence of opportunistic screening, but without organised screening programme. Data collection was completed at the end of 2007. As the three screening programmes started during 1999 and interval cancers need a 2-year follow-up to be exhaustively identified, intercantonal comparisons pertained to the 2000–2005 time period. Comparisons of breast cancer prognosis within and between cantons relied on clinical characteristics of cancers routinely notified to registries. Age was taken at cancer diagnosis (50–69).

results

Table 1 provides selected indicators of screening quality for the 195 561 screens carried out over the 1999–2006 time period in the Geneva, Vaud and Valais programmes. European norms were met for initial and subsequent rounds except the slightly exceeding recall rate in prevalent screen in Geneva and Valais (target: 7.0%). The recall rate was the indicator with the largest variation across programmes (6.4%–7.9% for prevalent round and 3.3%–4.8% for incident round).

Indicators of effectiveness by detection and screening modality are shown in Table 2 for Vaud and Table 3 for Valais, for women aged 50–69 years at diagnosis. International standards of effectiveness were reached for screen-detected cancers in both programmes. Half the reported cancers in these cantons were screen detected (Vaud: 51%, Valais: 53%), and screen detection occurred twice as often through organised than opportunistic screening.

Opportunistic and organised screening afforded a similar prognostic profile in Vaud (Table 2). In Valais, opportunistic screening was associated with a slightly more favourable prognostic profile (Table 3). Results consistently pointed towards an earlier detection of breast cancers in Vaud than Valais, whether within the programme or opportunistically. The prognostic profile was worst for unscreened (symptomatic) cases. In terms of prognosis, interval cancers fared slightly better than breast cancers diagnosed among unscreened subjects but were at a more advanced stage than screen-detected tumours.

Breast cancer prognostic indicators were systematically more favourable in cantons with than without a mammography screening programme (Table 4). For instance, the proportion of

Table 1. Selected indicators of performance in Swiss regional screening programmes (GE, VD and VS), women aged 50–69 years, 1999–2006

Performance indicator	GE, n = 38 506	VD, n = 104 166	VS, n = 52 889
Recall rate (%)			
Initial screen	7.9	6.4	7.1
Subsequent screen	4.8	3.9	3.3
Benign to malignant biopsy ratio			
Initial screen	n.a	0.47	0.55
Subsequent screen	n.a	0.28	0.24
Breast cancer detection rate			
Initial screen	6.1	7.6	6.2
Subsequent screen	5.9	5.9	4.8
Interval cancers (initial screen, proportional incidence)			
0–11 months after screening	22.7	24.0	27.3
12–23 months after screening	51.3	41.9	53.2

GE, Geneva; VD, Vaud; VS, Valais; n.a., not available.

Table 2. Distribution of prognostic indicators for breast cancer by detection and screening modality in the canton of Vaud, 2000–2005 (women aged 50–69 years at cancer diagnosis)

Prognostic indicators[a] (%)	Participants		Nonparticipants[b]	
	Screen detected, n = 488	Interval cancers, n = 133	Screened, n = 241	Unscreened, n = 560
In situ	18.9	9.0	22.4	3.6
≤1 cm	43.3	25.0	39.7	17.7
≤2 cm	83.2	71.6	84.4	54.6
Stage ≥ II	28.8	44.8	27.5	43.7
Node negative	72.0	58.6	73.0	58.5

[a]Except for the % percentage of *in situ* cases, indicators are based on invasive cancers only.

[b]Includes former participants for which the cancer was diagnosed >2 years after the last mammography test.

Table 3. Distribution of prognostic indicators for breast cancer by detection and screening modality in the canton of Valais, 2000–2005 (women aged 50–69 years at cancer diagnosis)

Prognostic indicators[a] (%)	Participants		Nonparticipants[b]	
	Screen detected, $n = 259$	Interval cancers, $n = 89$	Screened, $n = 137$	Unscreened, $n = 256$
In situ	10.8	5.6	13.1	5.5
≤2 cm[c]	75.8	54.7	79.7	51.2
Stage ≥ II	40.5	58.5	31.6	64.7
Node negative	69.6	58.5	81.0	54.0

[a]Except for the % percentage of *in situ* cases, indicators are based on malignant cancers only.
[b]Includes former participants for which the cancer was diagnosed >2 years after the last mammography test.
[c]pT stage was not directly available from the Valais Cancer Registry. Construction of this information was based on clinical and pathological data which did not allow to reliably estimate the percentage of malignant cases ≤1 cm (pT1a or pT1b).

Table 4. Prognostic indicators for breast cancer in Swiss cantons with and without a screening programme and according to prevalence of opportunistic screening (SG: low, TI: high), 2000–2005 (women aged 50–69 years at cancer diagnosis)

Prognostic indicators[a] (%)	Cantons with screening programmes			Cantons without screening programmes	
	VS, $n = 741$	VD, $n = 1422$	GE, $n = 921$	SG, $n = 686$	TI, $n = 721$
In situ	8.5	12.5	13.7	9.3	5.8
≤1 cm	–[b]	30.1	26.1	10.9	18.2
≤2 cm	64.2	70.1	70.4	49.6	63.5
Stage ≥ II	46.4	36.4	47.0	65.5	56.5
Node negative	67.2	65.2	67.1	56.0	55.4

[a]Except for the percentage of *in situ* cases, indicators are based on malignant cancers only.
[b]pT stage was not directly available and was reconstructed on the basis of clinical and pathological data from the Valais Cancer Registry.
VS, Valais; VD, Vaud; GE, Geneva; SG, St Gallen; TI, Ticino.

invasive cancers ≤10 mm was nearly thrice as low in St Gallen (screening coverage of ∼30%, entirely opportunistic) than in Vaud (screening coverage of ∼80% with ∼30% opportunistic screening as well). In the absence of organised screening, the higher the prevalence of opportunistic screening, the more favourable breast cancer prognosis was documented.

discussion

Organised screening was found to be as effective as opportunistic screening in regions covered by mammography screening programmes, a finding that few studies have been able to explore. Further, the positive association observed between prognostic indicators and prevalence of opportunistic screening in regions without screening programmes was strongly suggestive of the effectiveness of opportunistic screening.

These observations occurred in a setting, Switzerland, where European standards for screening effectiveness were met by organised programmes. Results were consistent across three regions with overall comparable proportions of target population covered by screening, but irrespective of the different attendance rates in these regional screening programmes (respectively, high, moderate and low). Although acceptable levels of performance indicators do not necessarily warrant a decrease in breast cancer mortality [15], the favourable stage shifting observed, particularly in cantons with organised screening programmes, augurs a screen-attributable decline in breast cancer mortality in these regions.

Two strengths of this study were the ability to separate diagnostic from opportunistic mammography on medical files and to accurately match programme-based screening and breast cancer records in these populations. However, some degree of misclassification of the modality of cancer diagnosis could not totally be avoided. On the one hand, opportunistic screening is not reimbursed by basic, compulsory health insurance in Switzerland but diagnostic screening is. Therefore, some asymptomatic patients might thus have been referred as having clinical symptoms to ensure health insurance coverage for the woman. Evidence to support this assumption was unavailable but such medical behaviour would probably underestimate the effectiveness of opportunistic screening since symptomatic cases likely correspond to more advanced lesions. On the other hand, anecdotic evidence indicated that a few symptomatic women attended the screening programmes to benefit from the cost-free examination. Excluding these women from the study would have required the systematic recording of their symptomatology.

Some variations in screening effectiveness were found between Swiss regional programmes. Although a detailed examination of the reasons underpinning these variations are beyond the scope of this paper, complementary analyses hint to differences in multiple reading strategy and minimum reading volume requirements as the most likely explanations. Vaud and Geneva programmes had similar radiological procedures and showed similar prognostic profile for breast cancers. Thus, the uptake in organised versus opportunistic mammography screening in these three cantons should not explain the slight, regional variations in organised screening effectiveness. A recent Danish study reported a considerably higher sensitivity in organised than opportunistic screening but similar specificity for both screening modalities [10]. How these different radiological performances will translate into effectiveness of organised and opportunistic mammography screening is yet to be quantified.

Heterogeneity in access to care and quality of treatment cannot be ruled out to explain some of the variations in breast cancer prognosis across Switzerland. Substantial differences in mortality trends predating the widespread use of mammography screening have been reported within Switzerland [16], as well as regional differences in breast cancer survival [17]. These studies support not only a better breast cancer diagnosis but also management in areas where organised screening has been implemented.

The major differences between opportunistic and organised screening in Switzerland lie in the frequency of the test (often annually for the former) and the inclusion of immediate,

additional investigations (three views per breast, ultrasound) when deemed necessary in opportunistic screening. Such differences should improve effectiveness of opportunistic screening alone, though in a non-cost-effective manner [18]. Compulsory, quality-controlled procedures for organised screening do not systematically apply to opportunistic screening, whereas the same radiologists generally carry out opportunistic and organised screening mammography with the same equipment in Switzerland. One may assume opportunistic screening to benefit from the training of radiographers, higher reading volume of radiologists and the technical, quality-controlled procedures.

The findings that high-quality mammography service screening can yield similar effectiveness as opportunistic screen warrants that extension of organised mammography screening to the whole of Switzerland should be a cost-effective measure. Comparisons of cost-effectiveness between various scenarios of attendance and coexistence for both screening modalities in Switzerland are under way [18].

acknowledgements

This study was partly based on the evaluation of the Vaud and Valais mammography screening programmes for which J-LB and FL have been mandated and was conducted as part of the national evaluation of breast cancer screening programmes in Switzerland, under the coordination of the Swiss Cancer League, for which J-LB was the scientific referent. The authors are grateful to J.-P. de Landtsheer, former Director of the Vaud Breast Cancer Screening Programme, for collecting and providing the data for the Vaud mammography screening programme, D. De Weck (Valais Cancer Registry) and Mr L. Randimbison (Vaud Cancer Registry) for matching the screening records with their cancer registry database, and Mr P. Pury (National Institute for Cancer Epidemiology and Registration) for computing and providing breast cancer prognostic indicators for the cantons of St Gallen and Ticino.

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