# Racial/ethnic differences in initiation of adjuvant hormonal therapy among women with hormone receptor-positive breast cancer

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## Abstract

**Purpose**—Mortality after breast cancer diagnosis is known to vary by race/ethnicity even after adjustment for differences in tumor characteristics. As adjuvant hormonal therapy decreases risk of recurrence and increases overall survival among women with hormone receptor-positive tumors, treatment disparities may play a role. We explored racial/ethnic differences in initiation of adjuvant hormonal therapy, defined as 2 or more prescriptions for tamoxifen or aromatase inhibitor filled within the first year after diagnosis of hormone receptor-positive localized or regional stage breast cancer. The sample included women diagnosed with breast cancer enrolled in Kaiser Permanente Northern California (KPNC).

**Methods**—Odds ratios [OR] and 95% confidence intervals [CI] compared initiation by race/ethnicity (Hispanic, African American, Chinese, Japanese, Filipino, and South Asian vs. non-Hispanic White (NHW)) using logistic regression. Covariates included age and year of diagnosis, area-level socioeconomic status, co-morbidities, tumor stage, histology, grade, breast cancer surgery, radiation and chemotherapy use.

**Results**—Our sample included 13,753 women aged 20–79 years, diagnosed between 1996 and 2007, and 70% initiated adjuvant hormonal therapy. In multivariable analysis, Hispanic and Chinese women were less likely than NHW women to initiate adjuvant hormonal therapy ([OR]=0.82; [CI] 0.71–0.96 and [OR]=0.78; [CI] 0.63–0.98; respectively).

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**Conclusions**—Within an equal access, insured population, lower levels of initiation of adjuvant hormonal therapy were found for Hispanic and Chinese women. Findings need to be confirmed in other populations and the reasons for under-initiation among these groups need to be explored.

## INTRODUCTION

Five-year age-adjusted breast cancer survival rates in the U.S. are highest among Asian/ Pacific Islanders (89.4%) followed by non-Hispanic White (87.5%), Hispanic (85.3%) and African American women (75.0%) [1]. Among Asian American subgroups, survival is highest among Japanese (91.5%) followed by Chinese (85.5%) and Filipina women (85.3%) [2]. Disparities in breast cancer survival may be due to racial/ethnic differences in stage at diagnosis, tumor biology (including hormone receptor status), socioeconomic characteristics and breast cancer treatment [3–5]. However, survival disparities are not fully explained by these factors, as African American and Hispanic women remain at increased risk of breast cancer death compared to non-Hispanic White women, after adjustment for stage, hormone receptor-status, socioeconomic status, and surgical and radiation treatment (HR=1.5 and HR=1.1, respectively) [5]. Differences in the use of other types of breast cancer treatment not captured by population-based cancer registries, including adjuvant chemotherapy and adjuvant hormonal therapy, may contribute to remaining survival differences [5–7].

Adjuvant hormonal therapy is associated with improved disease-free and overall survival among women with hormone receptor-positive breast cancer, irrespective of age, menopausal status, lymph node status or chemotherapy use [8–10]. A small number of studies to date have documented racial/ethnic differences in use of adjuvant hormonal therapy, indicating that, compared to non-Hispanic White women, Chinese [11], African American [6, 12, 13] and Hispanic women [12] are significantly less likely to use adjuvant hormonal therapy.

The optimal duration of use for adjuvant hormonal therapy is five years [14, 15], and early discontinuation and non-adherence to adjuvant hormonal therapy have been associated with mortality [10]. Although few prior adherence studies have reported on racial/ethnic differences in adherence to adjuvant hormonal breast cancer therapy, a variety of other factors have been associated with non-adherence to adjuvant hormonal therapy including patient perception of low risk for recurrence [16], experience of adverse events resulting from use of adjuvant hormonal therapy [17–19], older patient age [20], low socioeconomic status regardless of health insurance status [21], poor patient-provider communication [22], and psychological factors [18]. These factors may differ across racial/ethnic groups, leading to differences in adherence, potentially contributing to racial/ethnic differences in breast cancer survival.

In an effort to build upon findings from prior studies, we examined whether there were racial/ethnic differences in the initiation of adjuvant hormonal therapy among a large, racially and ethnically diverse population of women enrolled in Kaiser Permanente Northern California (KPNC), diagnosed with hormone receptor-positive breast cancer between January 1, 1996 and June 30, 2007. In light of persistent racial/ethnic differences in breast cancer survival at the national level, after controlling for tumor characteristics and surgical and radiation treatment, we were interested in examining whether there were racial/ethnic differences in the initiation of adjuvant hormonal therapy within the KPNC population.

## METHODS

### Study setting

KPNC is a large integrated health system providing comprehensive services to approximately 3.2 million individuals living in the Sierras, the San Francisco Bay Area, Sacramento, and the Central Valley of the state. Members of KPNC receive virtually all of their care from physicians affiliated with KPNC. KPNC maintains its own medical centers and clinics and its own hospital and ambulatory pharmacies, where patients receive over 90% of their prescriptions. Pharmacy data is maintained electronically. KPNC also maintains a cancer registry which reports to the Bay Area Surveillance, Epidemiology, End Results (SEER) program and the California State Cancer Registry.

### Study sample / Inclusion criteria

Through the KPNC cancer registry, we identified all female members of KPNC who were diagnosed with their first primary breast cancer between January 1, 1996 and June 30, 2007. Residence at the time of breast cancer diagnosis was geocoded and linked to 2000 U.S. Census data on education level, poverty and income at the block group level. We restricted our cohort to include women with estrogen (ER) and/or progesterone receptor (PR) positive localized or regional stage invasive breast cancer, who were members of KPNC during the year prior to diagnosis, and remained alive and enrolled in KPNC for the entire year following diagnosis. The Institutional Review Boards (IRB) at KPNC and Fred Hutchinson Cancer Research Center approved secondary data analysis.

Cancer registry and Census data were available for a total of 20,421 women who were diagnosed with breast cancer between January 1, 1996 and June 30, 2007 and enrolled in KPNC during the year prior to diagnosis. The cancer registry records information on hormone receptor status, as obtained from pathology reports, and 15,730 women in the sample were diagnosed with hormone-receptor positive breast cancer; 3,786 women with hormone receptor-negative tumors (negative for both ER and PR) and 905 women with tumors of unknown hormone receptor status were excluded.

Among women with hormone receptor-positive breast cancer, 15,320 were diagnosed with localized or regional stage breast cancer, classified according to SEER summary staging (localized, regional with direct extension or positive lymph nodes, or regional with direct extension including positive lymph nodes). A total of 15,035 of these women were identified in the KPNC cancer registry to be Non-Hispanic White, Hispanic, African American, Chinese, Japanese, Filipino, or South Asian (Asian Indian or Pakistani). All other racial/ethnic groups were excluded. Of the remaining sample, 13,863 women were between the ages of 20 and 79 years at time of diagnosis, and our final sample included 13,753 of these women who remained enrolled in KPNC for at least one year after breast cancer diagnosis. Our sample differed from two prior studies on adjuvant hormonal therapy adherence in KPNC, whose sample selection criteria resulted in the inclusion of primarily stage I patients [10, 23].

### Data measures

**Initiation of adjuvant hormonal breast cancer treatment—**Information on the initiation of adjuvant hormonal therapy after breast cancer diagnosis was obtained from KPNC outpatient pharmacy data. For each woman, prescriptions for tamoxifen, anastrazole, exemestane, and letrozole within the first year after diagnosis were reviewed, and women with at least two documented prescriptions that were filled for any of these medications within this time period were considered to have initiated adjuvant hormonal therapy. This definition is distinct from prior analyses of KPNC data [10, 23], which defined initiation as

one or more prescriptions filled. In our analysis, women with no records for these medications documented in KPNC pharmacy data, women with only one filled prescription, and women initiating their first two prescriptions later than one year after breast cancer diagnosis were considered to be non-initiators. This time restriction was applied due to: a) the lack of reliable information on recurrences from electronic data, and b) the low likelihood of recurrences within the first year after diagnosis (reported to be 5% overall in similarly staged patients) [24]. We wanted to avoid classifying women who began treatment later than one year after diagnosis as "initiators", given the possibility that they initiated therapy to treat recurrent rather than primary breast cancer.

**Race/ethnicity—**Information on race/ethnicity was obtained from the KPNC cancer registry. Race/ethnicity information in KPNC is typically obtained upon inpatient admission, or in our case, at the time of breast cancer diagnosis or admission for treatment. At the time of admission, race/ethnicity may be obtained directly from the patient or a relative or inferred by the attending health professional based on observation. Cancer registrars abstract this information and it is recorded in the patient's cancer registry record. Only those women who were identified as Non-Hispanic White, Hispanic, African American, Chinese, Japanese, Filipino or South Asian were included in the sample. The categories are provided as mutually exclusive.

**Covariates—**Covariates of interest as potential confounding characteristics included age at diagnosis, marital status, and year of diagnosis. Geocoded information on area-level education, poverty and income pertaining to 2000 Census-block group of residence at time of diagnosis was also available, and an aggregate score for socioeconomic status (SES) was generated for each patient following the methods outlined by Yost et al [25]. Component SES scores were categorized into quintiles based on the California statewide distribution.

ICD-9-CM diagnostic codes in KPNC inpatient and outpatient claims from patient visits beginning one year prior to breast cancer diagnosis were reviewed to identify those with a history of any of the comorbid conditions included in the Klabunde adaptation of the Charlson comorbidity index [26, 27]. Each condition was weighted accordingly, and each patient was assigned a summary score based on this index.

Tumor characteristics were obtained from KPNC cancer registry records. Tumor stage was categorized using the SEER summary stage classification system (localized or regional) and tumor size was categorized as <1cm or 1cm. Tumor histology type was collapsed into three categories including; ductal (ICD-O code 8500), lobular/mixed ductal lobular (ICD-O codes 8520, 8522, 8524), and all other specified histology types. Information on tumor grade (I–IV) was also available, as was information on use of other breast cancer treatments, including type of surgery performed for breast cancer (lumpectomy, mastectomy, or no surgery), and whether or not radiation and chemotherapy were received. The surgical, radiation and chemotherapy data were based on information recorded in the KPNC cancer registry on "first course of treatment".

### Statistical analysis

Distributions of key background and demographic characteristics, breast cancer tumor characteristics, prognostic factors and other covariates were examined across racial/ethnic groups, and comparing initiators to non-initiators. The descriptive statistics presented are based on non-missing values, and percentages of cases with missing data are provided in table footnotes. Chi-square tests were used to assess significant differences between groups with respect to categorical variables and t-tests were used to assess differences with respect to continuous variables (two-tailed significance level $p<0.05$).

Odds ratios [OR] and 95% confidence intervals [CI] were estimated for each racial/ethnic group, comparing initiation of adjuvant hormonal therapy for each group to non-Hispanic White women as the referent category. ORs were calculated using logistic regression with robust variance adjustment. Covariates selected for inclusion in logistic regression models were those that were associated in bivariate analysis with race/ethnicity, and with the outcome of interest (initiation, or timing of initiation) among the referent group (non-Hispanic White women). Final models included age at diagnosis, year of diagnosis, marital status, quintile of aggregate SES, Charlson comorbidity score, SEER stage, tumor histology, tumor grade, and first course of treatment, including type of surgical and radiation treatment, and use of chemotherapy. Analyses were conducted using Stata/SE Version 11.0.

We examined whether the association between race/ethnicity and initiation of adjuvant therapy varied according to a) early vs. late onset of breast cancer (<55 years vs. 55 years) and b) area-level SES (quintiles 1–3 vs. quintiles 4–5). Interactions for each of these variables were explored using the Wald test (significance level p<0.05) but were not statistically significant.

## RESULTS

### Patient characteristics

A total of 13,753 women in the KPNC system met eligibility criteria. Non-Hispanic White women made up the majority of the sample (76%), followed by Hispanic (8%), African American (6%), Filipino (4%), Chinese (4%), Japanese (2%) and South Asian women (<1%) (see Table 1). Mean age at diagnosis was 59 years ([SD]=11). Non-Hispanic White and Japanese women were the oldest on average at time of diagnosis while South Asian women were the youngest. African American women were the least likely to be married or living with a partner, and lived in areas with the lowest SES. Japanese women lived in areas with the highest SES. Comorbid conditions were most common among African American women and least common among South Asian women. Localized stage tumors were most common among Chinese, Japanese and non-Hispanic White women. Ductal tumors were most common among Chinese, Japanese and Filipino women. High grade tumors (grade II or higher) were most common among African American and Filipina women. Use of chemotherapy treatment was least common among non-Hispanic White women and most common among South Asian women.

A total of 9,568 women (70%) were identified through KPNC pharmacy records as having filled at least two prescriptions for adjuvant hormonal therapy during the first year after diagnosis; 80% of women had filled at least one prescription (data not shown). Compared to non-initiators, initiators were older on average, more likely to be married or living with a partner, more likely to have regional stage disease, larger ( 1 cm) tumors, lobular histology, and higher grade tumors. They also were more likely to have undergone mastectomy, or lumpectomy with radiation, and less likely to have used chemotherapy. Characteristics of this sample are further described in Table 1.

### Multivariable logistic regression

**Initiation of adjuvant hormonal therapy—**In multivariable-adjusted logistic regression analysis among cases diagnosed between 1996 and 2007, Chinese and Hispanic women were less likely than non-Hispanic White women to initiate adjuvant hormonal therapy ([OR]=0.82 [CI] 0.71–0.96 and [OR]=0.78 [CI] 0.63–0.98 respectively) (see Table 2). Initiation rates were similar comparing non-Hispanic White to African American, Filipino and South Asian women. Although findings did not reach statistical significance, we observed a trend towards greater likelihood of initiation among Japanese women.

In addition to racial/ethnic differences in initiation of adjuvant hormonal therapy, age at diagnosis was positively associated with initiation of therapy, as was year of diagnosis, and being married or living with a partner (see Table 2). Women with one or more comorbidities were less likely to initiate therapy, as were women with tumors of "other specified histology" compared to those with ductal tumors. Women with regional tumors (with direct extension or positive lymph nodes) were more likely to initiate than women with localized tumors, as were women with lobular compared to ductal tumors, and those with grade II compared to grade I tumors. Women who underwent lumpectomy with no radiation compared to mastectomy were less likely to initiate.

## DISCUSSION

A substantial majority of women diagnosed with hormone receptor-positive breast cancer within the integrated health system of KPNC initiated adjuvant hormonal therapy in the first year after diagnosis. On average, 70% of women diagnosed between January 1, 1996 and June 30, 2007 initiated therapy. Compared to non-Hispanic White women, initiation of adjuvant hormonal therapy was less common among Chinese and Hispanic women. There also was a suggestion of more frequent initiation among Japanese women. However, there were relatively few Japanese women in the sample, limiting our ability to detect a more definitive association.

The percentage of women initiating adjuvant hormonal therapy increased from earlier diagnosis years (67% between 1996 and 2001) to later diagnosis years (72% between 2002 and 2007). The increase in initiation was similar for each racial/ethnic group, and the observed racial/ethnic differences in initiation were similar across diagnosis years. Consistent with prior studies, we also found that a variety of tumor characteristics (stage, histology and grade) were independently associated with initiation of adjuvant hormonal therapy [28] as was the presence of comorbid conditions [28] and prior surgical and radiation treatment. Racial/ethnic differences in initiation persisted in the KPNC population despite adjustment for these factors in multivariable analysis.

Our main results can be compared to findings from the limited number of previous studies that identified racial/ethnic differences in the use of adjuvant hormonal therapies for the treatment of invasive breast cancer. Results for Hispanic women are consistent with findings from one of the only other studies to include Hispanic women, documenting a significantly lower likelihood of adjuvant hormonal therapy use among Hispanic vs. non-Hispanic White women (OR=0.95) [12]. Our findings are also similar to the one other study that considered initiation in Asian populations [11]. In that population-based study of women identified from the Greater Bay Area Cancer Registry diagnosed with localized breast cancer in 1994 at 50 years of age, Chinese women were more likely than non-Hispanic White women to experience non-use of adjuvant hormonal therapy for estrogen receptor-positive tumors (OR non-use=2.3) [11].

Four prior studies also examined use of adjuvant hormonal therapy in African American women [6, 12, 13, 28]. Specifically, two of these studies [6, 13] reported that non-Hispanic White women were more likely to use adjuvant hormonal therapy than African American women (OR =4.59 [6] and OR=2.09 [13]), and the third study [12] reported a lower likelihood of adjuvant hormonal therapy use among African American compared to non-Hispanic white women (OR=0.91). These findings are in contrast to our results, as we observed no differences in initiation between African American and non-Hispanic White women.

The fourth study also reported a greater likelihood of adjuvant therapy non-use among African American and Hispanic women, compared to non-Hispanic White women (OR non-use=2.0) [28]. However, the principal outcome combined use of hormonal and chemotherapy, and African American and Hispanic women were grouped together [28], precluding our ability to compare to compare findings for African American or Hispanic women alone. This study was based on a sample of women who had been diagnosed at a variety of institutions including municipal hospitals, tertiary referral centers and community hospitals throughout New York City.

The difference in results between our study and these prior studies that included African American women [6, 12, 13, 28] may in part reflect the fact that our population was contained within the KPNC health care system. Thus, all women in our study had health insurance, and healthcare was delivered through an integrated system, minimizing differences in access to care that may exist in the other studies. This may in part explain the lack of a difference in initiation we observed between African American and non-Hispanic White women. Quintile of aggregate SES was not associated with initiation in KPNC, supporting this notion. As all KPNC members were insured, SES did not have the same impact on treatment as it might have had in a population of women with varying levels of access to care. Women in KPNC also tended to live in areas of higher average SES compared to the California population statewide, as evidenced by the over-distribution of KPNC members in the highest quintiles of SES.

Second to health care access, treatment recommendations made by physicians may be most influential [29–31]. Information was not readily available in the KPNC cancer registry or pharmacy records on whether women's physicians had recommended adjuvant hormonal therapies, so we were unable to determine whether treatment was influenced primarily by physician recommendation or by other factors. Based on breast cancer tumor profile alone, adjuvant hormonal therapy should have been recommended by physicians for all women included in our analysis, with the exception of those with potential contraindications to use, including a history of blood clots, stroke, uterine cancer, or osteoporosis [32, 33]. Fortunately, information on these and other comorbid conditions was available from KPNC inpatient and outpatient records, and we were able to account for these conditions in our analysis with adjustment for the Charlson Comorbidity score.

Several other factors could have contributed to the observed differences in initiation across racial/ethnic groups. Hispanic breast cancer survivors, particularly those who are Spanish speakers, have expressed difficulties obtaining and using interpreters in the health care system [34], and these difficulties have implications for understanding the risks and benefits of breast cancer treatment. Low acculturation levels among some Asian American women have also been associated with difficult interactions with medical staff due to language barriers [34]. Additionally, a belief in traditional medicine over Western medicine, common among Chinese women [35], may influence decisions about initiating adjuvant hormonal therapy [36]. Research indicates that knowledge about the benefit of therapy has a significant impact on use [19, 37], and language difficulties and low health literacy among Hispanic and Chinese women may inhibit full comprehension of available treatment options and their risks and benefits. Important information about treatment may therefore be lost for less acculturated women due to language barriers. Future research should consider these factors.

The lower likelihood of adjuvant hormonal therapy initiation among Chinese women relative to non-Hispanic White women in KPNC may appear to contradict the fact that Asian American and non-Hispanic White women in the U.S. have similar risks of breast cancer mortality [5]. However, a prior analysis of KPNC data documented lower rates of

discontinuation of adjuvant hormonal therapy among Asian American women, compared to non-Hispanic White women [23]. While our analysis shows that Chinese women in KPNC are less likely to initiate adjuvant hormonal therapy, those who initiate may adhere to treatment for a longer period of time, positively impacting survival.

Our study has several strengths worth noting. The large size and ethnic diversity of our study population enabled us to examine initiation of adjuvant hormonal therapy among individual Asian subgroups. As our results indicate, there was heterogeneity in the KPNC population with respect to the direction and magnitude of the odds ratios associated with use of adjuvant hormonal therapy across different Asian subgroups. Studies combining women of different Asian ethnicities into one group may obscure important associations for individual subgroups. We were not able to look at individual subgroups of Hispanic women in our analysis based on unreliable information on country of origin, but there may be differences in initiation across Hispanic subgroups as well, and this will be important to examine in future studies.

An additional strength was the ascertainment of adjuvant hormonal therapy initiation from KPNC pharmacy records, which capture 90% of all prescriptions filled by KPNC patients. Medical records have been considered the gold standard for collecting adjuvant breast cancer treatment information [38, 39] as cancer registry records tend to underestimate use [40]. SEER records typically only include treatment received or planned during the first 4–6 months after diagnosis, and many women may not begin these therapies until after this period.

Further, as KPNC members received their prescriptions almost exclusively from KPNC pharmacies, we expect that our ascertainment of filled prescriptions was virtually complete. Defining "initiation" as two or more filled prescriptions within the first year after diagnosis could have led to some misclassification of women who filled the first prescription and actually did use the medication, but never refilled the prescription. Our strict definition of initiation may also explain why the percentages of initiation are lower than those reported in other studies [13, 28]. However, we believe that categorization of initiation as 2 or more filled prescriptions provides the best estimate of actual patient use.

We did not explore differences across racial/ethnic groups in adherence to adjuvant hormonal therapy, and as outlined in our introduction, early discontinuation and non-adherence to adjuvant hormonal therapy have been associated with mortality in the KPNC population [10]. An additional limitation is the potential for misclassification of race/ethnicity as it was obtained from the cancer registry. Previous research indicates that the total numbers of African American, Hispanic and Asian/Pacific Islander women are underestimated by SEER [41, 42]. However, any misclassification of race/ethnicity was likely non-differential with respect to initiation of adjuvant hormonal therapy, and under this circumstance, estimates of effect for each racial/ethnic minority group would only be biased towards the null.

## CONCLUSIONS

Within KPNC, 70% of women aged 20–79 years, diagnosed with hormone receptor-positive breast cancer between January 1, 1996 and June 30, 2007, initiated adjuvant hormonal therapy within the first year after diagnosis. Rates of initiation of adjuvant hormonal therapy increased over time, but the associations between race/ethnicity and initiation were similar across diagnosis years. Chinese and Hispanic women were less likely to initiate therapy than non-Hispanic White women. Substantial differences in access to care are not likely to explain these results as all women in the KPNC sample were insured. Findings need to be

confirmed in other populations of insured patients. If confirmed, alternative reasons for under-initiation among Chinese and Hispanic women need to be explored, and targeted interventions to increase initiation of adjuvant hormonal therapy among those at highest risk for non-use will be warranted. Future examination of differences across racial/ethnic groups with respect to physician-patient communication, patient understanding of and preferences for treatment, language barriers and cultural factors will be informative.

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**Table 1**

KPNC: Characteristics of women diagnosed with hormone receptor-positive breast cancer from January 1996–June 2007 (N=13,753)

| | non-Hispanic White n (%)* | Hispanic n (%)* | African American n (%)* | Chinese n (%)* | Japanese n (%)* | Filipino n (%)* | South Asian n (%)* | p-value | No initiation of adjuvant hormonal tx n (%)* | Initiation of adjuvant hormonal tx n (%)* | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10,443 (75.9) | 1,089 (8.0) | 841 (6.1) | 497 (3.6) | 206 (1.5) | 579 (4.2) | 98 (0.7) | | 4,185 (30.4) | 9,568 (69.6) | |
| **Background characteristics** | | | | | | | | | | | |
| Age at diagnosis (mean±SD) | 60.4 ± 10.9 | 56.0 ± 11.5 | 56.7 ± 11.8 | 56.0 ± 11.0 | 59.3 ± 10.8 | 54.6 ± 10.9 | 51.9 ± 11.2 | <0.001 | 58.0 ± 12.0 | 59.9 ± 10.8 | <0.001 |
| **Year of diagnosis (dx)** | | | | | | | | | | | |
| 1996 | 793 (7.6) | 63 (5.8) | 43 (5.1) | 32 (6.4) | 15 (7.3) | 34 (5.9) | 5 (5.1) | 0.001 | 542 (13.0) | 443 (4.6) | <0.001 |
| 1997 | 791 (7.6) | 57 (5.2) | 87 (9.8) | 35 (7.0) | 19 (9.2) | 28 (4.8) | 5 (5.1) | | 373 (8.9) | 644 (6.7) | |
| 1998 | 854 (8.2) | 87 (8.0) | 59 (7.0) | 28 (5.6) | 14 (6.8) | 30 (5.2) | 10 (10.2) | | 346 (8.3) | 736 (7.7) | |
| 1999 | 880 (8.4) | 89 (8.2) | 83 (9.9) | 28 (5.6) | 21 (10.2) | 47 (8.1) | 13 (13.3) | | 330 (7.9) | 831 (8.7) | |
| 2000 | 895 (8.6) | 89 (8.2) | 70 (8.3) | 32 (6.4) | 23 (11.2) | 51 (8.8) | 6 (6.1) | | 289 (6.9) | 877 (9.2) | |
| 2001 | 975 (9.3) | 99 (9.1) | 69 (8.2) | 43 (8.7) | 23 (11.2) | 49 (8.5) | 5 (5.1) | | 327 (7.8) | 936 (9.8) | |
| 2002 | 1,014 (9.7) | 108 (9.9) | 80 (9.5) | 63 (12.7) | 13 (6.3) | 57 (9.8) | 7 (7.1) | | 349 (8.3) | 993 (10.4) | |
| 2003 | 871 (8.3) | 95 (8.7) | 69 (8.2) | 47 (9.5) | 12 (5.8) | 53 (9.2) | 10 (10.2) | | 341 (8.2) | 816 (8.5) | |
| 2004 | 889 (8.5) | 108 (9.9) | 76 (9.0) | 54 (10.9) | 20 (9.7) | 60 (10.4) | 11 (11.2) | | 326 (7.8) | 892 (9.3) | |
| 2005 | 971 (9.3) | 126 (11.6) | 78 (9.3) | 47 (9.5) | 20 (9.7) | 59 (10.2) | 8 (8.2) | | 389 (9.3) | 920 (9.6) | |
| 2006 | 1,005 (9.6) | 121 (11.1) | 85 (10.1) | 53 (10.7) | 17 (8.3) | 77 (13.3) | 11 (11.2) | | 375 (9.0) | 994 (10.4) | |
| 2007 | 505 (4.8) | 47 (4.3) | 47 (5.6) | 35 (7.0) | 9 (4.4) | 34 (5.9) | 7 (7.1) | | 198 (4.7) | 486 (5.1) | |
| **Marital status[1]** | | | | | | | | | | | |
| Single, widowed, divorced | 3,783 (37.3) | 341 (32.3) | 406 (50.6) | 123 (25.4) | 65 (32.5) | 161 (28.1) | 26 (27.1) | <0.001 | 1,588 (39.4) | 3,317 (35.6) | <0.001 |
| Married or living with partner | 6,354 (62.7) | 696 (67.7) | 396 (49.4) | 358 (74.6) | 135 (67.5) | 413 (71.9) | 70 (72.9) | | 2,443 (60.6) | 6,001 (64.4) | |
| **Socioeconomic status[2]**** | | | | | | | | | | | |
| Lowest quintile | 270 (2.9) | 80 (8.0) | 111 (14.3) | 10 (2.1) | 2 (1.0) | 21 (3.9) | 2 (2.3) | <0.001 | 139 (3.7) | 357 (4.1) | 0.481 |
| 2nd quintile | 909 (9.6) | 171 (17.1) | 212 (27.3) | 29 (6.2) | 7 (3.7) | 55 (10.2) | 5 (5.8) | | 443 (11.7) | 945 (10.8) | |
| 3rd quintile | 1,789 (18.9) | 212 (21.1) | 176 (22.7) | 54 (11.6) | 27 (14.1) | 128 (23.8) | 13 (14.9) | | 718 (19.0) | 1,681 (19.2) | |

| | non-Hispanic White n (%)* | Hispanic n (%)* | African American n (%)* | Chinese n (%)* | Japanese n (%)* | Filipino n (%)* | South Asian n (%)* | p-value | No initiation of adjuvant hormonal tx n (%)* | Initiation of adjuvant hormonal tx n (%)* | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10,443 (75.9) | 1,089 (8.0) | 841 (6.1) | 497 (3.6) | 206 (1.5) | 579 (4.2) | 98 (0.7) | | 4,185 (30.4) | 9,568 (69.6) | |
| 4th quintile | 2,778 (29.3) | 304 (30.3) | 165 (21.2) | 152 (32.6) | 55 (28.6) | 186 (34.6) | 24 (27.6) | | 1,093 (28.8) | 2,571 (29.4) | |
| Highest quintile | 3,718 (39.3) | 236 (23.5) | 113 (14.5) | 222 (47.5) | 101 (52.6) | 148 (27.5) | 43 (49.4) | | 1,394 (36.8) | 3,187 (36.5) | |
| **Health-related indicators & tumor characteristics** | | | | | | | | | | | |
| **Charlson comorbidity index** | | | | | | | | | | | |
| 0 | 8,707 (83.4) | 886 (81.3) | 639 (76.0) | 423 (85.1) | 166 (80.6) | 472 (81.5) | 85 (86.7) | <0.001 | 3,444 (82.3) | 7,934 (82.9) | 0.577 |
| 1 | 1,293 (12.4) | 163 (15.0) | 137 (16.3) | 64 (12.9) | 25 (12.1) | 74 (12.8) | 9 (9.2) | | 556 (13.3) | 1,209 (12.6) | |
| 2 | 443 (4.2) | 40 (3.7) | 65 (7.7) | 10 (2.0) | 15 (7.3) | 33 (5.7) | 4 (4.1) | | 185 (4.4) | 425 (4.4) | |
| **SEER summary stage** | | | | | | | | | | | |
| Localized | 7,245 (69.4) | 699 (64.2) | 538 (64.0) | 358 (72.0) | 148 (71.8) | 384 (66.3) | 63 (64.3) | 0.001 | 2,915 (69.6) | 6,520 (68.1) | 0.032 |
| Regional, direct extension or LN | 2,999 (28.7) | 367 (33.7) | 287 (34.1) | 131 (26.4) | 54 (26.2) | 178 (30.7) | 31 (31.6) | | 1,176 (28.1) | 2,871 (30.0) | |
| Regional, direct extension + LN | 199 (1.9) | 23 (2.1) | 16 (1.9) | 8 (1.6) | 4 (2.0) | 17 (3.0) | 4 (4.1) | | 94 (2.3) | 177 (1.9) | |
| **Tumor size** | | | | | | | | | | | |
| <1 cm | 1,934 (19.8) | 178 (17.7) | 136 (17.5) | 97 (21.1) | 39 (20.1) | 97 (18.5) | 13 (14.0) | 0.285 | 1,050 (27.2) | 1,444 (16.1) | <0.001 |
| 1 cm | 7,857 (80.2) | 829 (82.3) | 641 (82.5) | 363 (78.9) | 155 (79.9) | 428 (81.5) | 80 (86.0) | | 2,818 (72.8) | 7,535 (83.9) | |
| **Histologic type[3]** | | | | | | | | | | | |
| Ductal | 7,217 (69.5) | 764 (70.7) | 588 (70.6) | 370 (74.8) | 152 (73.8) | 442 (76.9) | 67 (69.0) | <0.001 | 2,960 (71.3) | 6,640 (69.8) | <0.001 |
| Lobular/ mixed lobular | 2,299 (22.1) | 207 (19.2) | 162 (19.4) | 70 (14.1) | 37 (18.0) | 80 (13.9) | 15 (15.5) | | 743 (17.9) | 2,127 (22.3) | |
| Other specified histology | 866 (8.4) | 109 (10.1) | 83 (10.0) | 55 (11.1) | 17 (8.2) | 53 (9.2) | 15 (15.5) | | 449 (10.8) | 749 (7.9) | |
| **Tumor grade[a]** | | | | | | | | | | | |
| Grade I | 2,795 (30.4) | 250 (25.7) | 151 (19.9) | 115 (25.8) | 60 (32.8) | 105 (19.8) | 21 (23.3) | <0.001 | 1,089 (29.8) | 2,408 (28.3) | <0.001 |
| Grade II | 4,517 (49.1) | 488 (50.3) | 378 (49.8) | 222 (49.9) | 83 (45.3) | 276 (52.1) | 43 (47.8) | | 1,691 (46.3) | 4,316 (50.6) | |
| Grade III/IV | 1,886 (20.5) | 233 (24.0) | 230 (30.3) | 108 (24.3) | 40 (21.9) | 149 (28.1) | 26 (28.9) | | 872 (23.9) | 1,800 (21.1) | |
| **Treatment for breast cancer** | | | | | | | | | | | |
| **Surgery and radiation[3]** | | | | | | | | | | | |

| | non-Hispanic White | Hispanic | African American | Chinese | Japanese | Filipino | South Asian | p-value | No initiation of adjuvant hormonal tx | Initiation of adjuvant hormonal tx | p-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n (%)* | n (%)* | n (%)* | n (%)* | n (%)* | n (%)* | n (%)* | | n (%)* | n (%)* | |
| | **10,443 (75.9)** | **1,089 (8.0)** | **841 (6.1)** | **497 (3.6)** | **206 (1.5)** | **579 (4.2)** | **98 (0.7)** | | **4,185 (30.4)** | **9,568 (69.6)** | |
| *Mastectomy ± radiation* | 4,175 (40.4) | 458 (42.9) | 311 (37.1) | 224 (45.5) | 86 (42.6) | 310 (53.8) | 48 (49.5) | **<0.001** | 1,581 (38.1) | 4,031 (42.6) | **<0.001** |
| *Lumpectomy + radiation* | 4,343 (42.0) | 383 (35.9) | 330 (39.3) | 185 (37.6) | 80 (39.6) | 166 (28.8) | 32 (33.0) | | 1,547 (37.3) | 3,972 (42.0) | |
| *Lumpectomy, no radiation* | 1,630 (15.8) | 203 (19.0) | 169 (20.1) | 74 (15.0) | 32 (15.8) | 92 (16.0) | 16 (16.5) | | 912 (22.0) | 1,304 (13.8) | |
| *No surgery* | 186 (1.8) | 23 (2.2) | 29 (3.5) | 9 (1.8) | 4 (2.0) | 8 (1.4) | 1 (1.0) | | 106 (2.6) | 154 (1.6) | |
| **Chemotherapy**[3] | 3,948 (38.0) | 532 (49.2) | 361 (43.4) | 213 (43.0) | 86 (41.8) | 283 (49.0) | 49 (50.5) | **<0.001** | 1,723 (41.5) | 3,749 (39.4) | **0.021** |

[o] Initiation=2 or more prescriptions filled within the first year after diagnosis

[*] Percents based on non-missing values;

[**] Quintiles determined from Census block-group level SES distribution of the state of California

[1] 2.9% missing;

[2] 8.9% missing;

[3] 1% missing;

[a] 11.5% missing

**Table 2**

KPNC: Logistic Regression: Initiation[a] of adjuvant hormonal therapy among women diagnosed with hormone receptor-positive breast cancer (N=10,548)

| | Initiation[a] | |
|---|---|---|
| | N (%) | aOR (95% CI) |
| *Main exposure* | | |
| **Race/ethnicity** | | |
| *Non-Hispanic White* | 5,633 (71.0) | *Ref* |
| *Hispanic* | 553 (66.0) | **0.82 (0.71, 0.96)**[1] |
| *African American* | 449 (68.7) | 1.03 (0.85, 1.23) |
| *Chinese* | 264 (65.7) | **0.78 (0.63, 0.98)**[1] |
| *Japanese* | 121 (74.7) | 1.27 (0.89, 1.82) |
| *Filipino* | 346 (72.4) | 1.10 (0.89, 1.36) |
| *South Asian* | 50 (66.7) | 0.91 (0.55, 1.52) |
| *Covariates* | | |
| **Age at diagnosis (continuous years)** | n/a | **1.02 (1.01, 1.02)**[3] |
| **Year of diagnosis (continuous)** | n/a | **1.08 (1.06, 1.09)**[3] |
| **Relationship status** | | |
| *Single, widowed, divorced* | 2,601 (67.8) | *Ref* |
| *Married or living with partner* | 4,815 (71.7) | **1.28 (1.17, 1.39)**[3] |
| **Socioeconomic status*** | | |
| *Lowest quintile* | 308 (71.6) | *Ref* |
| *2nd quintile* | 806 (68.5) | 0.86 (0.67, 1.10) |
| *3rd quintile* | 1,441 (70.4) | 0.90 (0.71, 1.14) |
| *4th quintile* | 2,200 (70.8) | 0.92 (0.73, 1.15) |
| *Highest quintile* | 2,661 (70.3) | 0.89 (0.71, 1.12) |
| **Charlson comorbidity index** | | |
| *0* | 6,174 (70.8) | *Ref* |
| *1* | 898 (67.8) | **0.78 (0.69, 0.89)**[3] |
| *2* | 344 (69.2) | **0.76 (0.62, 0.93)**[2] |
| **SEER sumary stage** | | |
| *Localized* | 5,026 (70.0) | *Ref* |
| *Regional (direct extension or LN)* | 2,254 (71.3) | **1.12 (1.01, 1.25)**[1] |
| *Regional (direct extension + LN)* | 136 (67.3) | 0.93 (0.68, 1.28) |
| **Histologic type** | | |
| *Ductal* | 5,640 (69.8) | *Ref* |
| *Lobular/ mixed lobular* | 1,293 (75.0) | **1.15 (1.02, 1.30)**[1] |
| *Other specified histology* | 483 (64.8) | **0.75 (0.64, 0.88)**[2] |

| | Initiation[a] | |
|---|---|---|
| | N (%) | aOR (95% CI) |
| **Tumor grade** | | |
| *Grade I* | 2,107 (69.2) | *Ref* |
| *Grade II* | 3,762 (72.0) | **1.16 (1.04, 1.28)**[2] |
| *Grade III/IV* | 1,547 (67.9) | 1.04 (0.92, 1.18) |
| **Primary breast cancer treatment** | | |
| *Mastectomy with/without radiation* | 3,097 (72.5) | ***Ref*** |
| *Lumpectomy with radiation* | 3,193 (72.6) | 1.01 (0.91, 1.11) |
| *Lumpectomy, no radiation* | 1,033 (59.5) | **0.52 (0.46, 0.59)**[3] |
| *No surgery* | 93 (65.5) | **0.65 (0.45, 0.93)**[1] |
| **Chemotherapy treatment** | | |
| *No use of chemotherapy* | 4,434 (71.3) | Ref |
| *Use of chemotherapy* | 2,982 (68.9) | 1.01 (0.90, 1.13) |

[a]Initiation=2 or more filled prescriptions for adjuvant hormonal therapy in first year after diagnosis

[1]$p < 0.05$;

[2]$p < 0.01$;

[3]$p < 0.001$