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Acculturation and Breast Cancer Screening of Asian American Women in California

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Dartmouth College

2015

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An abstract of

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Abstract

Acculturation and Breast Cancer Screening of Asian American women in California
By Sandy Kim

Breast cancer incidence rates continue to rise in Asian American women, contrasting with the decreasing rates observed in non-Hispanic white (NHW) and black women and the stable rates observed in Hispanic women. Despite this increase in breast cancer incidence rates, Asian American women continue to have the lowest screening rates of all racial and ethnic groups. Acculturation has been linked to both the increase in incidence rates and the low rates of breast cancer screening. This thesis aims to study how acculturation indicators, interview language and nativity, impact screening rates in Asian American women. It hypothesizes that acculturation mediates the negative association between Asian American ethnicity and breast cancer screening adherence. Additionally, the study hypothesizes that more acculturated Asian American women will have higher odds of breast cancer screening adherence than less acculturated women. The study was developed using the Andersen Healthcare and Utilization model to identify focal relationships, mediating mechanisms, moderating relationships, and important covariates. Logistic regression analyses were conducted on pooled California Health Interview Survey from 2001 to 2009. Results from these analyses showed that most Asian American women, with the exception of Vietnamese women, had lower odds of adherence than the reference group NHW women. Acculturation was found to mediate the focal association in a suppressing, rather than enhancing manner. Korean and Chinese women who interviewed in English had higher odds of adherence than those who interviewed in non-English languages. Filipino and Japanese women who were born in the US had higher odds of adherence than those born elsewhere. Future studies on this topic should conduct qualitative interviews for Korean and Vietnamese American subpopulations. Additionally, the role of acculturation as a mediator should be analyzed more thoroughly with longitudinal data and a repeat analysis should be conducted on post Affordable Care Act data.

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Chapter 1 – Introduction

Overview

Breast cancer is the most commonly diagnosed cancer and second leading cause of death for Asian American women. In 2016, there were an estimated 11,090 new invasive breast cancer cases and 1,180 deaths among Asian American women (American Cancer Society, 2016). According to an original research article published by Liu et al., breast cancer incidence rates continue to rise annually for Asian American women, contrasting with the recent declines observed in other racial/ethnic groups (2012).

Despite these increases in breast cancer incidence, research has established that Asian American women have the lowest breast cancer screening rates of all racial and ethnic groups (Kagawa-Singer & Pourat, 2000). Disaggregated data for six major Asian American ethnic groups (Japanese, Filipina, Chinese, Korean, Vietnamese, and South Asian) have revealed disparities in screening rates with Japanese American women having the highest rates, comparable to non-Hispanic white (NHW) women, and Korean American women having the lowest screening rates. Other studies have found that Japanese and Filipino American women, groups with longer histories of immigration, have significantly higher rates of breast cancer screening compared to more recently immigrated Chinese, Korean, and Vietnamese women (Chen et al., 2004; Sadler et al., 2003; Kagawa-Singer et al., 2007; Lee et al., 2010; Wu, Bancroft, & Guthrie, 2005).

Acculturation is defined as the degree to which an individual adopts social norms, values, and practices of their new country rather than to those of their home country (Abraído-Lanza, 2009). Acculturation indicators such as English proficiency, time spent in the US, citizenship status, and language spoken at home are found to explain some but not all of the association

between Asian American ethnicity and low rates of cancer screening (Kagawa-Singer et al., 2007; Kandula et al., 2006; Lee et al., 2014; Ryu, Crespi, & Maxwell, 2013). The research supports that acculturation partially explains lower breast cancer screening rates for Asian American women.

Rationale

Most of the literature on breast cancer screening for Asian American women has focused on identifying factors that explain the low breast cancer screening rates observed. Such factors include the above mentioned acculturation indicators as well as factors such as marital status, education, income, and health insurance status. Most of these analyses have either been performed on collected data with samples from 500 to 1000 individuals or on one to two cycles of California Health Interview Survey (CHIS) data (Chen et al., 2004; Sadler et al., 2003; Gomez et al., 2007; Kagawa-Singer et al., 2007; Kagawa-Singer & Pourat, 2000; Lee et al., 2010). One study that pooled across CHIS cycles from 2001 to 2009 tracked changes in breast cancer screening rates over time for disaggregated Asian American women (Chawla et al., 2015).

This study aims to ascertain the impact a new acculturation indicator, interview language, may have on the odds of breast cancer screening adherence using pooled CHIS data from 2001 to 2009. Interview language has been identified by Lee et al. to be a better predictor of acculturation than self-rated English proficiency and percentage of life spent in the US for foreign-born Asian Americans (2011). Furthermore, foreign-born Asian Americans who interviewed in English closely resembled US born Asian Americans in terms of demographics, healthcare access, and services utilization. CHIS offers interviews in Mandarin, Cantonese, Korean, and Vietnamese. Thus interview language is used as an acculturation indicator in these subgroups. In a sub-analysis for Japanese, Filipino, and South Asian subgroups, nativity rather

than interview language is used as the primary acculturation indicator because CHIS does not offer their native Asian languages.

The results from this study would help to clarify the role acculturation plays on breast cancer screening adherence in Asian American women and identify vulnerable groups of Asian American women.

Research Questions

Due to limited research on how acculturation, measured via interview language and nativity, influences breast cancer screening adherence in disaggregated Asian American women, this study aims to identify whether Asian American women who are less acculturated are less likely to be adherent with current breast cancer screening guidelines. Stated more specifically, the primary research question is: *Does acculturation, measured via interview language, have an effect on breast cancer screening adherence among Chinese, Korean, and Vietnamese women in California?* A secondary research question is: *Does acculturation, measured via nativity, have an effect on breast cancer screening adherence among Filipino, Japanese, and South Asian women in California?*

The following hypotheses will be tested:

H1: Interviewing in English will partially explain the lower odds of breast cancer screening adherence for Chinese, Korean, and Vietnamese American women with the reference group of NHW women.

H2: Chinese, Korean, and Vietnamese American women who interview in English will have higher odds of breast cancer screening adherence than Chinese, Korean, and Vietnamese American women who interview in a non-English language.

H3: Being born in the US will partially explain the lower odds of breast cancer screening adherence for Japanese, Filipino, and South Asian American women with the reference group of NHW women.

H4: Japanese, Filipino, and South Asian American women born in the US will have higher odds of breast cancer screening adherence than Japanese, Filipino, and South Asian American women not born in the U.S.

Research Design

The Andersen Model for Healthcare Utilization (Andersen, 1995) is used to frame the focal relationship between Asian American ethnicity and breast cancer screening adherence. It is also used to identify predisposing, enabling, and need covariates. Acculturation is included in the framework as both a mediator and moderator. This study uses multivariable logistic regression to identify the association between Asian American ethnicity (reference group being NHW women) and breast cancer screening adherence. Acculturation will be included first as a mediator and then interacted with ethnicity as a moderator to test for differences by acculturated status. The study will be conducted on merged California Health Interview Survey (CHIS) datasets from 2001 to 2009 for a pooled analysis.

Study Implications

Results from this study have the potential to inform breast cancer screening interventions to target especially vulnerable populations. Specifically, findings from this study could identify women who should be targeted (i.e. Chinese, Korean, and Vietnamese women who choose not to interview in English) and which Asian American ethnic subgroups need more resources devoted towards outreach. In summary, the results from this study support the development of screening interventions to target low acculturated Asian American women particularly resistant to breast cancer screening.

Chapter 2: Literature Review

Overview

Breast cancer continues to be the most commonly diagnosed cancer and leading cause of death among Asian American women (American Cancer Society, 2016). Early detection and treatment of breast cancer is vital as five year survival rates decrease at later stages of diagnosis when aggressive tumors metastasize (Howlader et al., 2013). The American Cancer Society (ACS) and United States Preventive Task Force (USPTF) guidelines recommend regular breast cancer screening for age appropriate women (Oeffinger et al., 2015; Siu, 2016).

In contrast to the declining incidence rates observed in white and black women and the stable rates of Hispanic women, rising breast cancer incidence rates for Asian American women have been documented (Gomez et al., 2007). Breast cancer incidence in Asian American women vary threefold by ethnicity with Japanese American women having the highest incidence rates and Chinese and Korean American women having the lowest rates (Gomez et al., 2013). They also vary by generational status with especially concerning high pre- and peri-menopasual invasive breast cancer incidence trends observed in U.S. born Asian American women (Gomez et al., 2010).

Despite these increases, screening rates among Asian American women continue to lag behind other racial and ethnic groups ("UCLA Center for Health Policy Resarch" 2014). Current research on breast cancer screening has focused on disaggregating screening rates for heterogeneous Asian American ethnic subgroups (Chawla et al., 2015; Chen et al., 2004; Kagawa-Singer et al., 2007; Kagawa-Singer & Pourat, 2000; Pourat et al., 2010). Other studies have focused on analyzing the effect acculturation and healthcare access have on screening rates (Kandula et al., 2006; Lee et al., 2014; Pourat et al., 2010).

Previous studies have not analyzed the effects of acculturation indicator nativity in disaggregated Asian Americans or the effects of new acculturation indicator interview language in Asian American women. Given the evidence of acculturative effects on breast cancer incidence among Asian American women with immigrant and US born Asian American women having higher rates of incidence than native Asian women (Gomez et al., 2010), it is important to analyze the effects of acculturation on breast cancer screening adherence in disaggregated Asian American women. This study will analyze the effect acculturation, proxy measured via interview language, has on breast cancer screening adherence for Chinese, Korean, and Vietnamese women in California. A sub-analysis will analyze the effect acculturation, proxy measured via nativity, has on breast cancer screening adherence for Japanese, Filipino, and South Asian women in California.

Breast Cancer

Breast cancer consists of cancerous tumors, lumps, or mass formed from the overgrowth of cancerous cells originating in the breast tissue. There are two broad classifications of breast tumors: ductal carcinoma in situ and invasive. Ductal carcinoma in situ (DCIS) breast cancers remain localized in the cells lining the breast ducts while invasive breast cancers (the majority of breast cancers) infiltrate surrounding breast tissue. Over time, in situ breast cancers can progress to invasive stages while invasive cancers can metastasize to different organs. The Surveillance, Epidemiology, and End Results (SEER), a program of the National Cancer Institute that tracks cancer incidence over time, classifies invasive breast cancers' stages of diagnosis as local stage, wherein cancers are confined to the breast, regional stage, wherein tumors have spread to surrounding breast tissue, and distant stage, wherein tumors have metastasized to nearby organs or to lymph nodes above the collarbone (Young et al., 2001).

Invasive breast cancer is a collection of different tumors that can be divided into three molecular subtypes: Luminal, HER2, and Basal. Luminal subtypes have high expression of hormone receptors estrogen (ER) and progesterone (PR). A majority of invasive breast cancers are the luminal ER/PR positive subtype and respond well to endocrine therapy and chemotherapy. Luminal breast cancer subtypes also have generally good prognosis and high five-year survival rates. HER2 breast cancer subtype has a high expression of HER2, a proliferating factor, and comprises around 15% of invasive breast cancers. There is limited therapy and a poorer prognosis for this subtype. Lastly, the Basal subtype has a high expression of basal epithelial genes and comprises around 15% of invasive breast cancers. This subtype also typically presents as the "triple negative" subtype that does not express any hormonal receptors or the HER2 proliferating growth factor. There is very limited therapy for this subtype and a poor prognosis (Schnitt, 2010).

Breast Cancer Screening

Early detection of breast cancer remains vital to survival outcome, as the 5-year relative survival rate for all women is 99% for localized tumors, 84% for regional tumors, and 24% for distant stage tumors (Howlader et al. 2013). Because most early breast cancers are asymptomatic, regular mammographic screening is recommended for age appropriate women. A mammographic screening is a low dose x-ray procedure that allows healthcare professionals to see the internal structure of the breast. Breast cancer screening has been proven effective with meta-analyses of randomized trials showing that mammography reduces the risk of death from breast cancer by 15% to 20% (Gotzsche & Jorgensen 2013). Early detection of breast cancer by mammography screening improves chances of survival and increases the range of treatment options available.

The updated 2015 American Cancer Society (ACS) guidelines recommend that women should receive regular mammography screening beginning at 45 years of age. Specifically, women aged 45 to 54 years should be screened annually while women 55 years and older should be screened biennially. The ACS also released a recommendation that women should receive the opportunity to begin annual screening between the ages of 40 to 44 years (Oeffinger et al., 2015). Alternatively, the United States Preventive Services Task Force (USPSTF) updated 2016 screening recommendations consisted of biennial mammographic screening for women aged 50 to 74 years. They stressed the importance of individual decision making for regular mammographic screening in women between the ages of 40 to 49 years (Siu, 2016).

As early detection via screening influences survival outcomes, national and state funded public screening programs have been implemented. The Centers for Disease Control and Prevention (CDC) administers the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), which aims to provide access to timely breast and cervical cancer screening and diagnostic services to low-income, uninsured, and underinsured women. This federal program funds state breast and cervical cancer screening programs that provide low cost mammograms and pap tests to eligible women and prioritizes outreach to women 40 years and older ("CDC," 2016).

Asian American Population

Asian American is a term used to distinguish Americans of Asian descent or individuals with origins from the Far East, Southeast Asia, or the Indian subcontinent (Chen, 2005). Thus, Asian Americans are a diverse and heterogeneous population. Currently, the six largest Asian American groups are Chinese, Filipino, South Asian, Vietnamese, Korean, and Japanese (Hoeffel et al., 2012). Asian Americans vary widely on factors that affect healthcare access and use such

as English proficiency, education level, employment, income and health insurance. These differences are observed at both the level of ethnicity and nativity.

Table 1. Demographics of the Asian American population

	Chinese	Filipino	South Asian	Vietnamese	Korean	Japanese
Foreign born	76%	69%	87%	84%	78%	32%
U.S. citizen	69%	77%	56%	80%	67%	79%
Median age (yrs)	43	43	37	41	40	47
Married	59%	56%	71%	57%	56%	53%
Less than HS	18%	8%	9%	30%	8%	5%
Bachelor's degree	51%	47%	70%	26%	53%	46%
Low English	48%	22%	24%	59%	46%	18%
Poverty	14%	6%	9%	15%	15%	8%

(Kohut et al., 2013)

Heterogeneity observed by ethnicity

Asian Americans vary widely in demographics by ethnicity. Chinese, Korean, and Vietnamese are less likely to be English proficient, have lower levels of education, and more likely to live in poverty compared to Filipino, South Asian, and Japanese. Japanese have the highest proportion of US born American citizens. South Asians are the most educated with 70% of them having bachelor's degrees (Taylor et al., 2013). Income and employment differences contribute to health insurance coverage differences with Japanese and South Asian groups having the lowest uninsured rates and Koreans and Southeast Asians having the highest uninsured rates (Henry J. Kaiser Foundation, 2000).

Heterogeneity observed by nativity

Currently, around 74% of Asian American adults are first generation (foreign born), 19% are second generation (U.S. born), and 7% are third generation (native born with at least one

parent born in the U.S.). Second-generation Asian Americans have similar education levels to their first-generation counterparts but are less likely to be employed in service, maintenance, and transportation occupations and are more likely to work in sales, office support, and information and finance industries (Taylor et al., 2013).

In terms of healthcare access and utilization, foreign born Asian American adults are less likely than U.S. born Asian Americans to have regular care and see or talk to a doctor/specialist (Ye et. al, 2012). Another study found the medical expenditures of foreign born immigrant Asian Americans were equivalent to one half to two thirds of the medical expenditures of US born Asian Americans, independent of insurance (Ku, 2009). In conclusion, Asian Americans are heterogeneous by not only their ethnicities but also by their nativity. These differences then influence their access to and use of healthcare services such as breast cancer screening.

Breast Cancer Incidence among Asian American Women

Breast cancer incidence rates for most Asian American groups, with the exception of Japanese women, are steadily approaching their NHW counterparts. Moreover, the increase in breast cancer incidence observed in Asian American women over the past two decades contrasts directly with recent declines in incidence among NHW and black women and stable rates among Hispanic women. Since 2000, invasive breast cancer risks for Chinese and Korean women have surpassed Hispanic women (Gomez et al., 2013).

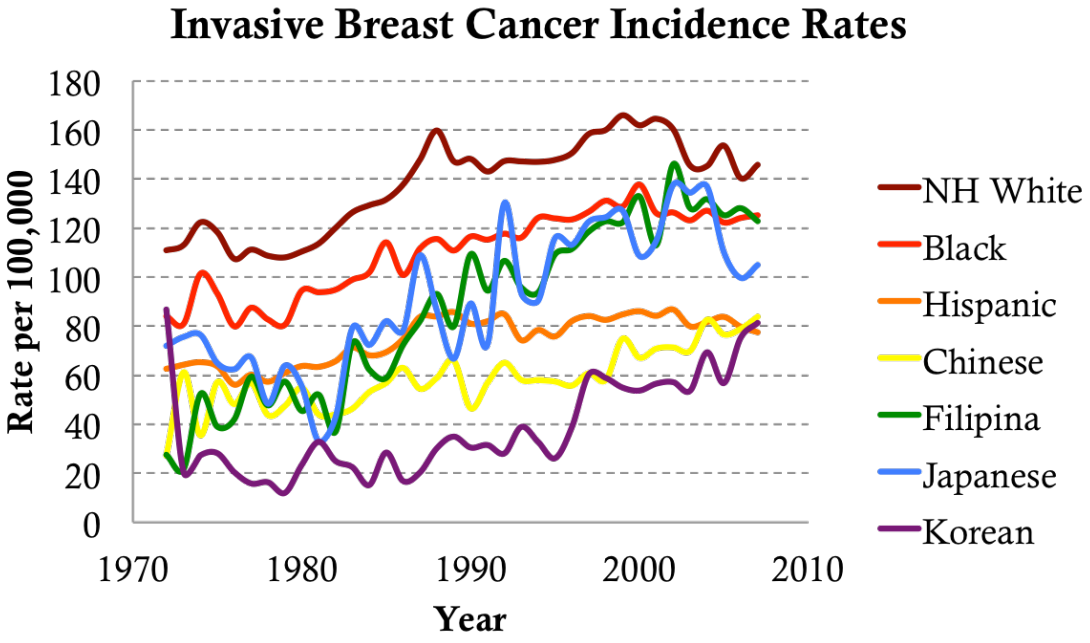
Asian American women have also been found to be vulnerable to the more aggressive HER2 positive breast cancer (Gomez et al., 2007; Gomez et al., 2013). A study in California demonstrated that Korean, Filipino, Chinese, and Vietnamese women had a higher risk of HER2 positive breast cancer than NHW women (Telli et al., 2011). Another study further corroborated this finding and added new information that Korean, Filipina, Chinese, and Southeast Asian women had increased risk for the ER negative, PR negative, HER2 positive subtype. This was an

important distinction to make as higher survival rates have been linked to hormone receptor positive HER2 breast cancer tumors than hormone negative HER2 positive subtypes (Parise & Caggiano, 2014, 2016).

Breast cancer incidence by ethnic subgroups

Heterogeneity in breast cancer incidence exists among Asian American ethnic subgroups. Breast cancer incidence rates vary three-fold by ethnicity from 35.0 per 100,000 in Cambodian women to 126 per 100,000 in Japanese women ("ACS" 2016; Gomez et al., 2010). Certain ethnic subgroups such as Japanese and Filipino American women already have comparable rates of breast cancer incidence to NHW women (Torre et al., 2016). Among Asian American subgroups, the highest increases in invasive breast cancer incidence were observed in Japanese and Filipino American women while the lowest increases were observed in Chinese and Korean women (Liu et al., 2012).

Figure 1. Breast Cancer Incidence Rates



(Liu et al., 2012)

Breast cancer incidence by nativity

Previous literature has established the association between immigration patterns of Asian American women and their subsequent increase in breast cancer risks, documenting higher breast cancer incidence rates among immigrant Asian American women and US born Asian American women in comparison to native Asian women. One study found that for US born women, rates of breast cancer risk increased if one or more parents were born in the U.S. as well (Ziegler et al., 1993). Another study documented breast cancer incidence trends for Chinese, Japanese, and Filipino American women from 1973 to 1986 and found U.S. born Chinese and Japanese American women had higher rates of incidence than their foreign born counterparts (Stanford et al., 1995).

Japanese American women present an interesting case study because they are more acculturated and have the highest proportion of second and third generation Asian American women. Beginning in the 1970s, a strong upward trend in breast cancer incidence rates for both first generation and second generation Japanese American women were observed with incidence rates closely approaching NHW women (Buell, 1973). Another seminal study in the 1990s found that breast cancer incidence rates in Japanese American women in Los Angeles were higher than the rates of Japanese women in Asia but that the increase in incidence rate depended on time of immigration. In other words, "early" immigrants and U.S. born Japanese American women had comparable breast cancer incidence rates to NHW women while "late" immigrants had breast cancer incidence rates between those of native Japanese women and NHW women (Shimizu et al., 1991).

Breast Cancer Screening among Asian American Women

There exist significant disparities in breast cancer screening rates between Asian Americans and other racial and ethnic groups. Asian American women across the U.S. have lower screening rates compared to NHW women and fail to meet the Healthy People 2000 objectives (Ghosh, 2003). In California, 72% of Asian American women reported a mammogram in the past 2 years compared to 83% of African American women, 81% of White women, and 77% of Latina women (UCLA Center for Health Policy and Research, 2014). Even after adjusting for access to care, several studies have found significant disparities in breast cancer screening rates between Asian American women and NHW women (Chen et al., 2004; Goel et al., 2003; Ryu et al., 2013).

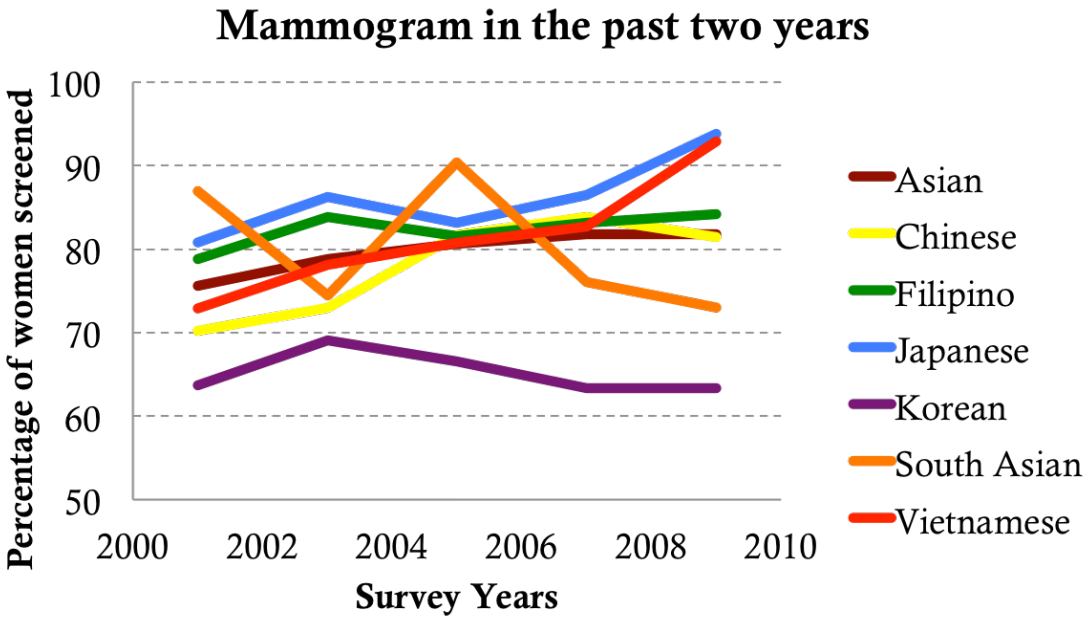
Breast cancer screening by ethnic subgroups

Disaggregated California Health Interview Survey (CHIS) data have allowed researchers to capture the heterogeneity in screening rates between ethnic groups. Researchers have found Japanese American women to have the highest rates of breast cancer screening and identified Chinese, Filipino, and Korean subgroups to have the lowest breast cancer screening rates (Chen et al., 2004; Kagawa-Singer et al., 2007; Kandula et al., 2006; Lee et al., 2010). CHIS data from 2011-2012 showed that while 84% of Japanese women reported receiving a mammogram only 52% of Korean women reported a recent mammogram (UCLA Center for Health Policy and Research, 2014).

Even after controlling for acculturation factors, socio-demographic indicators, and biological risk factors for breast cancer, significant disparities between breast cancer screening rates remained. Korean American women in particular continued to have the lowest probability of mammography receipt despite controlling for these factors (Kagawa-Singer et al., 2007). Current literature has attributed the persisting disparity after adjustment for access factors (health

insurance and socioeconomic status) to cultural and attitude barriers such as embarrassment, modesty, fatalism, knowledge and crisis orientation (Chen et al., 2004; Kagawa-Singer & Pourat, 2000; Lee-Lin et al., 2012; Lee et al., 2010; Lee et al., 2014; Lee et al., 2012).

Figure 2. Breast Cancer Screening Rates



(Chawla et al. 2015)

Acculturation and Breast Cancer

Acculturation and Breast Cancer Incidence

The increase in breast cancer incidence for immigrant Asian American women and U.S. born Asian American women has been attributed to changes in lifestyle factors such as Westernized diets and risk behaviors such as smoking and drinking.

Research in clinical nutrition has established an association between a Westernized red meat and potatoes diet and higher breast cancer risk in post-menopausal women. Conversely, a diet high in vegetables and raw fruit intake has been shown to confer protective effects against

breast cancer (Catsburg et al., 2015). Specifically in Asian American women, women who were high consumers of Western meat/starch and ethnic meat and low consumers of vegetable/soy diets displayed the highest risk for breast cancer (Wu et al., 2009). Dietary studies in Japanese and Japanese American women confirmed that a more acculturated Westernized diet versus the traditional Japanese diet led to an increase in breast cancer risk (Pierce et al., 2007; Shin et al., 2016).

Regular alcohol intake has also been observed more in U.S. born Asian American women than foreign born Asian American women, with U.S. born Japanese American women twice as likely as foreign born Japanese American women to be regular drinkers. Regular alcohol drinking was a significant risk factor breast cancer in Japanese American women, but not in Chinese and Filipina American women (Wu et al., 2012). Conversely, low levels of drinking and smoking among Asian American women had no association with increased risk of breast cancer (Brown et al., 2010).

Although environmental influences on breast cancer risk have not been studied directly in Asian American women, current literature attributes environmental toxins as a possible explanation for rising breast cancer incidence rates in Asian American women.

Acculturation and Breast Cancer Screening

Previous literature has established that acculturative indicators (English proficiency, time spent in the U.S., language use at home) and access factors (health insurance, income, educational level) partially explain lower breast cancer screening rates observed for Asian American women (Chen et al., 2004; Kagawa-Singer & Pourat, 2000; Lee-Lin et al., 2012; Lee et al., 2010; Lee et al., 2014; Lee et al., 2012).

Common acculturation indicators that are used to study breast cancer screening in Asian American women are English proficiency, time spent in the US, and citizenship. Many studies that have analyzed the effect of acculturation on breast cancer screening have used collected samples from 500 to 1000 individuals or one to two cycles of CHIS data (Chen et al., 2004; Sadler et al., 2003; Gomez et al., 2007; Kagawa-Singer et al., 2007; Kagawa-Singer & Pourat, 2000; Lee et al., 2010). With an indicator such as nativity, small sample sizes impede adequate analysis for "newer" immigrant groups such as Chinese, Korean, and Vietnamese Americans with fewer US born Asian Americans. Thus, most research on nativity in Asian Americans is forced to dichotomize aggregated Asian American groups into two samples of US born and foreign-born Asian Americans.

The original research question sought to understand how generational status affected breast cancer screening rates in disaggregated Asian American subgroups. Generational status was hypothesized to affect breast cancer screening adherence because US born Asian Americans differ from their immigrant parents in many respects. In general, they are more proficient in English and better understand how to navigate the current healthcare system. Furthermore, US born Asian Americans have been found to be more health literate, have a greater perceived need for breast cancer screening, and better understand the benefits of regular preventative cancer screening (Kandula et al., 2006). Research has already established differences in healthcare use and expenditures between US born and foreign-born Asian Americans (Ku, 2009; Ye et al., 2012).

In order to study this question within the constraints of publicly available CHIS data (i.e. small numbers of US born Asian Americans in Korean and Vietnamese subpopulations), a new acculturation indicator, interview language, was used based on the findings of an original

research article. Lee et al. (2011) performed t-tests to find which acculturation indicator (English proficiency, percentage of life in the US, nativity, and interview language) best predicted differences. They found interview language to be the best predictor as foreign-born Asian Americans who interviewed in English had similar demographics, health status, and healthcare utilization behaviors to US born Asian Americans (2011).

As such, this study sought to understand how the acculturation indicator, interview language, influences breast cancer screening adherence in Chinese, Korean, and Vietnamese women. Because CHIS is offered in English, Spanish, Mandarin, Cantonese, Korean, and Vietnamese, interview language is used as the acculturation indicator in Chinese, Korean, and Vietnamese subpopulations. Nativity is used in Japanese, Filipino, and South Asian populations. The study was performed on a pooled sample from CHIS cycles 2001-2009 to enable adequate sample size for a disaggregated analysis.

California

California is a unique state that provides low-income individuals access to health insurance and health care services. In 2013, California enacted an early health insurance expansion via a state Medicaid program that enrolled 600,000 childless, low-income adults. Furthermore, Covered California, the state's marketplace health insurance exchange, is one of the largest in the country and has covered millions since 2014 (Kaiser Commission on Medicaid and the Uninsured, 2015).

For breast cancer screening, women who do not qualify for NBCCEDP may still qualify for the state funded breast cancer early detection program, otherwise known as Every Woman Counts (EWC). While EWC receives both federal and state funding, state funds are used to provide services for women who do not meet federal eligibility requirements such as citizenship. These services include free clinical breast exams, mammograms, pelvic exams, and Pap tests.

Women who are within appropriate age ranges, have low-income, no or limited insurance, no cancer screening provision from Medi-Cal or other public programs, and live in California are eligible for free cancer screening ("Every Woman Counts," 2016).

California also has the greatest concentration of Asian Americans per county at a state level and ranks the second state with the greatest number of Asian Americans. Furthermore, Asian Americans make up 15% of the total population in California (Hoeffel et al., 2012). Given the demographics of California, data collected from this state survey represents a large proportion of Asian Americans in the US.

Summary

Current research has established the necessity of disaggregating breast cancer incidence and screening rates of heterogeneous Asian American subgroups due to differences in immigration, income, education, occupations, health insurance, and health services use (Camarota, 2012; Hoeffel et al., 2012; Frisbie, 2001; Ye et al., 2012). Research has also uncovered the need to disaggregate breast cancer screening rates not just by ethnicity, but also by acculturated status given the positive association between acculturation and breast cancer incidence (Buell, 1973; Gomez et al., 2010; Stanford et al., 1995; Shimizu et al., 1991; Ziegler et al., 1993).

The results and findings from this study aim to disaggregate breast cancer screening behavior of Asian American women by acculturated status, proxy measured via interview language and nativity, in order to provide more information for targeted breast cancer screening interventions.

Chapter 3: Methods

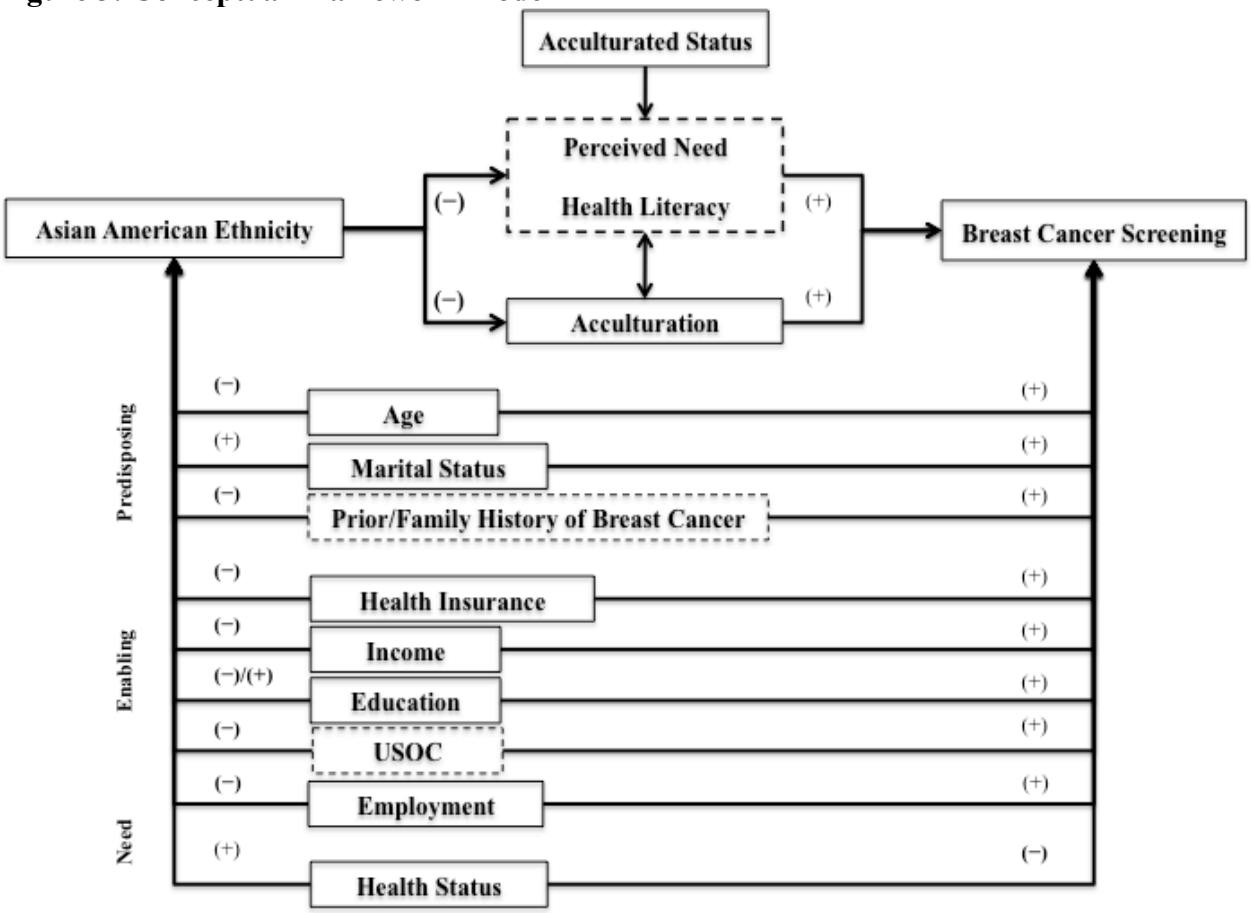
Overview

An analysis of breast cancer screening adherence for Asian American women from the six largest ethnic groups in California was conducted. To organize this analysis, the Andersen Model for Healthcare Utilization (Andersen, 1995) was used to identify covariates that correspond to the predisposing, enabling, and need categories. Using pooled CHIS cycles from 2001 to 2009, multivariable logistic regression models were conducted to test four proposed hypotheses.

Conceptual Framework

The Andersen Behavioral Model for Healthcare Utilization (Andersen, 1995) is used to analyze the relationship between Asian American ethnicity and breast cancer screening adherence. It also is used to consider the mediating and moderating effects of acculturation, measured by language of interview and nativity, on the focal relationship. The Andersen Model is useful for identifying the factors influencing health behaviors in vulnerable populations, such as minority racial and ethnic groups. This model organizes these factors into three categories of predisposing, enabling, and need characteristics. Predisposing factors include biological or social constructs that influence the propensity of seeking healthcare services. Enabling factors consist of constructs that either directly facilitate or impede access to healthcare. Need factors are real or perceived needs for healthcare that consequently affect healthcare utilization (Andersen, 1995). Unmeasured constructs are represented by a dotted line in the conceptual model while the positive and negative signs indicate the direction of the association between two constructs (Figure 3).

Figure 3: Conceptual Framework Model



Focal Relationship

The focal relationship for this conceptual model is the relationship between Asian American ethnicity and breast cancer screening adherence. Asian American ethnicity is defined as Americans of Asian descent or individuals with origins from the Far East, Southeast Asia, or the Indian subcontinent (Chen, 2005). These six major ethnic subgroups are Chinese, Filipino, South Asian, Vietnamese, Korean, and Japanese (Hoeffel et al., 2012). Breast cancer screening adherence is defined as receiving a mammograms in the past two years (Siu, 2016). With NHW race as the reference group, Asian American ethnicity is hypothesized to be negatively associated with breast cancer screening adherence based off the consensus of current literature (UCLA Center for Health Policy and Research, 2014; Chawla et al., 2015; Gomez et al., 2007).

Moderator

Acculturation is defined as the degree to which an individual adheres to social norms, values, and practices of their new country or to those of the US (Abraído-Lanza, 2009). In this study, acculturation was indicated by interview language based off the findings from Lee et al. (2011) that established interview language as the best proxy measure for acculturation in Korean, Chinese, and Vietnamese populations. In a sub-analysis, acculturation was measured through nativity serving as a moderator for Filipino, Japanese, and South Asian populations. More acculturated women are hypothesized to have higher rates of breast cancer screening than less acculturated women.

Mediators

Acculturation is a proposed mediator of the relationship between Asian American ethnicity and breast cancer screening adherence. Asian American ethnicity is predicted to be negatively associated with acculturation. Lower level of acculturation is thought to be associated with lower odds of breast cancer screening adherence.

Perceived need is defined as the individual's self determined need for healthcare services influenced largely by health beliefs and social structures (Andersen, 1995). Studies in the literature have suggested that foreign-born Asian women have lower rates of perceived need for preventive cancer screenings due to the lack of preventive services care and lower cancer incidence rates in their countries of origin (Chawla et al., 2015; Chen et al., 2004). Acculturation is positively associated with greater perceived need because the incidence rate of breast cancer is correlated with immigration and longer time spent in the U.S. Thus, acculturation will lead to an increase in perceived risk for breast cancer and consequently, an increase in perceived need for cancer screening.

Health literacy is the degree to which individuals are able to understand health information and is related to but separate from English proficiency" (Sentell & Braun, 2012). Acculturation is positively associated with health literacy because longer time spent in the U.S. and greater interaction with the healthcare system leads to an improvement in health literacy. Greater health literacy is then associated with a better understanding of the benefits of preventive cancer screening and subsequent higher rates of breast cancer screening compliance (Sentell & Braun, 2012).

Confounders

At the individual level, the following constructs are confounders organized into Andersen's predisposing, enabling, and need characteristics. These characteristics need to be controlled for in order to exclusively assess the focal relationship between Asian American ethnicity and breast cancer screening adherence and to analyze the mediating and moderating effects of acculturation.

Predisposing characteristics are confounders that include age, marital status, and prior/family history of cancer. Older age and being married or living with a partner are associated with higher rates of cancer screening in Asian American women in current literature (Chawla et al., 2015; Chen et al., 2004; Kagawa-Singer et al., 2007; Kandula et al., 2006; Lee et al., 2014; Ryu et al., 2013). Prior/family history of cancer can be an important confounder for the focal relationship because it is associated with the propensity for preventive cancer screening. Research has shown that the prevalence of common cancers observed in the U.S., such as breast cancer, increases in Asian American subgroups with longer immigration histories to the U.S. (Ziegler et al., 1993). Thus, it is hypothesized that more acculturated women are more likely to have both prior and family histories of breast cancer and will have subsequent higher rates of breast cancer screenings. Prior/family history of cancer will be unmeasured because this

information was not tracked across data cycles and will be indicated by the dotted outline in the conceptual framework (Figure 1).

Enabling characteristics that are confounders include income, education, employment, usual source of care (USOC), and health insurance status. It has been reported in literature that successive Asian American generations, and thus more acculturated, have higher income and educational attainment. They are also more likely to be insured adequately with no required copayment for preventive cancer screenings and have a usual source of care (Lee et al., 2014; Ye et al., 2012). These access factors facilitate the receipt of preventive cancer screening services because they remove communication and financial barriers (Ye et al., 2012). Thus, these access factors positively confound the hypothesized relationship between Asian American ethnicity and breast cancer screenings. USOC will be unmeasured in this analysis because of missing data in CHIS cycle 2007.

When examining need characteristics, health status can be defined as a holistic measure of the individual's mental social, and physical well-being (WHO Health Status Definition). According to the literature, health status has been shown to decrease as Asian Americans become more acculturated due to the adoption of a westernized diet and negative health behaviors such as smoking and drinking (Brown et al., 2010; Wu et al., 2012, 2009). Decreased health status is predicted to increase cancer preventive screenings as greater contact with the health care system may facilitate screening adoption. Decreased health status may also increase the perceived need for breast cancer screenings. As more acculturated Asian American women decline in health status, they are predicted to seek out more preventive care such as breast cancer screening.

Testable Hypotheses

The following hypotheses will be tested using multivariable logistic regression models.

H1: Interviewing in English will partially explain the lower odds of breast cancer screening adherence for Chinese, Korean, and Vietnamese American women with the reference group of NHW women.

H2: Chinese, Korean, and Vietnamese American women who interview in English will have higher odds of breast cancer screening adherence than Chinese, Korean, and Vietnamese American women who interview in a non-English language.

H3: Being born in the US will partially explain the lower odds of breast cancer screening adherence for Japanese, Filipino, and South Asian American women with the reference group of NHW women.

H4: Japanese, Filipino, and South Asian American women born in the US will have higher odds of breast cancer screening adherence than Japanese, Filipino, and South Asian American women not born in the U.S.

Dataset

California Health Interview Survey (CHIS) is the largest state health survey in America. Since 2001, CHIS has released data for each year with the current year being 2013-14. Survey topics include health status and conditions, health insurance, and access to care. CHIS is used for this study because of its large sample of Asian Americans and its inclusion of measures central to this analysis such as separate Asian American ethnicities, acculturation, and preventive cancer screenings (UCLA Center for Health Policy Research). This study uses multiple years of CHIS data from 2001, 2003, 2005, 2007, and 2009 to do a pooled analysis on ethnicity and breast cancer screening among Asian American women. Later CHIS cycles 2011-2012 and 2013-2014 were not included in this study because of the changed timeframe to yearly data collections.

Data are collected bi-annually via random digit dialing generated by a computer. The sample population represents the overall civilian population in California, with all counties in the state being sampled proportionately. From each household, a random adult, teenager, and child (if available) are surveyed over telephone. For years that surveyed only households with landlines, sample weight are provided to account for households without landlines. Additionally, sample weights are also provided to reduce any biased differences between respondents and non-respondents and account for undercoverage in the sampling frame (UCLA Center for Health Policy Research).

CHIS samples a little more than 40,000 adults each cycle with 41,478 adults in 2003 to 42,673 adults in 2011. It is conducted in various languages including English, Spanish, Chinese, (Mandarin and Cantonese), Vietnamese, Korean, and Japanese. Vietnamese and Korean subgroups are oversampled to reach a target sample size of 500 adults (UCLA Center for Health Policy Research).

All five cycles collected information on breast cancer screening. Prior history of cancer was measured in 2003 and 2005 while family history of cancer was measured in 2005 and 2009. Since prior and family history of cancer was not measured in all five cycles, it will remain unmeasured. As information for USOC is not available for CHIS 2007 data, a sensitivity analysis was conducted on pooled CHIS 2001, 2003, 2005, and 2009 data. Main components such as interview language, nativity, self-identified race and ethnicity, age, marital status, education, income, employment, health status, and health insurance status were asked in all five cycles and included in the analysis (UCLA Center for Health Policy Research, 2014).

Construct Measurement

Breast cancer screening. Breast cancer screening compliance was measured using dichotomous indicators for those that received breast cancer screening. Using the United States

Preventive Task Force (USTF) guidelines, participants were classified as adherent or non-adherent to guidelines of a mammogram every two years (Siu, 2016). Given the established findings of high rates of pre-menopausal breast cancer among Asian American women, women aged 40 to 64 years old were considered in this analysis (Gomez et al., 2010).

Acculturation. Acculturation was measured using interview language. Interview language is defined as the language in which the respondent interviewed for the CHIS survey. According to an original article conducted using 2003 CHIS data, interview language served as the best proxy measure for health status and access to care for Asian Americans, beating other acculturation indicators such as, length of stay, and self-rated English proficiency (Lee et al., 2011). In a sub-analysis, the acculturation indicator, nativity, was used for Asian American populations for which the native Asian language was not offered.

Predisposing characteristics. Age was measured as a continuous variable. For marital status, respondents were categorized as either married/living with a partner or not married/not living with a partner (inclusive of never married, widowed, divorced, and separated).

Enabling characteristics. An individual's socioeconomic status was measured using income and education. Income was measured by the CHIS encoded income as a percentage of the Federal Poverty Level (FPL) variable. FPL is conditional on the number of household members dependent on the respondent's income and the number of children below 18 years of age the respondent supports. The four categories of the CHIS constructed variable are 0 to 99% FPL, 100 to 199% FPL, 200 to 299% FPL, and 300+% FPL, these were used in this analysis to assess income. Education was a self-reported indicator and dichotomized into two groups: less than College, and College graduate. Employment status was dichotomized into employed and unemployed as asked in the data collection cycles. In terms of health insurance status,

respondents were asked if they had a private or public insurance plan for the past 12 months. If they had public health insurance, then they were asked to specify which plan it was (i.e. California Healthy Teen, Medicaid, Medicare, Medical, etc). Using their responses, health insurance status was categorized as private insurance, public insurance, and no insurance. Respondents with more than one kind of health insurance throughout the year were priority coded into private insurance.

Need characteristics. Health status was comprised of self-rated health status. Respondents were asked about their self-rated health status on a Likert scale from 1 to 5, with 1 representing excellent health and 5 representing poor health. The values from this scale measure were categorized into Excellent/Very Good, Good, and Fair/Poor.

Unmeasurable constructs. Health literacy, perceived need, prior/family history of cancer, and USOC was unmeasured.

Table 2. Construct Measurement

Construct	Measure	Hypothesized relationship to DV
Breast Cancer Screening	**Breast Cancer Screening:** dichotomous outcome Adherent with guidelines: mammogram in past 2 years (ages 40-64) Non-adherent with guidelines: no mammogram in past 2 years (ages 40-64)	
Acculturation	**Acculturation:** women will be classified into two categories More acculturated: Interview in English, US born Less acculturated: interview in other foreign language, foreign-born	As acculturation increases, compliance with breast cancer screening guidelines will increase.
Perceived need	*Unmeasurable due to no measures for perceived need (i.e. only women who did not receive screening were asked why they did not receive screening)*	As perceived need increases, preventive cancer screening use will increase.
Health Literacy	*Unmeasurable due to inadequate measures in data*	As health literacy increases, preventive cancer screening will increase.
Age	**Age group:** Continuous variable assessed in years	Older women will have higher screening rates in comparison to younger women.
Marital Status	**Marital Status:** Respondents categorized into two groups Married/Living with a partner, Not married/Living with a partner	Married women will be more compliant with breast cancer screening.
Prior/Family History of Cancer	*Unmeasured due to lack of questions in CHIS data year selected.*	Literature shows that prior/ family history of cancer correlates with increased screening rates.
Income	**Family Poverty threshold:** annual income divided by federal poverty level 0-99% FPL, 100-199% FPL, 200-299% FPL, 300% + FPL	Women in the highest income category will the have higher screening rates in comparison to women with the lowest income category.
Education	**Education:** Respondents categorized into four groups Less than College, College graduate	Higher education will be associated with greater breast cancer screening.
Employment	**Employment:** Respondents dichotomized into unemployed and employed. Unemployed, Employed	Employment is associated with greater breast cancer screening compliance.
USOC	*Unmeasurable due to missing data in CHIS cycle 2007.*	Patients with USOC will have higher breast cancer screening compliance rates than patients with no USOC.
Health Insurance Status	**Health Insurance status:** Respondents categorized into three groups. Respondents with more than one health insurance plan will be priority coded into private insurance. Private/HMO insurance, Private/non HMO insurance, Public insurance, No insurance	Patients with health insurance (private, then public) have higher screening rates than patient with no health insurance.
Health Status	**Self Rated Health Status:** Excellent to Poor on a scale from 1 to 5.	Lower health status will be associated with increased screening.

Analytic Strategy

All self-identified Asian American women and NHW women between the ages of 40 to 64 years from 2001 to 2009 were analyzed. Women from 40 to 50 years old were included in the analysis because of established findings of higher rates of invasive pre-menopausal breast cancer incidences among Asian American women (Gomez et al., 2010). Women who were older than 65 years older were not included in the sample because of Medicare enrollment. In the pooled analysis, women were categorized as compliant or non-compliant to the USTF breast cancer screening guidelines of a mammogram every two years (Siu, 2016).

Logistic regression was used to test all hypotheses. Regression coefficients were exponentiated and reported as odds ratios. For the first model, all covariates with the exception of acculturation indicators were included in the model. It is predicted that Asian American ethnicities will have smaller odds of breast cancer screening compliance than the NHW reference group.

Model 1

$$\textbf{(Breast Cancer Screening=1)} = B_0 + B_1X_{\text{Ethnicty}} + B_2X_{\text{Age}} + B_3X_{\text{Marital}} + B_4X_{\text{Education}} + B_5X_{\text{Income}} + B_6X_{\text{Employment}} + B_7X_{\text{Insurance}} + B_8X_{\text{Health}} + E$$

In the second model, acculturation was included in the multivariable logistic regression testing the likelihood odds ratio of breast cancer screening compliance. It is predicted that the odds ratio will decrease; indicating that acculturation partially explains the association between Asian American ethnicity and breast cancer screening compliance.

Model 2

$$\textbf{(Breast Cancer Screening=1)} = B_0 + B_1X_{\text{Ethnicty}} + B_2X_{\text{Acculturation}} + B_3X_{\text{Marital}} + B_4X_{\text{Education}} + B_5X_{\text{Income}} + B_6X_{\text{Employment}} + B_7X_{\text{Insurance}} + B_8X_{\text{Health}} + B_9X_{\text{Age}} + E$$

The third model interacts acculturation with Asian American ethnicity. It is hypothesized that less acculturated Asian American women will have lower odds of compliance than more acculturated Asian American women.

Model 3

$$\textbf{(Breast Cancer Screening=1)} = B_0 + B_1X_{\text{Ethnicty}} + B_2X_{\text{Acculturation}} + B_3X_{\text{Ethnicity*Acculturation}} + B_4X_{\text{Age}} + B_5X_{\text{Marital}} + B_6X_{\text{Education}} + B_7X_{\text{Income}} + B_8X_{\text{Employment}} + B_9X_{\text{Insurance}} + B_{10}X_{\text{Health}} + E$$

The main analysis will look at the novel acculturation indicator, interview language, in Chinese, Korean, and Vietnamese populations with the reference group of NHW women. A sub-analysis will look at acculturation indicator, nativity, in Filipino, Japanese, and South Asian populations with the reference group of NHW women.

Chapter 4 Results

Overview

The total size of the analytic sample was 54,152 women who were 40 to 64 years old, identified as either NHW or Asian American, and who were not missing information about mammography screening. Of this sample, 48,321 NHW women served as the reference group while 5,831 Asian American women served as the analytical group. Descriptive statistics of the populations differed by ethnicity with certain ethnicities such as Japanese having the highest mammography compliance rates and Koreans having the lowest (as seen in Table 3).

For the main analysis, a dichotomous dependent variable for breast cancer screening guideline adherence and the independent variable of Asian American ethnicity was analyzed in a multivariable logistic regression. The first model of mammographic adherence and Asian American ethnicity (reference group of NHW women) revealed that all women of Asian American ethnicities except for Vietnamese American women had lower odds of adherence than NHW women. The second model included the acculturation indicator variable, interview language, while the third model interacted interview language with Asian American ethnicity in Chinese, Korean, and Vietnamese populations. For Chinese and Korean subgroups, the odds of adhering to breast cancer screening guidelines increased when women interviewed in English rather than a foreign language.

A sub-analysis of the same models with acculturation indicator, nativity, was conducted on Japanese, Filipino, and South Asian populations. For Japanese and Filipino subgroups, the odds of being adherent with breast cancer screening guidelines increased when women were born in the US. Small sample sizes for South Asian women born in the US precluded accurate analysis.

An exploratory mediation analysis using the Karlson, Holm, and Breen (2011) method was conducted to further analyze acculturation's role as a mediator.

The results of the sensitivity analysis of all models being run on pooled CHIS 2001, 2003, 2005, and 2009 data with the inclusion of the potential confounder USOC are also included in this section. Results from sensitivity analyses that switched reference groups as well as sensitivity analyses that ran on NHW women only are also discussed.

Descriptive Statistics

The total analytic sample was 54,152 women aged 40 to 64 years old with information on mammography receipt. Of the total sample, 48,321 were NHW women while 5,831 were Asian American women. As seen in Table 2, the descriptive statistics of the study population were partitioned into the six major Asian American ethnic groups Chinese, Filipino, South Asian, Japanese, Korean, Vietnamese, the remainder group Other Asian, and the reference group of NHW women.

While NHW women serve as the reference group and were 20.3% non-adherent, Asian American women had higher proportions of being non-adherent. For example, 22.9% of Japanese American women were non-adherent compared to 40.7% of Korean women who were non-adherent. For acculturation indicators, interview language and nativity, 40.8% of Chinese American women chose to interview in a non-English language while more than half of Korean and Vietnamese American women chose to interview in a non-English language. In terms of nativity, almost 10% of Filipino American women were born in the US while over half of Japanese American women were born in the US. Small cell sample sizes of South Asian American women (approximately 2.5% were born in the US) affected sub-analysis results.

Demographics of the study population aligned with previous literature. More Asian American women belonged to the younger forty to forty-nine age group than NHW women.

More Asian American women, with the exception of Vietnamese American women, were college educated than NHW women. In contrast, almost half of Vietnamese American women in the sample reported a less than high school education. In terms of income, around 10% of Chinese and Korean women and 36% of Vietnamese American women reported incomes in the lowest category of 0-99% FPL while 75% and 83% of South Asian and Japanese American women respectively reported incomes in the highest category of 300% and above FPL.

Korean, Chinese, and Vietnamese women had higher proportions of no insurance than the NHW reference group, while Filipino, Japanese, and South Asian women had comparable or lower rates of no insurance. South Asian American women had the highest proportion of private insurance at 80.4% among Asian American women while Koreans and Vietnamese had the lowest proportion of private insurance at 54.2% and 46% respectively. In terms of self-rated health status, Japanese Americans and South Asian Americans had a lower percentage of fair/poor health status at 8.8% and 12.9% respectively, while Vietnamese had the highest percentage at 57.2%.

Table 3. Descriptive statistics of study population (Pooled sample of CHIS 2001-2009)

	NHW	Chinese	Filipino	South Asian	Japanese	Korean	Vietnamese	Other Asian	Total
N	48,321	1,471	968	340	558	1,012	941	541	54,152
Mammography									
Non-adherent	20.3%	24%	23.7%	25.6%	22.9%	40.7%	22.2%	30.3%	21%
Interview Language									
Not English	3.3%	40.8%	1.2%	0.6%	1.4%	68.5%	73.6%	30.3%	6.9%
Nativity									
Not born in the US	11.8%	82.7%	89.9%	97.9%	32.4%	98%	99.9%	81.7%	19.7%
Citizenship									
Non-citizen	4.1%	16.7%	20.2%	22.4%	15.8%	37%	17.6%	22%	6%
Age									
40-49	41.9%	47.5%	49.1%	60.3%	47.3%	57.7%	45%	54.5%	42.8%
Marital Status									
Married	56.1%	74.5%	69%	82.4%	64.5%	80.6%	69.6%	70.4%	57.9%
Education level									
College graduate	43.2%	55.4%	65.7%	77.6%	61.5%	53.5%	19.6%	47.9%	44.2%
Income as a % of FPL									
0-99% FPL	6.8%	11.5%	5.6%	5.6%	1.6%	10.9%	35.6%	13.5%	7.5%
100-199% FPL	11.4%	15.8%	14.6%	8.2%	5.7%	17.3%	23.5%	16.3%	11.9%
200-299%FPL	11.4%	11.6%	15.9%	11.5%	9.7%	17.9%	13.1%	13.9%	11.6%
300% FPL and above	70.3%	61.1%	63.9%	74.7%	83%	54%	27.8%	56.4%	68.9%
Working Status									
Not Working	66%	65.7%	78%	71.5%	66.5%	54.6%	47.7%	68%	65.7%
Health Insurance status									
No insurance	9.1%	13.8%	8.6%	9.1%	4.5%	37.8%	19.6%	12.4%	9.9%
Public insurance	10.5%	7.7%	11.1%	4.1%	3.9%	7.9%	34.4%	8.7%	10.6%
Private insurance	80.5%	78.5%	80.4%	86.8%	91.6%	54.2%	46%	78.9%	79.5%
Self rated Health status									
Excellent/Very Good	60.7%	43.8%	54.6%	55%	66.1%	28.4%	17.5%	43.1%	58.7%
Good	24.1%	33.1%	30.2%	32.1%	25.1%	38.7%	25.3%	33.8%	24.9%
Fair/Poor	15.1%	23.1%	15.2%	12.9%	8.8%	32.9%	57.2%	23.1%	16.4%

Main Analyses

The results of the first model, a logistic regression analyzing mammography adherence by Asian ethnicity, largely agree with established findings in the current literature. In comparison to the reference group of NHW women, all Asian American groups, with the exception of Vietnamese Americans, displayed lower odds of mammography compliance.

Table 4. Asian American ethnicity and breast cancer screening adherence

(1) Asian American ethnicity		
	Mammography	
NHW	*1.00*	*[1.00,1.00]*
Chinese	0.88	[0.72,1.08]
Filipino	0.89	[0.71,1.10]
South Asian	0.75	[0.56,1.01]
Japanese	0.70	[0.54,0.91]
Korean	0.51	[0.40,0.67]
Vietnamese	1.11	[0.82,1.49]
Other Asian	0.64	[0.49,0.84]
Age	1.08	[1.07,1.08]
Not married	*1.00*	*[1.00,1.00]*
Married	1.42	[1.32,1.53]
Less than college	*1.00*	*[1.00,1.00]*
College graduate	1.18	[1.09, 1.27]
0-99% FPL	*1.00*	*[1.00,1.00]*
100-199% FPL	1.04	[0.87,1.24]
200-299%FPL	1.09	[0.90,1.32]
300% FPL and above	1.49	[1.26,1.78]
Employed	*1.00*	*[1.00,1.00]*
Not employed	1.01	[0.93,1.09]
No insurance	*1.00*	*[1.00,1.00]*
Public insurance	2.36	[1.98,2.80]
Private insurance	3.30	[2.95,3.68]
Excellent/Very Good	*1.00*	*[1.00,1.00]*
Good	1.00	[0.92,1.09]
Fair/Poor	1.06	[0.96,1.19]
Observations	54152	

Exponentiated coefficients; 95% confidence intervals in brackets

Most covariates were found to be associated with the dependent variable of mammography screening adherence. As seen in the literature, married women with either public or private insurance had higher odds of being adherent to breast cancer screening guidelines than

women who were unmarried and uninsured. The odds ratios for education were as expected in that women who graduated college had higher odds of adherence than women who did not. In terms of income, women belonging to the 100-199% and 200-299% FPL categories were no more likely to be adherent than women belonging to the 0-99% FPL category. Only when women belonged to the 300% and above FPL category were they more likely to be adherent to screening guidelines than women in the bottom income category. Employment status and health status were not found to be significantly associated with breast cancer screening adherence.

In terms of income, the insignificant findings for women in the 100-199% and 200-299% FPL categories may have been due to California's unique status as a state that offers low-income individuals with subsidized health insurance and free breast cancer screening services.

In Table 5 and 6, results for all three logistic regression models performed on Chinese, Korean, and Vietnamese women are shown. First, Asian American ethnicities Chinese, Korean, and Vietnamese were regressed using the reference group of NHW women on breast cancer screening adherence. Chinese and Korean American women had lower odds of adherence than NHW women. Vietnamese American women were found to have slightly higher odds of adherence than NHW women. For the second model, the inclusion of interview language was statistically significant. However, contrary to expectations, with the addition of interview language odds ratios for Asian American women decreased rather than increasing to the null. All women who interviewed in English were around 35% less likely to be adherent with mammograms than women who interviewed not in English. While this finding was contrary to expectations, collapsing all race and ethnicity categories, including Asian American women who had relatively high adherence rates despite interviewing in non-English languages, could have contributed to the reversal.

Table 5. Main Analysis using Pooled CHIS 2001-2009 data for Chinese, Korean, and Vietnamese women

(1) Asian American Ethnicity		(2) Inclusion of Interview Language	
Mammography adherence		Mammography adherence	
NHW White	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Chinese	0.89	[0.73,1.08]	0.75	[0.61,0.91]
Korean	0.51	[0.39,0.66]	0.40	[0.30,0.54]
Vietnamese	1.14	[0.84,1.53]	0.90	[0.67,1.22]
Other Asian	0.65	[0.50,0.85]	0.60	[0.45,0.78]
Self reported Age	1.08	[1.07,1.09]	1.08	[1.07,1.09]
Not married	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Married	1.43	[1.32,1.55]	1.37	[1.27,1.49]
Less than college	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
College graduate	1.20	[1.11,1.29]	1.23	[1.14,1.32]
0-99% FPL	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
100-199% FPL	1.03	[0.86,1.23]	1.08	[0.91,1.30]
200-299%FPL	1.09	[0.90,1.32]	1.23	[1.01,1.49]
300% FPL+	1.45	[1.22,1.74]	1.67	[1.38,2.00]
Working	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Not working	1.01	[0.94,1.10]	1.01	[0.93,1.09]
No insurance	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Public insurance	2.42	[2.05,2.87]	2.60	[2.19,3.08]
Private insurance	3.19	[2.83,3.59]	3.39	[3.01,3.81]
Excellent/Very Good	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Good	1.02	[0.93,1.11]	0.99	[0.90,1.08]
Fair/Poor	1.06	[0.95,1.19]	0.99	[0.88,1.10]
Not English			*1.00*	*[1.00,1.00]*
English			0.63	[0.53,0.74]
Observations	52286		52286	

Exponentiated coefficients; 95% confidence intervals in brackets

Interaction odds ratios were calculated using the lincom command in STATA to isolate the effects of interviewing in English for each Asian ethnicity. Coefficients used in the calculations were extracted from the third model where interview language was interacted with ethnicity.

Chinese American women who interviewed in English were predicted to be 1.13 times more compliant than Chinese American women who interviewed in non-English languages while Korean American women who interviewed in English were 1.80 times more compliant than

Korean American women who interviewed in non-English languages. Vietnamese American women who interviewed in English were 14 percent less likely to be compliant than Vietnamese American women who interviewed in non-English languages.

Table 6. Interaction odds ratios for Chinese, Korean, and Vietnamese women

(3) Interaction of Interview Language		
	Mammography adherence	
*Chinese*Not English*	*1.00*	*[1.00,1.00]*
Chinese*English	1.13	[0.78,1.64]
*Korean*Not English*	*1.00*	*[1.00,1.00]*
Korean*English	1.80	[0.99,3.27]
*Vietnamese*Not English*	*1.00*	*[1.00,1.00]*
Vietnamese*English	0.86	[0.47,1.57]
*Other Asian*Not English*	*1.00*	*[1.00,1.00]*
Other Asian*English	1.06	[0.59,1.90]
Observations	52286	

Exponentiated coefficients; 95% confidence intervals in brackets

While not statistically significant, it was of especial interest that Vietnamese American women did not share the predicted patterns all other ethnic groups follow. In the first and second model, they were estimated to be more compliant with breast cancer screening guidelines than the NHW reference group while in the third model their interaction term was not significant.

Sub-analysis

Native Asian languages for Filipino, South Asian, and Japanese women were not offered in CHIS, rendering interview language an unfit indicator of acculturation. Pooled CHIS cycles from 2001 to 2009 also ensured that there was adequate sample size of US born Filipino and Japanese American women for this sub-analysis. Sample sizes for South Asian Americans were small however, limiting the results of this sub-analysis for that population.

As found in the results of Table 4 where all Asian American ethnicities were regressed against the reference group of NHW women on breast cancer screening adherence, Filipino, Japanese, and South Asian American women had lower odds of being adherent than NHW

women. Table 7 displayed the results of Models 1 and 2 in these subpopulations. Covariates followed similar trends described above for Table 4. Nativity was a significant covariate. Contrary to expectations, when nativity was included in the model, odds ratios for Asian American women decreased rather than increasing to the null as hypothesized. As with the reversal observed for interview language in Table 5, all women born in the US were found to have lower odds of being adherent to screening guidelines than women not born in the US. This result (found in Table 7) that was contrary to expectations was again attributed to the collapsing of women from all race and ethnicity categories into two categories of being born in the US and not born in the US.

Table 7. Sub-analysis using Pooled CHIS 2001-2009 data for Filipino, South Asian, and Japanese women

	(1) Asian American Ethnicity		(2) Including Nativity	
	Mammography adherence		Mammography adherence	
NHW	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Filipino	0.88	[0.70,1.09]	0.69	[0.55,0.88]
South Asian	0.75	[0.56,1.00]	0.58	[0.42,0.79]
Japanese	0.70	[0.54,0.90]	0.65	[0.50,0.85]
Other Asian	0.65	[0.49,0.85]	0.53	[0.40,0.69]
Age	1.08	[1.07,1.09]	1.08	[1.08,1.09]
Not married	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Married	1.46	[1.35,1.57]	1.41	[1.31,1.52]
Some College	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
College graduate	1.17	[1.08,1.26]	1.17	[1.08,1.26]
0-99% FPL	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
100-199% FPL	1.05	[0.87,1.27]	1.10	[0.91,1.32]
200-299% FPL	1.04	[0.85,1.28]	1.13	[0.92,1.39]
300% +FPL	1.45	[1.20,1.75]	1.60	[1.33,1.94]
Work Status	1.01	[0.93,1.10]	1.01	[0.93,1.09]
No insurance	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Public insurance	2.32	[1.94,2.77]	2.45	[2.05,2.93]
Private insurance	3.34	[2.96,3.76]	3.48	[3.09,3.92]
Excellent/Good	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Good	1.02	[0.93,1.11]	1.00	[0.91,1.08]
Fair/poor	1.08	[0.96,1.21]	1.05	[0.93,1.17]
Foreign Born	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
US Born			0.72	[0.64,0.80]
Observations	50728		50728	

Table 8 displayed the interaction odds ratios for Asian American ethnicity and nativity. As before, interaction odds ratios were calculated using the lincom STATA command and the regression coefficients produced in the third model where ethnicity and nativity were interacted. Filipino American women who were born in the US were 2.09 times more likely to be compliant with mammogram guidelines than Filipino American women who were not born in the US. Japanese American women born in the US were 1.87 times more likely to be compliant than Japanese American women not born in the US. Small sample sizes for South Asian American women led to the meaningless interaction odds ratio of 169.93.

Table 8. Interacted odds ratios for Filipino, South Asian, and Japanese women

(3) Interaction of nativity		
Mammography adherence		
*Filipino*Not born in US*	*1.00*	*[1.00,1.00]*
Filipino*Born in US	2.09	[0.96,4.55]
*South Asian*Not born in US*	*1.00*	*[1.00,1.00]*
South Asian*Born in US	169.93	[60.62,476.36]
*Japanese*Not born in US*	*1.00*	*[1.00,1.00]*
Japanese*Born in US	1.87	[1.09,3.18]
*Other Asian*Not born in US*	*1.00*	*[1.00,1.00]*
Other Asian*Born in US	1.18	[0.64,2.21]
Observations	50728	

Exponentiated coefficients; 95% confidence intervals in brackets

Exploratory Analysis

Given the lower odds of adherence for Asian American women when acculturation indicators were accounted for, a mediation analysis was conducted as an exploratory analysis. Using the Karlson, Holm, and Breen (KHB) (2011) Method, regression coefficients for the direct (dependent variable regressed on independent variable) and indirect (dependent and independent variable regressed on mediating variable) pathways were conducted. This method was selected as the most applicable for mediation analysis because it was able to compute logistic regression coefficients for multi-categorical independent variables and binary dependent variables (Breen, Karlson, & Holm, 2013).

Results for the mediation analysis indicated inconsistent mediation where the signs for the mediating pathway differed from the direct pathway. Thus, it is thought that acculturation factors interview language and nativity may have a suppressing effect on the association between Asian American ethnicity and breast cancer screening adherence. Stated otherwise, being more acculturated (interviewing in English and/or being born in the US) led to decreased adherence to breast cancer screening guidelines. Thus, when acculturation was accounted for in the analysis, odds of adherence for Asian American women decreased. However, given the difficulty of mediation analyses and the various factors that may not be accounted for, the accuracy of these results is questionable. Results for the KHB mediation analysis can be found in the appendix section.

Sensitivity Analysis

Sensitivity analyses for all models were conducted. Using pooled CHIS 2001, 2003, 2005, and 2009 data, models of the main analysis and sub-analysis were analyzed again with the inclusion of covariate USOC. Data from CHIS 2007 were excluded because they lacked values for USOC. Tables 9 through 12 displayed these results. No important differences in parameter estimates were found in these sensitivity analyses, adding strength to this study's analyses sans covariate USOC.

Sensitivity analyses were also conducted by modifying reference groups. In the main analysis, the reference group was switched from NHW women to Chinese women while in the sub-analysis the reference group was switched from NHW women to Filipino women. For the results of these sensitivity analyses, the odds ratios for acculturation indicators interview language and nativity were reversed. Stated otherwise, women who interviewed in English had higher odds of breast cancer screening adherence than women who interviewed in non-English

languages. Women who were born in the US had higher odds of breast cancer screening adherence than women who were born elsewhere.

An additional sensitivity analysis was conducted only on the NHW reference group. When the analytic cohort was limited to NHW women, interviewing in English and being born in the US led to reduced odds of mammogram adherence. These results pose interesting questions on the healthcare access and healthcare utilization behaviors of "less acculturated" NHW women. It is possible that less acculturated NHW women have higher odds of adherence for breast cancer screening guidelines because these women may immigrate from countries with universal health insurance and high screening rates. Further analysis would be required to identify what contributes to the reversal found in less acculturated NHW women.

Chapter 5 Discussion

Key Findings

While the findings from the main analysis support established literature that links acculturation to breast cancer screening behavior in Asian American women, it complicates the understanding of acculturation as a unidirectional process. Rather than the simple idea of more acculturation equaling better utilization of preventive health services, there could be a point in which too much acculturation leads to lower utilization of these services. When acculturation indicators, interview language and nativity, were added to the model, odds of adherence for breast cancer screening decreased rather than increasing to the null. An exploratory mediation analysis revealed that the mediating indirect pathway was negative and opposite in sign to the direct pathway. These results suggest that acculturation may have a suppressing effect rather than enhancing effect on breast cancer screening adherence. Furthermore, in a sensitivity analysis on the NHW reference group "less acculturated" NHW women (i.e. foreign born or women who chose to interview in non-English languages) were found to have higher odds of adherence than "more acculturated" NHW women.

Results from an interaction analysis identified highly vulnerable groups that were targetable by interventions. As hypothesized, Chinese and Korean American women who interviewed in English were found to be about 2 times more likely to be adherent to screening guidelines than Chinese and Korean American women who interviewed in other languages. As hypothesized, Filipino and Japanese American women who were born in the US were found to be about 2 times more likely to be adherent to screening guidelines than Filipino and Japanese American women born outside of the US.

By using the Andersen Healthcare Utilization model, this study was also able to comprehensively control for possible confounders and explore interesting associations. Health insurance was the most important covariate with profound effects on breast cancer screening adherence. Women with either public or private health insurance were more likely to be adherent to screening guidelines than women with no insurance. Women with private insurance had higher odds of adherence than women with public insurance. Enabling confounder working status and need covariate self-rated health status did not statistically influence regression results. This could be due to women receiving health insurance benefits from a spouse's employment health insurance plan. Additionally, self-rated health status may have different cultural connotations and not reflect a "true" health status in Asian American populations. Further analysis on these covariates is warranted.

Finally, the result for income, in that women did not have higher odds of adherence than women in the 0-99% FPL category until they reached the highest income category of 300% and above the FPL, was interesting. The data may reflect the uniqueness of California's health insurance coverage and free preventive cancer screening service that remove income as a major barrier to screening.

Finally, Vietnamese American women in California did not follow the expected trend as all the other Asian American women did. Despite predisposing and enabling characteristics that would bias this group towards low screening adherence (such as low-income, education, and interviewing in non-English languages), they had higher odds of adherence than the reference group NHW women. Although this could be due to small sample size, further analysis clarifying screening adherence in this subgroup is needed.

Study Implications

The results of this study further inform future breast cancer screening interventions for Asian American women. In particular, it highlights especially vulnerable populations that should be targeted aggressively such as Korean and Chinese American women who choose to interview in non-English languages. Furthermore, it shows that Vietnamese American women, even those who are less acculturated and interview in non-English languages, are predicted to have better breast cancer screening adherence odds than NHW women. Thus, this study supports previous literature showing that screening interventions targeting Vietnamese American women in California were successful (Chawla et al., 2015; Chen et al., 2004; Kagawa-Singer et al., 2007). Future interventions should focus on Asian American women who continue to lag behind.

Data for this study came from California, a state where 15% of the population is Asian American. California is a unique state that offers health insurance to state residents of low-income and free preventive cancer screenings to those who cannot afford it. Furthermore, many interventions targeting Asian Americans are conducted in "ethnic enclaves" where Asian Americans congregate. Thus, the results from this study apply to an Asian American population that have better access to preventive breast cancer screenings than Asian Americans who reside in other states.

While this study was not conducted with data post-ACA, given the current political climate and uncertainty for the future of the ACA, a brief analysis of how ACA and its repeal may impact study findings is warranted. A report released by the Center for American Progress documented that about 299,000 Asian Americans had signed up for individual health insurance through the marketplace platform from October 2013 to April 2014. In California, Asian Americans made up one-fifth of the enrollees in the state insurance exchange, equaling 230,000 individuals (Ramakrishnan, 2014). According to a research brief released by the Department for

Health and Human Services, 97,000 Asian Americans received coverage under the expanded Medicaid initiative, 2.7 million Asian Americans received coverage for preventive health services through private insurance while 867,000 Asian Americans received coverage for preventive health services through Medicare. From the RAND COMPARE microsimulation model, an estimated 2 million Asian Americans who otherwise would be uninsured were eligible for coverage through the ACA in 2016 (Chu et al., 2010). Furthermore the ACA has been shown to be effective in increasing odds of mammogram receipt among low-income minority women (Levy et al., 2012; Sabik et al., 2015). As insurance remains a significant predictor of breast cancer screening adherence in Asian American women, the ACA likely improved screening rates for these women.

Strengths and Limitations

There are several important strengths of this study. This study is the first known study to use the acculturation proxy measure of interview language in an analysis. As such, it has uncovered important information of designating Asian American women who choose not to interview for CHIS in English as an especially vulnerable subpopulation. It has also verified and updated the 2011 study published using CHIS data, which found Asian Americans who interviewed in English to be most similar to U.S. born Asian Americans (Lee et al., 2011).

Additionally, this study is the first to conduct a logistic regression analysis on pooled CHIS data from 2001 to 2009. Previous studies analyzing breast cancer screening in Asian American women have used only one to two CHIS data cycles (Chen et al., 2004; Sadler et al., 2003; Gomez et al., 2007; Kagawa-Singer et al., 2007; Kagawa-Singer & Pourat, 2000; Lee et al., 2010). This study was able to analyze nativity in Japanese and Filipino American women because of adequate sample sizes of US born women in these groups.

Finally, the last strength for this study is that it uses disaggregated data for Asian Americans. In the current Asian American health services research literature, researchers still struggle with analyzing disaggregated results due to many national surveys collecting data for a collective "Asian American" group. With disaggregated CHIS data, this study provides the odds of receiving a mammogram compared to the reference NHW group for each ethnic group.

Despite this study's stregths, this study has some limitations. First, The study was conducted using cross-sectional data pooled across five cycles of CHIS from 2001 to 2009. Because it was cross-sectional data, assertions of causation are difficult to make. Being pulled across five cycles of data, the analysis does not account for the passage of time and changes in USTPF and ACS breast cancer screening guidelines. Second, the survey results could reflect a social desirability reporting bias – particularly for low-income Asian American women – that has been documented among Asian American women in California. One research study suggested that breast cancer screening estimates should be adjusted downward from one-quarter to one-third for accurate results (McPhee et al. 2002).

A last potential limitation is that the results of this study are not generalizable beyond California. However, California does house almost half of the Asian American population in America and also acts as one of the most accessible states for immigrants through free breast screening programs such as "Every Woman Counts" and low cost insurance programs. The last limitation for this study is that it was conducted using pre-Affordable Care Act (ACA) data. Thus, the effects of ACA could not be discerned through this study.

Recommendations for Future Research

Future research should build upon the findings of this study by analyzing the ethnic subgroups and the factors contributing to their breast cancer screening compliance more closely. In particular, Korean and Vietnamese American women should be studied further because these

two groups do not follow expected trends. Finally, a repeat analysis with post ACA years from 2010 onwards should be conducted as Asian Americans were one of the racial and ethnic subgroups with the highest enrollment (Chu et al., 2010).

Korean American women continue to be the least adherent to screening guidelines, despite controlling for significant predisposing, enabling, and need confounders. Research that incorporates how South Korea's medical tourism industry may impact Korean American women's' breast cancer screening rates would be especially helpful. One qualitative study that analyzed 34 Korean American women found that a majority of these women preferred to have physical examinations and cancer screening services in Korea as opposed to the US. Decision-influencing factors included cheaper and higher quality services, convenient screening procedures, visiting family, and speaking to physicians in a native language. Aggressive South Korean advertising/marketing campaigns was identified as a facilitator (Oh et al., 2013).

Additionally, more research should be conducted on Vietnamese American women in California to ascertain what factors contribute to their high adherence to breast cancer screening guidelines despite having similar or less enabling demographics to other Asian American women. Previous literature has established the high adherence rate to aggressive screening interventions targeting Vietnamese American women in California. One such intervention conducted in 1996 found that a health information and education community campaign did have a modest impact on women with exposure to campaign materials (Nguyen et al., 2001). A different randomized control trial in 2009 found that lay health workers increased breast cancer screening among Vietnamese American women (Nguyen et al. 2009). An interesting research question to pursue with Vietnamese American women is to identify whether their incoming refugee status affected breast cancer screening adherence. It is possible that government outreach

programs for resettling refugees and other government benefits such as public health insurance may have fostered high screening rates despite low rates of acculturation, education, and income. More research needs to be done to identify why Vietnamese American women were so different from other Asian American women in this study.

Lastly, more sophisticated mediation analyses identifying how a complex process such as acculturation mediates breast cancer screening in Asian American women are needed. Research that analyzes acculturation as a bi-directional process and how levels of acculturation (low, medium, high) differentially impact health services utilization is needed.

Conclusion

In summary all Asian American women, with the exception of Vietnamese American women, had lower odds of breast cancer screening adherence than the reference group of NHW women. An exploratory mediation analysis using the KHB method indicated that acculturation indicators, interview language and nativity, may have a suppressing effect on the negative association between Asian American ethnicity and breast cancer screening adherence. Interaction analysis revealed that Chinese and Korean women who interviewed in English had higher odds of adherence than those who didn't while Filipino and Japanese women who were born in the US had higher odds of adherence than those born elsewhere. Having health insurance was the most significant predictor of breast cancer screening adherence while income levels were not significant – reflecting the unique status of California as a state that provides comprehensive health insurance to low-income women.

This study was the first to use the new acculturation indicator of interview language. It was also one of the few studies that analyzed the acculturation indicator, nativity, in a disaggregated Asian American sample. Future directions for this research include repeat analyses on longitudinal data and post ACA data as well as qualitative analyses for Korean and

Vietnamese subpopulations. Finally, a more sophisticated analysis that studies acculturation as a bi-directional mediator is warranted. Such an analysis may shed more understanding on acculturation's effects on breast cancer screening adherence and further inform breast cancer screening interventions for Asian American women.

Appendix

Table 9. KHB Mediation Analysis results

	Interview Language		Nativity	
Indirect effect	0.005	[0.003, 0.007]	0.002	[0.002, 0.003]
Direct effect	-0.011	[-0.015, -0.008]	-0.013	[-0.018, -0.009]
Total effect	-0.006	[-0.009, -0.003]	-0.011	[-0.015, -0.007]
Proportion of total effect mediated	-0.810		-0.184	

95% confidence intervals in brackets

Table 10. Sensitivity Analysis Interaction Odds Ratios using Pooled CHIS 2001, 2003, 2005, and 2009 data with USOC for Chinese, Korean, and Vietnamese women

(3) Interaction of Interview Language		
	Mammography adherence	
Chinese*Not English	Ref.	
Chinese*English	1.98	[1.2315,3.1797]
Korean*Not English	Ref.	
Korean*English	2.79	[1.6367,4.7665]
Vietnamese*Not English	Ref.	
Vietnamese*English	2.06	[0.9942,4.2751]
O/A* Not English	Ref.	
O/A*English	2.28	[1.2592,4.1158]
Observations	40490	

Exponentiated coefficients; 95% confidence intervals in brackets

Table 11. Sensitivity analysis Interaction Odds Ratios using Pooled CHIS 2001, 2003, 2005, and 2009 data with USOC for Filipino, South Asian, and Japanese women

(3) Interaction of Nativity		
	Mammography adherence	
Filipino*Foreign born	Ref.	
Filipino*US born	3.86	[1.4097,10.5634]
S/A*Foreign born	Ref.	
S/A*US born	273.03	[90.6181,822.6581]
Japanese*Foreign born	Ref.	
Japanese*US born	2.61	[1.4183,4.8140]
O/A* Foreign born	Ref.	
O/A*US born	2.23	[1.0848,4.5964]
Observations	39209	

Exponentiated coefficients; 95% confidence intervals in brackets

Table 12. Sensitivity Analysis using Pooled CHIS 2001, 2003, 2005, and 2009 data with USOC for Chinese, Korean, and Vietnamese women

	(1) Asian American Ethnicity		(2) Inclusion of Interview Language		(3) Interaction of Interview Language	
	Mammography compliance		Mammography compliance		Mammography compliance	
NHW	Ref.		Ref.		Ref.	
Chinese	0.9428	[0.7462,1.1912]	0.7805*	[0.6162,0.9886]	0.5065***	[0.3442,0.7451]
Korean	0.5179***	[0.4024,0.6666]	0.4008***	[0.3057,0.5257]	0.2474***	[0.1719,0.3559]
Vietnamese	1.1727	[0.8277,1.6615]	0.9164	[0.6446,1.3026]	0.6656	[0.4301,1.0299]
Other Asian	0.6526**	[0.4901,0.8689]	0.5902***	[0.4421,0.7879]	0.3246***	[0.1895,0.5563]
Self reported Age	1.0812***	[1.0744,1.0881]	1.0824***	[1.0755,1.0893]	1.0838***	[1.0769,1.0907]
Not married	Ref.		Ref.		Ref.	
Married	1.3956***	[1.2748,1.5279]	1.3452***	[1.2298,1.4715]	1.3451***	[1.2310,1.4699]
Less than HS	Ref.		Ref.		Ref.	
HS graduate	0.8699*	[0.7624,0.9926]	0.9346	[0.8189,1.0667]	0.9677	[0.8491,1.1028]
Some college	0.8224**	[0.7149,0.9461]	0.9019	[0.7876,1.0327]	0.9300	[0.8124,1.0648]
College graduate	1.0618	[0.9317,1.2100]	1.1553*	[1.0138,1.3165]	1.1673*	[1.0256,1.3285]
0-99% FPL	Ref.		Ref.		Ref.	
100-199% FPL	0.9806	[0.7914,1.2150]	1.0388	[0.8395,1.2855]	1.0669	[0.8625,1.3197]
200-299%FPL	1.1157	[0.8921,1.3955]	1.2458	[0.9927,1.5633]	1.3062*	[1.0410,1.6390]
300% FPL +	1.4692***	[1.1877,1.8175]	1.6782***	[1.3478,2.0896]	1.7609***	[1.4142,2.1927]
Working	Ref.		Ref.		Ref.	
Not working	0.9930	[0.9038,1.0910]	0.9882	[0.9004,1.0845]	0.9893	[0.9014,1.0859]
No insurance	Ref.		Ref.		Ref.	
Public insurance	1.9423***	[1.5873,2.3766]	2.0702***	[1.6932,2.5311]	2.1127***	[1.7282,2.5828]
Private insurance	2.3887***	[2.0675,2.7597]	2.5148***	[2.1817,2.8989]	2.5205***	[2.1891,2.9020]
Excellent/Very Good	Ref.		Ref.		Ref.	
Good	0.9479	[0.8567,1.0488]	0.9200	[0.8315,1.0179]	0.9120	[0.8244,1.0090]
Fair/Poor	1.0312	[0.9109,1.1674]	0.9626	[0.8511,1.0887]	0.9571	[0.8465,1.0821]
USOC	Ref.		Ref.		Ref.	
No USOC	0.3629***	[0.3149,0.4182]	0.3536***	[0.3072,0.4070]	0.3520***	[0.3062,0.4045]
Interview Language			0.6014***	[0.4986,0.7255]		
Observations	40490		40490		40490	

Exponentiated coefficients; 95% confidence intervals in brackets

Table 13. Sensitivity analysis using Pooled CHIS 2001, 2003, 2005, and 2009 data with USOC for Filipino, South Asian, and Japanese women

	(1) Asian American ethnicity		(2) Including Nativity		(3) Interacting Nativity	
	Mammography compliance		Mammography compliance		Mammography compliance	
NHW	Ref.		Ref.		Ref.	
Filipino	0.8448	[0.6562,1.0876]	0.6776**	[0.5152,0.8912]	0.5528***	[0.4090,0.7473]
South Asian (S/A)	0.7065*	[0.5131,0.9728]	0.5590**	[0.3951,0.7908]	0.4648***	[0.3298,0.6551]
Japanese	0.7055*	[0.5256,0.9470]	0.6644**	[0.4940,0.8936]	0.3481***	[0.2176,0.5568]
Other Asian (O/A)	0.6508**	[0.4884,0.8671]	0.5405***	[0.4026,0.7257]	0.4497***	[0.3251,0.6220]
Self reported Age	1.0824***	[1.0752,1.0896]	1.0831***	[1.0759,1.0904]	1.0841***	[1.0768,1.0913]
Not married	Ref.		Ref.		Ref.	
Married	1.3940***	[1.2780,1.5205]	1.3576***	[1.2456,1.4797]	1.3512***	[1.2407,1.4714]
Less than HS	Ref.		Ref.		Ref.	
HS graduate	0.8488*	[0.7353,0.9798]	0.8900	[0.7705,1.0281]	0.9072	[0.7875,1.0452]
Some college	0.8133**	[0.7044,0.9389]	0.8581*	[0.7473,0.9855]	0.8799	[0.7666,1.0099]
College graduate	1.0100	[0.8815,1.1573]	1.0425	[0.9128,1.1907]	1.0656	[0.9344,1.2153]
0-99% FPL	Ref.		Ref.		Ref.	
100-199% FPL	0.9493	[0.7533,1.1962]	0.9867	[0.7854,1.2395]	0.9946	[0.7931,1.2473]
200-299%FPL	0.9721	[0.7636,1.2377]	1.0413	[0.8164,1.3283]	1.0684	[0.8390,1.3605]
300% FPL +	1.3921**	[1.1115,1.7436]	1.5170***	[1.2071,1.9065]	1.5462***	[1.2325,1.9399]
Working	Ref.		Ref.		Ref.	
Not working	0.9963	[0.9060,1.0957]	0.9942	[0.9045,1.0928]	0.9879	[0.8993,1.0853]
No insurance	Ref.		Ref.		Ref.	
Public insurance	1.8634***	[1.4960,2.3212]	1.9404***	[1.5560,2.4197]	1.9683***	[1.5810,2.4505]
Private insurance	2.5663***	[2.2202,2.9665]	2.6455***	[2.2899,3.0564]	2.6726***	[2.3147,3.0858]
Excellent/Good	Ref.		Ref.		Ref.	
Good	0.9583	[0.8703,1.0551]	0.9412	[0.8551,1.0359]	0.9322	[0.8468,1.0262]
Fair/Poor	1.0464	[0.9204,1.1897]	1.0224	[0.8998,1.1618]	1.0106	[0.8896,1.1480]
USOC	Ref.		Ref.		Ref.	
No USOC	0.3550***	[0.3066,0.4111]	0.3507***	[0.3035,0.4052]	0.3500***	[0.3031,0.4042]
Nativity			0.7370***	[0.6485,0.8375]		
Observations	39209		39209		39209	

Exponentiated coefficients; 95% confidence intervals in brackets

Table 14. Sensitivity analysis with Chinese as the reference group

(1) Including Interview Language		
	Mammography compliance	
Chinese	*1.00*	*[1.00,1.00]*
Korean	0.58	[0.42,0.79]
Vietnamese	1.20	[0.81,1.76]
Other Asian	0.66	[0.47,0.92]
Not English	*1.00*	*[1.00,1.00]*
English	1.55	[1.18,2.04]
Self reported Age	1.06	[1.04,1.08]
Not married	*1.00*	*[1.00,1.00]*
Married	1.18	[0.88,1.56]
Less than college	*1.00*	*[1.00,1.00]*
College educated	1.06	[0.85,1.33]
0-99% FPL	*1.00*	*[1.00,1.00]*
100-199% FPL	0.88	[0.57,1.35]
200-299%FPL	1.11	[0.69,1.79]
300% FPL and above	1.24	[0.78,1.97]
Working	*1.00*	*[1.00,1.00]*
Not Working	0.98	[0.78,1.24]
No insurance	*1.00*	*[1.00,1.00]*
Public insurance	2.47	[1.56,3.92]
Private insurance	2.43	[1.73,3.42]
Excellent/Very Good	*1.00*	*[1.00,1.00]*
Good	1.02	[0.77,1.36]
Fair/Poor	1.19	[0.86,1.64]
Observations	3965	

Exponentiated coefficients; 95% confidence intervals in brackets

Table 15. Sensitivity analysis with Filipino as the reference group

(1) Including Nativity		
	Mammography compliance	
Filipino	*1.00*	*[1.00,1.00]*
South Asian	0.83	[0.58,1.19]
Japanese	0.54	[0.37,0.78]
Other Asian	0.61	[0.44,0.86]
Foreign born	*1.00*	*[1.00,1.00]*
US born	1.83	[1.25,2.68]
Age	1.08	[1.05,1.10]
Not married	*1.00*	*[1.00,1.00]*
Married	1.47	[1.11,1.96]
Less than college	1.00	*[1.00,1.00]*
College graduate	1.04	[0.93, 1.27]
0-99% FPL	*1.00*	*[1.00,1.00]*
100-199% FPL	0.87	[0.47,1.60]
200-299% FPL	0.74	[0.38,1.43]
300% +FPL	1.20	[0.67,2.15]
Working	*1.00*	*[1.00,1.00]*
Not working	1.00	[0.75,1.33]
No insurance	*1.00*	*[1.00,1.00]*
Public insurance	1.42	[0.70,2.86]
Private insurance	3.29	[2.11,5.14]
Excellent/Good	*1.00*	*[1.00,1.00]*
Good	0.94	[0.71,1.26]
Fair/poor	1.17	[0.78,1.77]
Observations	2407	

Exponentiated coefficients; 95% confidence intervals in brackets

Table 16. Sensitivity analysis with reference group NHW women

(1) Interview Language			(2) Nativity	
Mammography compliance			Mammography compliance	
Non-English interview	*1.00*	*[1.00, 1.00]*		
English interview	0.44	[0.36,0.54]		
Self-reported Age	1.08	[1.08,1.09]	1.08	[1.08,1.09]
Not married	*1.00*	*[1.00, 1.00]*	*1.00*	*[1.00, 1.00]*
Married	1.38	[1.28,1.50]	1.40	[1.29,1.52]
Less than College	*1.00*	*[1.00, 1.00]*	*1.00*	*[1.00,1.00]*
College graduate	1.22	[1.13,1.32]	1.20	[1.11,1.30]
0-99% FPL	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
100-199% FPL	1.19	[0.98,1.45]	1.13	[0.93,1.37]
200-299%FPL	1.38	[1.12,1.70]	1.24	[1.01,1.52]
300% FPL and above	1.90	[1.55,2.31]	1.70	[1.40,2.06]
Working	*1.00*	*[1.00, 1.00]*	*1.00*	*[1.00, 1.00]*
Working Status	1.01	[0.93,1.10]	1.01	[0.93,1.10]
No insurance	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Public insurance	2.79	[2.35,3.32]	2.63	[2.22,3.13]
Private insurance	3.61	[3.19,4.09]	3.49	[3.07,3.96]
Excellent/Very Good	*1.00*	*[1.00,1.00]*	*1.00*	*[1.00,1.00]*
Good	0.98	[0.90,1.08]	1.00	[0.91,1.10]
Fair/Poor	0.95	[0.85,1.07]	1.02	[0.90,1.14]
Not born in the US			*1.00*	*[1.00,1.00]*
Born in the US			0.64	[0.57,0.73]
Observations	48321		48321	

Exponentiated coefficients; 95% confidence intervals in brackets

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