# Characteristics of and differences between Pasifika women and New Zealand European women diagnosed with breast cancer in New Zealand

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## ABSTRACT

**AIM:** Breast cancer in New Zealand-based Pasifika women is a significant issue. Although Pasifika women have a lower incidence of breast cancer compared to New Zealand European women, they have higher breast cancer mortality and lower five-year survival. The aim of this study was to describe the characteristics and tumour biology of Pasifika women and to compare New Zealand European women to identify what factors impact on early (Stage 1 and 2) vs advanced stage (Stage 3 and 4) at diagnosis.

**METHOD:** Data on all Pasifika and New Zealand European women diagnosed with breast cancer (C50) during the period 1 June 2000 to 31 May 2013 was extracted from the Auckland and Waikato Breast Cancer Registries. Descriptive tables and Chi-square test were used to examine differences in characteristics and tumour biology between Pasifika and New Zealand European women. Logistic regression was used to identify factors that contributed to an increased risk of advanced stage at diagnosis.

**RESULTS:** A significantly higher proportion of Pasifika women had advanced disease at diagnosis compared to New Zealand European women (33.3% and 18.3%, respectively). Cancer biology in Pasifika women was more likely to be: 1) HER2+, 2) ER/PR negative and 3) have a tumour size of ≥50mm. Pasifika women live in higher deprivation areas of 9–10 compared to New Zealand European women (55% vs 14%, respectively) and were less likely to have their cancer identified through screening. Logistic regression showed that if Pasifika women were on the screen-detected pathway they had similar odds (not sig.) of having advanced disease at diagnosis to New Zealand European women.

**CONCLUSION:** Mode of detection, deprivation, age and some biological factors contributed to the difference in odds ratio between Pasifika and New Zealand European women. For those of screening age, adherence to the screening programme and improvements in access to earlier diagnosis for Pasifika women under the current screening age have the potential to make a substantial difference in the number of Pasifika women presenting with late-stage disease.

Breast cancer is a significant health issue for women in New Zealand. There are approximately 3,000 registrations and around 600 deaths during 2012.[1] One hundred and twenty Pasifika women were registered during the calendar year 2012, with 31 deaths of Pasifika women with breast cancer during the same period.[1] Differences for indigenous and ethnic minority populations around the world are well documented.[2–5] Within New Zealand there are many examples of inequitable outcomes that disadvantage minority populations.[6–13] Māori and Pasifika women with breast can-

cer have been shown to have much poorer outcomes than their New Zealand European counterpart. This is often characterised by the frequency of late-stage disease at diagnosis.[14–16]

'Pasifika' is a broad name for a heterogeneous group with a long history of migration to New Zealand from an array of island nations. Pasifika people are currently the fourth largest ethnic group in New Zealand, accounting for 7.4% of the New Zealand population.[17] The primary Pasifika population groups in New Zealand are Samoan, Cook Island, Tongan, Niuean, Fijian and Tokelauan. The average age of the Pasifika population is younger than other groups at 21.1 years, compared to 41.0 years for New Zealand European. Approximately two-thirds of the current New Zealand Pasifika population are New Zealand born.[17]

Pasifika women have been found to have a lower breast cancer incidence compared with other ethnic groups[9,18] but have an increased risk of breast cancer-specific mortality compared to New Zealand European women (Hazard ratio (HR) 1.25 (Confidence Interval (CI) 0.94, 1.68)).[12,19] Pasifika women are predominantly younger at diagnosis, come from more deprived areas and have larger tumour size with more ductal histology.[19] Sarfati et al (2005) found that during the 1980s to end of 1990s Pasifika women had a three-fold increase in breast-cancer mortality, from 11 to 96 deaths during the period.[12] Some of the major causes of disparity between the ethnic groups in New Zealand have been attributed to higher levels of deprivation and in particular, inadequate access to healthcare.[20–22]

The aim of this study was to describe the characteristics and tumour biology of Pasifika women and compare to New Zealand European women registered on the Waikato and Auckland Breast Cancer Registers during 1 June 2000 and 31 May 2013. The purpose was to consider which factors, including ethnicity, deprivation and mode of detection, impact on early (Stage 1 and 2) vs advanced stage (Stage 3 and 4) at diagnosis and to determine differences in cancer biology between all women recorded as 'Pasifika' and compare to New Zealand European women. Understanding the factors that contribute to poorer outcomes are important in addressing where to improve service provision.

# Methods

## Data sources

Data on all Pasifika and New Zealand European women diagnosed with breast cancer (C50) during the period 1 June 2000 to 31 May 2013 was extracted from the Auckland and Waikato Breast Cancer Registries (referred to as the combined register). Both registries are computer-based databases that confidentially capture all women diagnosed with breast cancer within their region. All women are placed on the register but can opt out if desired. The Waikato Breast Cancer Register began collecting data in November 2004, but undertook a back-dating project to complete records back to 1999. The Auckland Breast Cancer Register began in June 2000. Data collected and recorded on the register databases included: demographic details, mode of and characteristics at presentation, comorbidities (also from the National Minimum Data Set (NMDS)), investigations and information on the management of the disease, follow-up and outcomes.

The combined register was linked to National Ministry of Health (MOH) datamart via patient National Health Index number (NHI). The NHI is a unique identifier assigned to all individuals that are New Zealand residents. National MOH datamart included the New Zealand Cancer Register (NZCR), NMDS (or hospital discharge data), Mortality Collection (MORT) and Death Certificates.

## Study population

All Pasifika and New Zealand European women with an invasive breast cancer registration in the Auckland and Waikato Regions during the period 1 June 2000 to 31 May 2013 were included in the study.

## Study covariates

### Ethnicity

Ethnicity was collated from all datasets using Statistics New Zealand Ethnicity Classification. This classification system is a hierarchical structure with four levels. For this study, ethnicity has been coded to level two.[23] Pasifika ethnicity was assigned to a patient if they had any of the level one

or two ethnicity codes of 30 to 37, on any dataset.[23] Pasifika ethnicity was assigned from the datasets as follows: the combined registers: 832 women, and the MOH databases: 109 women. From the NZCR, it was identified 20 women on the combined register had dual Māori and Pasifika ethnicities assigned and were included in the analysis as Pasifika.

### Deprivation

Deprivation is derived by domicile at diagnosis. The New Zealand Deprivation Index (Dep Index) is a measure of nine factors (transport access, benefit, employment, income, communication access, single parent family, education, living space and home ownership) collected in the national census.[24] The Dep Index is a scale of 1 to 10, least deprived to most deprived.

### Stage

Cancer stage at diagnosis is classified from clinical notes within the respective breast cancer registers. Tumours are categorised into four cancer stages based on the size of the tumour and the extent of spread. Stage 1 is small and confined within the organ. Stage 2 usually means the cancer has not spread onto surrounding tissue but may have spread to the lymph nodes close to the tumour. Stage 3 is a larger cancer with some spread to the surrounding tissue and lymph nodes. Stage 4 is the spread of the cancer to other organ/s. Advanced disease is defined as Stage 3 and 4.[25]

### Comorbidity—Cancer, Care and Comorbidity Index (C3)

Comorbidities were identified from the National Minimum Data Set (NMDS) or hospital discharge data—those that had a hospital stay. Comorbidities were scored using the C3 score, a validated alternative to the Charlson and NCI indices in cancer populations.[26] The index collects up to 50 conditions to achieve a score. C3 only considers conditions that require hospital admission and overnight stay. Each registered comorbidity is coded on to the NMDS, which is a collection of all patient presentations (overnight) to hospital and if the comorbidity is recorded during the visit by a healthcare practitioner on the clinical note.

### Mode of detection

Mode of detection has been categorised into two groups: screen-detected and non-screen detected. 1) Screen-detected: in New Zealand Breast Screen Aotearoa (BSA), a publicly funded national screening programme that facilitates the access of women that fit eligibility criteria to attend and participate in the breast screen programme was introduced in December 1998. The screening programme was originally targeting women in the 50- to 64-year age bracket. The age range was extended during 2004 to include the following criteria: aged between 45 and 69 years; no symptoms of breast cancer; no mammogram in the previous 12 months; not pregnant/breastfeeding; New Zealand resident. Mammograms are available two-yearly for eligible women.[27] Breast screening can still be undertaken in private facilities at patient expense. 2) Non-screen detected: are all those cancers not detected through screening and include those identified symptomatically.

## Statistical analyses

Statistical analysis was performed in SPSS (IBM Corporation, New York, NY, USA. Characteristics of women diagnosed with breast cancer are presented in descriptive tables. Chi-square testing for the difference between Pasifika and New Zealand European women was undertaken. Incidence-rates were calculated per 1,000 cases in two age categories: <45 years (pre-screening age) and 45–69 years (screening age). Binary logistic regression was used to identify factors that contribute to the risk of being diagnosed with advanced stage disease (Stage 3 and 4) compared to early stage breast cancer (Stage 1 and 2) in Pasifika compared to New Zealand European women. Factors that were included were: ethnicity, age, year of diagnosis, mode of detection, deprivation, location (Auckland/Waikato), comorbidity score, oestrogen receptor status (ER), progestogen receptor status (PR) and human epidermal growth factor receptor 2 status (HER2). Stage of disease at diagnosis was examined as not-advanced (Stage 1 and 2) and advanced (Stage 3 and 4).

Ethical approval for the use of retrospective patient health data was granted for the study through the Northern A Health and Disability Ethics Committee, reference: 12/NTA/42/AM01.

# Results

There were 14,456 breast cancers registered on the combined register. A total of 11,267 were identified as Pasifika or New Zealand European, 941 and 10,326, respectively. Māori and other ethnic groups (n=3,189) were excluded. In-situ (Stage 0) cancers were excluded, leaving 9,780 invasive primary breast cancers; 853 Pasifika women and 8,927 New Zealand European women (Table 1). Two-thirds of Pasifika women were under 60 years old at the time of their diagnosis, compared to half of New Zealand European women. The average age for Pasifika and New Zealand European women was 54 years and 60 years, respectively. Pasifika women were more likely than New Zealand European women to be pre-menopausal at the time of their diagnosis (40.9% vs 26.7%, respectively).

**Table 1:** Distribution of patient and tumour characteristics comparing Pasifika and New Zealand European women registered in the Auckland and Waikato Breast Cancer Registers (2000–2013).

| | **Pasifika women** | | **NZ European women** | | | |
|---|---|---|---|---|---|---|
| | **All stage** | **Advanced** | **All stage** | **Advanced** | | |
| | **n (%)** | **n (% of all stage)** | **n (%)** | **n (% of all stage)** | **Odds ratio (OR)** | **P value** |
| **Age at diagnosis** | | | | | | |
| <45 years | 208 (24.4) | 91 (43.8) | 1,128 (12.60 | 314 (27.8) | 2.02 | <0.001 |
| 45–69 years | 541 (63.4) | 157 (29.0) | 5,524 (61.9) | 859 (15.6) | 2.22 | <0.001 |
| 70+ years | 104 (12.2) | 36 (34.6) | 2,275 (25.5) | 459 (20.2) | 2.09 | <0.001 |
| Total | 853 (100) | 284 (33.3) | 8,927 (100) | 1,632 (18.3) | 2.23 | <0.001 |
| **Stage at diagnosis** | | | | | | |
| Stage 1 | 240 (28.1) | | 4,000 (44.8) | | | |
| Stage 2 | 329 (38.6) | | 3,291 (36.9) | | | |
| Stage 3 | 196 (23) | | 1,283 (14.4) | | | |
| Stage 4 | 88 (10.3) | | 349 (3.9) | | | |
| Unknown | 0 (0) | | 4 (0.04) | | | |
| **Menopausal status** | | | | | | |
| Pre | 349 (40.9) | 139 (39.8) | 2,383 (26.7) | 541 (22.7) | 2.25 | <0.001 |
| Peri | 33 (3.9) | 8 (24.2) | 449 (5) | 74 (16.5) | 1.62 | 0.3653 |
| Post | 443 (51.9) | 130 (29.3) | 5,937 (66.5) | 998 (16.8) | 2.06 | <0.001 |
| Unknown | 28 (3.3) | 7 (25) | 158 (1.8) | 19 (12) | | |
| **C3 score** | | | | | | |
| 0 | 631 (74.0) | 212 (33.6) | 6,969 (78.1) | 1,248 (17.9) | 2.32 | <0.001 |
| 1 | 69 (8.1) | 24 (34.8) | 724 (8.1) | 141 (19.5) | 2.21 | 0.0045 |
| 2 | 61 (7.2) | 18 (29.5) | 511 (5.7) | 100 (19.6) | 1.72 | 0.0998 |
| 3 | 92 (10.8) | 30 (32.6) | 723 (8.1) | 143 (19.8) | 1.96 | 0.007 |
| **Year of diagnosis** | | | | | | |
| 2000–2003 | 168 (19.7) | 56 (33.3) | 2,249 (25.2) | 386 (17.2) | 2.41 | <0.001 |
| 2004–2006 | 192 (22.5) | 64 (33.3) | 1,944 (21.8) | 379 (19.5) | 2.06 | <0.001 |
| 2007–2009 | 220 (25.8) | 76 (34.5) | 2,132 (23.9) | 423 (19.8) | 2.13 | <0.001 |
| 2010–2013 | 273 (32.0) | 88 (32.2) | 2,602 (29.1) | 444 (17.1) | 2.31 | <0.001 |

**Table 1:** Distribution of patient and tumour characteristics comparing Pasifika and New Zealand European women registered in the Auckland and Waikato Breast Cancer Registers (2000–2013) (continued).

| | | | | | | |
|---|---|---|---|---|---|---|
| **Region** | | | | | | |
| Auckland | 801 (93.9) | 264 (33) | 6,717 (75.2) | 1,191 (17.7) | 2.28 | <0.001 |
| Waikato | 52 (6.1) | 20 (38.5) | 2,210 (24.8) | 441 (20) | 2.51 | 0.0019 |
| **Deprivation** | | | | | | |
| 1–2 | 42 (4.9) | 14 (33.3) | 2,183 (24.5) | 372 (17) | 2.43 | 0.0106 |
| 3–4 | 47 (5.5) | 19 (40.4) | 1,612 (18.1) | 265 (16.4) | 3.45 | <0.001 |
| 5–6 | 99 (11.6) | 25 (25.3) | 2,027 (22.7) | 357 (17.6) | 1.58 | 0.0720 |
| 7–8 | 188 (22) | 60 (31.9) | 1,765 (19.8) | 377 (21.4) | 1.73 | 0.0013 |
| 9–10 | 466 (54.6) | 160 (34.3) | 1,264 (14.2) | 251 (19.9) | 2.11 | <0.001 |
| Missing | 11 (1.3) | 6 (54.5) | 76 (0.9) | 10 (13.2) | | |
| **Mode of detection** | | | | | | |
| Not screen detected | 593 (69.5) | 258 (43.5) | 5,405 (60.5) | 1,381 (25.6) | 2.24 | <0.001 |
| Screen detected | 260 (30.5) | 26 (10) | 3,522 (39.5) | 251 (7.1) | 1.45 | 0.1112 |
| **Grade** | | | | | | |
| 1 | 140 (16.4) | 17 (12.1) | 2,151 (24.1) | 111 (5.2) | 2.54 | 0.0010 |
| 2 | 361 (42.3) | 110 (30.5) | 3,937 (44.1) | 678 (17.2) | 2.11 | <0.001 |
| 3 | 297 (34.8) | 130 (43.8) | 2,340 (26.2) | 633 (27.1) | 2.10 | <0.001 |
| Unknown | 55 (6.4) | 27 (49.1) | 499 (5.6) | 210 (42.1) | | |
| **ER/PR status** | | | | | | |
| ER and PR - | 181 (21.2) | 66 (36.5) | 1,602 (17.9) | 408 (25.5) | 1.68 | 0.0020 |
| ER and/or PR + | 639 (74.9) | 211 (33) | 7,108 (79.6) | 1,173 (16.5) | 2.49 | <0.001 |
| Unknown | 33 (3.9) | 7 | 217 (2.4) | 51 | | |
| **HER2 status** | | | | | | |
| Positive | 180 (21.1) | 86 (47.8) | 1,037 (11.6) | 324 (31.2) | 2.01 | <0.001 |
| Negative/Equivocal | 477 (55.9) | 150 (31.4) | 5,738 (64.3) | 996 (17.4) | 2.18 | <0.001 |
| Not done | 196 (23) | 48 (24.5) | 2,152 (24.1) | 312 (14.5) | 1.91 | 0.0003 |
| **Histology** | | | | | | |
| Ductal | 714 (83.7) | 241 (33.8) | 7,020 (78.6) | 1,206 (17.2) | 2.46 | <0.001 |
| Lobular | 61 (7.2) | 22 (36.1) | 1,128 (12.6) | 278 (24.6) | 1.72 | 0.0645 |
| Others incl. mixed | 67 (7.9) | 15 (22.4) | 621 (7) | 85 (13.7) | 1.82 | 0.0823 |
| Unknown | 11 (1.3) | 6 (54.5) | 158 (1.8) | 63 (39.9) | | |
| **Tumour size** | | | | | | |
| 0–9 | 99 (11.6) | 6 (6.1) | 1393 (15.6) | 37 (2.7) | 2.36 | 0.0999 |
| 10–19 | 175 (20.5) | 10 (5.7) | 3,069 (34.4) | 207 (6.7) | 0.84 | 0.7075 |
| 20–29 | 157 (18.4) | 26 (16.6) | 2,007 (22.5) | 285 (14.2) | 1.20 | 0.4878 |
| 30–49 | 196 (23) | 72 (36.7) | 1,360 (15.2) | 384 (28.2) | 1.48 | 0.0183 |
| 50+ | 152 (17.8) | 120 (78.9) | 600 (6.7) | 437 (72.8) | 1.40 | 0.1519 |
| Unknown | 74 (8.7) | 50 (67.6) | 498 (5.6) | 282 (56.6) | | |

Over time, the number of breast cancers diagnosed increased over the period 2000 to 2013, however the proportion of advanced cancers changed very little. Overall, breast cancers were more likely to be identified symptomatically, eg, palpable breast lump, nipple discharge. This was reflected in the stage at diagnosis with Pasifika women 2.6 times more likely to be diagnosed with Stage 4 breast cancers than New Zealand European women who are over one and a half times more likely than Pasifika women to have Stage 1 disease at diagnosis.

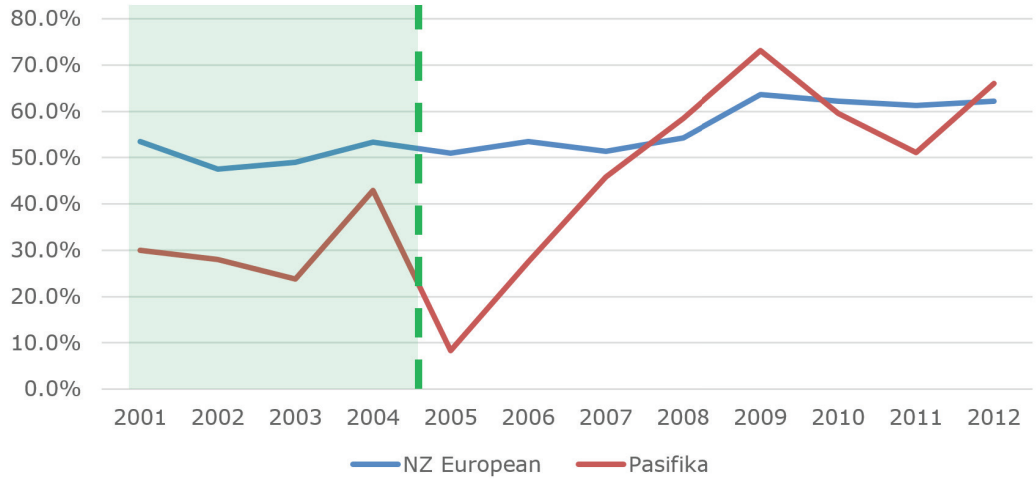
The characteristics of the breast cancer tumour differ between the two groups. Pasifika women were less likely than New Zealand European women to be PR negative (30.6% and 34.1%, respectively) and more likely to be ER negative (23.4% and 18.4%, respectively). Pasifika women were significantly more likely to be ER/PR negative (p value 0.002), be 1.8 times more likely to have a HER2 positive cancer (p value <0.0001) and have an increased likelihood of ductal cancer. The difference in size of tumour was substantial with Pasifika women over 2.5 times more likely to have a tumour 50mm or greater (p value <0.0001). Although nearly a quarter of women did not have a HER2 status recorded in the register, the vast majority (70%) of missing HER2 status data was from 2000–2003 when HER2 status was not routinely tested for and recorded. The proportion of missing HER2 data was similar between Pasifika and New Zealand European women (23.0% and 24.1%, respectively).

Pasifika women were significantly more likely to live in Auckland and be urban-based. They were also significantly more likely to live in a higher deprivation area than New Zealand European women with 54.6% of Pasifika women in the highest deprived area (9–10) compared to 14.2% of New Zealand European women. Conversely, New Zealand European women with breast cancer were significantly more likely to live in the lowest deprivation areas compared to Pasifika women (24.5% and 4.9%, respectively).

The C3 or comorbidity score was calculated from hospital discharge data, gathered from the National Minimum Data Set (NMDS). However, the majority of patients (78%) had no evidence of comorbidities. Pasifika women tended to be more likely to have one or more comorbidities.

Across the period 2001–2012, a lower proportion of Pasifika women were identified through screening compared to New Zealand European women (46.4% and 55.4%, respectively). Figure 1 shows the screening rates of women aged 45–69 years old at diagnosis. Over time the trend has changed with the proportion of women diagnosed by screening increasing (Figure 1).

**Figure 1:** Proportion of women aged 45 to 69 years diagnosed by screening annually (2001–2012).*




*Screening programme was initially 50 to 64 year olds during 2001–2004, then was extended to 45–69 year olds.

## Advanced stage of disease by ethnic group

Nearly half of the Pasifika women diagnosed with advanced stage at diagnosis were younger than 45 years old (43.8%), ie, younger than the screening age. This compares to less than one-third of New Zealand European women (27.8%). Within the older age categories 70 years plus, Pasifika women were significantly less likely to be diagnosed than New Zealand European women (12.2% and 25.5%, respectively).

Disparities in socio-economic factors and deprivation have been found to be associated with poorer outcomes, including late stage of disease at diagnosis and worse mortality outcomes.[28] Of those women with advanced stage disease at diagnosis, Pasifika women were significantly more likely to live in high deprivation of 9–10 compared to New Zealand European women (34.3% and 19.9%, respectively (OR 2.11; p <0.001)).

The proportion of Pasifika women diagnosed with advanced disease at diagnosis changed very little over time: from 33.3% during 2000–2003 to 32.2% during 2010–2013. The proportion of New Zealand European women with advanced disease at diagnosis remained below 20% during 2000–2013. The mode of detection for advanced disease was primarily through non-screened methods. However, 10.0% and 7.1% of Pasifika and New Zealand European women respectively with advanced stage breast cancer were diagnosed through screening.

## Factors associated with risk of Stage 3 and 4 diagnosis in Pasifika women compared to New Zealand European women

To understand the differences in outcomes for Pasifika vs New Zealand European women we undertook separate age-stratified multivariate analyses to investigate the contribution of factors that were considered clinically or theoretically important to advanced stage disease at diagnosis (Tables 2 and 3). For the screening age group 45–69 years old, with an odds ratio (OR) of 2.22 (1.819–2.710), we can account for 0.295 of the contribution to increased odds for factors; demographic, disease, residential area, comorbidity and screening status. Both deprivation and the mode of detection (screening status) were the largest contributing significant factors within the model.

**Table 2:** Adjusted OR and 95% CI for factors associated with advanced stage breast cancer at diagnosis in 45–69 year old Pasifika women compared to New Zealand European women.

| **Screening age 45–69** | | | **95% CI** | | |
|---|---|---|---|---|---|
| | | **OR** | **Lower** | **Upper** | **P value** |
| | Unadjusted | 2.220 | 1.819 | 2.710 | <0.001 |
| | **Adjusted for:** | | | | |
| **Demographics** | + Age | 2.176 | 1.781 | 2.658 | <0.001 |
| | +Year of diagnosis | 2.185 | 1.788 | 2.670 | <0.001 |
| **Disease factors** | + ER/PR status | 2.277 | 1.857 | 2.793 | <0.001 |
| **Area of residence** | + Auckland/Waikato | 2.341 | 1.904 | 2.878 | <0.001 |
| | + Deprivation | 2.109 | 1.676 | 2.655 | <0.001 |
| **Comorbidity** | + C3 score | 2.073 | 1.645 | 2.612 | <0.001 |
| **Healthcare access** | + Screening status | 1.925 | 1.513 | 2.449 | <0.001 |

**Table 3:** Adjusted OR and 95% CI for factors associated with advanced stage breast cancer at diagnosis in Pasifika women compared to New Zealand European women younger than the screening age.

| **Younger than screening age <45yrs** | | | **95% CI** | | |
|---|---|---|---|---|---|
| | | **OR** | **Lower** | **Upper** | **P value** |
| | Unadjusted | 2.016 | 1.489 | 2.731 | <0.001 |
| | **Adjusted for:** | | | | |
| **Demographics** | + Age | 2.018 | 1.489 | 2.734 | <0.001 |
| | +Year of diagnosis | 1.999 | 1.469 | 2.720 | <0.001 |
| **Disease factors** | + ER/PR status | 1.973 | 1.445 | 2.694 | <0.001 |
| **Area of residence** | + Auckland/Waikato | 2.027 | 1.479 | 2.777 | <0.001 |
| | + Deprivation | 1.546 | 1.078 | 2.216 | 0.018 |
| **Comorbidity** | + C3 score | 1.543 | 1.076 | 2.211 | 0.018 |

Although nearly a quarter of the HER2 status information was missing, it was modelled in a second (not included) model to ascertain the contribution that HER2 made. The contribution of HER2 to the disease factors of women in the screening age reduced the model from 1.925 to 1.864 (1.421–2.433; p<0.001).

For women diagnosed with breast cancer when they were younger than the screening age, ie, under 45 years old, the biggest contributing factor was deprivation (not sig.). HER2 status did not contribute to decreasing the OR (1.543; CI 1.044–2.280; p 0.029) for this younger group. For this age group it is likely that factors outside of those presented contribute to the increased OR.

## Contribution of mode of detection

To further understand the contribution of mode of presentation to advanced stage at diagnosis, we used forward stepwise logistic regression to analyse factors that contributed to the OR by screened vs non-screened detection pathways (Table 4). For those cases that were not-screened detected, we found that very few of the variables used in the modelling process (as outlined within the method section) accounted for the increased OR between the ethnic groups. HER2 status and age were the only two factors that were significant to outcomes for those women diagnosed on the symptomatic (non-screen detected) pathway. However, these decreased OR marginally, from 2.242 to 2.133.

**Table 4:** Adjusted OR and 95% CI derived from forward stepwise multivariate analyses for factors associated with advanced stage breast cancer at diagnosis in Pasifika women compared to New Zealand European women by mode of presentation (not stratified by age).

| | | **95% CI** | | |
|---|---|---|---|---|
| **Not screen detected** | **OR** | **Lower** | **Upper** | **P value** |
| A. Ethnicity | 2.242 | 1.885 | 2.667 | <0.001 |
| B. Ethnicity + HER2 | 2.231 | 1.825 | 2.729 | <0.001 |
| C. Ethnicity + HER2 + Age | 2.133 | 1.740 | 2.614 | <0.001 |
| **Screen detected cases** | | | | |
| A. Ethnicity | 1.495 | 0.967 | 2.313 | 0.071 |
| B. Ethnicity + HER2 | 1.390 | 0.859 | 2.249 | 0.180 |
| C. Ethnicity + HER2 + ER/PR status | 1.368 | 0.843 | 2.220 | 0.205 |
| D. Ethnicity + HER2 + ER/PR status + deprivation | 1.174 | 0.706 | 1.952 | 0.537 |

In contrast, nearly all the difference in OR for women who were diagnosed on a screen detected pathway was accounted for. Despite not reaching significance, HER2 status, ER/PR status and deprivation accounted for much of the increased OR for advanced stage at diagnosis, highlighting that if we can ensure that Pasifika women are on a screened pathway their risk of being diagnosed with advanced stage at presentation decreased substantially, with an adjusted OR of 1.174.

# Discussion

Early stage breast cancer at diagnosis typically has a better prognosis than for those with more advanced disease. Pasifika women within our study population were more likely to be younger at diagnosis, nearly twice as likely to be diagnosed at an advanced stage (Stage 3 and 4) and over two and a half times more likely to be diagnosed with metastatic disease than New Zealand European women. The higher odds of having advanced disease at diagnosis contributes negatively to outcomes from breast cancer for this population group.[29]

Factors that contributed to increased risk were aligned to what other researchers have found, that deprivation and mode of detection have a significant impact on advanced stage disease at diagnosis.[12–15] Biological factors, HER2 status and ER/PR status contributed in a small way to increased risk of being diagnosed with more advanced disease. Pasifika women were more likely to have a tumour equal to or greater than 50mm at diagnosis, more than twice as likely than for a New Zealand European woman. For Pasifika women who were post-menopausal this was 2.2 times greater than New Zealand European women. Adjusting for factors such as comorbidities and biological status made little difference to the risk of advanced disease.

The year 2005 was a significant year for Pasifika women. This was the year that Pasifika women had the lowest proportion of cancers diagnosed through screening (8.3%) and this was also the year that the screening age was extended to include women aged 45–49 years and 65–69 years.[30] The drop from over 40% detected by screening in 2004 to 8% in 2005 highlighted the significant disparity between the ethnicities during that period. Since 2008, over 50% of all breast cancers diagnosed were identified through screening.

Regular two-yearly breast screening has been shown to reduce the population risk of dying from breast cancer by about 30%.[31] Breast Screen Aotearoa (BSA) has focused on improving the participation of Pasifika women in mammography screening across New Zealand. This has resulted in participation rates of 72% for Pasifika women, exceeding the targeted coverage of 70% in the two years ending 31 March 2016.[32] Trends within BSA data highlight that participation of Pasifika women has steadily increased, and this has been linked to the decreased mortality rate in 'ever-screened' Pasifika women.[30]

Despite increased participation rates of Pasifika women in the national screening programme, we found that Pasifika women were less likely than New Zealand European women to be diagnosed through screening and more likely to be diagnosed at an advanced stage. There was also very little stage-shift in advanced disease at diagnosis for Pasifika women and no change to the gap between Pasifika and New Zealand European women. This could be due to an array of factors, including the younger age of the Pasifika population. However, the expected rate of reduction of advanced stage at diagnosis can differ from the actual proportion of late stage presentation for other reasons, including diagnostic improvements resulting in stage migration.[33]

Pasifika women are inequitably represented in areas of high deprivation. This may have some impact on access to timely and high-quality healthcare, including delays in diagnosis and treatment timeliness. High deprivation may also contribute to decreased accessibility to other facilities, for example private care. TinTin et al (2016) identified that outcomes were better for those able to access healthcare from a private institution compared to the public system.[34]

# Conclusion

Mode of detection, deprivation, age and tumour biology contribute to the risk of having advanced disease for Pasifika compared to New Zealand European women diagnosed with breast cancer. Proportionately, more Pasifika women are diagnosed with breast cancer younger than the screening age. Access to diagnostics from a younger age could facilitate diagnosis at an earlier stage for this group.

Pasifika women with breast cancer are much more likely to live with high deprivation. This disproportionately inhibits access to care. Addressing how women are diagnosed and improving access to earlier diagnosis has the potential to make a difference in numbers of Pasifika women who present with late stage disease. If screened regularly, Pasifika women have a similar proportion of advanced disease as New Zealand European women.

Further investigation into barriers to early presentation and early access to diagnostics is necessary to identify improved routes to diagnosis for the younger Pasifika population, and those that are outside of the screening age, to improve outcomes for this group.

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