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Clinical Studies

Small but significant socioeconomic inequalities in axillary staging and treatment of breast cancer in the Netherlands

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BACKGROUND: The use of sentinel node biopsy (SNB), lymph node dissection, breast-conserving surgery, radiotherapy, chemotherapy and hormonal treatment for breast cancer was evaluated in relation to socioeconomic status (SES) in the Netherlands, where access to care was assumed to be equal.

METHODS: Female breast cancer patients diagnosed between 1994 and 2008 were selected from the nationwide population-based Netherlands Cancer Registry ($N = 176\,505$). Socioeconomic status was assessed based on income, employment and education at postal code level. Multivariable models included age, year of diagnosis and stage.

RESULTS: Sentinal node biopsy was less often applied in high-SES patients (multivariable analyses, ⩽49 years: odds ratio (OR) 0.70 (95% CI: 0.56–0.89); 50–75 years: 0.85 (0.73–0.99)). Additionally, lymph node dissection was less common in low-SES patients aged ⩾76 years (OR 1.34 (0.95–1.89)). Socioeconomic status-related differences in treatment were only significant in the age group 50–75 years. High-SES women with stage T1–2 were more likely to undergo breast-conserving surgery (+radiotherapy) (OR 1.15 (1.09–1.22) and OR 1.16 (1.09–1.22), respectively). Chemotherapy use among node-positive patients was higher in the high-SES group, but was not significant in multivariable analysis. Hormonal therapy was not related to SES.

CONCLUSION: Small but significant differences were observed in the use of SNB, lymph node dissection and breast-conserving surgery according to SES in Dutch breast cancer patients despite assumed equal access to health care.
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Breast cancer is the most common cancer in females from Western countries, particularly in Western Europe (Ferlay *et al*, 2010). Incidence rates are generally highest among women with high socioeconomic status (SES) (Faggiano *et al*, 1997; Carlsen *et al*, 2008; National Cancer Intelligence Network, 2009; Spadea *et al*, 2009). However, at least for the Netherlands, we observed age-specific differences in this association. In women aged 25–44 years, the highest incidence rates were reported for those with high SES, whereas in those aged ⩾65 years rates were the lowest for those with a high SES. No socioeconomic inequalities were observed in those aged 45–64 years (Aarts *et al*, 2010).

Survival from breast cancer has been reported to be generally worse in those with low SES (Schrijvers *et al*, 1995; Bastiaannet *et al*, 2011), although better survival rates have been observed by others (Faggiano *et al*, 1997). In the Netherlands, an equal health-care system is provided and a health insurance is compulsory for all inhabitants. However, survival disparities from breast cancer have been reported. These were partly explained by tumour size (Bastiaannet *et al*, 2011) and by stage differences resulting from differences in attendance to the free population screening programme (Aarts *et al*, 2011).

Treatment disparities were present in studies from Denmark and the UK, which have shown that deprived women had higher mastectomy rates, although the odds of receiving radiotherapy after breast-conserving surgery was not associated with SES as well as chemotherapy and endocrine treatment (Norredam *et al*, 1998; Taylor and Cheng, 2003; Henley *et al*, 2005; Downing *et al*, 2007; Raine *et al*, 2010). Furthermore, the use of sentinel node biopsy (SNB) was higher in regions with a high educational level in the US (Halpern *et al*, 2009), but to our knowledge this has not been studied in other countries.

Although Dutch health care is supposedly equally accessible, socioeconomic treatment disparities were reported for colon, pancreas, prostate and oesophageal cancer (Aarts *et al*, submitted; Lemmens *et al*, 2005; van Oost *et al*, 2006; Bus *et al*, 2012). However, for breast cancer care it is not known whether there are differences in axillary staging and treatment. Therefore, we investigated the association between SES and the use of SNB, lymph node dissection, breast-conserving surgery, radiotherapy, chemotherapy and hormonal treatment for breast cancer in the Netherlands.

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PATIENTS AND METHODS

Patient selection

Female patients with their first primary breast cancer (invasive and *in situ*) diagnosed between 1994 and 2008 were selected from the Netherlands Cancer Registry. Patients with other tumours before their breast cancer were excluded. The nationwide Dutch network and registry of histopathology and cytopathology regularly submits reports of all diagnosed malignancies to the regional cancer registries. The national hospital discharge databank, which receives discharge diagnoses of admitted patients from all Dutch hospitals, completes case ascertainment. After notification, trained registry personnel collect data on diagnosis, staging and treatment from the medical records, including pathology and surgery reports, about 9 months after diagnosis, using the registration and coding manual of the Dutch Association of Comprehensive Cancer Centres.

Stage was divided according to TNM classification at the year of diagnosis. Pathological T, N and M stage was used; clinical stage was used if pathological was missing.

In the Netherlands, the SNB was gradually implemented from 1998 to 2003; we therefore studied the SNB from 2003 onwards. It is registered in six of nine regional registries; analyses on SNB were limited to these registries and to stage cT1,2N0M0,X.

National guidelines for treatment of breast cancer were introduced in the Netherlands in 2002 (Working Group Treatment Breast Cancer, 2002). Before that time, treatment was based on regional guidelines. Treatment was categorised as breast-conserving surgery, external beam radiotherapy after breast-conserving surgery, chemotherapy and hormonal therapy. The use of breast-conserving surgery and breast-conserving surgery plus external beam radiotherapy was studied among patients with stage T1,2N0M0,X breast cancer and chemotherapy and hormonal therapy in TanyN + M0,X breast cancer. The use of chemotherapy was studied from 2002 onwards, as treatment guidelines were rapidly changing before that time. The use strongly increased from 1994 to 2002 and gradually further increased afterwards. We were not able to classify chemotherapy as adjuvant or neoadjuvant.

The population-based screening programme for breast cancer in the Netherlands started around 1990 and covered in 1997 all women aged 50–69 years; in 1998 the upper age limit was extended to 75.

Socioeconomic status

Socioeconomic status was assigned to each patient using an area-based measure according to place of residence at the time of diagnosis. The area-based SES was provided by the Netherlands Institute for Social Research and consists of numbers from income, employment and education, which are provided to the institute by a private organisation that collects information by telephone calls with one person per 6-digit postal code area; this person is seen as representative for his or her area. Next, numbers are aggregated to 4-digit postal code areas. Validation studies indicate that these numbers at aggregated level approach the true situation (Tesser *et al*, 1995). A higher score represents a high social deprivation (low SES) and a low score represents little social deprivation and consequently a high SES. Scores were divided into quintiles.

Statistical analysis

All statistical tests were two-sided and were considered significant if $P \leqslant 0.05$. The distribution of sociodemographic and clinical characteristics was studied across the SES strata. Significance was tested with non-parametric tests (continuous variables) and χ^2-tests (categorical variables).

Analyses were stratified according to the age groups $\leqslant 49$, 50–75, $\geqslant 76$. The odds ratios (OR) were stratified by these age categories and adjusted for age (continuously), year of diagnosis, SES and T-stage. After excluding patients with unknown SES ($N = 445$) and non-carcinomas ($N = 1548$), data on 176 505 patients were analysed.

RESULTS

Patients with highest SES were on average 3 years younger ($P < 0.0001$) and had a lower stage of disease than patients with the lowest SES ($P < 0.001$; Table 1).

The use of the SNB procedure for stage cT1,2N0M0,X breast cancer increased from 74% in 2003 to 88% in 2008. In general,

Table 1 Patient characteristics of breast cancer patients in the Netherlands, diagnosed during 1994–2008

	Socioeconomic status									
	5. lowest		4.		3. intermediate		2.		1. highest	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
Period of diagnosis										
1994–1998	10 234	23	10 296	18	10 413	20	9372	20	11 689	20
1999–2003	11 990	20	11 616	21	11 580	19	12 695	19	11 845	20
2004–2008	13 077	18	13 389	20	13 308	21	13 234	21	11 767	20
*Age at diagnosis**,#										
Mean	62.2		61.4		60.7		59.9		59.3	
0–49	7673	22	8003	23	8477	24	9128	26	10 101	29
50–75	20 823	59	21 314	60	21 339	60	21 104	60	20 058	57
76 +	6805	19	5984	17	5485	16	5069	14	5142	15
*TNM stage**										
0 (*in situ*)	2755	8	2934	8	3100	9	3081	9	3150	9
1	11 964	34	12 203	35	12 384	35	12 636	36	12 561	36
2	14 686	42	14 682	42	14 402	41	14 437	41	14 566	41
3	3601	10	3450	10	3434	10	3271	9	3144	9
4	1899	5	1644	5	1601	5	1541	4	1425	4
Unknown	396	1	388	1	380	1	335	1	455	1

Abbreviation: TNM = tumour–node–metastasis. *$P < 0.0001$ (χ^2-test). #$P < 0.0001$ (*t*-test).

Table 2 The use of the sentinel node procedure and additional lymph node dissection for breast cancer patients in the Netherlands, diagnosed 2003–2008, stage cT1,2N0M0,X

			Sentinel node biopsy						Lymph node dissection in patients *with* sentinel node biopsy					
Age (years)	**Socioeconomic status**	**N_{total}**	**% SNB**	***P*-value**	**OR**	**95% CI**		**Trend**	**% LND**	***P*-value**	**OR**	**95% CI**		**Trend**
⩽49	1. Highest	1262	84.0	0.1	0.70	0.56	0.89	0.053	36.4	0.7	0.90	0.76	1.08	0.7
	2.	1305	85.4		0.80	0.63	1.02		36.6		0.91	0.76	1.08	
	3. Intermediate	1401	85.9		0.84	0.66	1.06		36.4		0.90	0.75	1.07	
	4.	1431	86.2		0.87	0.69	1.11		37.1		0.91	0.76	1.08	
	5. Lowest	1173	87.8		1.00				38.9		1.00			
50–75	1. Highest	2635	87.2	0.2	0.85	0.73	0.99	0.2	28.2	0.6	0.94	0.84	1.06	0.6
	2.	3405	87.6		0.90	0.77	1.04		30.3		1.03	0.93	1.16	
	3. Intermediate	3832	88.9		0.97	0.84	1.12		29.6		1.03	0.93	1.15	
	4.	4209	88.3		0.96	0.84	1.11		29.0		0.99	0.89	1.10	
	5. Lowest	3613	88.5		1.00				29.2		1.00			
⩾76	1. Highest	506	53.2	0.1	1.01	0.80	1.28	0.06	27.1	0.01	1.34	0.95	1.89	0.01
	2.	668	46.1		0.79	0.64	0.98		30.2		1.55	1.11	2.14	
	3. Intermediate	793	52.7		1.10	0.90	1.36		31.1		1.64	1.21	2.21	
	4.	1008	49.8		0.94	0.77	1.14		29.3		1.51	1.13	2.01	
	5. Lowest	966	50.9		1.00				21.5		1.00			

Abbreviations: 95% CI = 95% confidence interval; LND = lymph node dissection; OR = odds ratio, adjusted for age, year of diagnosis, T-stage and histology; SNB = sentinel node biopsy. *P*-values are from χ^2 test. Trend refers to *P*-value from trend test.

Table 3 Use of therapies for breast cancer in the Netherlands according to socioeconomic status, diagnosed during 1994–2008

	Age at diagnosis																	
	⩽49						**50–75**						**⩾76**					
	%	***P*-value**	**OR**	**95% CI**		**Trend**	**%**	***P*-value**	**OR**	**95% CI**		**Trend**	**%**	***P*-value**	**OR**	**95% CI**		**Trend**
Breast-conserving surgery, T1,2N0M0,X[a]																		
1. Highest SES	60.9	0.8	0.95	0.86	1.04	0.7	64.1	<0.0001	1.15	1.09	1.22	<0.0001	24.0	0.02	1.21	1.06	1.38	0.02
2.	61.2		0.97	0.88	1.07		63.8		1.09	1.03	1.16		22.6		1.10	0.96	1.26	
3. Intermediate	60.6		0.95	0.86	1.05		62.3		1.04	0.99	1.10		20.8		0.98	0.86	1.13	
4.	60.2		0.94	0.85	1.03		61.8		1.03	0.98	1.09		21.5		1.04	0.91	1.19	
5. Lowest SES	61.5		1.00				60.4		1.00				20.6		1.00			
Breast-conserving surgery + radiotherapy, T1,2N0M0,X[a]																		
1. Highest SES	58.9	0.8	0.96	0.87	1.05	0.8	62.3	<0.0001	1.16	1.09	1.22	<0.0001	18.3	0.5	1.10	0.95	1.28	0.5
2.	59.6		0.99	0.90	1.09		61.9		1.10	1.04	1.16		17.8		1.05	0.90	1.22	
3. Intermediate	59.1		0.97	0.88	1.07		60.5		1.05	0.99	1.11		16.6		0.96	0.83	1.11	
4.	58.3		0.95	0.86	1.05		60.0		1.04	0.99	1.10		17.1		1.02	0.88	1.17	
5. Lowest SES	59.3		1.00				58.4		1.00				16.7		1.00			
Hormonal therapy, TanyN + M0,X[b]																		
1. Highest SES	48.3	0.3	1.08	0.98	1.20	0.2	71.5	0.9	1.02	0.94	1.10	0.9	79.8	0.2	0.93	0.79	1.11	0.2
2.	50.4		1.11	1.00	1.23		71.3		1.01	0.93	1.09		78.9		0.93	0.79	1.10	
3. Intermediate	48.4		1.01	0.91	1.12		71.7		1.00	0.93	1.08		81.0		1.04	0.88	1.22	
4.	48.4		1.02	0.91	1.13		71.5		0.98	0.90	1.06		77.9		0.87	0.74	1.01	
5. Lowest SES	49.3		1.00				72.1		1.00				80.3		1.00			
Chemotherapy, TanyN + M0,X[c]																		
1. Highest SES	93.2	0.3	0.95	0.73	1.24	0.3	61.7	<0.0001	1.11	0.98	1.26	0.5	2.4	0.2	1.08	0.56	2.09	0.1
2.	93.3		0.97	0.75	1.27		58.8		1.03	0.91	1.17		1.3		0.45	0.22	0.91	
3. Intermediate	94.1		1.10	0.83	1.45		57.2		1.01	0.89	1.14		1.9		0.62	0.32	1.19	
4.	92.4		0.83	0.63	1.08		56.1		1.02	0.90	1.15		1.8		0.67	0.36	1.25	
5. Lowest SES	93.8		1.00				55.3		1.00				2.9		1.00			

Abbreviations: 95% CI = 95% confidence interval; OR = odds ratio; SES = socioeconomic status. *P*-value refers to χ^2-test. Trend refers to *P*-value for trend. [a]OR adjusted for age (continuously), year of diagnosis, T-stage (T2N0 *vs* T1N0). [b]OR adjusted for age (continuously), year of diagnosis, T-stage (T2N+, T3N+, T4N+ *vs* T1N+). [c]From 2002 onwards. OR adjusted for age (continuously), year of diagnosis, T-stage (T1N+, T3N+, T4N+ *vs* T2N+).

high-SES patients less often received SNB, with 1–3% lower rates in high- *vs* low-SES patients aged ⩽75, but not statistically significant (Table 2). These differences were significant in multivariable analyses (age ⩽49: OR 0.70 (95% CI: 0.56–0.89); 50–75 years: 0.85 (0.73–0.99)). In the oldest age group no consistent pattern on the use of SNB appeared. Compared with high SES, rates of lymph node dissection in addition to SNB were slightly higher in low-SES patients in the youngest age group (36% *vs* 39%, not statistically significant), and lower in low-SES patients in the oldest group (27% in high SES *vs* 22% in low SES, $P = 0.01$). In multivariable analyses, among the patients aged $\geqslant$76 receiving SNB, those with high SES more often received lymph node dissection compared with those with low SES, although not statistically significant for the highest SES group (OR 1.34 (95% CI: 0.95–1.89)).

Small, statistically significant socioeconomic differences were present in treatment selection in those aged 50–75 years. The use of breast-conserving surgery was slightly higher in high-SES patients (stage T1,2N0M0,X), i.e. 64% of patients with high SES compared with 60% of those with low SES (χ^2-test $P<0.0001$; Table 3). Nearly all of these patients received additional radiotherapy (97%), which was not significantly different between the SES groups. In multivariable analyses, the odds of breast-conserving surgery remained significantly increased (OR 1.15 (95% CI: 1.09–1.22) for high *vs* low SES), also for breast-conserving surgery plus radiotherapy (OR 1.16 (95% CI: 1.09–1.22); Table 3). In this early stage, an inverse association was observed for mastectomy, with lower rates in high-SES women aged 50–75 years (data not shown).

In those aged 50–75 years, the use of endocrine treatment was not related to SES, neither in univariable nor in multivariable analyses (Table 3). Rates of chemotherapy for node-positive breast cancer were highest in high-SES patients (62% *vs* 55% in low SES, χ^2-test $P<0.0001$), but were no longer significant in multivariable analyses (Table 3).

Of all therapies mentioned above, none was significantly related to SES in women aged <50 years. In women of age $\geqslant$76 years, the only significant associations were observed for breast-conserving surgery, with higher rates in the high-SES group (χ^2-test $P=0.02$, OR high *vs* low SES 1.21 (95% CI: 1.06–1.38)), and for chemotherapy, in which rates were reduced in the second highest SES group (OR 0.45 (95% CI: 0.22–0.91). The use of breast-conserving surgery and radiotherapy combined, however, was not significantly related to SES (OR 1.10 (95% CI: 0.95–1.28)).

DISCUSSION

This study shows that in the Netherlands, a country with assumed equal access to care, breast cancer patients with high SES were less likely to undergo SNB and, in the oldest group, more likely to receive additionally lymph node dissection. Furthermore, in patients aged 50–75 years the use of breast-conserving surgery and chemotherapy was significantly related to SES, although the absolute differences between the SES groups were generally small. In early-stage breast cancer, the use of breast-conserving surgery (+radiotherapy) was the highest in patients with high SES. This could not be fully explained by patient age, year of diagnosis and T-stage. Among the patients with node-positive breast cancer, a higher use of chemotherapy was observed among those with high SES. This difference, however, disappeared after adjustment for stage, age and year of diagnosis.

A prior US study showed higher rates of lymph node biopsy/sampling, that is, either axillary lymph node dissection or SNB, in areas where the education level was higher, although the absolute differences were small (Halpern *et al*, 2009). Our data suggest a poorer staging of the axillary lymph nodes and abandoning surgery in the armpit in patients with high SES. We cannot explain this observation as we expected the rates to increase with higher SES owing to — among others — better understanding of the importance of axillary staging. Possibly, patients with high SES are more conscious of the side effects of lymph node dissection, such as lymph oedema, and therefore are more inclined not to undergo this therapy. Previously, older age was associated with reduced likelihood of receiving lymph node biopsy (Halpern *et al*, 2009), but the mean age differed by only 3 years in our study, suggesting that age only little affected the staging procedure. Another study stated that among women undergoing breast-conserving surgery, those with comorbid conditions were less likely to receive axillary dissection (Louwman *et al*, 2005). As cancer patients with high SES have fewer comorbidities (Louwman *et al*, 2010), higher rates of axillary dissection would be expected among high-SES patients. We had no information on comorbidities in this study, but it probably has not contributed to the lower rates of SNB in high-SES patients in our study population. Besides, in the US, patients treated in hospitals with higher patient volumes were more likely to receive lymph node biopsy (Halpern *et al*, 2009). Possibly this has affected our results as well. Also, in the Netherlands, staging procedures and type of surgery depended on hospital characteristics, such as volume, with reducing differences over time (van Steenbergen *et al*, 2010). It should be noted, however, that absolute differences in our study were small and that statistical significance may have resulted from the large number of patients.

Our results on treatment selection are in line with and the order of magnitude is fairly similar to studies from Denmark and the UK. These studies have shown that women with a lower SES had higher mastectomy rates (Norredam *et al*, 1998; Taylor and Cheng, 2003; Henley *et al*, 2005) and lower breast-conserving surgery rates (Taylor and Cheng, 2003; Downing *et al*, 2007; Raine *et al*, 2010), although an age-dependent association has been observed as well (Thomson *et al*, 2001). Adjustment for stage explained the higher mastectomy rates observed in low SES (Henley *et al*, 2005), whereas the association remained significant after stratification by tumour size (Taylor and Cheng, 2003) and stage (our study, early stage (data not shown)). This implies that type of surgery chosen for the SES groups is not fully explained by stage and age in early-stage disease. Because of higher prevalence of concomitant diseases in patients with low SES (Louwman *et al*, 2010), type of surgery is expected to be less invasive owing to the poor general condition in low SES patients. In fact, we observed higher invasive surgery (mastectomy) rates in low SES. Presence of comorbidities might also be indicative of mastectomy to avoid the effects of radiotherapy, but this has not been studied before. A Northern Italian study found that presence of comorbidities reduced the odds of receiving radiotherapy after breast-conserving surgery (Rosato *et al*, 2009). Besides, that study also reported no educational differences in treatment of early-stage breast cancer after adjustment for comorbidities and hospital characteristics (Rosato *et al*, 2009). As discussed previously, hospital characteristics were affecting treatment selection, including type of surgery and use of radiotherapy, in the Netherlands as well (Vulto *et al*, 2005; Siesling *et al*, 2007; van Steenbergen *et al*, 2010), but we could not take these into account in our analyses. Nor were we able to investigate the contributions of ER status or grade, but previously these factors were reported to be not associated to SES (Henley *et al*, 2005). More active involvement of the patient in decision making led to higher mastectomy rates (Katz *et al*, 2005), but the effects in the Netherlands remain to be studied.

In our study, in accordance with the Dutch treatment guidelines (Oncoline. www.oncoline.nl.), nearly all patients undergoing breast-conserving surgery received additional radiotherapy (97%) and no differences were observed between the SES groups. Our results are in line with a study from the UK, in which the odds of receiving adjuvant radiotherapy was not associated with deprivation (Downing *et al*, 2007). Compared with the US, our rates of adjuvant radiotherapy are high (97% *vs* 73%) (Smith *et al*, 2010). Furthermore, in the US, large SES differences were observed, with adjuvant radiotherapy rates of 67% in patients with low SES *vs* 78% in those with high SES in the period 1991–2002, which were not explained by stage, hormone receptor status, grade, chemotherapy, comorbidity and surgeon characteristics (Hershman *et al*, 2008). Similar differences were observed in another US study investigating adjuvant radiotherapy rates according to race, which reported 74% in whites *vs* 65% in blacks (Smith *et al*, 2010), which remained also significant after adjustment for demographic, clinical (including comorbidities) and socioeconomic covariates.

Previous studies have reported inconsistent results with respect to the associations between SES and adjuvant radiotherapy, chemotherapy and endocrine treatment (Macleod *et al*, 2000; Taylor and Cheng, 2003; Downing *et al*, 2007), with higher rates in high SES in some studies but no association in others (Macleod *et al*, 2000; Downing *et al*, 2007; Bhargava and Du, 2009). Low educational level was associated with reduced doses of chemotherapy, whereas presence of comorbidities was not associated (Griggs *et al*, 2007). No data were available on chemotherapy doses from the Netherlands Cancer Registry. Besides, we have used the pathological staging supplemented with clinical TNM in case postoperative data were missing. As we were not able to classify chemotherapy as adjuvant or neoadjuvant, the staging may not be completely correct for the patients who received neoadjuvant chemotherapy.

Higher education predicted hormonal therapy use in older US breast cancer survivors (Yen *et al*, 2011). For those on hormonal therapy, wealthier women and women with insurance coverage for some or all medication costs were more likely to receive an aromatase inhibitor, which is prescribed by the American Society for Clinical Oncology (ASCO) (Yen *et al*, 2011). Owing to the Dutch obligatory health insurance for every inhabitant, insurance status is unlikely to affect treatment selection. This is in line with our finding that hormonal therapy was not related to SES in our study.

Unfortunately, patient preferences in itself could not be taken into account in this study. For example, the choice of mastectomy depends on the interplay between the surgeon's recommendations and patients' preferences for treatment (Hawley, 2010). The role of patient decision making (Smith *et al*, 2009) is likely to be influenced by health literacy, that is, 'The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions' (National Network of Libraries of Medicine, 2010). Low health literacy may lead to treatment options that are not fully understood, and therefore some patients may not receive the most appropriate treatment for their medical condition (Merriman *et al*, 2002). As SES can be linked with education, those with low SES are expected to be more vulnerable to low health literacy. A solution towards solving this might be to focus more on clear and adapted communication by health-care providers. In contrast, some patients do not want to be very involved in decision making (Lantz *et al*, 2005; Levinson *et al*, 2005).

Our study findings might be influenced by several limitations. First, we had no information on the presence of comorbidities, which may have affected therapy selection. Second, data on grade, ER status and PR status were not available, which might have affected our results. Third, we had no information on hospital characteristics, which affected therapy selection in Italy and the Netherlands; however, in the latter study, regional and hospital variation reduced over time (Rosato *et al*, 2009; van Steenbergen *et al*, 2010). Fourth, in this study we have used a measure of SES based on 6-digit postal code of the residential area. Our results may therefore be subject to ecological fallacy. Furthermore, our findings may be explained by some residual confounding. Although this measure of SES is not based on individual data on income, education or occupation, it covers a relatively small geographical area and thus is likely to represent a reliable approximation of individual SES. Previous studies in the Netherlands have proven that socioeconomic differences based on neighbourhood data tend to reflect socioeconomic differences accurately at the individual level (Bos *et al*, 2000, 2001; Smits *et al*, 2001). Furthermore, as the measure of SES used in this study is based on several outcomes, it also applies to older women (born before 1955), although their occupation or education does not always properly reflect their social class (Berkman and Macintyre, 1997).

Nevertheless, we have used population-based nationwide data, including all breast cancer patients from the Netherlands. We have thus provided a complete overview of the association between SES and the staging and treatment selection of breast cancer, which has not been done before.

CONCLUSION

Small but significant differences were observed in the use of SNB, lymph node dissection and breast-conserving surgery according to SES in Dutch breast cancer patients despite the assumed equal access to health care.

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Conflict of interest

The authors declare no conflict of interest.

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