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# Immigration history, lifestyle characteristics and breast density in the Vietnamese American Women's Health Study: a cross-sectional analysis

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## Abstract

**Purpose:** Breast density is an important risk factor for breast cancer and varies substantially across racial-ethnic groups. However, determinants of breast density in Vietnamese immigrants in the United States (US) have not been studied. We investigated whether reproductive factors, immigration history and other demographic and lifestyle factors were associated with breast density in Vietnamese Americans.

**Methods:** We collected information on demographics, immigration history and other lifestyle factors and mammogram reports from a convenience sample of 380 Vietnamese American women in California aged 40 to 70 years. Breast Imaging Reporting and Data System (BI-RADS) breast density was abstracted from mammogram reports. Multivariable logistic regression was used to investigate the association between lifestyle factors and having dense breasts (BI-RADS 3 or 4).

**Results:** All participants were born in Viet Nam and 82% had lived in the US for 10 years or longer. Younger age, lower body mass index, nulliparity/lower number of deliveries, and longer US residence (or younger age at migration) were associated with having dense breasts. Compared to women who migrated at age 40 or later, the odds ratios and 95% confidence intervals for having

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Research involving Human Participants and/or Animals

**Ethics approval**: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (University of Southern California Institutional Review Board, HS-15–00520) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

dense breasts among women who migrated in their 30's and 20's or earlier were 1.72 (0.96–3.07), and 2.48 (1.43–4.32), respectively.

**Conclusions:** Longer US residence and younger age at migration were associated with greater breast density in Vietnamese American women. Identifying modifiable mediating factors to reduce lifestyle changes that adversely impact breast density in this traditionally low-risk population for breast cancer is warranted.

### Keywords

Breast density; immigration; lifestyle; Asian ethnicity; risk factor

## Introduction

Epidemiological studies often present data on diverse groups of Asian Americans as a single category. However, studies have shown distinct cancer incidence and mortality patterns across Asian American subgroups, reflecting differences in immigration history, socioeconomic status, and other cancer-related lifestyles [1–4]. Vietnamese Americans are one of the fastest growing ethnic groups in the United States (US) in recent decades [5,6]. Between 1975 and 1996, the majority of Vietnamese Americans immigrated as refugees, and the Vietnamese immigrant population nearly quadrupled between 1980 and 2000 [7]. Since then, family ties has become the major immigration pathway and the Vietnamese American population now represents the fourth largest Asian American subpopulation with 1.7 million people [5,6]. Studies conducted in the 1970's documented that breast cancer incidence in first-generation Japanese immigrants in Hawaii was 2 to 3-fold higher, and incidence in second-generation immigrants was 3 to 5-folder higher than incidence among native Japanese [8,9,3]. Consistent with this observation, breast cancer incidence in Vietnamese Americans is at least two to three times higher than the incidence in Viet Nam [10–12], and has steadily increased from 52 per 100,000 between 1990–1994 to 72 per 100,000 in 2009s2011 [13,2]. This increasing trend contrasts with the stabilizing pattern in Japanese Americans and the decreasing trend in non-Hispanic whites (NHW) since the early 2000's [1] and underscores the importance of identifying lifestyle risk factors relevant to Vietnamese Americans. To our knowledge, no prior studies have investigated breast cancer risk factors in Vietnamese American women.

Breast density, or mammographic density, is a measure of the relative amount of epithelium and connective tissue in the breast and is one of the strongest risk factors for breast cancer [14]. Breast cancer risk in women with very dense breasts (greater than 75% of mammographic density) is 4–5 times higher than risk in women with almost entirely fatty breasts (<5% of mammographic density) after adjustment for age and body mass index (BMI) [15]. Breast density increased in women who received estrogen and progestin combined therapy in randomized clinical trials [16,17] and decreased after women stopped using hormone therapy [18]. Longitudinal changes in breast density have been associated with changes in breast cancer risk [19–21]. Identifying determinants of breast density can potentially identify modifiable preventive factors for breast cancer.

Established breast cancer risk factors such as low parity, early menopause, and menopausal hormone therapy use have been consistently found to be associated with increased breast density, but the associations with other breast cancer risk factors such as earlier age at menarche, later age at first birth and breastfeeding have been less consistent [22–31]. Obesity is positively associated with risk of postmenopausal breast cancer [32,33] and inversely associated with risk of premenopausal breast cancer [32]. Breast density is inversely associated with BMI (at the time of mammography) regardless of menopausal status [26], reflecting the fact that BMI is highly correlated with the amount of fat tissue in the breast, which determines total breast area, the denominator of breast density [14].

Despite substantial heterogeneity in breast density across racial/ethnic groups [37–39], the vast majority of studies of mammographic density have been conducted in non-Hispanic whites. The few studies that have been conducted in Asian Americans were mostly limited to Japanese- and Chinese-Americans in California and Hawaii [38,37,40–42]. Nonetheless, existing data indicate that breast density is associated with immigration history and level of acculturation in Asian Americans. Japanese Americans had higher breast density compared to native Japanese [42], and a higher level of acculturation was associated with higher breast density among Chinese Americans [43]. No prior studies have reported on breast density in Vietnamese American women.

We conducted a cross-sectional study among a convenience sample of 380 Vietnamese American women in California to investigate lifestyle factors related to breast density using a subjective classification routinely used in radiology clinical practice, the Breast Imaging Reporting and Data System (BI-RADS). We report on descriptive characteristics such as demographics, immigration history, and other lifestyle factors related to breast cancer risk as well as the association between these factors and BI-RADS breast density in this study population.

## Methods

### Participants:

Eligible participants were Vietnamese American women living in California who were ages 40 or older and had a mammogram within 5 years at time of interview. We limited the study to women over the age of 40 because breast cancer screening is typically conducted in this age group. A total of 423 participants were recruited between July 1, 2016 and March 31, 2018.

### Recruitment:

This study is a part of a cross-sectional study directed at workplace exposures in nail salon workers, the Vietnamese American Women's Health Study (VAWHS). Since one of the primary goals of the VAWHS was to evaluate the breast cancer risk factor profiles of Vietnamese American women working in nail salons, our recruitment strategies were designed to over-sample nail salon workers.

**In-person recruitment at nail salons:** In-person solicitation has been used in previous studies of nail salon workers [44,45]. An experienced bi-lingual interviewer visited nail

salons in the East Los Angeles area and nearby cities in Orange County, California with a large Vietnamese population. The interviewer canvassed the area and visited nail salons where potentially eligible manicurists were working (i.e. female Vietnamese Americans). To avoid approaching workers who were busy with clients, the interviewer visited nail salons multiple times during non-peak business hours, mostly between Monday and Wednesday and in the early morning and afternoon. A total of 143 nail salons were visited and 235 nail salon workers were approached. Of them, 45 women were ineligible due to age (n=27), mammogram non-availability (n=17), or not being Vietnamese (n=1). Of the 190 eligible women, 145 women participated, resulting in a participation rate of 76%. The reasons for non-participation included: not interested or too busy (n=14), concern about confidentiality (n=9), cannot schedule an interview until the end of the study (n=6), other (n=4) or no reason (n=12).

**Mailing to licensed manicurists:** We obtained a commercially available list of licensed manicurists from the California Boards of Barbering and Cosmetology and mailed out a study invitation to manicurists with Vietnamese surnames and whose first dates of licensure were earlier than 1995, thus likely to be older than 40. We mailed out invitation letters printed in both Vietnamese and English to 500 manicurists. Only eight manicurists responded and six women participated in the study. Because of the low participation rate using this approach (<2%), we abandoned this recruitment method after the first mailing of invitation letters.

**Recruitment at health fairs and community organizations:** We recruited participants at community health fairs and religious organizations in Orange County, California where organized community health events (e.g. exercise classes) were offered to the public and the organization members. 109 women were recruited through this approach; the majority were not nail salon workers.

**Referrals by the participants:** The study participants volunteered or were asked by the study team to refer other potentially eligible women. Nearly all referred participants were eligible and participated in the study (n=111). The majority of them were not working in nail salons.

**Recruitment through existing network health workers:** We also reached out to health workers in northern California with established connections with Vietnamese American women through previous health survey studies in nail salons and personal relationships [44]. We recruited 52 women through this approach; the majority (~80%) were residents of Santa Clara County or Alameda County in Northern California [44] and the remainder (~20%) were residents in Orange County and Los Angeles County in Southern California.

### Data and mammogram collection:

The bilingual interviewer conducted in-person (for those in Southern California) or telephone (for those in Northern California) interviews using a structured questionnaire that asked for detailed information on demographics, immigration history, English proficiency,

occupation, medical history, mammographic screening, health insurance, height and weight, smoking and alcohol use, and reproductive and menstrual history. The participants were also asked whether their doctors had ever told them “you have dense breasts” and if yes, whether “the fact that you have dense breasts influenced your decision to participate in this study”. During the interview, the participants were asked to provide names of mammography facilities where they obtained mammogram screenings. A copy of their mammograms and mammogram reports from the identified facilities was requested and obtained for 404 of the 423 participants by the end of the study in June 2018. For patients with multiple mammograms, the most recent was used to best match the interview date when information on lifestyle factors was collected. From the collected mammogram reports, we abstracted information on BI-RADS breast density. BI-RADS is a standard measure of breast density routinely used in radiology clinical practice that classifies breast density into one of the four broad categories “1: almost entirely fatty, 2: scattered fibroglandular density, 3: heterogeneously dense; 4: extremely dense” [46,47]. Women with heterogeneously or extremely dense breasts (categories 3 and 4) are considered to have dense breasts [48]. This information is routinely included in mammogram reports from radiologists. BI-RADS density information was available for 399 participants. After further excluding 9 women who self-reported a history of cancer (none had breast cancer at time of interview) and 10 women who had missing information on demographic or other lifestyle characteristics that were included in the multivariable analyses (see below), 380 women were included in the final analysis.

### Statistical analysis:

We conducted descriptive data analyses to summarize the distributions of demographic and lifestyle characteristics as well as BI-RADS categories of the 380 study participants. Associations between demographic and lifestyle characteristics at time of the mammogram such as age, BMI, parity, duration of breastfeeding, menopausal status, hormone therapy use, age at menarche, immigration history, and education and dense breasts defined as BI-RADS categories of 3 or 4 were evaluated using multivariable logistic regression analysis. We first adjusted for age and BMI (both as continuous variables) and then additionally adjusted for other factors shown to be associated with breast density in prior studies [22–30,42,43] such as parity (0, 1–2, 3–4, 5+ deliveries), menopausal status (premenopausal, postmenopausal), hormone therapy (never, ever), education level (<6 years, 6–12 years, 13+ years), and length of US residence (≤5, 6–10, 11–20, 21–30, and 31+ years). As in other recent studies of determinants of breast density using BI-RADS measures [31,25], we included both age and BMI as covariates in all statistical models due to their strong inverse associations with breast density [37].

Results were nearly identical when we additionally adjusted for smoking (never, ever) or alcohol consumption (weekly, never or less than once a week). Further adjustment for age at menarche (≤12, 13–14, 15, 16+ years old), English-speaking proficiency (not very well or not at all, somewhat well, pretty well or fluent), ethnicity (Kinh Vietnamese, Chinese Vietnamese), Medi-Cal insurance (yes, no), age at first delivery and duration of breastfeeding (among parous women), current working status and nail salon work did not change the results. Thus, these variables were not included in the final model.

The study was approved by the University of Southern California institutional review board (IRB). We obtained informed consent and Health Insurance Portability and Accountability Act (HIPAA) authorization. Participants were provided with a small-amount gift card to compensate for their time commitment.

## Results

The mean age of the convenience sample of 380 Vietnamese American women was 54.8 (SD 7.4) years. All participants were born in Viet Nam and 82% had resided in the US for at least 10 years (Table 1). The majority of participants self-reported as Vietnamese (Kinh) while 15% reported as Chinese-only or mixed Chinese and Vietnamese. All participants had their interview conducted in Vietnamese. Only 9% responded that they “speak English pretty well or fluently” and about half (47%) of participants achieved 10–12 years of education. Nearly half of the participants had Medi-Cal insurance, and another 21% had health insurance through Covered California under the Affordable Care Act. The proportion of each insurance type remained similar when excluding participants aged 65 or older and eligible for Medicare.

Participants were generally lean; the mean BMI ($kg/m^2$) was 22.9 (SD 3.0). Nearly one-third of participants (30%) reported an age at menarche of age 16 years or older, 89% had at least one child, and smoking (2%) or weekly alcohol drinking (2%) were very uncommon. About 20% of never smokers reported being regularly exposed to passive smoking at home. Since our recruitment strategies targeted nail salon workers, 44% of our participants were currently working in nail salons (Table 1).

All women had previous screening mammograms prior to interview (eligibility criterion) and more than 70% of the participants had 3 or more mammogram screenings prior to interview. Because 92% had a mammogram screening within 1 year, the likelihood of significant changes in lifestyle between the date of mammogram and the date of interview was low (Table 2). About one-third (35%) had BI-RADS density category 2 (scattered fibroglandular tissue) and 50% had BI-RADS density category 3 (heterogeneously dense). Nearly all (96%) BI-RADS density assessments were from mammograms taken after 2013 when the $5^{th}$ edition BI-RADS guidelines were published [47]. Only 49 women (13%) responded ‘yes’ when asked if they were ever informed by a physician that they had dense breasts and, of them, only 10 women reported that having dense breasts influenced their study participation. Therefore, the likelihood of obtaining biased results due to selective participation of women with dense breasts is low.

Age, BMI, and number of deliveries were inversely associated with having dense breasts (BI-RADS 3 or 4), but self-reported menopausal status and later age at first birth were not associated with breast density (Table 3). The odds ratio (OR) of having dense breasts for women having 5 or more deliveries compared to women not having any deliveries was 0.35 (95% CI: 0.12–0.97; P for trend=0.006). The positive association between breast density and higher education levels and postmenopausal hormone therapy use attenuated when other covariates besides age and BMI were adjusted for; however, the number of ever hormone

users was small. Although not statistically significant, longer duration of breastfeeding was associated with decreased breast density (Table 3).

Increasing length of US residence was associated with increased breast density (OR=2.87, 95% CI=1.16–7.09, for 31+ vs. ≤5 years of US residence; P for trend=0.006). Since all models were adjusted for current age (i.e. age at mammogram), age at US migration would indicate the length of US residence. For example, for women who were age 50, migration at age 20 would mean US residence for 30 years. We observed similar results when we included age at migration instead of length of US residence in the model. Younger age at US migration was statistically significantly associated with increased risk of having dense breasts (OR=2.48, 95% CI=1.43–4.32, for <30 years old vs. 40+ years old; P for trend=0.001). Compared to women who migrated at 40+ years old, the ORs for those who migrated between ages 20–29 or before age 20 were 2.20 (95% CI=1.25–3.88) and 4.70 (95% CI=1.78–12.4), respectively (P value for trend of 0.001). However, this result was based on only 36 women who migrated to the US before age 20.

## Discussion

In this report, we have characterized the demographic characteristics and other breast-cancer related lifestyle characteristics and their associations with breast density in a convenience sample of 380 Vietnamese American women in California. Our analyses of BI-RADS breast density show that younger age, lower BMI, and nulliparity/lower number of deliveries were associated with increased breast density. Length of US residence (or younger age at migration), which has been shown to be associated with increased breast cancer risk, was also associated with increased density. To our knowledge, this is the first study reporting on breast density and lifestyle factors associated with breast density in the Vietnamese American population.

Because the current study was based on a convenience sample, we compared the characteristics of this study population with those of a sample representative of the general population of Vietnamese American women in California using data from the California Health Interview Survey (CHIS), a large scale survey study conducted in multiple languages, including Vietnamese, that provides representative data for diverse ethnic subgroups living in California [49]. Participants in our study were similar to the Vietnamese American women in the most recent CHIS who were ages 40–70 with respect to BMI, nulliparity, age at first delivery, alcohol consumption, smoking, and insurance coverage (2016–2017 CHIS data for BMI, smoking, and insurance coverage; 2003–2009 CHIS data for parity and alcohol drinking). However, nearly 30% of Vietnamese women in the 2001 CHIS survey reported 5 or more births compared to 9.5% of our study participants. This may reflect differences in the two populations or a temporal change in reproductive characteristics because information on number of births among parous women is not available in more recent CHIS surveys [49]. In addition, compared to the 2015–16 CHIS, the proportion receiving mammograms within 2 years of our study was much higher (>90% vs. 73%) and may reflect our eligibility criterion of mammogram screening (within 5 years) [49].

Breast density is one of the strongest risk factors for breast cancer [14] and is widely accepted as a useful marker of breast cancer risk [50–53]. Although the available data indicate a substantial heterogeneity in breast density across racial/ethnic groups [37–39] and within Asian subgroups [37,54], the vast majority of studies on breast density and its determinants have been conducted among non-Hispanic white women [37,15]. Previous studies in Asian Americans included US Chinese, Filipino, and Japanese women [38,37,40–42]. Studies in Asia have mainly included East Asians (i.e. Chinese, Japanese, Koreans) in China, Singapore, Japan, and Korea [25,22,31,55,30], Malay and Indians in Malaysia and Singapore [54,37,56], as well as women in Mongolia [57] and Viet Nam [58]. In a recent report from Viet Nam, determinants of high breast density (BI-RADS categories 3 and 4) among 345 breast cancer patients and 1306 women without breast cancer included younger age, lower BMI, premenopausal status, lower number of deliveries, earlier age at last birth, and higher amount of vegetable intake [58].

The observed inverse associations between breast density and age, BMI, and increasing number of deliveries in this study have been well established in previous studies [14,23,37,30,59,41,22,42,58], including studies of Asian women [30,59,41,22,42,58]. The observed suggestive positive association between older age at menarche and breast density is consistent with the finding that breast density does not mediate the protective role of later menarche against breast cancer [60]. Earlier studies, including studies among Asian women [25,22,42,29,58,31], reported positive associations [61,23], no associations [25,22,42,29,26,58,31] or inverse associations [31] between later menarche and breast density. Menopausal status was not associated with breast density in our study, in contrast to earlier findings [42,25,31,22,37,58]; this needs to be re-examined using more quantitative percent density measurements. Hormone therapy use was rare (7% of postmenopausal women ever used hormone therapy in our study) and would thus explain a small proportion, if any, of the increasing risk observed in this population. The associations between age at first birth [22–27] and breastfeeding [28,29,25,30,22,24] and breast density independent of number of births are less clear.

Higher education levels have been associated with increased risk of breast cancer and are thought to be a proxy marker of other factors related to breast cancer including reproductive and lifestyle characteristics [62–64]. The observed positive association between higher education levels and breast density when adjusting for age and BMI attenuated after additionally adjusting for potential confounders including reproductive and menstrual factors. This is consistent with findings from other studies [23,62,22,65,26], indicating that education levels are likely associated with density as a proxy marker for other risk factors.

Interestingly, longer residence in the US, or younger age at migration, among Vietnamese American women was associated with higher breast density. This indicates that environmental and lifestyle changes in Vietnamese American women, particularly changes that may have occurred at younger ages and/or over a prolonged time period, or during vulnerable windows of exposure, may have a significant impact on women’s breast density and hence their breast cancer risk. Our finding is consistent with observations that Japanese American immigrant women in Hawaii had higher breast density compared to Japanese women in Japan [42] and that a higher level of acculturation, measured by English

proficiency and interactions with non-Chinese individuals, was associated with higher breast density among Chinese Americans living in the Philadelphia region [43]. Data from the New York Mammographic Density Study also showed that US-born Hispanics had higher breast density compared to foreign-born Hispanics and, among foreign-born Hispanics, women who migrated before age 20 years appeared to have higher density compared to those who migrated after age 30 [66]. These findings are in line with findings from previous breast cancer studies. In a case-control study of Chinese, Japanese, and Filipino women in California and Hawaii conducted in the 1980's, the ORs of breast cancer for women who migrated prior to age 16, 16–25, 26–35, 36–45, and 46+ compared to women born in the US were 0.65, 0.67, 0.62, 0.50, and 0.31, respectively [67], implying that a younger age at migration (i.e. prior to age 35) is associated with increased risk among women who were born in Asian countries. Similar results were observed for length of US residence. It remains uncertain which of the two factors (age at migration or length of US residence) may be more important due to the high correlation between the two, especially in analyses that adjusted for age. A similar pattern was observed in a case-control study of Hispanic women in the San Francisco Bay Area. Compared to US-born women, those who migrated as adults showed substantially lower risks (ORs for postmenopausal breast cancer: 0.34 to 0.44) while those who migrated in their childhood (age <10) and adolescence (age 10–19) had moderately lower risks (ORs 0.79 and 0.69, respectively) [68].

It has been suggested that early life factors are important determinants of breast cancer risk [69,68]. A 2019 meta-analysis showed that a Western dietary pattern with high levels of red/processed meats, high-fat dairy products, potatoes, and sweets was associated with increased breast cancer risk [70]. Data from the Nurses' Health Study II further suggested that red meat intake in early adulthood was associated with increased breast cancer risk [71] and that animal fat intake in adolescence was modestly associated with higher breast density in premenopausal women [72]. Therefore, earlier, and hence, prolonged exposure to a Western diet may contribute to the increased risk observed with longer duration of US residence and earlier age at migration [69]. Among Chinese Americans in the Philadelphia region, the association between acculturation level and breast density was attenuated when adjusting for dairy food intake (OR of having dense breast for the highest level of acculturation changed from 2.7 to 2.4), indicating that dietary factors may mediate a part of the association between acculturation and breast cancer risk in Chinese immigrants [43].

One limitation of this study is our use of a convenience sample. Our recruitment strategies initially targeted nail salon workers; thus, the study population was not intended to be a representative sample of the general population of Vietnamese American women. We also were not able to investigate the effects of smoking and alcohol consumption due to the small number of study participants who reported to having these exposures. We used the four-category BI-RADS scale, which only provides a qualitative assessment of breast density. Since we did not use a quantitative assessment of breast density, such as percent density measures obtained by computer-assisted techniques [73], we could not separately examine the two components of breast density: dense area (numerator) and total breast area (denominator). Thus, we are unable to determine if the observed associations are due to associations with the fatty tissue in the breast or dense tissue in the breast. Nevertheless, BI-RADS has been a useful measure of breast density as this information is routinely included

in mammogram reports from radiologists and has been used in breast density studies in China [31,25] and Mongolia [57], as well as a study of Chinese Americans in the Philadelphia region [43].

In conclusion, our study is the first investigation of breast density and its association with demographics, immigration, and reproductive factors in Vietnamese American women. Our results indicate that longer duration of US residence and earlier age at migration is associated with higher breast density, a strong risk factor of breast cancer. Further investigation is warranted to identify modifiable environmental and lifestyle factors mediating the increase in breast density and breast cancer risk among immigrant women from low risk countries.

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**Table 1.**

Demographics and lifestyle characteristics of participants

| Characteristics | N (%) or Mean ± SD |
|---|---|
| Age (mean ± SD) | 54.8 ± 7.4 (range 40–70) |
| 40–49 | 106 (28%) |
| 50–59 | 167 (44%) |
| 60–70 | 107 (28%) |
| Country of birth | |
| Viet Nam | 380 (100%) |
| Ethnicity | |
| Vietnamese only (Kinh) | 324 (85%) |
| Chinese only or Chinese and Vietnamese mixed | 56 (15%) |
| US residence (years) | 21.9 ± 10.4 (range 0–42) |
| ≤5 | 35 (9%) |
| 6–10 | 37 (10%) |
| 11–20 | 71 (19%) |
| 21–30 | 162 (43%) |
| 31+ | 75 (20%) |
| Age at US migration (years) | 32.9+ 10.9 (range 10–66) |
| <20 | 36 (9%) |
| 20–29 | 131 (34%) |
| 30–39 | 109 (29%) |
| 40+ | 104 (27%) |
| Education (years of schooling) | |
| <6 years | 22 (6%) |
| 6–9 years | 72 (19%) |
| 10–12 years | 180 (47%) |
| 13–15 years | 63 (17%) |
| 16+ years | 43 (11%) |
| English proficiency | |
| Fluent or speak pretty well | 35 (9%) |
| Speak somewhat well | 233 (61%) |
| Speak not very well | 90 (24%) |
| Not at all | 22 (6%) |
| Speaking English at home | |
| No | 272 (72%) |
| Yes | 108 (28%) |
| Health insurance | |
| No insurance | 26 (7%) |
| Medi-Cal only | 180 (47%) |
| Medicare (all were of ages 65 or older) | 18(5%) |
| Covered California | 81 (21%) |

| Characteristics | N (%) or Mean ± SD |
|---|---|
| Other HMO | 44 (12%) |
| Other PPO | 27 (7%) |
| Other/Unknown type | 4 (1%) |
| Age at menarche (years) | 14.5 ± 1.8 (range 11–19) |
| ≤12 | 53 (14%) |
| 13–14 | 148 (39%) |
| 15 | 64 (17%) |
| 16+ | 115 (30%) |
| Menopausal status and hormone therapy use | |
| Premenopausal | 130 (34%) |
| Postmenopausal | 250 (66%) |
| Never used hormone therapy | 233 (93%) |
| Ever used hormone therapy | 17(7%) |
| Number of deliveries | |
| 0 | 41 (11%) |
| 1–2 | 206 (54%) |
| 3–4 | 97 (25%) |
| 5+ | 36 (10%) |
| Age at first delivery for parous women (years) | 27.2 ± 5.9 (range 16–46) |
| <20 | 23 (7%) |
| 20–<25 | 109 (32%) |
| 25–<30 | 86 (25%) |
| 30–<35 | 76 (22%) |
| 35+ | 45 (13%) |
| Breastfeeding duration for parous women (years) | |
| Did not breastfeed | 87 (26%) |
| < 1 | 92 (27%) |
| 1 – <2 | 53 (16%) |
| 2 – <5 | 86 (25%) |
| 5+ | 21 (6%) |
| BMI ($kg/m^2$; mean ± SD) | 22.9 ± 3.0 (range 16.2–35.6) |
| <18.5 | 13 (3%) |
| 18.5– <23 | 206 (54%) |
| 23 – <27.5 | 132 (35%) |
| 27.5+ | 29 (8%) |
| <25 | 289 (76%) |
| 25 – <30 | 83 (22%) |
| 30+ | 8 (2%) |
| Smoking | |
| Never | 373 (98%) |
| Ever | 7 (2%) |
| Regular passive smoking at home (among 373 never smokers) | 76 (20%) |

| Characteristics | N (%) or Mean ± SD |
|---|---|
| Weekly alcohol drinking | |
| Never | 372 (98%) |
| Ever | 8 (2%) |
| Occupation | |
| Never worked in the US | 31 (8%) |
| Not currently working but had a job previously | 77 (20%) |
| Currently working in Nail Salon | 166 (44%) |
| Currently working in other industries | 106 (28%) |

Abbreviations: BMI, body mass index.

**Table 2.**

Mammogram screening history, knowledge of dense breasts, and distribution of BI-RADS breast density

| Mammogram screening and breast density | N (%) |
|---|---|
| Number of mammogram screening prior to interview | |
| 1–2 | 89 (23%) |
| 3–5 | 113 (30%) |
| 6–10 | 116 (31%) |
| 11–15 | 39 (10%) |
| 16–20 | 23 (6%) |
| Time interval between interview and most recent mammogram | |
| Same year | 290 (76%) |
| 1 year | 59 (16%) |
| 2 years | 16 (4%) |
| 3 years or more | 15 (4%) |
| BI-RADS density (in the most recent mammogram) | |
| 1 | 25 (7%) |
| 2 | 138 (36%) |
| 3 | 189 (50%) |
| 4 | 28 (7%) |
| Ever informed by a physician of having dense breasts | |
| Never or don't know what dense breast means | 331 (87%) |
| Ever informed by a physician of having dense breasts | 49 (13%) |
| Among women with dense breasts in most recent mammogram (n=217)[§] | |
| Never or don't know what dense breast means | 177 (82%) |
| Ever informed by a physician of having dense breasts | 40 (18%) |
| Among women informed by a physician of having dense breasts (n=49) | |
| Having dense breasts influenced study participation | 10 (20%) |

[§]Dense breast was defined as BI-RADS category 3 (heterogeneously dense) or 4 (extremely dense).

**Table 3.**

Odds ratios (OR) and 95% confidence intervals (CI) of having dense breasts (BI-RADS category 3 or 4 vs. 1 or 2) in association with lifestyle and demographic factors in Vietnamese American women*

| | Dense (BI-RADS 3 or 4) N (%) | Non-dense (BI-RADS 1 or 2) N (%) | Age and BMI- adjusted OR (95% CI) | P-value | Multivariable OR (95% CI)¶ | P-value |
|---|---|---|---|---|---|---|
| Age (per year) | Mean: 53.7 (SD: 7.5) | Mean: 56.3 (SD: 7.0) | 0.96 (0.93–0.98) | 0.002 | 0.95 (0.91–0.99) | 0.024 |
| BMI (per Kg/m$^2$) | Mean: 22.5 (SD: 2.9) | Mean: 23.4 (SD: 3.1) | 0.90 (0.84–0.97) | 0.005 | 0.92 (0.86–0.99) | 0.034 |
| Education | | | | | | |
| <6 years | 8 (4%) | 14 (9%) | 1 (Ref) | | 1 (Ref) | |
| 6–12 years | 140 (65%) | 112 (69%) | 1.58 (0.62–3.98) | | 1.14 (0.43–3.00) | |
| 13+ years | 69 (32%) | 37 (23%) | 2.44 (0.92–6.50) | | 1.48 (0.52–4.17) | |
| Trend (Per category) | | | | 0.032 | | 0.29 |
| Age at menarche (years) | | | | | | |
| ≤12 | 30 (14%) | 23 (14%) | 1 (Ref) | | 1 (Ref) | |
| 13–14 | 76 (35%) | 72 (44%) | 0.83 (0.44–1.59) | | 0.86 (0.44–1.66) | |
| 15 | 44 (20%) | 20 (12%) | 1.52 (0.70–3.31) | | 1.64 (0.73–3.66) | |
| 16+ | 67 (31%) | 48 (29%) | 1.01 (0.51–1.98) | | 1.27 (0.63–2.58) | |
| | | | | 0.52 | | 0.16 |
| Menopausal status | | | | | | |
| Premenopausal | 85 (39%) | 45 (28%) | 1 (Ref) | | 1 (Ref) | |
| Postmenopausal | 132 (61%) | 118 (72%) | 1.00 (0.52–1.91) | 0.99 | 1.05 (0.54–2.06) | 0.89 |
| Hormone therapy (among postmenopausal women) | | | | | | |
| Never | 122 (92%) | 111 (94%) | 1 (Ref) | | 1 (Ref) | |
| Ever | 10 (8%) | 7 (6%) | 1.59 (0.54–4.67) | 0.40 | 1.19 (0.39–3.62) | 0.76 |
| Number of delivery | | | | | | |
| 0 | 26 (12%) | 15 (9%) | 1 (Ref) | | 1 (Ref) | |
| 1–2 | 134 (62%) | 72 (44%) | 0.99 (0.49–2.02) | | 1.07 (0.52–2.22) | |
| 3–4 | 47 (22%) | 50 (31%) | 0.56 (0.26–1.20) | | 0.62 (0.28–1.36) | |
| 5+ | 10 (5%) | 26 (16%) | 0.28 (1.10–0.75) | | 0.35 (0.12–0.97) | |
| Trend P (Per category) | | | | 0.001 | 0.006 | |
| Age at first birth (among parous women; years) | | | | | | |
| <30 | 113 (59%) | 105 (71%) | 1 (Ref) | | 1 (Ref) | |

| | Dense (BI-RADS 3 or 4) N (%) | Non-dense (BI-RADS 1 or 2) N (%) | Age and BMI- adjusted OR (95% CI) | P-value | Multivariable OR (95% CI)[¶] | P-value |
|---|---|---|---|---|---|---|
| 30+ | 78 (41%) | 43 (30%) | 1.56 (0.98–2.50) | 0.063 | 1.14 (0.67–1.92) | 0.63 |
| Duration of breastfeeding (among parous women) | | | | | | |
| Did not breastfeed | 58 (30%) | 29 (19%) | 1 (Ref) | | 1 (Ref) | |
| < 1 year | 64 (34%) | 28 (19%) | 1.16 (0.61–2.21) | | 1.27 (0.66–2.44) | |
| 1 – <2 | 27 (14%) | 26 (17%) | 0.57 (0.28–1.15) | | 0.78 (0.37–1.65) | |
| 2+ | 42 (22%) | 65 (44%) | 0.39 (0.21–0.72) | | 0.69 (0.34–1.40) | |
| Trend P (Per category) | | | | 0.0003 | | 0.19 |
| Length of US residence (years) | | | | | | |
| ≤5 | 14 (6%) | 21 (13%) | 1 (Ref) | | 1 (Ref) | |
| 6–10 | 19 (9%) | 18 (11%) | 1.62 (0.62–4.25) | | 1.51 (0.56–4.08) | |
| 11–20 | 38 (18%) | 33 (21%) | 1.73 (0.74–4.03) | | 1.49 (0.62–3.55) | |
| 21–30 | 101 (47%) | 61 (37%) | 2.82 (1.30–6.11) | | 2.38 (1.07–5.29) | |
| 31+ | 45 (21%) | 30 (18%) | 3.17 (1.33–7.56) | | 2.87 (1.16–7.09) | |
| Trend P (Per category) | | | | 0.002 | | 0.006 |
| Age at US migration (years) | | | | | | |
| 40+ | 41 (19%) | 63 (39%) | 1 (Ref) | | 1 (Ref) | |
| 30–39 | 65 (30%) | 44 (27%) | 2.11 (1.20–3.69) | | 1.72 (0.96–3.07) | |
| <30 | 111 (51%) | 56 (34%) | 2.58 (1.50–4.43) | | 2.48 (1.43–4.32) | |
| Trend (Per category) | | | | 0.001 | | 0.001 |
| English proficiency | | | | | | |
| Speak not very well or not at all | 57 (26%) | 55 (34%) | 1 (Ref) | | 1 (Ref) | |
| Speak somewhat well | 139 (64%) | 94 (58%) | 1.35 (0.85–2.15) | | 1.00 (0.60–1.66) | |
| Fluent or speak pretty well | 21 (10%) | 14 (9%) | 1.41 (0.64–3.11) | | 0.88 (0.37–2.08) | |
| Trend (Per category) | | | | 0.23 | | 0.82 |

[¶]Odds ratios and 95% confidence intervals were estimated by using multivariable logistic regression models. All variables presented in the table were adjusted for age, BMI, education, menopausal status, hormone therapy, number of delivery, and length of US residence (except for analysis of age at US migration).