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Patterns of axillary lymph node metastases and recurrent disease in grade 1 breast cancer in a New Zealand cohort: Does ethnicity matter?

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ABSTRACT

Background: In New Zealand, Māori and Pacific women are more likely than New Zealand/European women to present at a younger age with larger tumours and metastatic disease. Survival rates are also differential by ethnicity. Many factors are believed to be responsible for this including differences in comorbidities, delays to presentation and delays in treatment. It is unclear whether these differences exist amongst women with grade 1 cancer in New Zealand. Therefore, we examined patterns of axillary nodal involvement, recurrent disease and mortality in grade 1 breast cancer in New Zealand women, and whether ethnicity was an important predictor for any of these outcomes.

Method: Data was retrieved from the Auckland Breast Cancer Registry (ABCR) and the Waikato Breast Cancer Registry (WBCR) which are prospective, population-based databases. All women newly diagnosed with grade 1 primary invasive breast cancer between 1 June 2000 and 31 May 2013 were identified from the two registries.

Results: There were 2857 grade 1 breast cancers diagnosed over this time period. Axillary lymph nodes were involved in 19.0% of women, and 5.1% developed recurrent disease (locoregional or distant). Pacific and Māori women were more likely than NZ European women to have larger tumours and lymphovascular invasion (LVI). Predictors for axillary node involvement were tumour size greater than 10 mm, LVI and non-screen detected cancers. Tumour size greater than 10 mm, lobular carcinoma and BCS without radiotherapy were predictive of recurrent and or metastatic disease. Ethnicity was not observed to be an independent predictor for axillary nodal involvement, recurrent and/or metastatic disease, or breast cancer specific mortality amongst New Zealand women with grade 1 breast cancer.

Conclusion: Ethnicity was not a predictor of axillary node involvement, recurrent disease or mortality in grade 1 breast cancer in our population.

1. Background

Breast cancer is the most common cancer amongst New Zealand women and the second most common cause of cancer death. There are four main ethnic groups in New Zealand: (1.) NZ European (2.) Māori (3) people from the islands in the Pacific region, and (4.) a substantial Asian ethnic group. By the 2006 census, the New Zealand population was just over 4 million with 65% NZ European, 14% Māori, 7% Pacific, 9% Asian and around 11% identifying with other ethnic groups [1]. Previous analyses have shown that Māori and Pacific women have a disproportionate burden of poorly differentiated invasive breast cancer compared to NZ European women and are more likely to be younger, have larger tumours and distant disease [2,3]. Adjusting for these factors attenuates differences in survival between Pacific and NZ European women but it does not improve the disparity between Māori and NZ European women [2].

Axillary lymph node status is the single most important prognostic factor in breast cancer [4,5]. The underlying pathways of lymph node involvement remain unclear but predictors of axillary lymph node involvement in early breast cancer include increasing tumour size, higher grade, lymphovascular invasion (LVI), younger age, multifocality, and retro-areolar or lateral tumour location [6–8]. Whilst there is a substantial body of literature looking at node involvement in early breast cancer, these are largely based on size criteria [9,10]. However, whereas size is

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representative of tumour chronology, that is, how long it has been present, inherent tumour biology is also an important factor [11]. It has been suggested that ethnic differences in tumour biology may contribute towards ethnic disparities in disease presentation and outcome [12]; and there is a small body of literature that supports this [13–16].

In the United States, black women are twice as likely to die from early stage breast cancer than non-hispanic white women, and this is attributed to biological differences [16]. To our knowledge, there is no work looking at ethnic differences in the behaviour of low grade breast cancers in New Zealand, and specifically, whether ethnicity is a predictor of poor outcome in grade 1 disease. Survival rates in low-grade breast cancer are excellent and therefore any differences in outcome might suggest biological differences. grade 1 breast cancer makes up nearly 40% of screen detected cancers in New Zealand and 19% of non-screen detected cancers [17]. Screening coverage is variable between ethnicities with rates of uptake ranging from 54% to 79% for Māori across NZ [18] whilst NZ European women have achieved target coverage of 70% since 2010 [19]. Lower rates of screen detected breast cancer amongst Māori women is an important contributor to more advanced disease at diagnosis and lower survival rates than their NZ European counterparts [20]. In addition to this, recent work has reported that Māori and Pacific women in New Zealand are less likely to adhere to their adjuvant hormonal therapy and more likely to have significant delays to adjuvant radiotherapy [21,22]. It is unclear whether these important differences in presentation and outcome exist amongst women with grade 1 breast cancer in New Zealand.

The major aims of our study were to: (i) analyse disease characteristics by ethnicity for women in NZ presenting with grade 1 breast cancer, (ii) identify predictive factors for axillary lymph node involvement and recurrent disease in grade 1 breast cancer amongst NZ women, (iii) identify predictive factors for breast cancer specific mortality in grade 1 breast cancer amongst New Zealand women.

2. Method

2.1. Study population

Data were retrieved from the Auckland Breast Cancer Registry (ABCR) and the Waikato Breast Cancer Registry (WBCR) which are prospective, population-based databases. All women newly diagnosed with grade 1 primary invasive breast cancer between 1 June 2000 and 31 May 2013 were identified from the two registries. The WBCR commenced in 1999 and the ABCR in 2000. Coverage for the WBCR data is complete for 98% of all cancers within the Waikato region [20]. Prior to 2012, inclusion of women in the ABCR required patient consent and this was not achieved in less than 10% of new breast cancers. Following approval by the regional ethics committee, inclusion of all women within the Auckland region is automatic and coverage has reached 99%. The database contains patient demographics, risk factors, preoperative scans and pathology, surgical data, histopathology, treatment details, an annual update of outcome data (local/regional recurrence, metastasis and disease-free survival), cause and date of death.

2.2. Study covariates

Patient ethnicity was identified from the respective registry, which records self-assigned ethnicity; this is collected as per the Ministry of Health ethnicity data protocols [23]. Previous work has demonstrated that misclassification of ethnicity on the cancer registry resulted in an undercount of nearly a third for Māori cancer registrants (compared to census ethnicity), and this dropped to a 15% undercount by 2004 [24]. Ethnicity was categorized into Māori, Pacific, Asian, NZ European, other and unknown.

Cancer stage at diagnosis was defined according to the tumour, node, and metastasis (TNM) staging system [25]. Oestrogen (ER) and progesterone (PR) receptor status was determined based on the results of immunohistochemistry tests and classified as positive or negative. Human epidermal growth factor receptor 2

Table 1
Distribution of biological characteristics by ethnicity amongst women with grade 1 breast cancer.

Characteristic		NZ European		Māori		Pacific		Asian		
		n	%	*n*	%	*n*	%	*n*	%	*p*
Size	<10 mm	856	39.7%	74	31.2%	39	30.2%	79	39.3%	<0.001
	10–20 mm	884	41.0%	99	41.8%	43	33.3%	80	39.8%	
	20–50 mm	367	17.0%	51	21.5%	33	25.6%	36	17.9%	
	>50 mm	50	2.3%	13	5.5%	14	10.9%	6	3.0%	
LN	N0	1640	79.6%	166	73.5%	93	74.4%	160	83.3%	0.101
	N1	339	16.4%	50	22.1%	24	19.2%	27	14.1%	
	N2	72	3.5%	6	2.7%	8	6.4%	4	2.1%	
	N3	10	0.5%	4	1.8%	0	0.0%	1	0.5%	
	Unknown	99		12		5		10		
ER/PR	Negative	2100	97.9%	232	98.3%	125	99.2%	197	98.5%	0.134
	Positive	45	2.1%	4	1.7%	1	0.8%	3	1.5%	
	Unknown	15		2		4		2		
HER-2	Negative	1505	94.6%	192	96.0%	101	97.1%	162	97.6%	0.001
	Equivocal	45	2.8%	3	1.5%	0	0.0%	1	0.6%	
	Positive	41	2.6%	5	2.5%	3	2.9%	3	1.8%	
	Unknown	569		38		26		36		
LVI	Negative	1996	92.4%	208	87.4%	113	86.9%	185	91.6%	0.011
	Positive	164	7.6%	30	12.6%	17	13.1%	17	8.4%	

LN—lymph nodes; ER/PR—oestrogen and progesteron receptor status; HER-2—human epidermal growth factor receptor 2; LVI—lymphovascular invasion.

(HER-2) status was based on immunohistochemistry and by Fluorescent in-situ hybridization (FISH) [26]. Axillary lymph node status is recorded as per nodal staging guidelines according to the American Joint Committee on Cancer (AJCC) [25]. Therefore, the sentinel lymph node is processed using 4 levels and a cytokeratin stain.

Lymphovascular invasion is defined as being present if peritumoural lymphovascular space invasion is identified. "Other" histological tumour subtypes include mucinous, micropapillary and tubular which accounts for less than 5% of all breast cancers.

2.3. Outcome variables

Date and cause of death for all deceased women and date of first local or metastatic breast cancer recurrence (censored at 31/12/2014) were identified from respective registries and the Mortality Collection of the Ministry of Health. All patients within the New Zealand health system are allocated a National Health Index (NHI) number and annual updates for recurrence data are performed using the NHI through public hospitals, and where necessary, data entry personnel physically attend private providers to retrieve and update information. Follow up duration was calculated from the date of diagnosis to date of death, or to the date of the last follow up when the patient was known to be alive (censored at 31/12/2014).

2.4. Statistical analysis

Chi squared (χ^2) test for trend was used to test for univariate differences among groups of interest. Logistic regression models were used to explore factors associated with positive axillary nodal status at diagnosis. Multivariable Cox proportional hazard models were used to calculate hazard ratios with 95% confidence intervals to identify socio-demographic, tumour and treatment characteristics associated with cancer recurrence and cancer specific mortality. A further analysis was performed using only cases with complete data for all variables. Results of this analysis were similar to those obtained from the full Cox proportional hazards regression model, and these data are not presented in this report. Imputation of missing values was not undertaken due to the similarity of these results. Statistical analyses were performed in SPSS (Version 22).

3. Results

There was a total of 12,390 invasive cancers identified for the 13-year study period. Grade was documented for 94.5% of cases. There were 2857 grade 1 cancers (24.4%) and thus included for analysis. Of these, 1640 women (75.7%) were NZ European, 166 (8.3%) were Māori, 93 (4.6%) were Pacific women, and the rest were Asian, other and unknown at 160 (7.1%), 63 (2.7%) and 42 (1.6%) respectively.

Māori and Pacific women were significantly more likely to present with larger tumours with 60.3% of NZ European women presenting with tumours >10 mm compared to 68.7% of Māori women and 69.8% of Pacific women (Table 1). Similarly, Māori and Pacific women were more than 1.5 times more likely to present with lymphovascular invasion than NZ European women. There was no difference observed in rates of lymph node involvement by ethnicity at disease presentation. The majority of grade 1 cancers were ER/PR positive and this was similar across all ethnicities.

Axillary lymph node status was unknown for 126 women (4.4%), and therefore excluded. A total of 545 women (19.0%) had involved nodes at the time of diagnosis (Table 2). Younger age at diagnosis and over 80 years, Māori compared with NZ European ethnicity, larger tumour size, non-screen compared with screen detection, mixed compared with ductal/lobular histology and LVI were associated with significantly higher risks of having positive lymph nodes at diagnosis in the univariate analysis. Only tumour size greater than 10 mm, non-screen detection and LVI remained significant in the multivariate analysis. Ethnicity did not reach significance for predicting nodal involvement at diagnosis (19.5%,

Table 2
Factors associated with nodal positivity compared with node negativity in univariate and multivariate logistic regression analysis.

Characteristic		Univariate			Multivariate		
		OR	95% CI	p	OR	95% CI	p
Age	<40	1.74	1.04–2.91		1.15	0.63–2.11	
	40–49	Ref		0.000	Ref		0.065
	50–59	0.82	0.64–1.05		0.97	0.73–1.30	
	60–69	0.58	0.45–0.75		0.74	0.54–1.00	
	70–79	1.01	0.75–1.36		0.72	0.49–1.04	
	80+	2.01	1.44–2.80		0.62	0.39–1.00	
Ethnicity	NZ European	Ref			Ref		
	Māori	1.41	1.03–1.93	0.033	1.09	0.77–1.57	0.610
	Pacific	1.34	0.88–2.03	0.167	1.21	0.76–1.92	0.421
	Asian	0.78	0.53–1.16	0.215	0.70	0.45–1.08	0.106
Tumour size	≦10 mm	Ref		0.000	Ref		0.000
	>0 mm	3.07	2.50–3.78		3.42	2.63–4.46	
Detection	Screen	Ref		0.000	Ref		0.002
	Non-screen	2.25	1.89–2.67		1.46	1.15–1.84	
ER/PR	Positive	Ref		0.780	Ref		0.617
	Negative	1.09	0.59–2.02		1.22	0.56–2.66	
HER-2	Negative	Ref		0.823	Ref		0.144
	Equivocal	0.90	0.46–1.78		0.86	0.37–1.97	
	Positive	0.74	0.37–1.49		0.41	0.17–0.96	
Histology	Ductal	Ref			Ref		
	Lobular	1.30	0.94–1.78	0.114	1.21	0.83–1.75	0.329
	Mixed	2.21	0.93–5.26	0.075	2.24	0.86–5.80	0.097
	Other	0.50	0.38–0.67	0.000	0.34	0.23–0.50	0.000
LVI	No	Ref		0.000	Ref		0.000
	Yes	6.13	4.63–8.13		5.69	4.19–7.73	
Multifocality	No	Ref		0.170	Ref		0.549
	Yes	1.28	0.90–1.84		1.14	0.75–1.73	

ER/PR—oestrogen and progesteron receptor status; HER-2—human epidermal growth factor receptor 2; LVI—lymphovascular invasion.

Table 3
Mean time to recurrence or death.

Disease status	n	Mean time	Median	Range (years)
Total deaths	322	5.28	4.90	0.06–14.09
Breast Cancer	61	4.76	4.48	0.06 – 13.59
Other causes	261	5.36	5.04	0.13–12.77
Recurrences	142	4.35	3.90	0.21 - 12.30

Table 4
Univariate and multivariate Cox proportional analysis of factors associated with local and metastatic recurrence of breast cancer (for non-metastatic cancers undergoing primary surgery $n = 2780$).

Characteristic		Univariate			Multivariate		
		HR	95% CI	p	HR	95% CI	p
Age	<40	1.59	0.80–3.15		0.97	0.43–2.17	
	40–49	Ref		0.000	Ref		0.114
	50–59	0.50	0.32–0.77		0.54	0.33–0.87	
	60–69	0.49	0.31–0.77		0.58	0.36–0.94	
	70-79	0.75	0.45–1.24		0.59	0.33–1.06	
	80+	1.01	0.56–1.82		0.68	0.34–1.36	
Ethnicity	NZ European	Ref			Ref		
	Māori	1.89	1.13–3.16	0.015	1.57	0.93–2.66	0.094
	Pacific	0.60	0.19–1.90	0.391	0.44	0.14–1.42	0.170
	Asian	0.69	0.30–1.58	0.381	0.51	0.22–1.17	0.111
Year	2000–2003	Ref		0.071	Ref		0.896
	2004–2006	1.43	0.93–2.19		0.85	0.52–1.40	
	2007–2009	1.80	1.14–2.84		0.84	0.48–1.47	
	2010–2013	1.81	1.02–3.19		0.78	0.37–1.62	
Tumour size	≦10 mm	Ref		0.000	Ref		0.005
	>10 mm	2.48	1.69–3.64		1.85	1.21–2.83	
Detection	Screen	Ref		0.000	Ref		0.082
	Non-screen	2.50	1.82–3.42		1.42	0.96–2.11	
ER/PR	Positive	Ref		0.006	Ref		0.140
	Negative	2.55	1.30–4.99		1.98	0.80–4.92	
HER-2	Negative			0.570	Ref		0.672
	Equivocal	0.52	0.16–1.68		0.37	0.09–1.52	
	Positive	1.29	0.53–3.17		0.77	0.23–2.57	
Histology	Ductal	Ref			Ref		
	Lobular	2.40	1.55–3.72	0.000	2.05	1.24–3.40	0.005
	Mixed	1.48	0.37–5.99	0.582	1.14	0.25–5.13	0.869
	Other	0.82	0.51–1.34	0.433	0.84	0.48–1.45	0.527
LVI	No	Ref		0.012	Ref		0.737
	Yes	1.79	1.13–2.83		1.10	0.64–1.87	
Multifocality	No	Ref		0.504	Ref		0.951
	Yes	1.22	0.68–2.20		0.98	0.52–1.87	
N	0	Ref		0.000	Ref		0.863
	1+	1.59	1.12–2.26		1.03	0.75–1.41	
Treatment	Mastectomy	Ref			Ref		
	BCS + RT	0.32	0.21–0.50	0.000	0.73	0.49–1.09	0.122
	BCS only	0.59	0.38–0.91	0.018	2.27	1.44–3.60	0.000

ER/PR—oestrogen and progesteron receptor status; HER-2—human epidermal growth factor receptor 2; LVI —lymphovascular invasion; N—nodal status.

25.2% and 24.6% for NZ European, Māori and Pacific women respectively).

A total of 142 (5.1%) disease recurrences (local and metastatic) and 61 (2.1%) deaths due to breast cancer were observed during the follow up period (Table 3). Ninety (63.4%) of the recurrences occurred during the first five years while the rest were after five years. Median follow up was 4.9 years (mean 5.3 years, range 0.02–14.09 years). Characteristics associated with disease recurrence and breast cancer specific mortality are shown in Tables 4 and 5, respectively. Tumour size greater than 10 mm (HR = 1.85, 1.21–2.83), lobular compared with ductal histology (HR = 2.05, 1.24–3.40) and BCS without adjuvant radiotherapy (HR = 2.27, 1.44–3.60) were significantly associated with breast cancer recurrences in the multivariate Cox regression model.

We found that a total of 306 women underwent wide excision of their primary breast cancer without adjuvant radiotherapy. NZ European women made up the majority of this group (75.5%) with Maori and Pacific women occupying 8.5% and 3.6% respectively. This rate did not change significantly over this time period, nor did they differ by screen-detected (52.6%) vs non-screen detected (47.4%) cancers.

Tumour size greater than 10 mm at diagnosis (HR = 7.04, 2.09–23.7), ER/PR negativity (HR = 3.09, 1.10–8.71), lobular compared with ductal histology (HR = 2.39, 1.02-5.61) and metastatic disease at diagnosis (HR = 128.5, 39.2–421.6) were significant predictors of breast cancer specific mortality in the multivariate model. There were no differences in breast cancer specific mortality by ethnicity.

4. Discussion

In this cohort of New Zealand women with grade 1 breast cancer, 19.0% of women presented with positive axillary nodes. This is in keeping with reports of nodal involvement in 23.9% of grade 1 breast cancer [7], and rates of 18–48% for early T1–T2 breast cancers [6,7,27]. Important predictors for axillary node involvement in our study were tumour size greater than 10 mm, LVI and non-screen detected cancers. Tumour size greater than 10 mm, lobular carcinoma and BCS without radiotherapy were predictive of recurrent and or metastatic disease. Despite Pacific and Māori women being significantly more likely to present with larger tumours, ethnicity was not an important predictor for axillary lymph node involvement, recurrent disease or mortality. It follows on, that in this cohort, screen-detected low grade breast cancer was not a predictor of either recurrence or breast cancer mortality.

Grade 1 breast cancer has a long natural history and a limitation to our study in this regard is the short followup time with a median of 4.9 years. There were only 61 deaths (2.1%) during this time period due to relatively indolent behaviour of grade 1 cancers. It is likely that more meaningful data will be obtained with longer followup. Given the low event rate in grade 1 cancer, one consideration might be to limit the recurrence and mortality analysis to non-screen detected cancers, although this would also reduce the number of events.

A further limitation of this study is the lack of data from the central and southern regions of New Zealand. The second highest population of Pacific people in New Zealand is found in the Wellington region, with 3 times that of the Pacific population found in the Waikato region, but it was not technically feasible to include them in the analysis because their database only commenced in 2010. As a result, the numbers of Māori, Pacific and Asian women in this cohort are very low, and therefore our findings may be reflective of a lack of power rather than ethnicity not being a predictor. It would be useful to utilise national data in the future.

Table 5
Univariate and multivariate Cox proportional analysis of factors associated with breast cancer specific mortality.

Characteristic		Univariate			Multivariate		
		HR	95% CI	*p*	HR	95% CI	*p*
Age	<40	0.65	.29–1.45		2.70	0.51–14.1	
	40–49	Ref		0.000	Ref		0.166
	50–59	0.65	0.33–1.29		1.99	0.59–6.69	
	60–69	0.32	0.16–0.64		3.44	1.12–10.6	
	70–79	0.31	0.16–0.63		3.57	1.04–12.3	
	80+	0.48	0.23–1.02		5.18	1.31–20.4	
Ethnicity	NZ European	Ref			Ref		
	Māori	1.26	0.38–4.14	0.702	0.80	0.26–2.45	0.702
	Pacific	0.81	0.11–5.92	0.832	1.48	0.43–5.07	0.530
	Asian	0.46	0.06–3.34	0.440	0.91	0.21–3.94	0.898
Year	2000–2003	Ref		0.055	Ref		0.807
	2004–2006	1.44	0.94–2.21		1.05	0.45–2.45	
	2007–2009	1.81	1.14–2.86		0.85	0.30–2.40	
	2010–2013	1.91	1.09–3.36		1.56	0.42–5.74	
Tumour size	≦10mm	Ref		0.000	Ref		0.002
	>10mm	2.43	1.66–3.56		7.04	2.09–23.7	
Detection	Screen			0.000			0.966
	Non-screen	2.48	1.81–3.39		1.02	0.48–2.17	
ER/PR	Positive	Ref		0.006	Ref		0.032
	Negative	2.55	1.30–5.00		3.09	1.10–8.71	
HER-2	Negative	Ref		0.562	Ref		0.092
	Equivocal	0.52	0.17–1.64		1.34	0.31–5.80	
	Positive	1.29	0.53–3.15		2.96	0.84–10.4	
Histology	Ductal	Ref			Ref		
	Lobular	2.36	1.53–3.66	0.000	2.39	1.02–5.61	0.045
	Mixed	1.37	0.34–5.55	0.659	1.70	0.15–19.2	0.668
	Other	0.81	0.50–1.31	0.395	0.24	0.06–0.86	0.029
LVI	No	Ref		0.012	Ref		0.746
	Yes	1.80	1.14–2.84		0.83	0.27–2.54	
Multifocality	No	Ref		0.578	Ref		0.917
	Yes	1.18	0.66–2.13		1.06	0.33–3.41	
N stage	0	Ref		0.000	Ref		0.533
	1+	1.58	1.11–2.25		0.78	0.36–1.70	
M stage	0	Ref		0.000	Ref		0.000
	1	118.20	73.2–189.1	128.5	39.2–421.6		

ER/PR—oestrogen and progesteron receptor status; HER-2—human epidermal growth factor receptor 2; LVI—lymphovascular invasion; N—nodal stage; M—metastasis.

Grade of disease was not recorded for 676 of 12390 breast cancers diagnosed during this period and axillary lymph node status was not known for 126 of 2857 women with grade 1 breast cancer. It is known that patterns of missing data vary by deprivation and ethnicity with Pacific women less likely to have complete data than NZ European women [2].

Ethnicity was not a predictor of recurrence nor mortality and therefore we believe that increasing the proportion of screen detected low grade breast cancers will make an important contribution to improving disparities in outcome in New Zealand. Breast Screen Aotearoa (BSA) is a national breast-screening program in New Zealand that offers free screening mammograms to all asymptomatic women aged 45–69 years. Although coverage rates for Māori women continue to improve, they are still significantly less than non-Māori with 2-year coverage rates in the Waikato and Auckland regions ranging between 58% and 66% for Maori women and 65.5–70.1% for their non-Maori counterparts [28]. Coverage rates for Pacific women range from 60% to 77%. A BSA audit reported screen detected cancers by histological grade of 37%, 44% and 18% for grade 1, 2 and 3 respectively; and 19%, 42% and 39% for their non-BSA counterparts [17]. It is unclear whether there are ethnic differences in the distribution of histological grade by mode of detection. However, recent work has reported that within the Waikato region, Māori women are more likely to be diagnosed with more advanced cancer than NZ European women and that this is due to lower rates of screen detected cancers [20]. Previous work in New Zealand has demonstrated that Māori patients with stage III colon cancer are less likely to be referred for chemotherapy than their non-Māori counterparts and more likely to experience delays to treatment [29]. Given the impact of treatment on recurrence, future work also needs to look at differences in referral patterns after breast cancer, uptake of treatment, and pathways to ensure equal access to adjuvant therapy.

5. Conclusion

Tumour size greater than 10 mm and LVI were signficantly associated with axillary lymph node involvement. Despite Pacific and Maori women being more likely than NZ European women to

present with larger grade 1 tumours and LVI, ethnicity was not an independent predictor for axillary lymph node involvement in our study. Nor was ethnicity an independent predictor for recurrence or mortality in grade 1 breast cancer.

Conflicts of interest

None.

References

[1] I. Meredith, D. Sarfati, T. Ikeda, J. Atkinson, T. Blakely, High rates of endometrial cancer among Pacific women in New Zealand: the role of diabetes, physical inactivity, and obesity, Cancer Causes Control 23 (6) (2012) 875–885.

[2] F. McKenzie, L. Ellison-Loschmann, M. Jeffreys, Investigating reasons for ethnic inequalities in breast cancer survival in New Zealand, Ethn. Health 16 (6) (2011) 535–549.

[3] S. Seveviratne, I. Campbell, N. Scott, R. Shirley, T. Peni, R. Lawrenson, Accuracy and completeness of the New Zealand Cancer Registry for staging of invasive breast cancer, Epidemiology 38 (2014) 638–644.

[4] R.J. Steele, The axillary lymph nodes in breast cancer. Seven years on, J. R. Coll. Surg. Edinb. 28 (5) (1983) 282–291.

[5] B. Fisher, N.H. Slack, Number of lymph nodes examined and the prognosis of breast carcinoma, Surg. Gynecol. Obstet. 131 (1) (1970) 79–88.

[6] D.E. Rivadeneira, R.M. Simmons, P.J. Christos, K. Hanna, J.M. Daly, M.P. Osborne, Predictive factors associated with axillary lymph node metastases in T1a and T1b breast carcinomas: analysis in more than 900 patients, J. Am. Coll. Surg. 191 (1) (2000) 1–6.

[7] C.H. Yip, N.A. Taib, G.H. Tan, K.L. Ng, B.K. Yoong, W.Y. Choo, Predictors of axillary lymph node metastases in breast cancer: is there a role for minimal axillary surgery? World J. Surg. 33 (1) (2009) 54–57.

[8] E. Yoshihara, A. Smeets, A. Laenen, A. Reynders, J. Soens, C. Van Ongeval, et al., Predictors of axillary lymph node metastases and their applicability in clinical practice, Breast 22 (2013) 357–361.

[9] A. Barth, P. Craig, M. Silverstein, Predictors of axillary lymph node metastases in patients with T1 breast carcinoma, Cancer 79 (10) (1997) 1918–1922.

[10] M. Chadha, A. Chabon, P. Friedmann, B. Vikram, Predictors of axillary lymph node metastases in patients with T1 breast cancer. A multivariate analysis, Cancer 73 (2) (1994) 350–353.

[11] A. Smeets, A. Ryckx, A. Belmans, H. Wildiers, P. Neven, G. Floris, et al., Impact of tumour chronology and tumour biology on lymph node metastasis in breast cancer, Springerplus 23 (2) (2013) 480.

[12] G.U. Dachs, M.J. Currie, F. McKenzie, M. Jeffreys, B. Cox, S. Foliaki, et al., Cancer disparities in indigenous Polynesian populations: Maori, Native Hawaiians and Pacific people, Lancet Oncol. 9 (5) (2008) 473–484.

[13] J.E. Cunningham, W.M. Butler, Racial disparities in female breast cancer in South Carolina: clinical evidence for a biological basis, Breast Cancer Res. Treat. 88 (2) (2004) 161–176.

[14] L.P. Middleton, V. Chen, G.H. Perkins, V. Pinn, D. Page, Histopathology of breast cancer among African–American women, Cancer 97 (suppl. 1) (2003) 253–257.

[15] H. Aziz, F. Hussain, C. Sohn, et al., Early onset of breast carcinoma in African American women with poor prognostic factors, Am. J. Clin. Oncol. 22 (5) (1999) 436–440.

[16] J. Iqbal, O. Ginsburg, P.A. Rochon, P. Sun, S.A. Narod, Differences in breast cancer stage at diagnosis and cancer-specific survival by race and ethnicity in the United States, JAMA 313 (2) (2015) 165–173.

[17] C.W.L. Ooi, I.D. Campbell, J. Kollias, P. de Silva, National breast cancer audit: overview of invasive breast cancer in New Zealand, NZMJ 125 (1359) (2012) 7–16.

[18] B. Robson, J. Stanley, T. Ikeda, Stairmand. BreastScreen Aotearoa: Independent Monitoring Report 4, Screening and Assessment July 2010 to June 2012, Te Roopu Ranahau Hauora a Eru Pomare, University of Otago Wellington, New Zealand, 2014.

[19] A. Page, S. Morrell, R. Taylor BreastScreen Aotearoa, Independent Monitoring Report, Screening and assessment report of women attending BSA, Wellington National Screening Unit, Ministry of Health, 2014.

[20] S. Seneviratne, I. Campbell, N. Scott, R. Shirley, R. Lawrenson, Impact of mammographic screening on ethnic and socioeconomic inequities in breast cancer stage at diagnosis and survival in New Zealand: a cohort study, BMC Public Health 15 (1) (2015) 46.

[21] S. Seneviratne, I. Campbell, N. Scott, C. Coles, R. Lawrenson, Treatment delay for Maori women with breast cancer in New Zealand, Ethn. Health 20 (2) (2015) 178–193.

[22] S. Seneviratne, I. Campbell, N. Scott, M. Kuper-Hommel, G. Round, R. Lawrenson, Ethnic differences in timely adjuvant chemotherapy and radiation therapy for breast cancer in New Zealand: a cohort study, BMC Cancer 14 (2014) 839–847.

[23] Ministry of Health. (2004). Ethnicity Data Protocols for the Health and Disability Sector. Retrieved 15/05/2014, from http://www.health.govt.nz/publication/ethnicity-data-protocols-health-and-disability-sector

[24] Atkinson J, Shaw C, Blakely T, Stanley J, Sloane K. Linkage of Census and Cancer Registrations, 1981-2004. CancerTrends Technical Report: Number 1. Department of Public Health, University of Otago, Wellington.

[25] American Joint Committee on Cancer (2010). AJCC Cancer Staging Manual. New York, Springer-Verlag.

[26] G. Pauletti, W. Godolphin, M.F. Press, D.J. Slamon, Detection and quantitation of HER-2/neu gene amplification in human breast cancer archival material using fluorescence in situ hybridization, Oncogene 13 (1) (1996) 63–72.

[27] A. Barth, P.H. Craig, M.J. Silverstein, Predictors of axillary lymph node metastases in patients with T1 breast carcinoma, Cancer 79 (1997) 1918–1922.

[28] Ministry of Health. 2015. BSA Auckland District Health Board Coverage Report: period ending 30 June 2015. Wellington: Ministry of Health.

[29] S. Hill, D. Sarfati, T. Blakely, B. Robson, G. Purdie, E. Dennett, et al., Ethnicity and management of colon cancer in New Zealand. Do indigenous patients get a worse deal? Cancer 116 (2010) 3205–3214.