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## Screening caused rising incidence rates of ductal carcinoma in situ of the breast

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**Abstract** The purpose of this study was to examine trends in incidence and detection of ductal carcinoma in situ (DCIS) of the breast in southern Netherlands in the period 1984–2006 and assess the effect of mass screening. All patients with primary DCIS registered between 1984 and 2006 in the population-based Eindhoven Cancer Registry were included ( $n = 1,767$ ). These data were linked to data from the population-based screening programme. The incidence of DCIS of the breast increased from 3/100,000 to almost 34/100,000 person-years in women aged 50–69 years in southern Netherlands since 1984. Mass screening was responsible for this increase. A stable 60% of DCIS was screen-detected. Over 11% of breast cancer patients have DCIS. In conclusion, the incidence of DCIS increased markedly in southern Netherlands with a clear effect of mammography screening since 1992.

**Keywords** DCIS · Trend · Incidence · Screening

### Introduction

Breast cancer incidence has been increasing in the Netherlands [1]. Ductal carcinoma in situ (DCIS) of the breast is considered a precursor state of breast cancer. DCIS is often asymptomatic and is usually detected during mammographic screening [2]. Detection rates of DCIS have increased rapidly over the past decades, which is generally attributed to use of mammography [3]. However, direct evidence for the impact of screening is scarce [4, 5].

In southern Netherlands, the first round of a population-based screening programme was implemented in the period 1992–1996, offering free biannual mammography to women aged 50–69 years with a response rate of almost 85% [6]. Since 1999, women aged 70–75 years are also invited. The purpose of this study is to examine trends in incidence and detection of DCIS in southern Netherlands in the period 1984–2006 and assess the effect of mass screening.

### Methods

Population-based data from the Eindhoven Cancer Registry (ECR) were used. The ECR records data on all patients newly diagnosed with cancer in the southern part of the Netherlands, an area with 10 community hospitals and two radiotherapy institutes. Information on patient characteristics such as gender and date of birth, and tumour characteristics such as date of diagnosis, tumour type, subsite [International Classification of Diseases for Oncology (ICD-O-3), histology, stage (Tumour Lymph Node-Metastasis (TNM)), clinical classification], grade and treatment, are obtained routinely from the medical records. For the present study, all patients with primary DCIS

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registered between 1984 and 2006 in the ECR area were included ( $n = 1,767$ ).

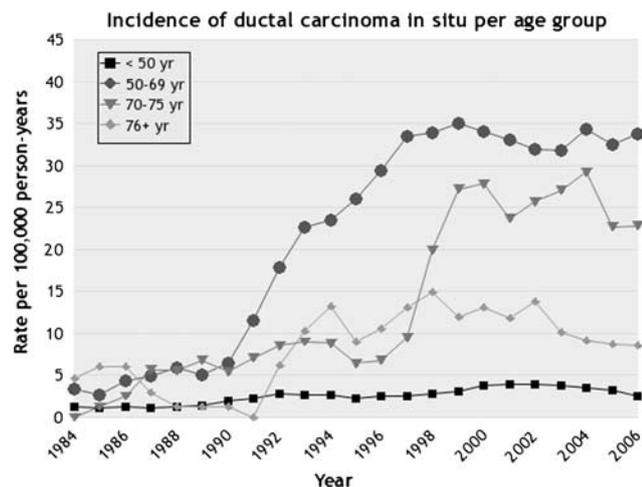
Data of these patients were linked to the database of the population-based screening programme for breast cancer in southern Netherlands (BoBZ). A screen-detected tumour had to be detected within 1 year after the screening following referral [7]. Permission was obtained for record linkage and to eliminate false-positive matches.

Linkage between ECR and screened women resulted in a study population of 1,125 newly diagnosed cases as the screening region does not exactly cover the ECR registration area.

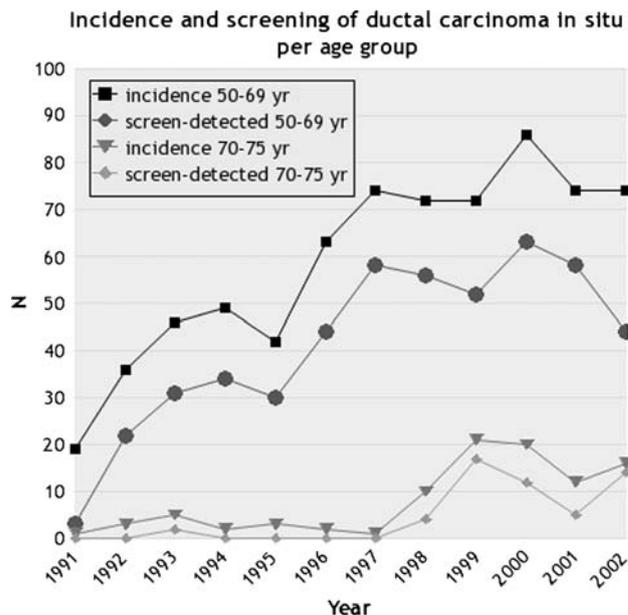
These patients were divided into age groups according to the age limits used by the screening programme (<50, 50–69, 70–75, and 75+ years). Age-specific annual incidence rates were calculated per 100,000 person-years as 3-year moving averages. SAS system 9.1 (SAS Institute, Cary, NC) was used for the statistical analyses.

## Results

From 1984 to 2006 the detection rate of DCIS among women aged 50–69 years increased from 3/100,000 to almost 34/100,000 person-years in southern Netherlands, especially in the period 1991–1999, and stabilizing hence (Fig. 1). The increasing incidence at age 50–69 paralleled the detection of DCIS by mass screening (Fig. 2). Under age 50 years a slight increase in DCIS was seen from 1/100,000 in 1984 to 3/100,000 person-years in 2005. For women aged 70–75 years a slight increase in incidence rate was seen since 1984, intensifying during 1997 to 1999 from 10/100,000 to 27/100,000 person-years (Fig. 1). Since 1998 the screen-detected incidence of DCIS in



**Fig. 1** Incidence rate of DCIS in the ECR region as 3-year moving averages ( $n = 1,767$ )



**Fig. 2** Absolute numbers of incident and screen-detected DCIS patients in the ECR region ( $n = 874$ )

women aged 70–75 years paralleled the overall incidence of DCIS (Fig. 2). For patients aged over 76 years the incidence increased from 5/100,000 person-years to 9/100,000 person-years. Contralateral DCIS incidence was stable over the study period with two cases annually (data not shown).

Since 1996, about 60% of the patients with DCIS remained screen-detected (Fig. 1).

Of all breast cancer cases, DCIS showed an increase from 1.1% in the period 1984–1990 to 7.4% in 2001–2005, going from 3.4% to 11.6% at age 50–69 years (data not shown).

## Discussion

Our results clearly show the effect of mammography screening on the incidence of DCIS. In the age groups 50–69 years as well as 70–75 years, the incidence rates have risen sharply since the start of the screening programme in 1991 and 1999, respectively.

For women aged 50–69 and 70–75 years the increased incidence of DCIS can be attributed to screening, since the screen-detected incidence paralleled the overall incidence. For women aged 70–75 years the screening effect started later, since in 1999 the age limits for screening were extended to 75 years. Among women below age 50 the rising incidence may be attributed largely to the more vigorous search for families with heritable breast cancers in the Netherlands [8], following the identification of BRCA1 and BRCA2 mutations since 1995. In addition, the

increased public awareness of breast cancer and improved detection methods resulted in increased detection of DCIS.

The increase in incidence of DCIS is in line with previous studies, being largest in the age groups invited for mammography screening [4, 5, 9, 10]. A fivefold increase in incidence of DCIS has been shown in several US studies [9, 11, 12]. Using the Surveillance, Epidemiology and End Results (SEER) database the incidence increased from 2.4/100,000 in 1973 to 15.8/100,000 in 1992 [9]. In Europe similar trends were seen. In Italy a fivefold increased risk was observed between 1988 and 1999 [4] and a 4.5-fold increase in the Swiss Canton of Vaud from 1.0/100,000 in 1977–1979 to 7.1/100,000 person-years in 1990, levelling off thereafter [10].

After the sharp increase following the introduction of screening, the incidence of DCIS as well as the proportion of patients detected by screening remained rather stable. This might indicate that other risk factors did not play a major role in the increasing incidence of DCIS or that risk factors for DCIS might have changed to a more favourable pattern, like decreased hormone replacement therapy [13], resulting in a stable incidence. Yet Barchielli et al. calculated that 39% of the increase found in their study could be attributed to other factors than screening [4].

In conclusion, the incidence of DCIS increased markedly in southern Netherlands with a clear effect of mammography screening since 1992. New cases of DCIS continue to develop between screening rounds at a constant rate. Digital mammography breast cancer screening is forthcoming in the Netherlands, which might increase the incidence rates of DCIS.

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