A Population Based Study of Variations in the Prognosis of Breast Cancer at Diagnosis: Failure to Operate for Early Breast Cancer in Older Women.

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Abstract

Background: Deprivation, non-white ethnicity and young age are associated with late presentation of breast cancer. Older women are less likely to have surgery. The aim of this study was to identify groups likely to present with early or late breast cancer and to examine operation rates in a large population.

Methods: Registrations for 2007 were combined with Hospital Episode Statistics (HES) comorbidity data for England. Early breast cancer was correlated to the Nottingham Prognostic Index (NPI) Excellent and Good Prognostic Groups (EPG/GPG) and tumours ≤20mm. Late presentation was correlated to the Poor Prognostic Group (PPG) and not receiving surgery. Adjustments were made for age, deprivation, ethnicity, screen-detection (SD) and Charlson comorbidity score.

Results: EPG/GPG tumours or tumours ≤20mm were more likely in the SD and more affluent cohorts. Those aged 0-39 or of Black/Asian ethnicity were less likely to have EPG/GPG tumours. PPG tumours were less likely in women aged 60-69 and in the SD cohort.

Women aged 70-79 were more likely to present with good prognosis tumours ($p<0.01$) but those over 70 were less likely to have small tumours.

Those aged ≥70 or with a Charlson score of ≥2 were less likely to receive surgery ($p< 0.01$).

Conclusions: Women with screen-detected breast cancer or from affluent cohorts were likely to have tumours of good prognosis. Young women, deprived patients and certain ethnic groups present with more advanced tumours. Older women have larger tumours but otherwise of relatively good prognosis and this would not account for the failure to operate.

Keywords.

breast neoplasm; data collection; age factors; comorbidity; ethnic groups; socioeconomic status

Introduction

The Second All Breast Cancer Report (SABCR), which analysed over 50,000 cases of breast cancer presenting in the UK in 2007, highlighted the increasing evidence that deprivation and older age are associated with late presentation of breast cancer[1]. However, this study confirmed that, although older women were less likely to have small tumours and to be treated by surgery, the prognostic features of their breast cancers were otherwise more favourable [2, 3]. There is increasing concern that older women may be denied surgical treatment solely on the ground of age [4], but it seems likely that comorbidity may be a significant confounding factor [5]. Records of comorbidity available for England and the 2007 SABCR data for England alone have therefore been further analysed to examine this question.

The aim of this study was to identify those groups likely to present with early or late breast cancer and to examine the respective operation rates in a large population.

Methods

Data for the cohort of women in England included in the SABCR were constructed using National Cancer Registration Database (NCDR), Hospital Episode Statistics (HES), Breast Cancer Clinical Outcome Measures (BCCOM) audit and NHS Breast Screening Programme and Association of Breast Surgery audit data. The likelihood of presenting with early breast cancer was correlated to the following prognostic markers, a) the Nottingham Prognostic

Index (NPI) Excellent & Good Prognostic Groups (EPG/GPG) and b) a tumour with diameter of 20mm or less. The likelihood of late detection of breast cancer was correlated to c) the NPI Poor Prognostic Group (PPG) and d) not having a surgical operation.

Each of the four outcomes (as defined above) were analysed with the following factors: age group by decade from ≤39 to 80+ years, ethnic group, deprivation quintile, comorbidity as assessed by the Charlson Comorbidity Index [6] and screening status; these were included as potential explanatory variables in the regression models.

In order to calculate Charlson Co-morbidity Index scores, individual patients were matched to HES data in order to identify episodes of treatment for comorbid conditions in the 30 months prior to and 3 months post cancer diagnosis. The scores associated with each comorbid [6] condition were then summed in order to provide an overall score for each patient. Where a patient had similar conditions recorded (e.g. liver disease and severe liver disease) the condition with the highest score was retained. The index cancer and all other cancer diagnoses were removed from the calculation so that a comorbidity score in the absence of cancer was derived.

Charlson comorbidity scores were not obtained for 3,996 patients (11%) who could not be matched to a HES record. The proportion of patients without a HES match varied from 8% in the 0-39 year age group to 10% in those aged 70-79 years and 22% in those aged 80 years and above (Table 2).

Statistical analysis. A number of binary variables were generated based upon tumour characteristics (NPI and tumour size), and the presence/absence of surgical treatment in order to distinguish between Early/Not Early and Late/Not Late diagnosis. The likelihood of presenting with early or late presentation breast cancer was investigated using multivariate logistic regression models. The effect of ethnicity, age at diagnosis, surgical treatment, deprivation, co-morbidity and method of presentation were included as independent categorical variables in each logistic regression model. The results are presented as

adjusted odds ratios. The following were used as the base level for comparison: age group - 50-59 years; deprivation quintile - most deprived (quintile 1); ethnicity - white; surgical treatment - surgery; screening status - symptomatic; Charlson Comorbidity Index score = 0. Early or Late presentation were the dependent variables throughout. All analyses were conducted in Stata 11.2 (*StataCorp LP, College Station, Texas USA*).

Results

In 2007, 37,113 women in England presented with primary invasive breast cancer, of whom 30,318 (82.7%) had their first surgical treatment within 6 months of their diagnosis recorded in the NCDR). A further 351 women (1%) had their first surgical treatment within 6 months of their diagnosis recorded on HES and 135 women had their first surgery between 6 months and two years after their diagnosis (0.4%).

The proportion of women who did not have surgery within 6 months recorded in the NCDR was 8.4% in those aged under 70 years, but this rose to 22% in those aged 70-79 years and 59% in those aged 80 years or over (Table 1). In women aged under 80 years, a Charlson Comorbidity Index (CCI) score could be derived for 91% of women, but in those aged 80 years and over, a CCI score was available for only 78% of cases. In women aged under 70 years, a CCI score of greater than 2 was recorded for 2.1% of cases, rising to 5.9% in those aged 70-79 years and 8.7% in those aged 80 years and over. For women aged 0-69 years, the proportion of cases recorded with a CCI score of 0 was 86% (decreasing from 94% (0-39 years) to 82% (60-69 years). Even in those women aged 70 years or over, 72% had no recorded comorbidity (CCI score = 0) (Table 2).

The following groups were more likely to have a good prognosis EPG/GPG breast cancer ($p<0.02$): women whose breast cancer was screen-detected rather than symptomatic; women from the average and most affluent cohorts (quintiles 3 & 5); women aged 40-49 years, 60-69 years and 70-79 years. Women of Black or Asian Ethnicity (BAE) and women

aged 0-39 years were less likely to have an EPG/GPG breast cancer (p,0.02): (Figure 1 and Table 3).

The following groups were more likely to have a small breast cancer ≤20mm in diameter: women whose breast cancer was screen-detected; women from the average, the more and most affluent cohorts (quintiles 3 - 5); women aged 40-49 years and 60-69 years. Women of BAE, women aged 70-79 years and 80 years or over were statistically significantly less likely to have a breast cancer ≤20mm in diameter ($p<0.03$) (Figure 2 and Table 4).

Women of BAE and of Chinese or other ethnicity were more likely to have a poor prognosis PPG breast cancer ($p=0.02$): Women aged 60-69 years and women with screen-detected breast cancers were less likely to have a poor prognosis PPG breast cancer ($p=0.02$) (Figure 3 and Table 5). Women with screen-detected breast cancers were significantly less likely not to have an operation ($p<0.001$). Women aged 70-79 years and 80 years or over, and women with a CCI score of 2 or more, were more likely not to have an operation ($p=0.01$). However, the availability of HES data is dependent on a hospital admission and it is probable that those women who did not have surgery will have had a higher level of comorbidity. (Figures 4 & 5 and Table 6).

Discussion

This study has shown in a large population that the prognostic indicators for breast cancer at presentation and the primary treatment vary with socio-economic status, ethnicity, screen detection, comorbidity and age. There is a wealth of evidence in the literature that older women with breast cancer receive less aggressive treatment for operable breast cancer in terms of surgery (4), radiotherapy [7] and chemotherapy [8]. The question that remains unanswered is whether they are disadvantaged mainly on the basis of their age or whether individual circumstances including patient choice indicate that conservative management may be in their best interests. Women of lower socioeconomic status or of certain ethnic

origins [9, 10] may be particularly at risk of suboptimal treatment outcomes and there is increasing evidence that comorbidity has to be considered in the multidisciplinary management of patients [11].

The First All Breast Cancer Report on symptomatic and screen-detected breast cancers in the UK presenting in 2006, showed that in England those known to be of black ethnicity were more likely to present with larger, poor prognosis tumours and at an earlier age than the white population [10]. The Second All Breast Cancer Report on symptomatic and screen-detected breast cancers in the UK presenting in 2007, confirmed that screen-detected cancers were smaller and of a better prognosis and, as with most studies, that although tumours in older women were larger, they were biologically less active [1-3, 12, 13]. This is consistent with the findings in the 70-79 year old age group in the present study, Social deprivation was associated with more advanced tumours and worse survival [1].

The present study reanalysed the 2007 data collected for England where comorbidity data are available, and this additionally shows that women with a CCI score of 2 or more have a significantly increased likelihood of not having surgery for their newly diagnosed breast cancer. Older patients are shown to have a higher prevalence of significant morbidity (Table 2) but, of those aged 70 years or over, 72% had no recorded morbidity (CCI score = 0) and, of those aged over 80 years, only 9% had a CCI score of two or more. Jacobs et al have shown that comorbidity rapidly increases from age 78 years so that at age 85 years the rate is triple that of those aged 70 years [14]. Only 41% of the 80+ year age group had surgical treatment and, although it is likely that comorbidity is only a contributory factor for the very low rate of surgical treatment for operable breast cancer, most of those who did not have surgery will not have a HES record of comorbidity. It is also evident that the level of comorbidity recorded on HES is significantly under-recorded [15, 16].

Nevertheless, the currently available information shows that this is a significant factor in the very low level of operative treatment. Deviation from treatment guidelines in the elderly is

commonly reported in association with comorbidity and patient preference [17], and it would seem that patient preference and perhaps clinical preference for non-operative primary treatment in the elderly may be the prime cause of what might appear to be suboptimal care.

Most published studies on comorbidity show that patients who receive less aggressive treatment fare worse [11, 18]. Age and comorbidity are closely inter-related and the latter becomes more severe with increasing age but in patients aged over 80 years, treatment is less aggressive and age is the stronger determinant [19]. Surgical treatment in the age group 70-79 years is rather less than in those aged under 70 years (78% vs 92% in the present study), but the picture for patients aged 80 years or over is very different, with much lower rates for both surgery [4] and adjuvant therapy [20]. Racial differences in comorbidity, apart from deprivation are mostly related to an increased prevalence of hypertension and diabetes in Black populations [21] but cardiovascular disease and mental illness are the most important factors in European populations [18]. In the present study the more affluent were more likely to present with good prognosis breast cancer and those of Black or Asian ethnicity were more likely to have tumours which carry a poor outlook. The finding of poor outcomes in the most deprived in the population and some ethnic groups is well documented in the literature [1, 9]. Patients aged 0-39 years were less likely to present with favourable tumours which is not unexpected, but conversely, those aged 40-49 years fared better. Women in the age group 60-69 years were more likely to have good prognosis tumours than those aged 50-59 years, which might be explained by an increased proportion of screen-detected tumours detected in the incident (subsequent) screening round versus the prevalent first screening round.

Several studies have shown that intercurrent disease outpaces breast cancer as the leading cause of death in the elderly [22-24]. Comorbidity makes a greater difference to survival in patients with low risk breast cancer [17, 22] and with increasing CCI score the risk of dying of breast cancer increases as well as death from intercurrent disease [5]. However a review of

the ATAC trial at 10 years showed that the risk of recurrence increased with age, and the risk of death without recurrence increased with age and comorbidity score [25].

There are several randomised trials which compare surgery with or without tamoxifen versus conservative hormone treatment alone for operable breast cancer in the elderly, but only one trial has shown a modest overall survival advantage for the surgical removal of the tumour [26]. Nevertheless, a Cochrane Review concluded that surgery for the elderly with ER positive early breast cancer gives better local control, and that primary endocrine therapy (PET) should be reserved for patients with significant comorbid disease or who refuse surgery [27]. When PET is used in the appropriate setting the outcome is satisfactory, and although Hille et al found that, of those patients initially considered unfit for or who declined surgery, 39% eventually had an operation [28], that was not the finding in the present study.

With increasing age, patients with operable breast cancer who are offered an informed choice between primary endocrine therapy (PET) and surgery, up to half may opt to avoid or delay operative treatment [29]. A cancer-specific geriatric assessment of functional capacity predicts overall survival and may be useful in guiding decision making [30], but to involve patients in the decision making is important [31] From the patient's perspective, if offered a choice between an operation and perhaps trying the effect of hormone treatment first, the latter option may be very persuasive, even if the possible downsides of avoiding surgery have been spelt out. From the clinician's viewpoint, Stotter has found that the patient's frailty may be overestimated and their life expectancy underestimated. Furthermore the difficulty of communicating the options is greater than in a younger person [31]. Clearly comorbidity is a factor which may weigh against surgery in the elderly, but to what extent this consideration is responsible for the best option to be declined is uncertain.

Patients at the extremes of age, deprived patients and certain ethnic groups may present with more advanced tumours. Conversely screen-detected breast cancers present earlier.

That elderly patients present with larger tumours may be related to lack of screening in this age group but this may influence against surgery for otherwise good prognosis tumours.

However, the failure to operate for early breast cancer in the elderly may be related to comorbidity as well as patient choice.

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Conflict of interest.

The authors declare no conflict of interest

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Figure captions.

Figure 1 Likelihood of presenting with a good prognosis breast cancer (EPG/GPG)

Figure 2 Likelihood of presenting with a small breast cancer ≤20mm

Figure 3 Likelihood of presenting with a poor prognosis breast cancer (PPG)

Figure 4 Likelihood of not having a surgical operation

Figure 5 Variation with age and comorbidity in the number of women receiving surgery for invasive breast cancer

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Table 2 Variation in Charlson Comorbidity Index Score with age group

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Table 6 Likelihood of not having a surgical operation

Table 1 Variation in surgical treatment with age at diagnosis

	Surgery				
	Received surgery		Did not receive surgery		
Age	Number	Proportion	Number	Proportion	Total
0-39	1,549	90%	175	10%	1,724
40-49	4,986	91%	508	9%	5,494
50-59	7,637	93%	602	7%	8,239
60-69	8,754	91%	831	9%	9,585
70-79	5,108	78%	1,436	22%	6,544
80+	2,284	41%	3,243	59%	5,527
Total	30,318	82%	6,795	18%	37,113

Table 2 Variation in Charlson Comorbidity Index score with age group

	Cases not matched to HES		Charlson score										
			0		1		2		3		4		
Age group	No. cases	%	No. cases	%	No. cases	%	No. cases	%	No. cases	%	No. cases	%	Total
0-39	143	8%	1,480	94%	87	6%	12	1%	0	0%	2	0%	1,724
40-49	535	10%	4,510	91%	382	8%	56	1%	10	0%	1	0%	5,494
50-59	736	9%	6,583	88%	739	10%	138	2%	26	0%	17	0%	8,239
60-69	722	8%	7,233	82%	1,237	14%	280	3%	75	1%	38	0%	9,585
70-79	625	10%	4,344	73%	1,046	18%	351	6%	108	2%	70	1%	6,544
80+	1,235	22%	2,962	69%	723	17%	373	9%	135	3%	99	2%	5,527
Total	3,996	11%	27,112	82%	4,214	13%	1,210	4%	354	1%	227	1%	37,113

Figure 1 Likelihood of presenting with a good prognosis breast cancer (EPG/GPG)

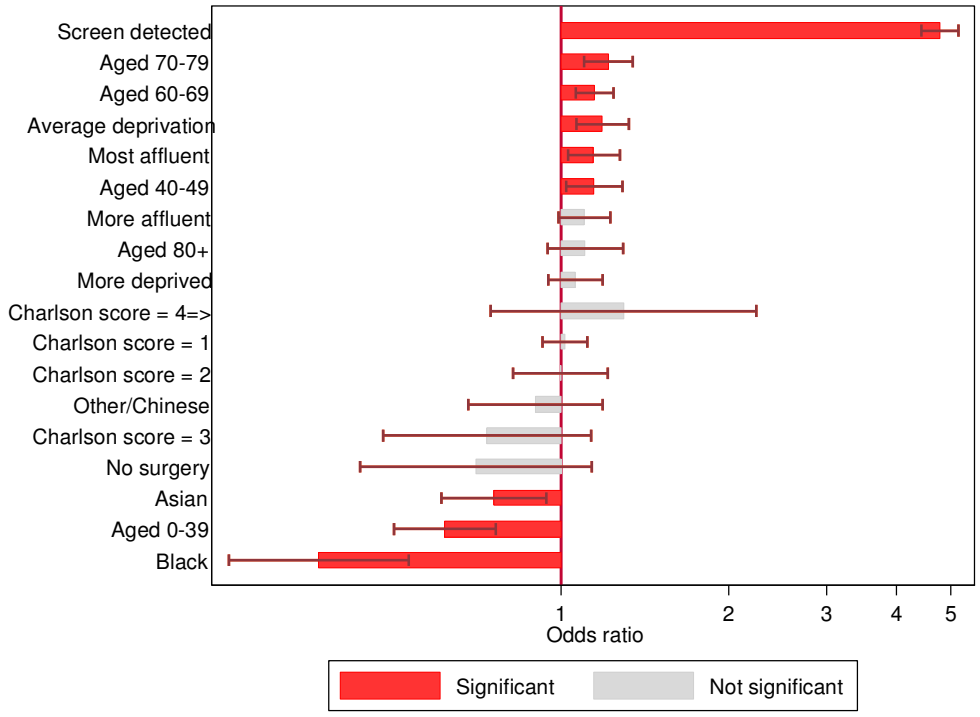


Table 3 Likelihood of presenting with a good prognosis breast cancer (EPG/GPG)

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	0.76 (0.61,0.94)	-2.52	0.01
Black	0.37 (0.25,0.53)	-5.28	0.00
Other/Chinese	0.90 (0.68,1.19)	-0.75	0.45
Age group			
Aged 0-39	0.62 (0.50,0.76)	-4.49	0.00
Aged 40-49	1.15 (1.02,1.29)	2.30	0.02
Aged 50-59	Base level		
Aged 60-69	1.15 (1.06,1.24)	3.44	0.00
Aged 70-79	1.22 (1.10,1.35)	3.76	0.00
Aged 80+	1.11 (0.95,1.29)	1.27	0.20
Surgical treatment			
Surgery	Base level		
No surgery	0.70 (0.44,1.13)	-1.44	0.15
Deprivation			
Most deprived	Base level		
More deprived	1.06 (0.95,1.19)	1.04	0.30
Average deprivation	1.19 (1.07,1.32)	3.13	0.00
More affluent	1.10 (0.99,1.23)	1.77	0.08
Most affluent	1.14 (1.03,1.27)	2.48	0.01
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	1.02 (0.93,1.11)	0.34	0.73
Charlson score = 2	1.00 (0.82,1.21)	-0.03	0.98
Charlson score = 3	0.74 (0.48,1.13)	-1.39	0.16
Charlson score ≥ 4	1.29 (0.75,2.24)	0.92	0.36
Screening status			
Symptomatic	Base level		
Screen detected	4.78 (4.44,5.16)	40.42	0.00

Figure 2 Likelihood of presenting with a small breast cancer ≤20mm

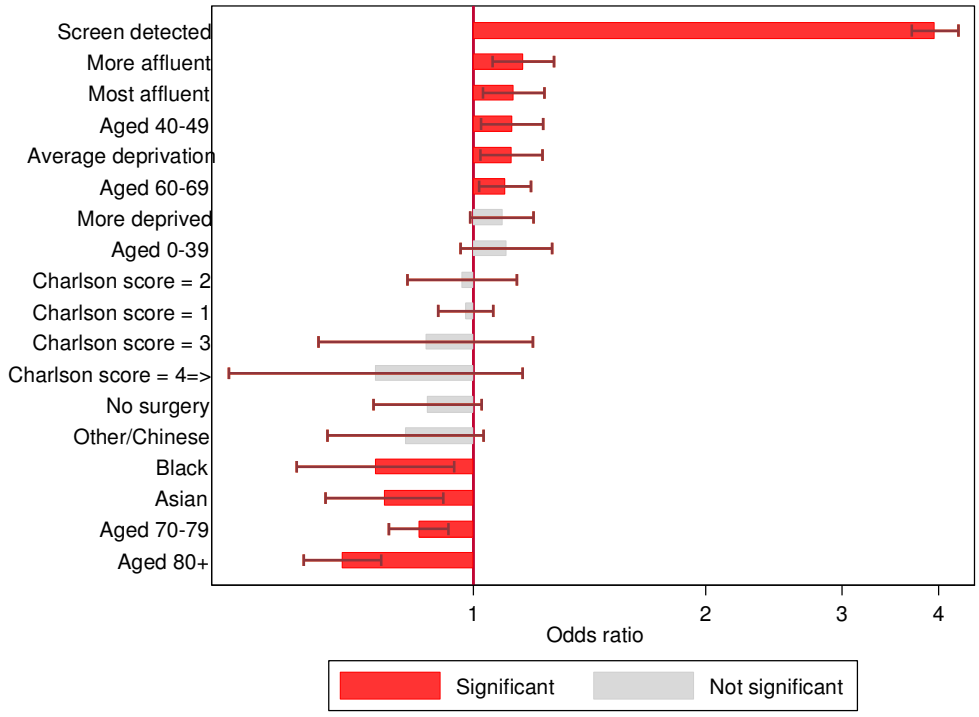


Table 4 Likelihood of presenting with a small breast cancer ≤20mm

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	0.77 (0.64,0.91)	-2.96	0.00
Black	0.75 (0.59,0.94)	-2.44	0.01
Other/Chinese	0.82 (0.65,1.03)	-1.71	0.09
Age group			
Aged 0-39	1.10 (0.96,1.26)	1.41	0.16
Aged 40-49	1.12 (1.02,1.23)	2.44	0.01
Aged 50-59	Base level		
Aged 60-69	1.10 (1.02,1.19)	2.36	0.02
Aged 70-79	0.85 (0.78,0.93)	-3.65	0.00
Aged 80+	0.68 (0.60,0.76)	-6.69	0.00
Surgical treatment			
Surgery	Base level		
No surgery	0.87 (0.74,1.02)	-1.67	0.09
Deprivation			
Most deprived	Base level		
More deprived	1.09 (0.99,1.20)	1.77	0.08
Average deprivation	1.12 (1.02,1.23)	2.41	0.02
More affluent	1.16 (1.06,1.27)	3.19	0.00
Most affluent	1.13 (1.03,1.24)	2.54	0.01
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	0.98 (0.90,1.06)	-0.56	0.57
Charlson score = 2	0.97 (0.82,1.14)	-0.42	0.68
Charlson score = 3	0.87 (0.63,1.19)	-0.87	0.38
Charlson score ≥ 4	0.75 (0.48,1.16)	-1.31	0.19
Screening status			
Symptomatic	Base level		
Screen detected	3.96 (3.70,4.24)	38.94	0.00

Figure 3 Likelihood of presenting with a poor prognosis breast cancer (PPG)

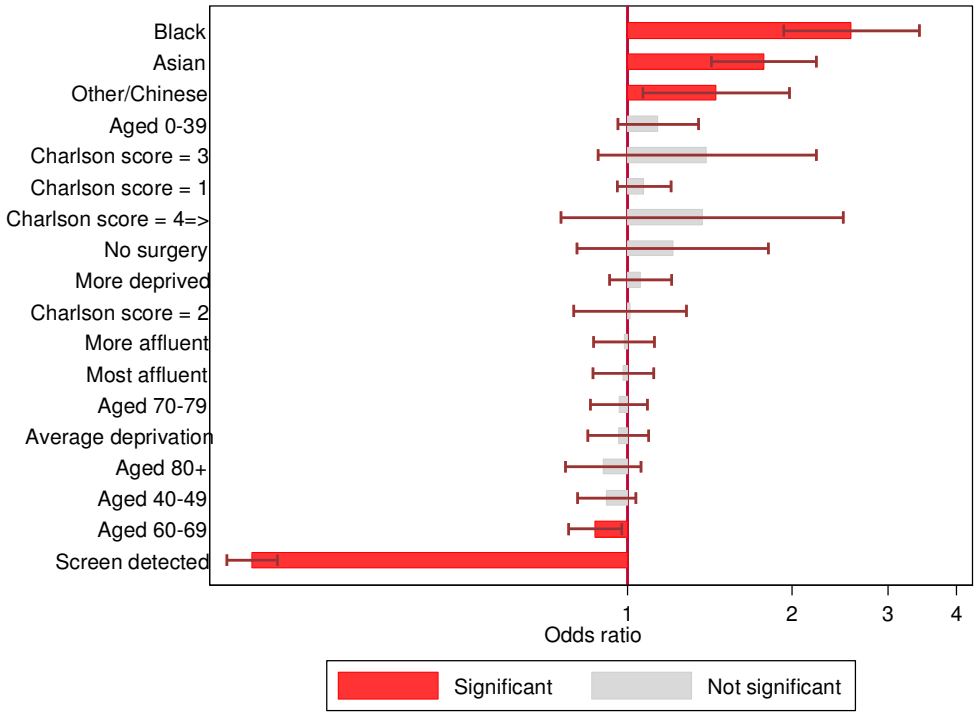


Table 5 Likelihood of presenting with a poor prognosis breast cancer (PPG)

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	1.78 (1.42,2.22)	5.09	0.00
Black	2.58 (1.93,3.43)	6.48	0.00
Other/Chinese	1.45 (1.07,1.98)	2.38	0.02
Age group			
Aged 0-39	1.14 (0.96,1.35)	1.50	0.13
Aged 40-49	0.92 (0.81,1.04)	-1.40	0.16
Aged 50-59	Base level		
Aged 60-69	0.87 (0.78,0.98)	-2.38	0.02
Aged 70-79	0.97 (0.86,1.09)	-0.57	0.57
Aged 80+	0.90 (0.77,1.06)	-1.25	0.21
Surgical treatment			
Surgery	Base level		
No surgery	1.21 (0.81,1.81)	0.93	0.35
Deprivation			
Most deprived	Base level		
More deprived	1.06 (0.93,1.21)	0.85	0.39
Average deprivation	0.96 (0.85,1.09)	-0.58	0.56
More affluent	0.99 (0.87,1.12)	-0.21	0.83
Most affluent	0.98 (0.86,1.12)	-0.26	0.79
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	1.07 (0.96,1.20)	1.22	0.22
Charlson score = 2	1.01 (0.80,1.28)	0.09	0.93
Charlson score = 3	1.40 (0.88,2.22)	1.43	0.15
Charlson score ≥ 4	1.37 (0.76,2.49)	1.04	0.30
Screening status			
Symptomatic	Base level		
Screen detected	0.21 (0.18,0.23)	-29.10	0.00

Figure 4 Likelihood of not having a surgical operation

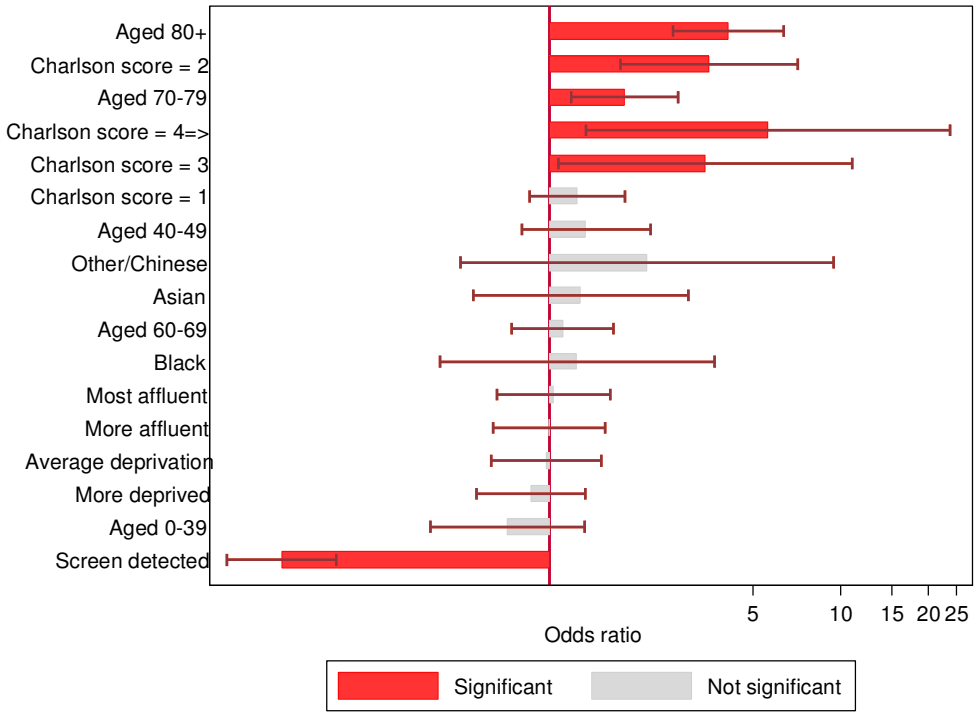
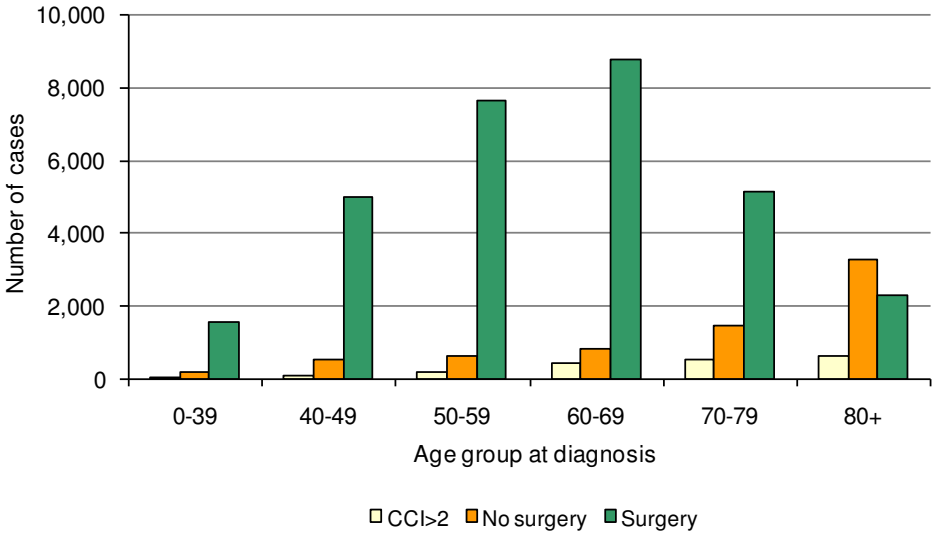


Table 6 Likelihood of not having a surgical operation

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	1.29 (0.55,3.01)	0.58	0.56
Black	1.25 (0.42,3.70)	0.40	0.69
Other/Chinese	2.17 (0.50,9.47)	1.03	0.30
Age group			
Aged 0-39	0.72 (0.39,1.32)	-1.06	0.29
Aged 40-49	1.34 (0.81,2.23)	1.13	0.26
Aged 50-59	Base level		
Aged 60-69	1.11 (0.74,1.66)	0.52	0.60
Aged 70-79	1.82 (1.19,2.77)	2.77	0.01
Aged 80+	4.12 (2.66,6.40)	6.32	0.00
Surgical treatment			
Surgery	Omitted from analysis		
No surgery			
Deprivation			
Most deprived	Base level		
More deprived	0.87 (0.56,1.33)	-0.66	0.51
Average deprivation	0.98 (0.63,1.51)	-0.11	0.91
More affluent	1.00 (0.64,1.55)	0.00	1.00
Most affluent	1.03 (0.66,1.62)	0.15	0.88
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	1.25 (0.86,1.82)	1.16	0.25
Charlson score = 2	3.55 (1.76,7.15)	3.54	0.00
Charlson score = 3	3.44 (1.07,11.00)	2.08	0.04
Charlson score ≥ 4	5.63 (1.34,23.76)	2.35	0.02
Screening status			
Symptomatic	Base level		
Screen detected	0.12 (0.08,0.19)	-9.56	0.00

Figure 5 Variation with age and comorbidity in the number of women receiving surgery for invasive breast cancer



Tables

Table 1 Variation in surgical treatment with age at diagnosis

	Surgery				
	Received surgery		Did not receive surgery		
Age	**Number**	**Proportion**	**Number**	**Proportion**	**Total**
0-39	1,549	90%	175	10%	1,724
40-49	4,986	91%	508	9%	5,494
50-59	7,637	93%	602	7%	8,239
60-69	8,754	91%	831	9%	9,585
70-79	5,108	78%	1,436	22%	6,544
80+	2,284	41%	3,243	59%	5,527
Total	30,318	82%	6,795	18%	37,113

Table 2 Variation in Charlson Comorbidity Index score with age group

	Cases not matched to HES		Charlson score										
			0		1		2		3		4		
Age group	No. cases	%	No. cases	%	No. cases	%	No. cases	%	No. cases	%	No. cases	%	Total
0-39	143	8%	1,480	94%	87	6%	12	1%	0	0%	2	0%	1,724
40-49	535	10%	4,510	91%	382	8%	56	1%	10	0%	1	0%	5,494
50-59	736	9%	6,583	88%	739	10%	138	2%	26	0%	17	0%	8,239
60-69	722	8%	7,233	82%	1,237	14%	280	3%	75	1%	38	0%	9,585
70-79	625	10%	4,344	73%	1,046	18%	351	6%	108	2%	70	1%	6,544
80+	1,235	22%	2,962	69%	723	17%	373	9%	135	3%	99	2%	5,527
Total	3,996	11%	27,112	82%	4,214	13%	1,210	4%	354	1%	227	1%	37,113

Table 3 Likelihood of presenting with a good prognosis breast cancer (EPG/GPG)

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	0.76 (0.61,0.94)	-2.52	0.01
Black	0.37 (0.25,0.53)	-5.28	0.00
Other/Chinese	0.90 (0.68,1.19)	-0.75	0.45
Age group			
Aged 0-39	0.62 (0.50,0.76)	-4.49	0.00
Aged 40-49	1.15 (1.02,1.29)	2.30	0.02
Aged 50-59	Base level		
Aged 60-69	1.15 (1.06,1.24)	3.44	0.00
Aged 70-79	1.22 (1.10,1.35)	3.76	0.00
Aged 80+	1.11 (0.95,1.29)	1.27	0.20
Surgical treatment			
Surgery	Base level		
No surgery	0.70 (0.44,1.13)	-1.44	0.15
Deprivation			
Most deprived	Base level		
More deprived	1.06 (0.95,1.19)	1.04	0.30
Average deprivation	1.19 (1.07,1.32)	3.13	0.00
More affluent	1.10 (0.99,1.23)	1.77	0.08
Most affluent	1.14 (1.03,1.27)	2.48	0.01
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	1.02 (0.93,1.11)	0.34	0.73
Charlson score = 2	1.00 (0.82,1.21)	-0.03	0.98
Charlson score = 3	0.74 (0.48,1.13)	-1.39	0.16
Charlson score ≥ 4	1.29 (0.75,2.24)	0.92	0.36
Screening status			
Symptomatic	Base level		
Screen detected	4.78 (4.44,5.16)	40.42	0.00

Table 4 Likelihood of presenting with a small breast cancer ≤20mm

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	0.77 (0.64,0.91)	-2.96	0.00
Black	0.75 (0.59,0.94)	-2.44	0.01
Other/Chinese	0.82 (0.65,1.03)	-1.71	0.09
Age group			
Aged 0-39	1.10 (0.96,1.26)	1.41	0.16
Aged 40-49	1.12 (1.02,1.23)	2.44	0.01
Aged 50-59	Base level		
Aged 60-69	1.10 (1.02,1.19)	2.36	0.02
Aged 70-79	0.85 (0.78,0.93)	-3.65	0.00
Aged 80+	0.68 (0.60,0.76)	-6.69	0.00
Surgical treatment			
Surgery	Base level		
No surgery	0.87 (0.74,1.02)	-1.67	0.09
Deprivation			
Most deprived	Base level		
More deprived	1.09 (0.99,1.20)	1.77	0.08
Average deprivation	1.12 (1.02,1.23)	2.41	0.02
More affluent	1.16 (1.06,1.27)	3.19	0.00
Most affluent	1.13 (1.03,1.24)	2.54	0.01
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	0.98 (0.90,1.06)	-0.56	0.57
Charlson score = 2	0.97 (0.82,1.14)	-0.42	0.68
Charlson score = 3	0.87 (0.63,1.19)	-0.87	0.38
Charlson score ≥ 4	0.75 (0.48,1.16)	-1.31	0.19
Screening status			
Symptomatic	Base level		
Screen detected	3.96 (3.70,4.24)	38.94	0.00

Table 5 Likelihood of presenting with a poor prognosis breast cancer (PPG)

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	1.78 (1.42,2.22)	5.09	0.00
Black	2.58 (1.93,3.43)	6.48	0.00
Other/Chinese	1.45 (1.07,1.98)	2.38	0.02
Age group			
Aged 0-39	1.14 (0.96,1.35)	1.50	0.13
Aged 40-49	0.92 (0.81,1.04)	-1.40	0.16
Aged 50-59	Base level		
Aged 60-69	0.87 (0.78,0.98)	-2.38	0.02
Aged 70-79	0.97 (0.86,1.09)	-0.57	0.57
Aged 80+	0.90 (0.77,1.06)	-1.25	0.21
Surgical treatment			
Surgery	Base level		
No surgery	1.21 (0.81,1.81)	0.93	0.35
Deprivation			
Most deprived	Base level		
More deprived	1.06 (0.93,1.21)	0.85	0.39
Average deprivation	0.96 (0.85,1.09)	-0.58	0.56
More affluent	0.99 (0.87,1.12)	-0.21	0.83
Most affluent	0.98 (0.86,1.12)	-0.26	0.79
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	1.07 (0.96,1.20)	1.22	0.22
Charlson score = 2	1.01 (0.80,1.28)	0.09	0.93
Charlson score = 3	1.40 (0.88,2.22)	1.43	0.15
Charlson score ≥ 4	1.37 (0.76,2.49)	1.04	0.30
Screening status			
Symptomatic	Base level		
Screen detected	0.21 (0.18,0.23)	-29.10	0.00

Table 6 Likelihood of not having a surgical operation

Characteristics	Odds ratio (95% CI)	z	p
Ethnicity			
White	Base level		
Asian	1.29 (0.55,3.01)	0.58	0.56
Black	1.25 (0.42,3.70)	0.40	0.69
Other/Chinese	2.17 (0.50,9.47)	1.03	0.30
Age group			
Aged 0-39	0.72 (0.39,1.32)	-1.06	0.29
Aged 40-49	1.34 (0.81,2.23)	1.13	0.26
Aged 50-59	Base level		
Aged 60-69	1.11 (0.74,1.66)	0.52	0.60
Aged 70-79	1.82 (1.19,2.77)	2.77	0.01
Aged 80+	4.12 (2.66,6.40)	6.32	0.00
Surgical treatment			
Surgery *No surgery*	Omitted from analysis		
Deprivation			
Most deprived	Base level		
More deprived	0.87 (0.56,1.33)	-0.66	0.51
Average deprivation	0.98 (0.63,1.51)	-0.11	0.91
More affluent	1.00 (0.64,1.55)	0.00	1.00
Most affluent	1.03 (0.66,1.62)	0.15	0.88
Comorbidity			
Charlson score = 0	Base level		
Charlson score = 1	1.25 (0.86,1.82)	1.16	0.25
Charlson score = 2	3.55 (1.76,7.15)	3.54	0.00
Charlson score = 3	3.44 (1.07,11.00)	2.08	0.04
Charlson score ≥ 4	5.63 (1.34,23.76)	2.35	0.02
Screening status			
Symptomatic	Base level		
Screen detected	0.12 (0.08,0.19)	-9.56	0.00

Figure legend(s)

Figure legends

Figure captions.

Figure 1 Likelihood of presenting with a good prognosis breast cancer (EPG/GPG)

Figure 2 Likelihood of presenting with a small breast cancer ≤20mm

Figure 3 Likelihood of presenting with a poor prognosis breast cancer (PPG)

Figure 4 Likelihood of not having a surgical operation

Figure 5 Variation with age and comorbidity in the number of women receiving surgery for invasive breast cancer

Figures

Figure 1 Likelihood of presenting with a good prognosis breast cancer (EPG/GPG)

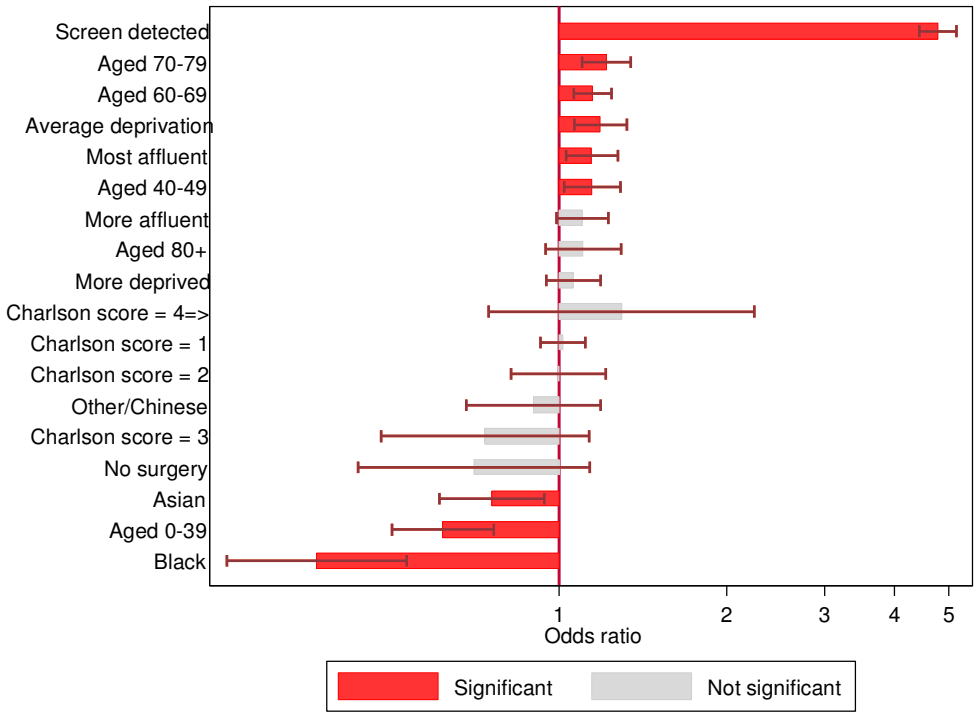


Figure 2 Likelihood of presenting with a small breast cancer ≤20mm

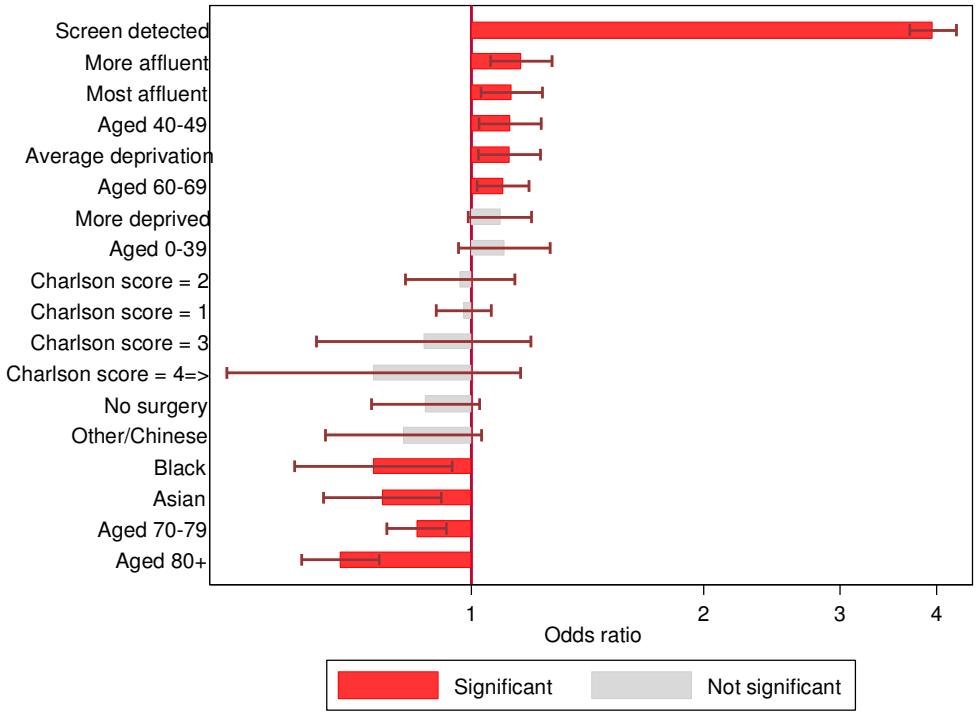


Figure 3 Likelihood of presenting with a poor prognosis breast cancer (PPG)

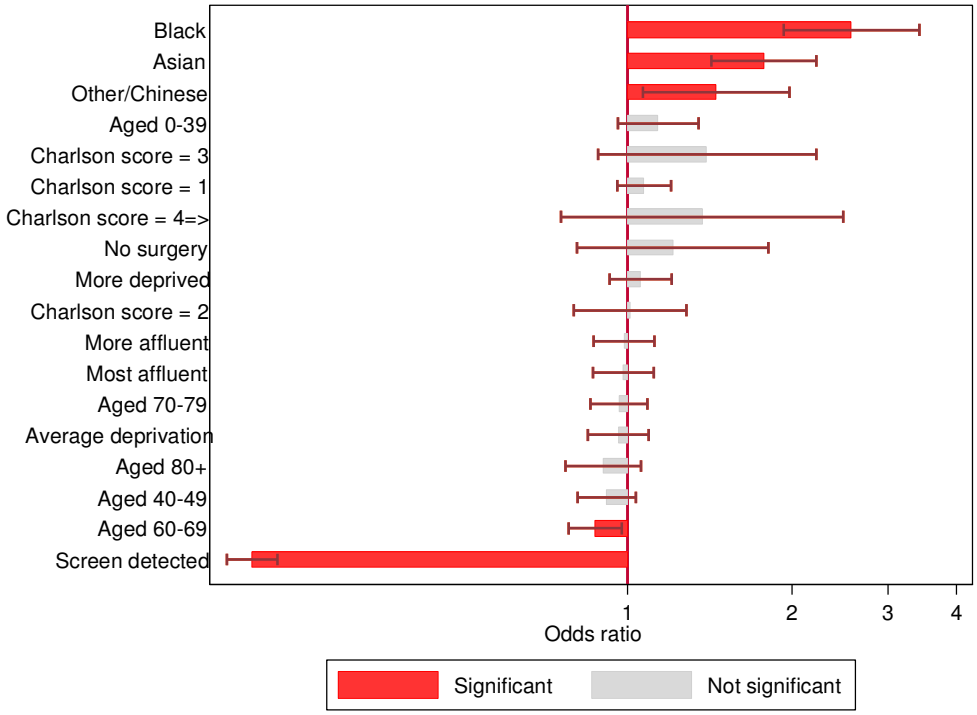


Figure 4 Likelihood of not having a surgical operation

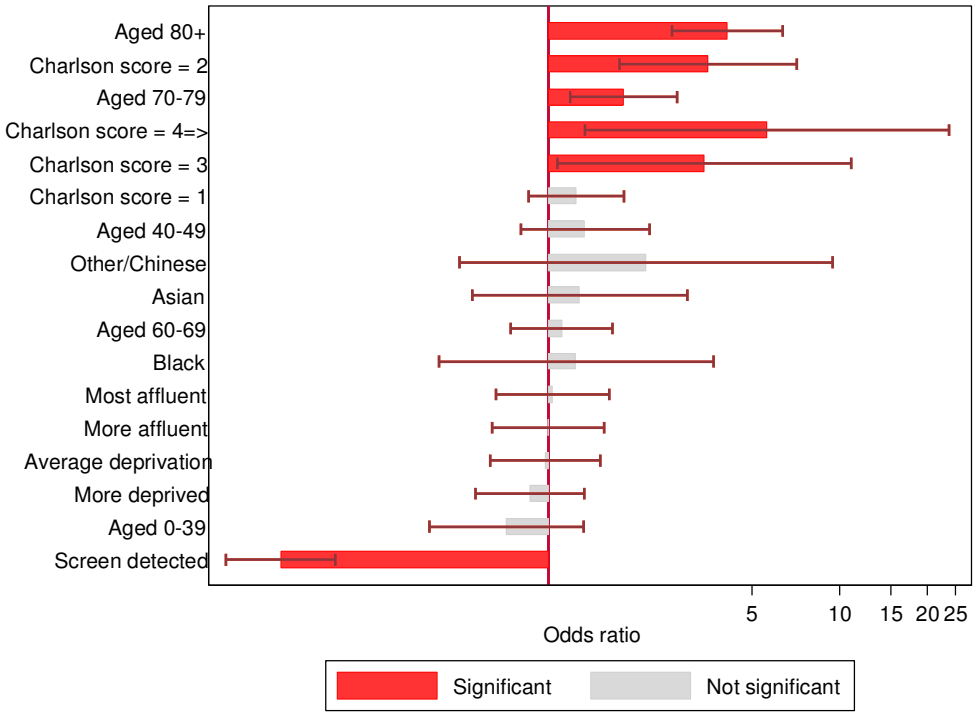
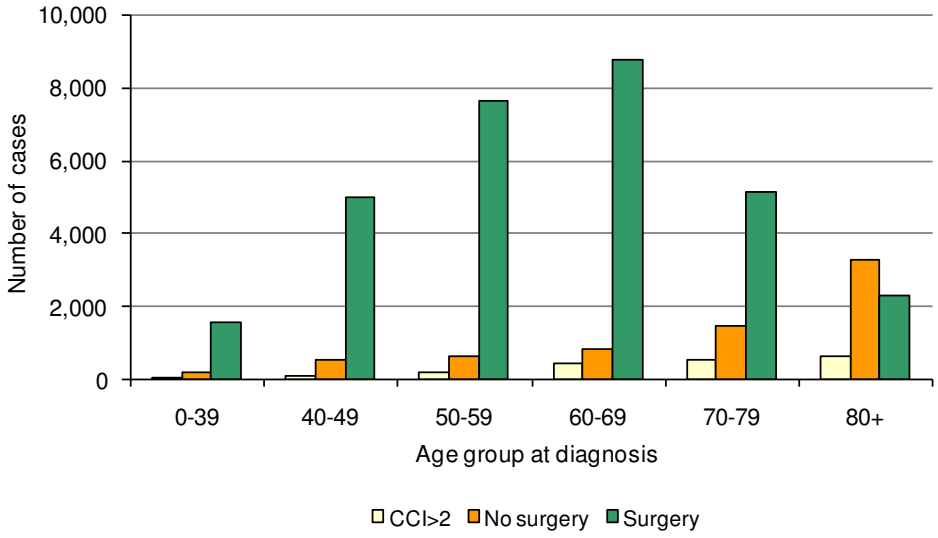


Figure 5 Variation with age and comorbidity in the number of women receiving surgery for invasive breast cancer



***Conflict of Interest statement**

Conflict of interest statement.

A Population based study of variations……

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Conflict of interest.

The authors declare no conflict of interest