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Characterizing breast cancer incidence and trends among Asian American, Native Hawaiian, and non-Hispanic White women in Hawai‘i, 1990–2014

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Abstract

Purpose: To characterize breast cancer (BC) incidence by age at diagnosis and BC subtype among disaggregated Asian American, Native Hawaiian, and Pacific Islander (AANHPI) women and non-Hispanic White (NHW) women in Hawai‘i.

Methods: Using 1990–2014 data from the Hawai‘i Tumor Registry, we estimated age-adjusted incidence rates (AAIR) of BC and the annual percent change in BC incidence by age (<50 and ≥50 years) and BC subtype (hormone receptor [HR]+/human epidermal growth factor receptor 2

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Author Contributions

This study was conceptualized by IC, AHW and UI. All authors contributed to the development of the study methodology. Data curation and formal analysis were performed by MAM and AV. Data visualizations were developed by MAM, AV, and UI. The first draft of the manuscript was written by UI. All authors reviewed and edited previous versions of the manuscript and all authors read and approved the final manuscript.

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval

This is a secondary analysis of publicly available, deidentified, aggregate data. Therefore, ethical approval was not required.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

[HER2]−, HR+/HER2+, HR−/HER2+, triple negative BC) for Filipino American (FA), Japanese American (JA), Native Hawaiian (NH), and NHW women.

Results: Among young (<50 years) women, annual BC incidence increased 2.9% (1994–2014) among JA and 1.0% (1990–2014) among NHW women. Incidence was highest among young JA women (2010–2014 AAIR 52.0 per 100,000; 95% confidence interval [CI] 45.6, 58.9). HR+/HER2− BC, the major BC subtype, was similarly highest among young JA women (AAIR 39.5; 95% CI 33.9, 45.4). Among older (≥50 years) women, annual BC incidence increased 1.6% (1990–2014) among FA and 4.2% (2006–2014) for JA women. BC incidence was highest among older NH women (AAIR 137.6, 95% CI 128.2, 147.4), who also displayed highest incidence of two subtypes: HR+/HER2− (AAIR 106.9; 95% CI 98.6, 115.5) and HR+/HER2+ (AAIR 12.1; 95% CI 9.4, 15.1).

Conclusion: We observed high and increasing BC incidence among JA women ages <50 years and high incidence among NH women ages ≥50 years. These results highlight racial and ethnic differences in BC incidence among disaggregated AANHPI populations in Hawai‘i by age and BC subtype.

Keywords

Breast cancer; breast cancer subtypes; incidence; Hawai‘i; race; ethnicity; age

INTRODUCTION

Breast cancer is the leading cause of cancer and the second-leading cause of cancer-related deaths among women in the United States (US) [1,2]. Established risk factors for breast cancer include a family history of breast cancer, older age at first full-term pregnancy, nulliparity, oral contraceptive use, physical inactivity, and alcohol consumption [3]. A noted difference in breast cancer risk by menopausal status is the role of body mass index; obesity is associated with a decreased risk of breast cancer among premenopausal women but an increased risk among postmenopausal women [4,5]. Most of the established risk factors largely reflect those identified for hormone receptor positive (HR+) breast cancers (estrogen receptor positive [ER+] or progesterone receptor positive [PR+]) or for luminal A (HR+ and human epidermal growth factor receptor 2 negative [HER2−]) breast cancers [6,7]. About 68% of all incident breast cancer cases are HR+/HER2− breast cancer subtypes, which are associated with the most favorable prognosis, whereas about 10% are triple negative breast cancers (TNBC; ER−/PR−/HER2−), which are associated with the poorest prognosis [8].

In 2014–2018, the state of Hawai‘i had the fifth highest breast cancer incidence in the US with an age-adjusted incidence rate (AAIR) of 139.6 cases per 100,000 women [2]. Hawai‘i is a racially and ethnically diverse state with a unique distribution of Asian American, Native Hawaiian, and Pacific Islander (AANHPI) populations, and has the highest proportion of Asian American residents in the US [9,10]. Recent work by Loo et.al. described the breast cancer incidence and trends among women in Hawai‘i with disaggregated groups of AANHPI women [11]. Using data from the National Cancer Institute’s (NCI) Surveillance, Epidemiology, and End Results (SEER) Program for 2010–2013, the study showed that breast cancer incidence was highest among Native Hawaiian women compared to Chinese,

Filipino, Japanese, and non-Hispanic White women in Hawai‘i, and with racial and ethnic differences in breast cancer trends and incidence by subtype, but incidence patterns by age were not evaluated [11].

Breast cancer incidence differs greatly by age and is four-times higher among women ages ≥50 years than women ages <50 years [12]. About 18% of all incident breast cancers in the US are diagnosed among women <50 years of age, who are more likely than older women to be diagnosed at advanced stages and with TNBC, with noted worse outcomes [12,13]. Furthermore, a study on the distribution of age at breast cancer diagnosis in the US revealed differences in the average age at diagnosis by race and ethnicity and called for additional work to describe these racial and ethnic differences [14]. Using 1992–2002 SEER incidence data, Fong et.al. described a bimodal distribution for age at breast cancer diagnosis among AANHPI women in Hawai‘i showing an early-onset peak around age 50 years and late-onset peak around age 70 years [15]. This is in contrast with the unimodal distribution with an early-onset peak (around age 50 years) observed among AANHPI women in mainland US [15]. However, in the Fong paper, the results were presented for all AANHPI women combined.

Given the high incidence and unique bimodal age distribution for breast cancer among women AANHPI in Hawai‘i, a highly diverse population, there is a need to fully understand age-specific breast cancer incidence patterns among distinct AANHPI racial and ethnic groups in the state. This report builds upon prior research [9] to examine breast cancer incidence and incidence trends among a multiethnic population of women in Hawai‘i, by age and breast cancer subtype separately by racial and ethnic group.

METHODS

Study data

Invasive breast cancer (ICD-O-3 C50.0–50.9) diagnosed among women in Hawai‘i from January 1, 1990 through December 31, 2014 were obtained from the Hawai‘i Tumor Registry, an NCI SEER registry, using the SEER*Stat database that includes details on specific AANHPI populations in the state [16]. SEER data on race and Hispanic ethnicity were generally based on patient’s medical records; although a patient can have multiple racial categories logged in SEER data, only the primary race variable in the database was used to classify cancer cases by race and Hispanic ethnicity categories [17]. Asian American and Native Hawaiian women were included in this analysis regardless of Hispanic ethnicity. For stability of incidence rates, we examined the four largest racial and ethnic groups: Filipino American, Japanese American, Native Hawaiian, and non-Hispanic White women.

Information on race and ethnicity, summary stage, and age at diagnosis are routinely reported to the registry. The SEER variable for summary stage was used, including localized and advanced (regional and distant disease) stage. Hormone receptor (HR) and HER2 status were available for the five-year period 2010–2014 only as HER2 status was not collected by SEER registries prior to 2010. We classified HR+ breast cancer as ER+ or PR+, and HR− breast cancer as ER− and PR−. HER2 status was classified as HER2+ or HER2−. Breast cancer subtypes were defined as HR+/HER2−, HR+/HER2+, HR−/HER2+, and TNBC

(HR−/HER2−). Subjects with missing subtype information, about 5% of Japanese American and non-Hispanic White women, and about 4% of Filipino American and Native Hawaiian women, were excluded from our subtype-specific analyses.

Statistical analysis

Using SEER*Stat, we abstracted data for a total of 18,621 female invasive breast cancer cases from Hawai'i's SEER registry, diagnosed between 1990–2014 among the Filipino American, Japanese American, Native Hawaiian, and non-Hispanic White population [16]. Race, ethnicity and age-specific population data for the state of Hawai'i were applied as denominators for the analysis. Incidence rates were calculated as cases per 100,000 women and age standardized to the 2000 US standard population [18]. Joinpoint regression models were used to calculate the annual percent change (APC) in incidence rates among all groups and for each racial and ethnic group. Among US women, the average age at menopause is 50 years, therefore all analyses were conducted by age at diagnosis, <50 years versus ≥50 years, to represent premenopausal and postmenopausal populations, respectively [19]. Up to five joinpoints were allowed. We examined AAIRs and 95% confidence intervals (CI) by age at diagnosis (<50 years versus ≥50 years) and breast cancer subtype (HR+/HER2−, HR+/HER2+, HR−/HER2+, and TNBC) for the most recent 5-year period (2010–2014), overall and by racial and ethnic group. The incidence rate ratios (IRR) were calculated by dividing each racial and ethnic group's 2010–2014 AAIR by the non-Hispanic White women's 2010–2014 AAIR [20].

APCs were considered statistically significant if the associated 95% CI excluded zero. IRRs were deemed statistically significant if the 95% CI excluded 1.00. All hypotheses were two-sided and assessed at a significance level of $p<0.05$. AAIRs, IRRs, and associated 95% CIs were calculated using SAS software version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

We describe the population characteristics of women with an invasive breast cancer diagnosis from 1990–2014 by racial and ethnic group in Table 1. The highest proportion of cases were diagnosed at ages 50–59 for Filipino American women (26.6%), ages 60–69 for Native Hawaiian women (27.4%), and ages 70+ for Japanese American (38.0%) and non-Hispanic White (29.5%) women. The highest proportion of advanced tumors (regional and distant) was observed among Native Hawaiian women (36.7%) with the lowest proportion observed among Japanese American women (25.1%). Native Hawaiian women had the highest proportion of HR+/HER2− breast cancer (76.2%). Filipino American and Native Hawaiian women had similar proportions of HR+/HER2+ breast cancer (9.1% for both), but Filipino American women had the highest proportion of the HR−/HER2+ (6.7%) and TNBC (10.1%) subtypes.

Breast cancer incidence trends and incidence among women ages <50 years

Breast cancer incidence increased an average of 0.6% per year (95% CI 0.1, 1.2) among young women, i.e., ages <50 years, of all race and ethnicities combined in 1990–2014 (Figure 1). Although breast cancer incidence decreased 7.1% annually (95% CI −17.9, 5.2)

for young Japanese American women from 1990–1994, incidence increased an average of 2.9% each year (95% CI 1.8, 4.0) from 1994–2014. Breast cancer incidence also increased 1.0% per year (1990–2014; 95% CI 0.1, 1.0) for young non-Hispanic White women. Breast cancer incidence was stable among young Filipino American (APC 0.0; 95% CI −1.4, 1.3) and Native Hawaiian women (APC −0.5; 95% CI −1.6, 0.5) from 1990–2014.

Among young women, the 2010–2014 breast cancer incidence was 38.4 per 100,000 women (95% CI 35.9, 41.0) for all racial and ethnic groups (Table 2). Incidence was highest among Japanese American (AAIR 52.0; 95% CI 45.6, 58.9) followed by non-Hispanic White (AAIR 39.8; 95% CI 34.8, 45.1), Native Hawaiian (AAIR 33.2; 95% CI 28.7, 38.1), and Filipino American women (AAIR 31.7; 95% CI 27.4, 36.4). Compared to young non-Hispanic White women, incidence rates among young Japanese American women were 31% higher (IRR 1.31; 95% CI 1.09, 1.56) whereas incidence among young Native Hawaiian woman and young Filipino American women were lower (IRR 0.84; 95% CI 0.69, 1.01 and IRR 0.80; 95% CI 0.66, 0.97, respectively), although the difference was not statistically significant among Native Hawaiian women.

HR+/HER2− breast cancer was the most commonly diagnosed subtype among young women (AAIR 26.7; 95% CI 24.6, 28.9) (Table 2). Incidence of HR+/HER2+ breast cancer was 4.4 per 100,000 women (95% CI 3.6, 5.3), followed by TNBC (AAIR 3.2; 95% CI 2.5, 4.0), and the HR−/HER2+ breast cancer subtype (AAIR 2.2; 95% CI 1.7, 2.9). The incidence for the HR+/HER2− subtype was also highest among young Japanese American women (2010–2014 AAIR 39.5; 95% CI 33.9, 45.4), intermediate in young non-Hispanic White women (AAIR 26.7; 95% CI 22.7, 31.1) and young Native Hawaiian women (AAIR 22.9; 95% CI 19.2, 27.0), and lowest among young Filipino American women (AAIR 20.5; 95% CI 17.1, 24.3). Compared to young non-Hispanic White women, incidence of HR+/HER2− breast cancer was higher among young Japanese American women (IRR 1.31, 95% CI 1.09, 1.56) and lower among young Filipino American women (IRR 0.80; 95% CI 0.66, 0.97). The incidence of HR+/HER2+, HR−/HER2+ and TNBC varied slightly by racial and ethnic group among young women. The incidence of HR+/HER2+ breast cancer was notably lowest among young Native Hawaiian women (AAIR 3.4; 95% CI 2.1, 5.1) while young Japanese American women had a notably high incidence of TNBC (AAIR 4.3; 95% CI 2.6, 6.4) but these subtype differences were not statistically significant by race and ethnicity.

Breast cancer incidence trends and incidence among women ages ≥50 years

Among all racial and ethnic groups, breast cancer incidence among older (ages ≥50 years) women increased 4.4% per year (95% CI 2.1, 6.7) from 1990–1998, followed by a decrease of 2.7% per year (95% CI −4.9, −0.4) from 1998–2006, then an increase of 2.4% per year (95% CI 0.7, 4.2) from 2006–2014 (Figure 1). From 1990–2014, the largest increase in incidence trends was a 5.0% annual increase (95% CI 2.9, 7.0) among Japanese American women in 1990–2001, followed by a non-significant decreasing trend in 2001–2006 (APC −6.7; 95% CI −14.2, 1.5) and then a 4.2% increase per year (95% CI 1.2, 7.3) from 2006–2014. An annual 1.6% increase (95% CI 0.8, 2.4) was observed among older Filipino American women, but incidence remained stable among older Native Hawaiian women

(APC 0.3; 95% CI −0.4, 1.1) and non-Hispanic White women from 1990–2014 (APC −0.2; 95% CI −0.8, 0.3).

Among older women, Native Hawaiian women had the highest breast cancer incidence from 2010–2014 (AAIR 137.6; 95% CI 128.2, 147.4) (Table 2). This was followed by the breast cancer incidence in older Japanese American women (AAIR 107.1; 95% CI 100.9, 113.4), non-Hispanic White women (AAIR 100.7; 95% CI 94.7, 106.9), and Filipino American women who had the lowest AAIR in this age group (AAIR 77.9; 95% CI 71.8, 84.2). Compared to non-Hispanic White women, incidence rates were statistically significantly higher among older Native Hawaiian women (IRR 1.37; 95% CI 1.25, 1.49) while the higher rates among older Japanese American women were not statistically significantly different (IRR 1.06; 95% CI 0.98, 1.15). Incidence rates among older Filipino American women were 23% lower than rates among older non-Hispanic White women (IRR 0.77; 95% CI 0.70, 0.85).

In older women, as in younger women, HR+/HER2− breast cancer was the most common breast cancer subtype (AAIR 77.1; 95% CI 74.2, 79.9), which was followed by TNBC (AAIR 8.5; 95% CI 7.6, 9.5), HR+/HER2+ (AAIR 7.3; 95% CI 6.4, 8.2) and HR−/HER2+ breast cancer (AAIR 4.2; 95% CI 3.6, 4.9) across all racial and ethnic groups combined (Table 2). The incidence of the HR+/HER2− and HR+/HER2+ subtypes were highest among older Native Hawaiian women (AAIR 106.9; 95% CI 98.6, 115.5 and AAIR 12.1; 95% CI 9.4, 15.1, respectively). Among older Native Hawaiian women, incidence of HR+/HER2− breast cancer was 1.38 times that of non-Hispanic White women (95% CI 1.25, 1.49) and incidence of HR+/HER2+ was about twice that of non-Hispanic White women (IRR 2.09, 95% CI 1.25, 1.49). HR+/HER2− incidence was lowest among older Filipino American women (AAIR 55.5; 95% CI 50.5, 60.9); the IRR compared to non-Hispanic White women was 0.72 (95% CI 0.64, 0.80). The incidence of HR−/HER2+ was lowest among older Japanese American women (AAIR 3.6; 95% CI 2.5, 4.8) but incidence was similar across all other racial and ethnic groups for this subtype. Conversely, Japanese American women had the highest incidence of TNBC among older women (AAIR 9.4; 95% CI 7.6, 11.3), although rates were otherwise similar across racial and ethnic groups.

DISCUSSION

In this study, we characterized the incidence and trends across four racial and ethnic groups by age and breast cancer subtype using population-based data from the Hawai‘i Tumor Registry. We observed differences in breast cancer incidence trends from 1990 through 2014 by race and age. A small but statistically significant 0.6% average annual increase in breast cancer incidence was observed from 1990–2014 among all young (ages <50 years) women combined. Young Japanese American and non-Hispanic White women had significantly increasing trends in 1994–2014 and 1990–2014, respectively. Increasing breast cancer incidence trends were also observed among older women, with the largest increases among Japanese American and Filipino American women. In 2010–2014, breast cancer incidence was highest among Japanese American women ages <50 years and Native Hawaiian women aged ≥50 years. Not surprisingly, a high incidence of HR+/HER2− was also observed among young Japanese American women and older Native Hawaiian women.

Older Native Hawaiian women also had the highest incidence of HR+/HER2+ breast cancer. Filipino American women in both age groups had the lowest incidence of overall breast cancer and HR+/HER2− breast cancer.

Obesity is an important risk factor for postmenopausal breast cancer and has been estimated to account for about 10% of the breast cancers diagnosed in the US [21,22]. The high incidence of HR+ breast cancer diagnosed among older Native Hawaiian women may be explained, in part, by a higher prevalence of obesity and high waist-hip ratios observed among Native Hawaiian women compared to non-Hispanic White and Asian American women in Hawai‘i [23–25]. Sarink and colleagues recently reported in the Multiethnic Cohort Study a positive association between obesity and ER+ postmenopausal breast cancer, with the strongest hazard ratios observed among Native Hawaiian (hazard ratio 1.47; 95% CI 1.14–1.89) and Japanese American women (hazard ratio 1.63; 95% CI 1.32–2.02).

Among premenopausal women, reproductive factors associated with an increased risk of breast cancer include early age at menarche and late age at first full-term pregnancy [26–28]. Aspects of acculturation among young Japanese Americans may contribute to the increasing breast cancer incidence, such as having children later in life and fewer children [3]. Prior studies in Japan have reported an increasing prevalence of decreasing age at menarche, older age at first full-term pregnancy, higher nulliparity, increasing height, and a higher alcohol intake among younger birth cohorts of Japanese women [29]. Reproductive risk factors are also associated with an increased risk of HR+ breast cancers and a large Danish study found that increasing age at first full-term pregnancy was associated with a higher risk of ER+ breast cancer among women ages <50 years compared to women ages ≥50 years [30–32]. Reproductive factors may contribute to the increased incidence of HR+ breast cancers among young Japanese American women in Hawai‘i.

We observed some similarities in breast cancer incidence patterns for Filipino and Japanese women in Hawai‘i and California [33]. In California, incidence was stable among young Filipino American women but statistically significantly increased for older Filipino American women during overlapping time periods (1990–2014 in Hawai‘i and 1988–2013 in California). However, incidence patterns for Japanese Americans in the two study regions were somewhat divergent. Breast cancer incidence was stable for young Japanese American women in California (1988–2013 APC 0.6) but increased for young Japanese American women in Hawai‘i (1994–2014 APC 2.9). Among older Japanese women, the California study described an increase in breast cancer incidence from 1988–1998 (APC 3.9) which was similar to the increase we observed from 1990–2001, but unlike our study, statistically significant changes in breast cancer incidence were not observed from 1998–2013. These findings suggest similar patterns in lifestyle and risk factors among Filipino populations in Hawai‘i and California, but that patterns of postmenopausal weight gain, use of menopausal hormones, and combinations of other factors may differ among older Japanese American women in Hawai‘i compared to California.

We also compared breast cancer trends and incidence of Filipino and Japanese women in the US to rates in the Philippines or in Japan. According to a 2018 Global Cancer Observatory report, breast cancer incidence in the Philippines decreased for both young (2.4% per

year) and older (2.2% per year) women during 1983–2012 while incidence was stable among young Filipino American women in Hawai‘i (1990–2014 APC 0.0) but increased 1.6% per year (1990–2014) among older Filipino American women [34]. In Japan, breast cancer incidence increased considerably from 1998–2010 among young (APC 3.8) and older (APC 5.6) Japanese women [34]. Furthermore, the Japanese Breast Cancer Registry (JBCR) described a high incidence of breast cancer diagnosed among young women in 2004–2011, which coincided with the high incidence of breast cancer that we observed among young Japanese American women in Hawai‘i [35]. Overall, these comparisons suggest similar trends in breast cancer incidence among Filipino American women in Hawai‘i and in California, but that trends in the US may differ from trends observed in the Philippines. In contrast, Japanese Americans in Hawai‘i and in Japan displayed similar trends but they differ from the trends for Japanese American women in California.

After the Women’s Health Initiative’s 2002 results showed that estrogen + progestin hormone therapy was associated with an increased risk of cardiovascular disease and breast cancer [36], a sharp decline in hormone therapy prescriptions [37,38] as well as a decline in postmenopausal breast cancer incidence was observed [39]. We observed decreasing trends in breast cancer incidence among Japanese American and non-Hispanic White women of ages ≥50 years in Hawai‘i. However, we observed increasing breast cancer incidence rates among Filipino American women and stable trends among Native Hawaiians. The trends observed among Japanese American and non-Hispanic White women are consistent with some other reports that found decreases in breast cancer incidence [39,40]. There are likely other breast cancer risk factors operating in the older female population in Hawai‘i.

This study has several strengths. In this analysis, using disaggregated AANHPI race and ethnic groups allowed for an improved assessment of populations at high-risk for breast cancer in Hawai‘i. The Hawai‘i Tumor Registry has well-established definitions of breast cancer and subtype which minimized misclassification of the outcome. To our knowledge this paper presents the first summary of breast cancer incidence and trends among AANHPI women in Hawai‘i by race, ethnicity, and age, with assessments by breast cancer subtype, including HER2 status. However, a limitation of using registry data is the misclassification of race and ethnicity which could lead to biased results and cannot be ruled out, although this is likely to be minimal based on previous studies [41,42]. Small numbers in some of the age-, race-, and ethnic-specific analyses by breast cancer subtypes precluded adequate statistical power to detect statistically significant differences in the incidence of HR− breast cancers.

CONCLUSION

This study continued previous work to describe differences in breast cancer risk among disaggregated AANHPI women in Hawai‘i. We observed racial and ethnic differences in breast cancer incidence and trends among specific AANHPI women in Hawai‘i by age. We found that Japanese American women have the highest incidence of breast cancer among women ages <50 years and Native Hawaiian women have the highest incidence of breast cancer among women ages ≥50 years. It is important to evaluate patterns in breast cancer incidence to identify high-risk women that may benefit from targeted prevention

and screening efforts. Trends in breast cancer incidence across racial and ethnic groups in Hawai‘i had not previously been reported by age, and more importantly, studies of breast cancer risk factors among young women in Hawai‘i are sparse. Additional research is warranted to explore the genetic, environmental, and social factors that contribute to differences in breast cancer risk among disaggregated AANHPI women. This study affirms the importance of evaluating cancer risk among disaggregated racial and ethnic groups and with considerations of differences by age.

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Data Availability

The data analyzed in this study are available from the Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 9, plus remainder of CA and NJ, Nov 2016 Sub (1990–2014) detailed API plus White Non-Hispanic - pops projected from populations (no HTR adjustment), National Cancer Institute, DCCPS, Surveillance Research Program, released May 2017, based on the November 2016 submission.

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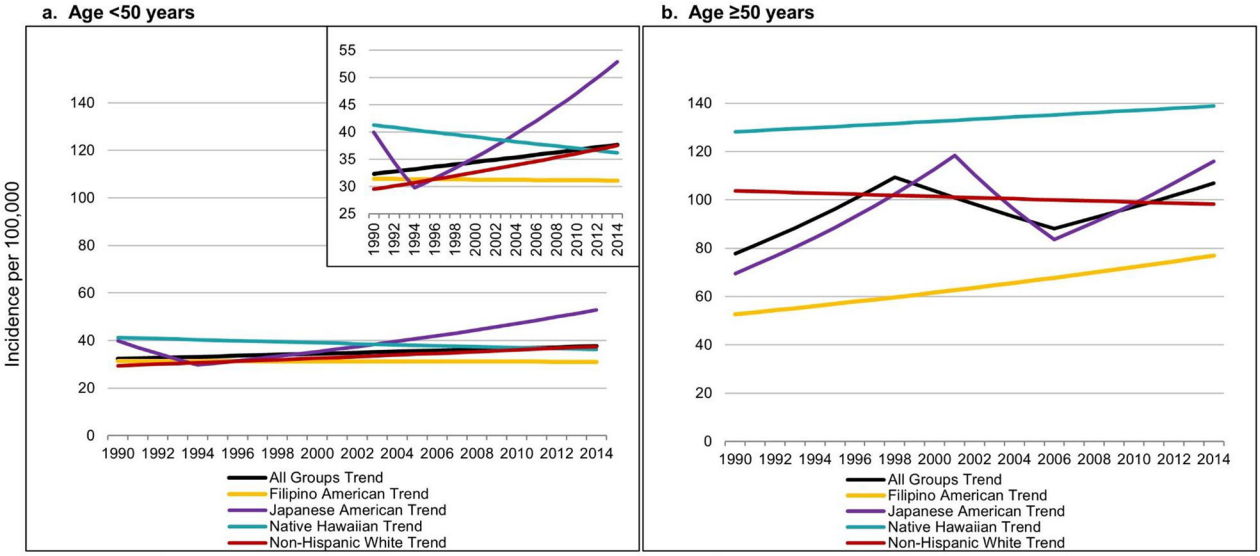

Race and Ethnicity	Age <50 years		Age ≥50 years	
	Year segment	*APC (95% CI)*	*Year segment*	*APC (95% CI)*
All Groups	1990-2014	0.6 (0.1, 1.2)*	1990-1998	4.4 (2.1, 6.7)*
			1998-2006	-2.7 (-4.9, -0.4)*
			2006-2014	2.4 (0.7, 4.2)*
Filipino American	1990-2014	0 (-1.4, 1.3)	1990-2014	1.6 (0.8, 2.4)*
Japanese American	1990-1994	-7.1 (-17.9, 5.2)	1990-2001	5.0 (2.9, 7.0)*
	1994-2014	2.9 (1.8, 4.0)*	2001-2006	-6.7 (-14.2, 1.5)
			2006-2014	4.2 (1.2, 7.3)*
Native Hawaiian	1990-2014	-0.5 (-1.6, 0.5)	1990-2014	0.3 (-0.4, 1.1)
Non-Hispanic White	1990-2014	1.0 (0.1, 1.9)*	1990-2014	-0.2 (-0.8, 0.3)

Figure 1. Breast cancer incidence rates and trends in Hawai‘i by race and ethnicity and age, 1990–2014

*APC statistically significantly differs from 0 at $P<0.05$

Abbrevations: APC, annual percent change; CI, confidence interval

Table 1.

Population characteristics among women diagnosed with invasive breast cancer in Hawai‘i by race and ethnicity, 1990–2014

	Total	Filipino American	Japanese American	Native Hawaiian	Non-Hispanic White
N (%)	18621 (100)	2602 (14.0)	6502 (34.9)	3928 (21.1)	5589 (30.0)
Age					
>30	83 (0.4)	18 (0.7)	15 (0.2)	28 (0.7)	22 (0.4)
30–39	868 (4.7)	180 (6.9)	205 (3.2)	230 (5.9)	253 (4.5)
40–49	3085 (16.6)	557 (21.4)	874 (13.4)	718 (18.3)	936 (16.7)
50–59	4460 (24.0)	691 (26.6)	1318 (20.3)	1070 (27.2)	1381 (24.7)
60–69	4683 (25.1)	638 (24.5)	1619 (24.9)	1078 (27.4)	1348 (24.1)
70+	5442 (29.2)	518 (19.9)	2471 (38.0)	804 (20.5)	1649 (29.5)
Stage					
Localized	12633 (69.1)	1659 (64.9)	4811 (74.9)	2442 (63.3)	3721 (68.5)
Regional + Distant	5638 (30.9)	898 (35.1)	1611 (25.1)	1416 (36.7)	1713 (31.5)
Subtype (2010–2014)					
HR+/HER2−	3538 (74.8)	568 (70.1)	1153 (75.9)	783 (76.2)	1034 (75.2)
HR+/HER2+	370 (7.8)	74 (9.1)	102 (6.7)	93 (9.1)	101 (7.3)
HR−/HER2+	207 (4.4)	54 (6.7)	52 (3.4)	45 (4.4)	56 (4.1)
Triple Negative	396 (8.4)	82 (10.1)	138 (9.1)	66 (6.4)	110 (8.0)
Unknown	220 (4.7)	32 (4.0)	74 (4.9)	40 (3.9)	74 (5.4)
Year of Diagnosis					
1990–1994	2738 (14.7)	297 (11.4)	1027 (15.8)	507 (12.9)	907 (16.2)
1995–1999	3510 (18.8)	427 (16.4)	1320 (20.3)	710 (18.1)	1053 (18.8)
2000–2004	3748 (20.1)	463 (17.8)	1367 (21.0)	802 (20.4)	1116 (20.0)
2005–2009	3894 (20.9)	605 (23.3)	1269 (19.5)	882 (22.5)	1138 (20.4)
2010–2014	4731 (25.4)	810 (31.1)	1519 (23.4)	1027 (26.1)	1375 (24.6)

*Data presented as frequencies and column percentages.

Abbreviations: HER2, human epidermal growth factor receptor 2; HR, hormone receptor; (−), negative; (+), positive.

Table 2.

Breast cancer incidence rates and incidence rate ratios by race and ethnicity and breast cancer subtype among women ages <50 years and women ages ≥50 years in Hawai‘i, 2010–2014.

Breast Cancer Characteristic	Race and Ethnicity	Age <50			Age ≥50		
		N_{cases}	Incidence (95% CI)	IRR (95% CI)	N_{cases}	Incidence (95% CI)	IRR (95% CI)
All Breast Cancer							
	All Groups	865	38.4 (35.9, 41.0)		3866	101.6 (98.4, 104.9)	
	Non-Hispanic White	237	39.8 (34.8, 45.1)	1.00 (ref)	1138	100.7 (94.7, 106.9)	1.00 (ref)
	Filipino American	190	31.7 (27.4, 36.4)	**0.80 (0.66, 0.97)**	620	77.9 (71.8, 84.2)	**0.77 (0.70, 0.85)**
	Japanese American	242	52.0 (45.6, 58.9)	**1.31 (1.09, 1.56)**	1277	107.1 (100.9, 113.4)	1.06 (0.98, 1.15)
	Native Hawaiian	196	33.2 (28.7, 38.1)	0.84 (0.69, 1.01)	831	137.6 (128.2, 147.4)	**1.37 (1.25, 1.49)**
HR+/HER2−							
	All Groups	603	26.7 (24.6, 28.9)		2935	77.1 (74.2, 79.9)	
	Non-Hispanic White	159	26.7 (22.7, 31.1)	1.00 (ref)	875	77.6 (72.3, 83.1)	1.00 (ref)
	Filipino American	123	20.5 (17.1, 24.3)	**0.77 (0.61, 0.97)**	445	55.5 (50.5, 60.9)	**0.72 (0.64, 0.80)**
	Japanese American	186	39.5 (33.9, 45.4)	**1.48 (1.20, 1.83)**	967	81.8 (76.4, 87.3)	1.05 (0.96, 1.16)
	Native Hawaiian	135	22.9 (19.2, 27.0)	0.86 (0.68, 1.08)	648	106.9 (98.6, 115.5)	**1.38 (1.24, 1.53)**
HR+/HER2+							
	All Groups	98	4.4 (3.6, 5.3)		272	7.3 (6.4, 8.2)	
	Non-Hispanic White	30	5.1 (3.4, 7.2)	1.00 (ref)	71	5.8 (4.5, 7.3)	1.00 (ref)
	Filipino American	29	4.9 (3.3, 6.8)	0.95 (0.57, 1.58)	45	5.8 (4.2, 7.6)	1.00 (0.69, 1.45)
	Japanese American	19	4.2 (2.5, 6.4)	0.83 (0.46, 1.47)	83	7.2 (5.6, 8.9)	1.23 (0.90, 1.69)
	Native Hawaiian	20	3.4 (2.1, 5.1)	0.67 (0.38, 1.17)	73	12.1 (9.4, 15.1)	**2.09 (1.50, 2.89)**
HR−/HER2+							
	All Groups	50	2.2 (1.7, 2.9)		157	4.2 (3.6, 4.9)	
	Non-Hispanic White	*	*	*	49	4.6 (3.4, 6.0)	1.00 (ref)
	Filipino American	16	2.7 (1.5, 4.1)	*	38	4.7 (3.3, 6.4)	1.03 (0.68, 1.58)
	Japanese American	11	2.6 (1.3, 4.4)	*	41	3.6 (2.5, 4.8)	0.78 (0.51, 1.17)
	Native Hawaiian	16	2.7 (1.5, 4.1)	*	29	4.7 (3.1, 6.5)	1.01 (0.64, 1.61)
Triple Negative							

Breast Cancer Characteristic	Race and Ethnicity	Age <50			Age ≥50		
		N_{cases}	Incidence (95% CI)	IRR (95% CI)	N_{cases}	Incidence (95% CI)	IRR (95% CI)
	All Groups	72	3.2 (2.5, 4.0)		324	8.5 (7.6, 9.5)	
	Non-Hispanic White	19	3.2 (1.9, 4.8)	1.00 (ref)	91	8.0 (6.4, 9.8)	1.00 (ref)
	Filipino American	15	2.5 (1.4, 3.9)	0.79 (0.40, 1.55)	67	8.7 (6.7, 10.9)	1.08 (0.79, 1.48)
	Japanese American	20	4.3 (2.6, 6.4)	1.36 (0.72, 2.54)	118	9.4 (7.6, 11.3)	1.17 (0.89, 1.54)
	Native Hawaiian	18	3.1 (1.9, 4.8)	0.99 (0.52, 1.89)	48	7.8 (5.7, 10.2)	0.97 (0.68, 1.37)

*Cannot calculate rates or IRRs due to case count ≤10 among Non-Hispanic White women

Abbreviations: CI, confidence interval; HER2, human epidermal growth factor receptor 2; HR, hormone receptor; IRR, incidence rate ratio; (−), negative; (+), positive.