The Dissertation Committee for Thuy Quynh Ngoc Do Certifies that this is the approved version of the following dissertation:

Explaining Screening Mammography Disparities among Asian Americans through the Andersen's Behavioral Model of Health Services Use: Results from the California Health Interview Survey, 2001-2009

Committee:

M. Kristen Peek, PhD,
Supervisor or Mentor

Karl Eschbach, PhD

Rebeca Wong, PhD

Catherine Cooksley, DrPH

Ying Xu, MD, MS

Dean, Graduate School

Explaining Screening Mammography Disparities among Asian Americans through the Andersen's Behavioral Model of Health Services Use: Results from the California Health Interview Survey, 2001-2009

By

Thuy Quynh Ngoc Do, BS, MPH

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Dedication

This is dedicated to my parents, Chinh Do and Gam Nguyen, who sacrificed everything to come to the U.S. and start a new life. Thank you for your love and encouragement in helping me realize that I could do anything that I set my mind to.

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Explaining Screening Mammography Disparities among Asian Americans through the Andersen's Behavioral Model of Health Services Use: Results from the California Health Interview Survey, 2001-2009

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Thuy Quynh Ngoc Do, B.S., M.P.H, Ph.D.

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Supervisor: M. Kristen Peek

Asian Americans may be one of the fastest growing racial/ethnic groups in the United States, but remains one of the most poorly understood minorities in terms of screening mammography adherence. Numerous studies have examined factors associated with mammography utilization and women's adherence to screening mammography guidelines. Less attention has been directed to screening mammography among Asian Americans and how nativity influences it. Using an adapted Andersen's Behavioral Model of Health Services Use and data from the California Health Interview Survey (2001-2009), this study sought to (1) determine if screening mammography adherence rates vary across racial/ethnic groups and nativity.; (2) determine the relationship between predisposing, enabling, and need factors on screening mammography adherence among Asian Americans and to determine if there are differences by nativity; and (3) determine if the effect of the health care and/or social environment on screening mammography adherence among Asians varies by nativity. Screening mammography adherence was based on self-reported receipt of a mammogram within the past 2 years. Results showed an annual increase (7.9%) in screening mammography adherence of Californian women $\geq$ 40 years from 2001 to 2009. The prevalence of screening mammography adherence varied over time, race/ethnicity, nativity and age. Compared to NHWs, screening mammography rates were lower among Asians/Pacific Islanders (AOR = 0.81, 95% CI = 0.73-0.92) and the other or mixed race group (AOR = 0.77, 95% CI = 0.63-0.87) even after adjusting for age, education and health behaviors. It did not vary between U.S.-born and native-born Asians. After adjusting for individual factors (predisposing, enabling, need, and health behaviors), screening mammography was associated with age (50-64), marital status, being uninsured, being sedentary, and prior cancer preventive services. The effect of the health care environment on screening mammography was more evident than the effect of the social environment. Regardless of nativity, prior receipt of cancer prevention services and doctor examining breasts for

lumps was positively associated with screening mammography adherence. Understanding the individual and environmental factors that impact screening mammography adherence may inform intervention strategies. Cultural beliefs and practices may influence the risk factors for breast cancer and shape the existential and experiential meaning of breast cancer and screening. Hence, a doctor's recommendation may increase adherence.

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List of Abbreviations

ACS	American Cancer Society
AAPI	Asian American/Pacific Islander
BRFSS	Behavioral Risk Factor Surveillance System Survey
CDC	Centers for Disease Control and Prevention
CHIS	California Health Interview Survey
GSBS	Graduate School of Biomedical Science
HP2010	Healthy People 2010
NCCN `	National Comprehensive Cancer Network
NBCCEDP	National Breast and Cervical Cancer Early Detection Program
NHIS	National Health Interview Survey
NHW	Non-Hispanic White
SES	Socioeconomic status
TDC	Thesis and Dissertation Coordinator
U.S.	United States
USPSTF	U.S. Preventive Services Task Force
UTMB	University of Texas Medical Branch

Chapter 1: Introduction

When President Richard Nixon signed the National Cancer Act on December 23, 1971, a "war on cancer" was officially declared (Freeman, 2008). Over the last 41 years, there has been considerable progress in the understanding of cancer, especially at the molecular level (Brown, 2010; Freeman, 2008). One of the greatest achievements is that cancer has been deconstructed from an all-encompassing disease term into different types of cancer. Technological advances now let us classify each type of cancer by its DNA mutation, gene amplification or defect (Brown, 2010). As a result, cancer treatments have become more effective, more targeted and less destructive (Freeman, 2008). The 5-year relative survival rate in the United States (U.S.) for all cancers combined has increased from 49% for all cancers diagnosed between 1975 and 1977 to 67% for all cancers diagnosed between 2001 and 2007 (American Cancer Society (ACS), 2012a).

Not every American has benefited from the progress made in the war on cancer. Research has shown that disparities exist across different cancer outcomes including incidence, stage of diagnosis, survival and mortality and can vary by race/ethnicity and/or socioeconomic status (SES) (ACS, 2012a; Blackman & Masi, 2006; Byers et al., 2008; Gomez et al., 2010; Miller et al., 2008; Ravesteyn et al., 2011; Yi et al., 2011). While some of the racial/ethnic groups have experienced either decreasing or leveling off cancer rates, others have experienced increases in cancer burden. The unequal burden of cancer stems from a critical disconnect between what has been discovered through biomedical research and what is delivered to Americans in terms of prevention, diagnosis, and treatment of cancer (Freeman, 2008; Haynes & Smedley, 1999). For ethnic minorities, the unequal cancer burden may lead to reduced life expectancy, poorer quality of life, decreased economic productivity, and increased healthcare costs (Centers for Disease Control and Prevention (CDC), 2004). Even when insurance status, income, age, and severity of conditions are equivalent, research has shown that minority populations such as African Americans and Asian Americans do not have equal access to care or treatment (Smedley, Stith & Nelson, 2003). In order to implement interventions to eliminate those disparities, it is imperative that we determine which ethnic minorities experience a heavier burden of cancer and determine the causes.

Cancer was the second leading cause of death in all women in 2010 (CDC's Office of Women's Health, 2013). It was the leading cause of death in American Indian/Alaska Native, Asian/Pacific Islander, and Hispanic females (CDC's Office of Women's Health, 2013). Since Asian Americans recently surpassed Hispanics as the fastest growing racial/ethnic group in the U.S. comprising one out of every 20 Americans, it is necessary to look at cancer disparities experienced by Asian Americans (Hoeffel et al., 2012; Pew Research Center, 2012). Between 2000 and 2010, the number of Asians living in the U.S. increased by 45.6% from 11.9 million to 17.3 million with a third (5.6 million) living in California (Hoeffel et al., 2012).

BREAST CANCER DISPARITIES

With the exception of skin cancer, breast cancer is the most common cancer diagnosed in U.S. women with rates varying by race/ethnicity, socioeconomic status, and insurance status (ACS, 2012a; Miller et al., 2008; Peek & Han, 2004). Breast cancer accounts for nearly 1 out of 3 cancers affecting U.S. women (ACS, 2012b). A U.S. woman has a 1 in 8 lifetime risk of developing invasive breast cancer and a 1 in 36 chance (~3%) that it will be responsible for her death (ACS, 2013). In 2013, there will be 232,340 new cases of female invasive breast cancer and 39,620 female deaths from breast cancer (ACS, 2013). Breast cancer incidence and mortality increases with age. Ninety-five percent of new cases and 97% of breast cancer deaths occur in women aged 40 years and older (ACS, 2012b). The median age at the time of breast cancer diagnosis for females was 61 years during 2004 to 2008 (ACS, 2012a). After lung cancer, breast cancer is the second leading cause of cancer death in U.S. females (ACS, 2012a). While there has been a steady overall decline in U.S. cancer mortality rates, there are still racial/ethnic differences in breast cancer incidence, stage at diagnosis, and survival (ACS, 2012a; Gomez et al., 2010; Miller et al., 2008; Ravesteyn et al., 2011; Yi et al., 2011).

Nationally, non-Hispanic White (NHW) women have the highest breast cancer incidence. Between 2004 and 2008, the breast cancer incidence in female Asian Americans was 84.9 per 100,000 compared to 125.4 per 100,000 for NHWs and 116.1 per 100,000 for non-Hispanic blacks (ACS, 2012a). Despite having lower breast cancer incidence compared to NHWs, vulnerable populations such as racial/ethnic minorities, the elderly, and the poor continue to have a disproportionate burden of breast cancer (Peek & Han, 2004). This is attributed to a higher proportion being diagnosed at advanced stages (Eley et al., 1994; Hedeen & White, 2001; Lannin et al., 1998, Randolph et al., 2002). Previous studies have shown late stage breast cancer diagnosis in Hispanics, Native American/Alaska Natives, Asians and low-income women, especially among immigrants and less acculturated, are due to less access to screening, (Hedeen & White, 2001; Lannin et al., 1998; Randolph et al., 2002).

At least half of all new cancers, including breast cancer, can be detected earlier through screening (ACS, 2012a). Regular screening can lead to the detection and removal of precancerous growths and increases the ability to diagnose and treat breast cancer at an earlier stage. Mammography is the most widely used screening tool for breast cancer with strong evidence benefitting women aged 40-74 years (Duffy et al., 2003; Humphrey et al., 2002; National Cancer Institute, 2013). If breast cancer can be diagnosed and treated earlier, then the chance of survival is greater (Lauver, Coyle & Panchmatia, 1995). Getting a mammogram every one to two years reduces the likelihood that a woman aged 40 and over will die by 16% (Office of Disease Prevention and Health Promotion, 2004). On average, a mammogram can locate a cancerous tumor one to three years before a woman can feel it with her fingers (Office of Disease Prevention and Health Promotion, 2004). When breast cancer has developed to a size that can be felt, the most common physical sign of a cancerous tumor is a painless lump (ACS, 2012a).

POPULATION TRENDS IN MAMMOGRAPHY UTILIZATION

From 1987 to 2000, mammography utilization increased in women aged 40 years and older. Data from the National Health Interview Survey (NHIS) has shown that the percentage of women who reported that they had a mammogram in the previous 2 years increased dramatically from 39.1% in 1987 to 70.1% in 2000 (Swan et al., 2003), which exceeded the Healthy People 2010 (HP2010) target of 70% (Objective 3-13) (National Center for Health Statistics, 2012).

Although mammography screenings for most groups has increased since 1987, no striking improvements have been observed for groups with the greatest need (Swan et al., 2003). Using 2000 NHIS Data, Swan et al. (2003) found that women with no usual source of care or health insurance are falling further behind despite overall gains. In addition, women who are poorer, less educated, recent immigrants (within the last 10 years), or Hispanic, Asian, or American Indian/Alaska Native are less likely to receive mammograms (Swan et al., 2003). Mammography rates dropped to 68.3% in 2005 and rose slightly to 68.5% in 2008. According to the *Healthy People 2010 Final Review*, mammography screening rates did not change between 1998 and 2008 (National Center for Health Statistics, 2012). In both years, 67% of women aged 40 and over had received a mammogram within the past 2 years.

Despite the great success of mammography in detecting breast cancer early, recent articles in the popular press suggest a decline in the rates of mammography use among women nationally and in specific states (Breen et al., 2007). Feldstein et al. (2006) reported that mammography declined between 1999 and 2002 from 67% to 62.5% among patients in non-profit group-model health maintenance organizations in the Pacific Northwest. Even more disturbing is that 33 states have reported a decline in mammography claims for Medicare beneficiaries. According to the California Behavioral Risk Factor Survey, 61% of women of screening age reported having a mammogram in the past year (2010) compared to only 39% in 1987 (ACS, California Department of Public Health, 2011). However, a recent trend in mammography rates reflects as much as a 4% decline nationwide.

Changes in screening rates have an immediate impact on the reported incidence of breast cancer and mortality (Breen et al., 2007). Incidence is affected when patients are diagnosed earlier because mammography is introduced. Patients who would have had their disease detected clinically in the future are being diagnosed earlier with their incidence captured earlier. Conversely, if mammography rates drops then women who are diagnosed with breast cancer will be detected later. This may result in a short term drop in incidence. As Breen et al. (2007) points out, an increase in breast cancer incidence associated with screening is a positive indication of dissemination and will lead to an eventual reduction in mortality. A decrease in incidence associated with a decline in screening may indicate a future increase in mortality from breast cancer.

Screening Guidelines

Some of the decline in the screening may be attributed to the specific age to be screened. The precise age to start and end screening has been contested. Some studies support starting mammography screening for women aged 40 (Humphrey et al., 2002; Mandelblatt et al., 2010; Taber et al., 2001) while other studies do not (Buist et al., 2004; Nelson et al., 2009; U.S. Preventive Services Task Force (USPSTF), 2009). Buist et al. (2004) argue that mammography screening is less sensitive for young women aged 40 to 49 years than for women aged 50 years and older. Mandelblatt et al. (2010) found that initial biennial mammography screening at age 40 may reduce mortality by an additional 3%, but consumes more resources and produces false positives. The results also suggest that initiating screening at 40 may save more life years than extending screening past age 69 (Mandelblatt et al., 2010). Other studies show that the use of regular mammography screening among women aged 40 to 74 in randomized trials is associated with reducing breast cancer mortality (Duffy et al., 2003; Humphrey et al., 2002; Nelson et al., 2009). More research is needed to fully understand the natural history of the disease and balance the risks and benefits of treatment in older age groups, specifically supporting mammography past age 70 (Mandelblatt et al., 2010; Nelson et al., 2009). The one constant among experts is that breast cancer screening should only be used when the potential benefits clearly outweigh the potential harms (National Comprehensive Cancer Network, 2011; USPSTF, 2009). Since breast cancer typically produces no symptoms when the tumor is small and most treatable, it is very important for women to follow recommended screening guidelines in order to detect breast cancer at an early stage. Since the screening guidelines vary, it may cause confusion.

Guidelines have been established by the American Cancer Society, the National Comprehensive Cancer Network (NCCN), and the U.S. Preventive Services Task Force. The ACS recommends that women aged 20 to 39 years old receive a clinical breast examination at least every three years and women aged 40 years and older receive an annual mammogram (ACS, 2012b). The NCCN, a not-for-profit alliance of 23 of the world's leading cancer centers, recommends annual mammography screening for women aged 40 years and older at normal risk for breast cancer (NCCN, 2011). The NCCN argues that age should not be absolute when determining who should get a mammogram. When considering an appropriate screening routine, it is imperative to consider the patient’s individual risk factors. U.S. Preventive Services Task Force is an independent panel of experts in primary care and prevention that is convened by the U.S. Public Health Service and Department of Health and Human Services to review evidence on hundreds of preventive services and to recommend tests, immunizations, and other medical interventions only when scientific investigation clearly demonstrates that they are effective.

The latest USPSTF guidelines recommend biennial mammography for women aged 50 to 74 years (USPSTF, 2009). The USPSTF does not recommend teaching breast self-examination. For women aged 75 years and older, there is insufficient evidence to assess the additional benefits and harms of screening mammography (USPSTF, 2009). The USPSF (2009) states that the "precise age at which the benefits from screening mammography justify the potential harms is a subjective judgment and should take into account patient preferences." For consistency since the data period covered in this study spans from 2001-2009, the screening guidelines set forth by the USPSTF in 2002 will be followed. The 2002 USPSTF recommendation was that screening mammography is recommended every one to two years, with or without clinical breast examination, for women aged 40 years and older (USPSTF, 2010). This screening schedule is somewhat consistent with both ACS and NCCN recommendations

Understanding the differences in mammography screening among population groups including the successes or failures are essential in planning a public health strategy to reduce or eliminate breast cancer disparities (Swan et al., 2003). This is particularly important in minority populations, such as Asian Americans and Pacific Islanders, where factors influencing the adherence to mammography screening guidelines have not been well studied. Although proven screening techniques exist for breast cancer, they are underused by minority women (ACS, California Department of Health, 2011; Calle et al., 1993). Non-Hispanic white women are more likely to have been recently screened (63%) than non-Hispanic black and Asian women (56% and 55% respectively), but less likely than Hispanic women (66%) (ACS, California Department of Public Health, 2011).

Efforts have been made at the national level to address the differences in breast cancer screening behavior including the Breast and Cervical Cancer Mortality Prevention

Act of 1990, the National Strategic Plan for the Early Detection and Control of Breast and Cervical Cancer, the Breast and Cervical Cancer Prevention and Treatment Act of 2000, and the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), a program to improve access for underserved women to receive breast and cervical cancer screening services throughout the U.S. Since 1991, the NBCCEDP has served more than 4.3 million women and diagnosed more than 56,662 breast cancers (CDC, 2013). As a result of these efforts, poor women have shown the largest increase in mammography use in recent years (ACS, California Department of Public Health, 2011). When the Breast and Cervical Cancer Prevention and Treatment Act of 2000 was passed by Congress, women who were diagnosed through the NBCCEDP were eligible for treatment through Medicaid.

SIGNIFICANCE AND PURPOSE OF THE STUDY

Given that the determinants of mammography are driven by a complex set of social, economic, cultural and health system factors (Freeman, 2008), this study will use a multivariate theoretical framework. Andersen's Behavioral Model of Health Services Use (Andersen Model) is often used as the theoretical framework for studying differences in health care access, outcomes, and quality (Andersen, 1968; Andersen, 1995). The Andersen Model was originally intended for understanding health care services utilization – not the interactions that take place when someone receives health care or the impact on health outcomes (which was later added). The initial Andersen Model developed in the 1960s used the family as the primary unit of analysis to define and measure health care access (Andersen, 1968). To account for the "potential heterogeneity of family members," the model shifted focus from the family to the individual (Andersen, 1968; Andersen, 1995).

The Andersen Model has been used in studies of older Asian Americans. The only change was that immigrant status (e.g., citizenship, birthplace, country of origin, and years living in the U.S.) was added to the model as an important predictor (enabling factor) of health services use (Choi, 2001; Kuo & Torres-Gil, 2001; Pourat et al., 1999). The Andersen Model posits that untimely access to health care may potentially cause adverse health outcomes, such as death. In this study, the fourth phase of the Andersen Model will be used to determine the individual and environmental factors that are driving the screening mammography differences among U.S.-born and foreign-born Asian Americans diagnosed with breast cancer (Figure 1). The Andersen Model will help guide hypotheses, specify which factors to include, and direct the analyses.

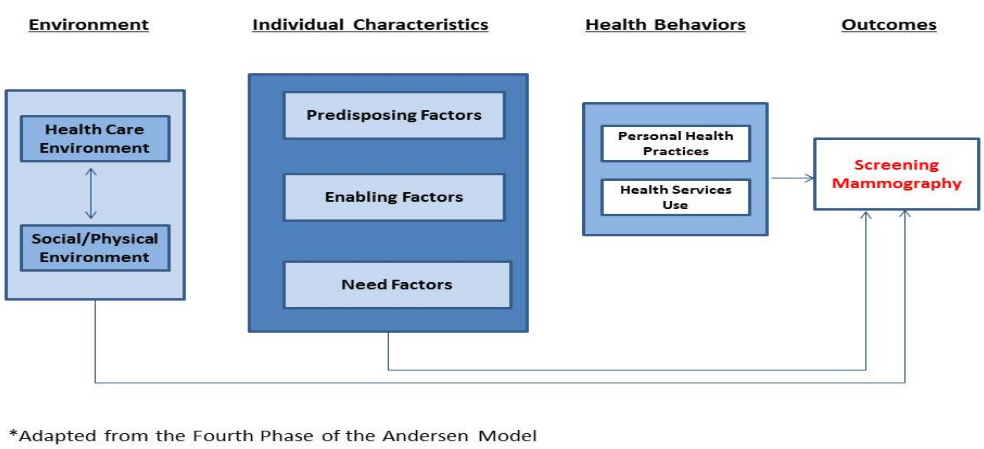


Figure 1.1: Conceptual Model Adapted from Andersen's Behavioral Model of Health Services Use

In order to address the gaps in the research on Asian Americans, this study builds on previous studies that assessed cancer outcomes by ethnicity and immigrant status (Gomez, Clarke, et al., 2010; Gomez, Quach, et al., 2010; Yi et al., 2012). Although the studies looked at similar factors, there were factors that were left out of the analyses. An adapted version of the Andersen's Behavioral Model of Health Services Use (Figure 1) (introduced in more detail in Chapter 3) will be used as the theoretical framework to examine how *predisposing*, *enabling* and *need factors* affect screening mammography adherence. ***Screening mammography adherence*** is defined as self-report of a mammogram in the past two years for women aged 40 years and older. The primary purposes of this dissertation are to (1) document the health disparities that exist in screening mammography adherence and (2) determine the influence of individual and environmental factors that are driving the screening mammography differences between U.S.-born and foreign-born Asian Americans in California.

California is comprised of diverse individuals differing by ethnicity, culture, language, sexual identity, immigration history, and socioeconomic status. This rich diversity offers the unique opportunity to investigate disparities and understand the unequal burden of breast cancer among underserved groups. This project will use data from five waves of the California Health Interview Survey (CHIS 2001, 2003, 2005, 2007, and 2009), a population-based telephone survey that has been conducted biennially since 2001. The CHIS is a geographically, stratified, biennial, random-digit dialed, population-based, omnibus health survey of non-institutionalized persons in California aged 18 years and older. It is the largest telephone survey in California and is a collaborative project of the UCLA Center for Health Policy Research, the California

Department of Health Services, and the Public Health Institute. Interviews are conducted in a variety of languages: English, bilingual (English and non-English native language), Spanish, Vietnamese, Korean, and Chinese (Mandarin and Cantonese dialects). The CHIS serves as a great source to study breast cancer screening among Asian Americans because it includes the largest sample of Asian American subgroups in the U.S. It also provides detailed information on extensive health-related factors. The CHIS collects information on health status, health conditions, health-related behaviors, health insurance coverage, health care access, and other health and health-related issues. The following are the specific aims for the proposed project:

SPECIFIC AIMS

This dissertation seeks to improve the understanding of screening mammography adherence among Asian Americans, specifically, the individual and environmental factors driving the racial/ethnic differences. It will also address the limitations in previous research in regards to using a theoretical framework to guide the research, looking at trends data and accounting for cultural factors and health risk behaviors. The specific aims and representative hypotheses are described in the section below.

Specific Aim I

To determine if screening mammography adherence rates vary across racial/ethnic groups and nativity

DESCRIPTION OF SPECIFIC AIM I

Breast cancer is the most common form of cancer and second leading cause of cancer death among U.S. women. Adherence to mammography screening guidelines is associated with a lower risk of being diagnosed with invasive breast cancer. Research examining the reasons and barriers to why specific racial/ethnic groups get mammography, especially among Asians, is limited. Many of the studies are either dated, use non-population-based samples or do not look at trend data.

There is no evidence to indicate that screening among Asian Americans is different than other minority women. All racial/ethnic minorities have documented underutilization of preventive health services that reflect sociodemographic variables, cultural barriers, and health systems obstacles (Peek & Han, 2004). However, Asian-American women are the least likely to have ever had a mammogram compared to other racial/ethnic groups. Since most Asian women are foreign-born, these women are at particularly high risk for underuse of mammography. Only 39.3% of women living in the U.S. for less than 10 years reported having a mammogram within the prior 2 years compared to 64.7% of women living in the U.S. for 10 years or more and 71.3% of women born in the U.S. (Swan et al., 2003).

Research has shown that their breast cancer risk increases with years living in the U.S. Reynolds et al. (2011) found that breast cancer risk for young Asian women born in California during the 1960s was actually higher than white women. In the case of young Filipina women, the risk was higher than young African American women (OR = 1.72 versus OR = 1.59). According to a study by Gomez et al. (2010), subpopulations of U.S. Asian women had incidence rates of invasive breast cancer almost two times higher than do foreign-born Asian women in all groups except Japanese. Since U.S. Asian women have shown higher incidence ofbreast cancer than foreign-born Asian women, it is assumed that mammography use will show a similar pattern.

REPRESENTATIVE HYPOTHESES

1. Screening mammography adherence (mammogram within 2 years) will higher among non-Hispanic whites and lower among Asian Americans.
2. Compared to U.S.-born Asian Americans, screening mammography adherence will be lower in foreign-born Asians Americans.

Specific Aim II

To determine the relationship between predisposing, enabling, and need factors on screening mammography adherence among Asian Americans and to determine if there are differences by nativity.

DESCRIPTION OF SPECIFIC AIM II

Asian Americans are a heterogeneous group of more than 20 countries of origin, 30 ethnic groups, and 200 languages or dialects (Chen, 2005). The factors that may affect one group may not affect another. Since most U.S. Asians are foreign-born, their individual beliefs about cancer screening and prevention may defer those born in the U.S. Foreign birth and limited English proficiency has been associated with poor health communications, language barriers, and lower rates of health insurance (Jacobs et al., 2005; Thamer et al., 1997). Those factors may also play a role in breast screening. According to Andersen (1968), the usage of health care services is dependent on predisposing, enabling, and need factors. Their tendency to access health care (*predisposing factors*) may be dependent on demographics, social position, and beliefs that the health services are beneficial. The factors that may enable them to access these services include resources found within the family (e.g., socioeconomic status, education, and residence) and the community (e.g., access to health care facilities). Need is determined by the necessity to access health care services (e.g., general health status).

Representative Hypotheses

1. The effect of individual characteristics on screening mammography adherence will vary between U.S.-born and foreign-born Asian American women for:
    a. ***Predisposing***: *age, race/ethnicity, household size, marital status, U.S.-born, years living in the U.S, age at menarche, age of first birth, level of English proficiency;*
    b. ***Enabling factors***: *employment, insured, usual source of care;*
    c. ***Need factors****: general health condition and more than 1 chronic condition.*

Specific Aim III

To determine if the effect of the health care and/or social environment on screening mammography adherence among Asian Americans varies by nativity.

Description of Specific Aim III

Reviews on cancer screening have acknowledged the importance of understanding the full context of breast cancer screening, which might include geographical, cultural, psychological and societal factors (Curry & Emmons, 1994; Rakowski & Breslau, 2004; Meissner et al., 2007; Wang et al., 2006; Wang et al., 2009). It is important to understand how someone decides to get screened for breast cancer (Rakowski & Breslau, 2004). Cancer is stigmatized illness in Asian culture. Attachment to the Eastern view of care is strongly related to a woman's educational level. Screening has been shown to be higher in Chinese women who are more educated and grasp a better understanding of Western preventive care, diagnosis and treatment of cancer (Wang et al., 2006; Wang et al., 2009). Since doctors are viewed as authority figures, a physician's recommendation will increase the likelihood of being screened. A women who has seen her doctor more than once within the last year and has had her breasts examined will have a higher chance of following the proper screening guidelines. In regards to the social environment, compliance and non-compliance with preventive measures have been linked to more social ties. For example, a study by Belgrave & Lewis (1994) showed that social support was significantly associated with appointment keeping behavior and adherence to health activities for diabetes.

Representative Hypotheses

1. The effect of the environmental variables will vary between U.S-born and foreign-born Asian women.
    a. Health care environment: Screening mammography will be higher for women who have seen her doctor within the last year and had her breasts examined for lumps.
    b. Social environment: Screening mammography will be higher for women who have lived at her address for more than 120 months and feel safe in her neighborhood.

Research Significance

Over the past decade, there has been increasing awareness of cancer disparities. Two major reports by the Institute of Medicine (1999, 2002) have stimulated the creation and strengthening of federal programs to reduce cancer disparities: *Unequal Burden of*

Cancer and *Improving Palliative Care for Cancer.* The issue of Asian American disparities was not brought into the forefront until President Clinton signed an executive order for Asian American/Pacific Islander (AAPI) initiative in June of 1999 (Chen, 1999). The goals were to improve access to and use of health and human services, research AAPI health, cross-cutting collaboration to enhance health and human services consumer service to AAPIs, AAPI data, and training issues.

By 2050, the Census estimates that the Asian population may account for 40.6 million (9.2%) of the U.S. population (U.S. Census, 2008). Using simple racial categories (i.e., NHW, Non-Hispanic black, Hispanic, Native American, Asian/Pacific Islander or other) overgeneralizes the differences and causes researchers to assume similar health status, service needs, and utilization patterns (Ryu, Young, & Kwak, 2002; Pourat et al., 2010). Caution should be used when combining different Asian groups to study health behaviors (Tang et al., 1999).

There is very little research examining how cultural factors (i.e., nativity, years in U.S., and English proficiency) may influence screening behavior among Asians living in the U.S. Just like other minority women, Asian Americans may not follow the mammography screening guidelines because of lack of time, money, health insurance, transportation or having a usual source of care; no encouragement from physicians or family; and perceptions that mammograms are inconvenient, uncomfortable, or dangerous (Gomez, Tan, Keegan, & Clarke, 2007; Tang, Solomon, & McCracken, 2000; Yi & Reyes-Gibby, 2002). This study builds on previous research that assessed cancer screening differences race/ethnicity and immigrant status (Gomez, Clarke, et al., 2010; Gomez, Quach, et al., 2010; Gomez et al., 2007; Kandula et al., 2006; Yi et al., 2012).

The following factors were not included previously: health care environment factors (e.g., doctor visits/recommendation), social/physical environment (e.g., neighborhood, rural/urban) and individual-level factors (e.g., household size, insurance, employment). However, this study will use individual and environmental factors outlined by a theoretical framework (Andersen Model) to determine if there is variation in screening mammography adherence among specific Asian subgroups as well as determine whether it varies by immigrant status.

DISSERTATION STRUCTURE

The structure of the dissertation is presented as follows. Chapter 2 provides a literature review on the topic of breast cancer disparities and Asians. It also discusses the possible impact of birthplace on mammography use among Asian Americans. Chapter 3 introduces the Andersen's Behavioral Model of Health Services Use (Andersen Model) as the theoretical framework for this study. This chapter also provides information on how the Andersen Model can be used in studying factors related to screening mammography adherence. Chapter 4 describes the study sample, measures, and methods in addressing each of the specific aims. Specifically, it describes the statistical techniques to examine each specific aim. Chapters 5 through 7 provide results of the analyses for Specific Aims I, II and III. The last chapter (Chapter 8) includes a thorough discussion of the results, strengths and limitations of the dissertation, and possible avenues for future research.

CHAPTER 2: LITERATURE REVIEW

This chapter provides an overview of the literature that pertains to Asian American women and breast cancer. The chapter is organized as follows: an overview of Asian Americans racial/ethnic category, Asian American characteristics, Asian Americans and breast cancer screening; immigrant trends; risk factors associated with mammography; and chapter summary.

OVERVIEW OF ASIAN AMERICANS

Asian Americans represent a diverse group with diverse histories, languages, cultures and characteristics (Pew Research Center, 2012). Recently, Asians surpassed Hispanics as the fastest growing racial/ethnic group comprising one out of every 20 Americans (Hoeffel et al., 2012). Between 2000 and 2010, the number of Asians living in the U.S. increased by 45.6% to 17.3 million (Hoeffel et al., 2012). According to the Office of Management and Budget, "Asian" is used to categorize individuals with origins from the Far East, Southeast Asia, or the Indian subcontinent (Hoeffel et al., 2012; Humes, Jones & Ramirez, 2011). This represents a diverse group including Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. The six largest Asian subgroups (in descending order) are Chinese, Filipino, Indian, Vietnamese, Korean and Japanese (Pew Research Center, 2012). These six groups represent approximately 83% of all U.S. Asian adults. The groups that are included in this study are Japanese, Chinese, Filipino, Korean, Vietnamese, and other. Although Indians may be the third largest Asian group, they are inclusive of various ethnic groups (Kwong et al., 2005) and were included in the other group. A more detailed description of the Asian subgroup analyses is provided in Chapter 4.

Asian Racial/Ethnic Category

Race has been collected since the first U.S. decennial census in 1790 (Humes et al., 2011). However, there was no distinction made for people of Asian descent until 1860 when the first Asian response category (Chinese) was added to the California census and to other states' censuses in 1870 (Hoeffel et al., 2012). A second Asian category (Japanese) was added in 1870 in California only and other states in 1890. In the 1910 Census, detailed Asian groups that did not have separate categories were tabulated from a general "Other" write-in box (Hoeffel et al., 2012). From the 1920 Census to the 1980, more Asian categories were added. Starting with the 2000 Census, individuals were given the option of self-identifying with more than one race (Humes et al., 2011).

Since 2000, the number of individuals who identified themselves as either Asian alone or in combination with another race increased more than four times faster than the entire U.S. population, i.e., 43.3% increase among Asians compared to 9.7% for the total population (Hoeffel et al., 2012). In 2010, the Asian alone or in combination with another race grew to 17.3 million. The largest multi-race combination among Asians is Asian and White. Sixty-one percent (1.6 million out of 2.6 million) of those who reported they were Asian and one or more races was Asian and White. California has the largest Asian alone-or-in-combination population in 2010 (5.6 million) (Hoeffel et al., 2012). Six detailed Asian categories have been added (Asian Indian, Chinese, Filipino, Japanese, Korean and Vietnamese) since the 1980 Census.

Immigrant Trends

With nearly 40 million foreign-born persons (13% of the total population) living in the U.S. in 2010 and 28.2% of this population was born in Asia (Greico et al., 2012), studying disease trends in immigrant populations has become progressively more urgent, especially in the state of California. In 2010, more than 1 in 4 foreign-born residents lived in California (Greico et al., 2012). According to the U.S. Census Bureau, foreign born refers to anyone who is not a U.S. citizen at birth (Greico et al., 2012). This includes naturalized citizens, lawful permanent residents, temporary migrants (e.g., foreign students), humanitarian migrants (e.g., refugees), and undocumented migrants. The term native born refers to anyone born in the United States, Puerto Rico, or a U.S. Island Area, or those born abroad of at least one U.S. citizen parent.

Most of the Asian population growth in the U.S. is attributed to immigration. In 2010, 66.5% of those identified as Asians alone were foreign-born (Hoeffel et al., 2012). Asian Americans originate from 28 Asian countries (Louie, 2001). In 2010, the largest Asian American and Pacific Islander subgroups were Chinese (3.5 million), Asian Indian (2.9 million), Filipino (2.6 million), Vietnamese (1.6 million), Korean (1.5 million), Japanese (0.8 million), and Native Hawaiian and Other Pacific Islanders (0.5 million) (Humes et al., 2011).

Asians are either immigrants (59%) or descendants of immigrants (41%) (Pew Research Center, 2012). Asian Americans have a long history in the U.S. It is crucial to understand why specific Asian subgroups came to the U.S. (Louie, 2001; Takaki, 2008). Asian Americans have been immigrating to the U.S. since the 1880's when thousands came to work in agriculture, construction and other low wage jobs. For more than a century, the Asian American population grew steadily because of severe restrictions or outright prohibitions that were imposed on Asian immigration. The Chinese Exclusion Act of 1882 barred Chinese immigrants for ten years (later extended) and prohibited Chinese immigrants from naturalizing. The provisions were not repealed until 1943. The Gentleman's Agreement of 1907 allowed immigration of family members of U.S. Japanese to come to the country, but stopped the issuance of passports for new Japanese laborers. The Immigration Act of 1917 barred immigration from most Asian countries. The National Origins Act of 1942 exempted Filipinos, but extended earlier prohibitions on Asian immigration. In 1952, the McCarran-Walker Immigration and Naturalization Act allowed Asian Americans to become naturalized U.S. citizens. The passage of 1965 immigration law opened the doors for new immigration from Asia. As new opportunities to immigrate arise, the foreign-born population has been growing. In 1980, the foreign-born Asian population was 2.2 million. It grew by 2.3 million in the 1980's, 2.9 million in the 1990's and 2.8 million from 2000 to 2010 (Hoeffel et al., 2012; Pew Research Center, 2012). By 2050, the Census estimates that the Asian population may account for 9.2% (40.6 million) of the U.S. population (U.S. Census, 2008).

IMMIGRATION HISTORY

In 2010, Chinese Americans are the largest Asian group in the U.S. (Hoeffel et al., 2012) and make up 24% of the adult Asian population (Pew Research Center, 2012). The Chinese were the first group of Asians to come to America in 1849 (Louie, 2001) and the first to be added to the U.S. Census (Pew Research Center, 2012). The immigration pattern of Chinese Americans is characterized as three waves: 1849-1882, 1882-1943, after 1965 (Lehman, 2000). The first wave of Chinese immigration was sparked by the discovery of gold at Sutter's Mill in California in 1848 and the promise of Gam Saan (Gold Mountain) coupled with worsening political and economic conditions in China. Most came to the U.S. to build the transcontinental railroad (Louie, 2001). Some sought sanctuary from the intense conflicts in China caused by the British Opium wars. Others wanted better economic conditions because they were forced to pay high taxes to the Communist government. When gold became harder to find and railroad construction was completed, hostility toward immigrants increased. A series of legislation including the 1882 Chinese Exclusion Act prohibited the Chinese from naturalizing or immigrating. As a result, the Chinese population in the U.S. fell to less than 50,000 in 1920 from a peak of 107,000 in 1890 (Pew Research Center, 2012). Prior to 1950, a majority of Chinese immigrants were illiterate laborers who emigrated from predominantly Cantonese-speaking areas of Canton and Hong Kong. The second wave of immigrants (after 1950) included many highly educated professionals and politicians escaping the intellectual and political oppression of communist rule in Mainland China and were mostly from Mandarin-speaking areas of China and Taiwan. The third and current wave of Chinese immigrants occurred about the passage of the landmark Immigration and Nationality Act of 1965 (Pew Research Center, 2012). This wave of immigrants includes a greater variety of educated professionals, uneducated laborers, refugees and business persons as well as non-working family members who immigrated under the family reunification provisions of current immigration laws (Pew Research Center, 2012). Today's immigrants from China represent a variety of languages and traditional lifestyles.

Filipino Americans make up the second largest Asian group in the U.S. (Hoeffel et al., 2012). There have been four waves of immigration from the Philippines: pensionados, agricultural immigrants (1907-1930), postwar immigrant, and post-1965 immigrants (Bankston, 2006). Immigration from the Philippines began after the U.S. acquired it in 1898 as a result of the Spanish-American War (Pew Research Center, 2012). The Pensionado Act was passed in 1903. It provided funds to qualified students to study in the U.S. The second wave of Filipino immigrants went directly to Hawaii to work on plantations and on the west coast during the 1920's. Immigration was limited when the Philippines became a U.S. Commonwealth in 1934. In 1946, it became an independent nation. After World War II, the third wave of Filipino immigrants occurred, which included wives of U.S military personnel and Filipino nurses. The last wave of Filipino immigrants includes immediate relatives of U.S. citizen or noncitizen legal residents of the United States. After the 1965, many Filipinos came to the U.S. to escape the Ferdinand Marcos regime and for employment opportunities (Pew Research Center, 2012).

Vietnamese Americans are the fourth largest Asian group and represent about 10% of the U.S. adult Asian population. Vietnamese immigration is largely a result of U.S. involvement in the Vietnam War. They were resettled in the U.S. to escape the possibility of political persecution and physical dangers. Vietnamese immigration occurred in four distinct waves: early to mid-1970's, late 1970's, 1980's, and mid-1990's (Pew Research Center, 2012). The first wave of immigrants left Vietnam in the early and mid-1970's and included about 130,000 refugees after the fall of Saigon in 1975. This population could speak some English, came from urban areas, and were economically better off than the rest of the population. They were airlifted out in U.S. helicopters. The second wave of Vietnamese refugees was less educated and poorer than the first wave. Most of the refugees left without capital or possessions. This wave fled by boat and spent months or years in refugee camps before being resettled in the U.S. under the sponsorship of churches, social agencies or families. The third wave of Vietnamese immigrants entered the U.S. after 1980 under a formal immigration process that resulted from an agreement between Vietnam and the U.S. The fourth wave includes a growing number of immigrants who came under family unification visas (Pew Research Center, 2012).

Koreans are the fifth largest Asian subgroup and represent about 10% of the adult Asian American population (Hoeffel et al., 2012). There are three distinct waves of Korean immigration to the U.S. and each took place under different sociohistorical circumstances (Hurh, 1998). The first wave of Korean immigrants (1903-1905) was mostly workers recruited to work on sugar plantations in Hawaii due to labor shortage (Hurh, 1998; Louie, 2001). Many were Christian (40%) and built many churches in Hawaii (Pew Research Center, 2012). Korean immigration was sparse throughout World War II. The immigrants to mainland U.S. included about a thousand workers from Hawaii, 100 mail-order “picture brides” and 900 students (Pew Research Center, 2012). The second wave of Korean immigration (1951-1964) occurred as a direct consequence of the post-World War II divided occupation of Korea, the Korean War, and U.S.-Korean military alliance. The immigrants were composed primarily of Korean wives of American servicemen, war orphans, refugees and some professionals including students (Hurh, 1998). A majority of the current Korean population came after 1965. Like other

Asian subpopulations, the last wave of immigrants was a result of the U.S. Immigration Act of 1965, which heavily favored family reunification. It gave preferential treatment to spouses, children, parents and siblings of permanent residents or U.S. citizens (Hurh, 1998). Education increased in Korean in the 1960's and 1970's, but the job opportunities were not available. As a result, many skilled professionals moved to the U.S. and some founded small businesses (Pew Research Center, 2012).

Japanese Americans make up the sixth largest Asian group in the U.S. and account for 7% of the adult Asian population (Pew Research Center, 2012). From 1910 to 1960, they made up the largest Asian American group with much of their growth through births. The Japanese immigrated to Hawaii around 1885 for the promise of employment and to escape economic hardships (Louie, 2001). Large number of Japanese immigrants did not come to the U.S. until the 1890's. Japanese immigrants were sought to replace Chinese workers after the Chinese Exclusion Act of 1882. By 1910, the Japanese American population was more than 72,000 and exceeded the Chinese American population. Unlike Chinese immigrants, the U.S. government allowed immigration of Japanese women (as spouses) as part of the Gentleman's Agreement between President Roosevelt and Japan in 1907 (Pew Research Center, 2012). This allowed Japanese Americans to settle down and establish communities. However, Japan's attack on Pearl Harbor triggered a U.S. declaration of war against Japan and entry into World War II. Thousands of Japanese Americans were relocated and placed in internment camps.

ASIANS, BREAST CANCER AND BREAST CANCER SCREENING

Asian Americans may be one of the fastest growing racial/ethnic groups in the U.S., but they remain one of the most poorly understood minorities in terms of breast cancer. Since most data sets are not large enough to permit investigation of intraethnic differences, Asians are typically aggregated in studies and portrayed a model minority. In order to properly examine these differences, it is necessary to have an appropriate data source. California is home to the largest and most diverse AAPI population (Gomez et al., 2010; Hoeffel et al., 2012).

Although a number of studies have examined the relationship between race/ethnicity and breast cancer screening, the public is usually unaware of the extent and magnitude of the health-related issues that affect Asian American women, specifically in terms of mammography. A systematic quantitative literature review on mammography utilization of papers published from 1988 to 2004 reported a small percentage of the papers involved Asians (i.e., Chinese) (Schueler, Chu & Smith-Bindman, 2008).

Incidence, Mortality and Five-Year Survival for Breast Cancer

Breast cancer is the most common cancer diagnosed among U.S. women with the lowest rates reported for Asians (ACS, 2012b; Babey et al., 2003; Miller et al., 2008). Although Asians are less likely to develop breast cancer than NHWs, they are more likely to present late stage breast cancer at the time of diagnosis, later initiation of treatment, and lower survival rates than NHWs (Miller et al., 2008). There are significant racial and ethnic disparities in breast cancer incidence, mortality and survival in the U.S. (ACS, 2012a, Blackman & Masi, 2006; Byers et al., 2008; Wells & Roetzheim, 2007). Overall, African Americans have the highest rate of breast cancer death (32.4 per 100,000) and

Hispanics have a disproportionately high rate of breast cancer death for their incidence (ACS, 2012b).

Compared to other NHW and other minority groups, AAPI women have lower rates in cancer prevalence and incidence, but escalating mortality rates. While cancer mortality rates are decreasing for other racial/ethnic groups, AAPIs have not shared in those gains. Between 1980 and 1993, the cancer death rate for Asian American/Pacific Islander women increased by 240% (National Center of Health Statistics, 1996). According to Eberhardt, Ingram and Makuc (2001), the death rate for all cancers in AAPI women increased by 302% in 2001, the highest percentage increase for all U.S. ethnic/racial groups. In recent years, the mortality rates of breast cancer in Asians are slowly approaching those of NHW women.

One of the strongest predictors of survival is the stage of diagnosis (extent or spread of cancer when it is first diagnosed) (ACS, 2012a). There is evidence that Asians are more likely to be diagnosed in the advanced stages of the disease than non-Hispanic Whites (Mo, 1992; Earp et al., 1995). According to the California Behavioral Risk Factor Survey, about 71% of the female breast cancers in 2009 were diagnosed at an early stage (in situ or localized) (ACS, California Department of Public Health, 2011). From 2000-2009, the five-year relative survival rate for California women was 91% for all stages (ACS, California Department of Public Health, 2011). The five-year survival for California women diagnosed with localized breast cancer was 100% compared to 26% for women diagnosed with distant stage (ACS, California Department of Public Health, 2011).

Despite having the lowest breast cancer incidence and mortality, there are distinct differences within Asian subgroups and by nativity. Reynolds et al. (2011) found that breast cancer risk for young Asian women born in California during the 1960's was higher than white women. In the case of young Filipina women, the risk was higher than young African American women (OR =1.72 versus OR = 1.59) (Reynolds et al., 2011). According to Miller et al. (2008), there is a 3-fold difference between the population with the highest incidence rate of breast cancer (Japanese women: 126 per 100,000) and the lowest (Laotian women: 44 per 100,000). According to a study by Gomez et al. (2010), subpopulations of U.S. Asian women had incidence rates of invasive breast cancer almost two times higher than do foreign-born Asian women in all groups except Japanese.

There is also evidence that breast cancer risk rises after Asian women migrate to the U.S. (Ziegler et al., 1996; Ziegler et al., 1993). Studies have shown that in as little as 10 years the types and incidence of cancer that immigrants have will match their host culture (Ziegler et al., 1993). For example, Asian women from Asia only have 25-50% of the rate of breast carcinoma of NHWs. After one generation, the rates approach those of NHW females. Ziegler et al. (1993) found that third- and fourth-generation Asian Americans born in the West had a 60% higher cancer risk than those born in the East. In addition, immigrants who lived in Western U.S. for more than 10 years had an 80% higher risk of breast cancer than more recent immigrants (Ziegler et al., 1993).

For patients diagnosed with breast cancer between 2001 and 2007, the five-year cause-specific breast cancer survival rate are 88.8% for NHWs, 77.5% for non-Hispanic blacks, 85.6% for American Indians/Alaska Natives, 90.7% for Asians, 85.4% for Pacific Islanders, and 83.8% for Hispanics (ACS, 2012a). The five-year cause-specific breast cancer survival rate varied among different Asian subgroups from 89.3% in Filipinos to 93.0% in Japanese. Breast cancer mortality is largely due to late diagnosis and late diagnosis is directly related to the underutilization of mammography. It is important to focus on factors that possibly affect mammography among Asians.

Breast Cancer Detection and Screening

Mammography has been shown to reduce the risk of dying from breast cancer through several randomized trials and population-based screening evaluations (ACS, 2012a). When breast cancer is detected early, a patient has a greater range of treatment options, including less-aggressive surgery (e.g., lumpectomy versus mastectomy) and less-aggressive adjuvant therapy (ACS, 2012a). Typically, breast cancer produces no symptoms when the tumor is small and most treatable. The most common physical symptom is a painless lump when it does grow to a size that can be felt. The ACS (2012a) lists breast pain and heaviness; breast changes such as thickening, swelling, or redness of the breast's skin; and nipple abnormalities such spontaneous discharge especially if it is bloody, erosion, inversion or tenderness as less common signs and symptoms for breast cancer. Although screening does not prevent breast cancer from developing, it does play a significant role in reducing the morbidity and mortality in women with breast cancer (ACS, 2012b; Tang et al., 1999).

As mentioned in Chapter 1, screening guidelines for breast cancer have been established by the ACS, the National Comprehensive Cancer Network, and the U.S. Preventive Services Task Force to reduce morbidity and mortality. Since the data period covered in this study spans from 2001-2009, the screening guidelines set forth by the USPSTF in 2002 will be followed. The 2002 USPSTF recommendation is that screening mammography is recommended for women aged 40 years and older every one to two years with or without clinical breast examination (USPSTF, 2010).

For three decades, *Healthy People 2000, 2010 and 2020* has provided science-based, 10-year national objectives for improving the health of all Americans (U.S. Department of Health and Human Services, 2012). For cancer, *Healthy People* sets national objectives for use of the recommended cancer screening tests. Since the data spans from 2001-2009, the *Healthy People 2010* objective (objective 3-13) will be used as the target goal. The *Healthy People 2010* objective was to increase the proportion of women over the age of 40 receiving a mammogram within past 2 years (CDC, n.d.). The National Health Interview Survey (NHIS) is the data set that provides the means to measure progress on the *Healthy People 2010* goal. Between 1998 (baseline) and 2008 (most recent data point), mammogram screening in women aged 40 and over did not change (CDC, n.d.). In both years, 67% of women aged 40 and over had received a mammogram within the past 2 years. This is below the *Healthy People 2010* goal of 70%. Screening rates were significantly lower among Asians than among NHWs and non-Hispanic blacks (CDC, 2012). Higher mammography screening was positively associated with education, income, living in an urban or metropolitan environment, and persons without disabilities (CDC, n.d).

POSSIBLE FACTORS ASSOCIATED WITH MAMMOGRAPHY

Some of the same factors that are associated with breast cancer risk are associated with mammography use. Many of the known breast cancer risk factors are not modifiable. These include age, family history, early menarche, and late menopause

(ACS, 2012a). Other strategies that have been identified to prevent breast cancer include avoiding weight gain, breast feeding for an extended time (more than one year), regular physical activity, and minimizing alcohol intake (ACS, 2012b). Several studies have confirmed that alcohol consumption increases the risk of breast cancer as well as the tendency to follow mammography screening guidelines (ACS, 2012b; Baan et al., 2007; Coughlin et al., 2004; Key et al., 2006; Singletary & Gapstur, 2001). Alcohol increases risk by increasing estrogen and androgen levels (Singletary & Gapstur, 2001). The risk of breast cancer is dose-dependent and exists regardless of the type of alcohol consumed. Additional modifiable factors associated with increased breast cancer risk include postmenopausal obesity and use of combined estrogen and progestin menopausal hormones (ACS, 2012a). There is a complex relationship between known risk factors and breast cancer risk. For example, some risk factors directly increase lifetime exposures of breast tissue to hormones (i.e., early menarche, late menopause, obesity, and hormone use) while other factors, e.g., higher socioeconomic status, are only correlates of reproductive behavior or other factors (ACS, 2012a).

Over the past 20 years, mammography use has increased dramatically for women in the U.S. (Swan et al., 2003; Breen et al., 2007). According to the National Health Interview Survey, mammography use within the last two years among women aged 40 years and older has gone from 29% in 1987 to 55.8% in 1992 to 70% in 2000 (Swan et al., 2003; Breen et al., 2007). However, these mammography rates have fallen since 2000.

Like breast cancer risk, factors associated with mammography are diverse and complex. Screening behaviors vary among women from different age, race and socioeconomic groups (Calle et al., 1993). A large body of research indicates that mammography use is lower in ethnic minority women than NHWs. Historically, most of the research points to socioeconomic status as one of the major factors in explaining mammography use (Breen, Kessler & Brown, 1996; Fox, Marata & Stein, 1991; Katz & Hofer, 1994; O'Malley et al., 2001). More recent research points to other factors, such as access, breast cancer history, lifestyle, issues, personal beliefs, and cultural issues, have been associated with mammography (Schueler et al., 2008). Specifically, research has shown that lower income and education, minority status, single status, older age, lack of knowledge regarding screening and cancer, lack of physician referral/recommendation, poorer access to health care, lack of trust in hospitals and doctors, language barriers, fear of radiation, forgetting, embarrassment, pain, anxiety and cost are common barriers to cancer screening (Alexandraki & Mooradian, 2010; Calle et al., 1993; Schueler et al., 2008; Gomez et al., 2007).

Like other minority women, Asian Americans may not follow the prescribed screening guidelines because of lack of resources (e.g., time, money, health insurance, transportation, or usual source of care) (Ko et al., 2003; Maxwell, Bastani, & Warda, 1998; McPhee et al., 1997); lack of encouragement from friends, family or physicians (Maxwell et al., 1998; Yi & Reyes-Gibby, 2002; Yu, Hong, & Seetoo, 2003); and cultural perceptions that mammograms are inconvenient, uncomfortable, or dangerous or that breast cancer is not a serious illness (Gomez et al., 2007; Ho et al., 2005; Yi & Reyes-Gibby, 2002). For immigrants, sociocultural factors are influential. Low mammography use has been associated with low levels of education, inability to speak English, and low level of acculturation (Gomez et al., 2007; Ho et al., 2005; McPhee et al., 1997). Even though prior studies have been able to identify relevant factors that are independently associated with mammography, many studies have been conducted with convenience samples rather than population-based samples. When they have used population-based samples, trends analyses have not been conducted. For example, several studies looking at screening differences in Asian Americans use data from the Behavioral Risk Surveillance System (which does not contain enough Asians for comparison) or single years of the California Health Interview Survey. In the next sections, I will cover possible factors that have been shown to be associated with mammography adherence in Asian American women.

As a group, Asian Americans share distinct economic and demographic characteristics that can affect mammography use, especially in terms of nativity, educational attainment, income and family structure. This may highlight the different immigrant waves. Asian Americans are more likely to be foreign-born, educated, report higher median annual household income and median household wealth, married, more likely to live in mixed neighborhoods, marry across racial lines, and live in multi-generational family households (28% versus 14%) (Pew Research Center, 2012).

Education

Educational attainment is almost 75% higher in Asians than the U.S. population overall. Among adults aged 25 years and older, 49% of Asian Americans hold at least a college degree compared to 28% of the U.S. population (Pew Research Center, 2012). Education varies by Asian country of origin with Vietnamese as the only group below the U.S. average (29%). Among recent immigrants from Asia, educational attainment is high. For example, 61% of recent Asian immigrants aged 25 to 64 years old had a college degree compared to 30% of other recent immigrants. More than half of new immigrants aged 25 to 65 from China, the Philippines, Korea and Japan are college educated, but only 17% of recent immigrants from Vietnam are college educated. Higher education is associated with the tendency to receive mammograms.

Acculturation

Only a limited number of studies have looked at cultural factors (e.g., nativity, years in the U.S. and English proficiency) as predictors for breast cancer screening (Kandula et al., 2006; Tang et al., 1999). Given that most U.S. Asians are foreign-born, their individual beliefs about cancer screening and prevention may differ from those born in the U.S.

Nativity, years in the United States and proficiency of the English language may be markers of cultural differences that impact breast cancer disparities (Kandula et al., 2006). Preliminary evidence suggests that nativity and living in the U.S. for fewer years were associated with lower breast and cervical cancer screening compared to those born in the United States (Kandula et al., 2006). Using data from the 2001 CHIS, Kandula et al. (2006) found that foreign-born Asians were more than twice as likely as U.S. NHWs to report that the single most prominent reason that they did not get screened is because they "haven't had problems or symptoms." Foreign birth and limited English proficiency are also associated with poor health communications, language barriers (Jacobs et al., 2005), and lower rates of health insurance (Thamer et al., 1997).

In addition to differences in culture, Asians Americans vary in the length of residency in the U.S. Some groups like Chinese and Japanese have resided in the U.S. for generations while others are more recent immigrants (e.g., Koreans, Hmong, Vietnamese, Laotians, and Cambodians). Low mammography use has been associated with low levels of education, inability to speak English, and low level of acculturation (Ho et al., 2005; McPhee et al., 1997). Research has shown that the cancer incidence among recent immigrants reflects the incidence rates of their country of origin. There is evidence that breast cancer risk rises after Asian women migrate to the U.S. (Ziegler et al., 1996). Historically, breast cancer incidence rates have been four to seven times higher in the U.S. than in China or Japan. Over the course of several generations, there is a shift in breast cancer incidence toward the rates of their adopted country (Gomez et al., 2010; Ziegler et al., 1993). Their adoption of Western habits, both good and bad including cancer preventive screening also increases.

Income and Household Size

According to the Pew Research Center (2012), the key factors in explaining the above-average household incomes for Asian Americans are educational attainment and occupational patterns. In 2010, the ratio of Asian to NHW income was 1.18 (DeNavas-Walt, Proctor & Smith, 2012). Since almost half of all Asian American adults (49%) have a college education, their income potential is higher than the U.S. population. In addition, median income can also be viewed in the context of the number of earners per household and household size. Asian American households have more earners on average (1.6) than U.S. households overall (1.4) (Pew Research Center, 2012). Hence, more earners will boost overall household income. However, Asians American household size (3.1) is larger than the average U.S. household size (2.6). As a result, income must be divided among a larger group of people. Household size varies among Asian subgroups from 2.4 in Japanese and 2.6 in Korean to 3.6 in Vietnamese.

Asian Americans are more likely to live in a two parent household because of higher rate of marriage and lower rate of having children out of wedlock (Pew Research Center, 2012). The percentage of children living with two parents varies among the Asian subgroups from 74% for Filipino children to 92%for Indian children. In addition, multigenerational families are more common in Asian households than those headed by other race and ethnic groups. In 2010, multigenerational homes accounted for 28% of households headed by non-Hispanic Asians, which is higher than for households headed by non-Hispanic blacks (26%), Hispanics (25%) and NHWs (14%).

Health Insurance Status

Given their high educational attainment and income, Asian Americans are also more likely to be uninsured than non-Hispanic Whites (Asian & Pacific Islander American Health Forum, 2012; Chu, Wong, Robinson & Finegold, 2012). Most studies have focused on general immigrants. The high rate of uninsurance in specific Asian American subgroups is attributed to high employment in or ownership of small businesses that do not offer health insurance benefits (Asian & Pacific Islander American Health Forum, 2012). For example, more than half of Korean Americans work in businesses with less than 25 employees. Only half of those employees receive employer-sponsored coverage. Koreans have the highest self-employment among Asian subgroups (Pew Research Center, 2012). As a result, Korean Americans have one of the lowest rates (49%) of employer-sponsored health coverage among Asian Americans (Asian & Pacific Islander American Health Forum, 2012).

There has been little research examining the insurance coverage of specific Asian immigrant groups. Foreign-born U.S. residents and individuals residing in the U.S. for less than 15 years are vulnerable to not having health insurance (Thamer et al., 1997). The uninsurance rate for Asians increased from 16.5% in 2000 to 18.1% in 2010. As a group, Asian Americans and Pacific Islanders are more likely to be uninsured than NHWs (Asian & Pacific Islander American Health Forum, 2012; Chu et al., 2012). The uninsurance rate for Asians increased from 16.5% in 2000 to 18.1% in 2010 (DeNavas-Walt, Proctor & Smith, 2012).

The extent of uninsurance varies considerably by Asian subgroup (Chu et al., 2012). The rates vary from 6.6% for Japanese Americans, 10.9% for Filipino Americans, 13.4% for Chinese Americans, 16.7% for Native Hawaiian and Pacific Islander Americans, 19.8% for Vietnamese Americans, and 25.5% for Korean American. It is estimated that the expansion of Medicaid eligibility and the creation of Affordable Insurance Exchanges through the Affordable Care Act would expand coverage for 2.0 million Asian Americans by 2016 who would otherwise be uninsured (Chu et al., 2012).

Public programs, such as Medicaid and Children's Health Insurance Program, play a pivotal role in reducing uninsurance rates among Asian Americans, Native Hawaiians and Pacific Islanders (Asian & Pacific Islander American Health Forum, 2012). Expansions in these programs have helped decrease the number of uninsured. However, many Asians who qualify for public programs remain uninsured because of language and cultural barriers in the enrollment process, misinformation about eligibility and family hardships, such as food and housing insecurity (Asian & Pacific Islander American Health Forum, 2012).

Health Behaviors

For Asian Americans, culture not only consists of American culture but also their culture of origin. Culture can influence attitudes, beliefs and behaviors about health and illness, which may or may not discourage mammography use (Facione & Katapodi, 2000; Tang et al., 1999). Culture plays a decisive role in health promotion and maintenance. Specifically, culture can affect lifestyle factors, such as diet, exercise, weight norms, work environment, birth rates, age at first birth, and health seeking behavior (Kagawa-Singer, 2001). Health behaviors may be associated with the likelihood of getting a mammography (Lim, 2010). Smoking, drinking, diet and exercise are associated with mammography adherence. Cancer screening, like mammography and Pap smears, are more health service dependent. Preventive health services only occur when there is some sort of need or urgency.

Health Service Utilization

Cultural beliefs and practices may influence the risk factors for cancer and shape the existential and experiential meaning of cancer. According to Kagawa-Singer (2001), culture affects how individuals weigh the costs and benefits of screening, early detection, treatment, and rehabilitation. Issues such as the meaning of cancer, the invasiveness of the screening test itself, and the significance and different meanings of the particular body part targeted for screening vary across cultures and may account for lower screening rates (Kagawa-Singer et al., 2010). In addition, prior experience with the health care system influences how individuals make decisions seek medical care, choose treatment and adhere to treatment protocols.

One aspect of Asian culture that may serve as a barrier to mammography is the focus on crisis instead of prevention. Unless there is actual symptomology, Asians do not typically visit physicians (Nguyen et al., 2002; Tang et al., 1999). The preventive strategies that are emphasized are those that can be done on one's own such as maintaining a healthy diet, achieving good spiritual balance, and consuming herbs that promote health (Kagawa-Singer, 2001; Tang et al., 1999). Asian women often de-emphasize and sacrifice their own needs for those of their family (Ashing-Giwa et al., 2004; Kagawa-Singer et al., 2010). They do not want to burden the family with their needs (Tam Ashing, Padilla, Tejero & Kagawa-Singer, 2003). These women are more concerned about supporting their families than seeking early care. Additionally, foreign-born individuals are more likely to encounter barriers related to health care access (e.g. lack of insurance or usual source of care) (Thamer & Rhinehart, 1998; Ku & Mutani, 2001).

Self-Rated Health

There is growing evidence that culture and language can affect perceptions, attitudes, health behaviors, and illness presentations (Institute of Medicine, 2002; Kleinman, 2004). It is plausible that these effects extend to how individuals respond to questions about self-rated health. Overall, Asians are more likely to rate their self-rated health lower than non-Hispanic Whites (Kandula, Lauderdale & Baker, 2007). All Asian groups are less likely to endorse "excellent" health than non-Hispanic Whites, but the Chinese and Vietnamese more likely to report "fair or poor" health. Unlike non-Hispanic Whites, Asians do not rate health according to the medical disease model in which describes health is defined as the absence or presence of a medical disease. Instead, health is thought to include physical, emotional, and spiritual health. Asians may not endorse speaking about one's health as excellent or very good because the terms may be perceived as overtly positive or optimistic.

Cultural Beliefs Important to Mammography But Not Captured

One of the key factors that are relevant to mammography adherence is cultural beliefs about health services use. Even though these are not available in this data set, it is beneficial to keep them in mind in understanding what predicts mammography use in Asian American women. It is also a limiting factor in this study.

A unique barrier to timely and adequate cancer screening and treatment for Asians is the concept of face (Kagawa-Singer, 2001; Zane, Takeuchi & Young, 1994). According to Kagawa-Singer (2001), face can exert significant social control on health behavior. It has been used simplistically to predict cancer outcomes and applied homogenously to low acculturated individuals. It is a social construct representing "the honor and reputation of one's family and social network" (Kagawa-Singer, 2001, p. 227). Cancer is a stigmatized illness. If one knows that they have cancer, it not only affects the individual, but their entire social structure and standing.

Many Asian subgroups have traditional healing techniques and practitioners. As a result, and many individuals use Western biomedicine in conjunction with their traditional therapies (Kagawa-Singer, 2001). Some Asian immigrants believe in the yin and yang theory or the Ayuverdic principle. This is based on the belief that there needs to be a balance of the two energy forces to maintain health. Many Asian immigrants rely on folk medicine or traditional healers and only see a physician when symptoms become severe (Louie, 2001). According to Lin-Fu (1994), they dislike blood sampling, invasive procedures, and hospitalizations. Others believe in supernatural forces and ancestral transgression. For example, Southeast Asians' health care practices include *cao gio* (Vietnamese) or kos khyal (Cambodian), which mean to "scratch or rub the wind" (Louie, 2001). This treatment is commonly applied to the neck, back, chest, and arms and is thought to bring the toxic "wind" to the surface of the body. Unmarried women, especially Vietnamese women, avoid Papanicolaou tests and pelvic examinations.

SUMMARY OF LITERATURE REVIEW

Asian Americans represent a diverse group with diverse histories, languages, cultures and characteristics (Pew Research Center, 2012). As a group, Asian Americans share distinct economic and demographic characteristics that can affect mammography use, especially in terms of nativity, educational attainment, income and family structure. All factors may affect mammography and adherence to screening guidelines. Mammography utilization varies among women from different age, race and socioeconomic groups. The factors associated with mammography screening patterns are diverse and complex. There is a complex set of social, economic, cultural and health system factors that determine mammography adherence (Freeman, 2008; Gomez et al., 2007). While the available evidence suggests that socioeconomic factors are associated with mammography use, these effects are not terribly well understood in Asian Americans and how they differ by nativity.

The purpose of Chapter 2 was to provide context on Asian Americans and breast cancer. It is important to understand how the Asian American category developed, the rich immigrant history, the factors that have been associated with mammography use in other minority women, and how these factors affect mammography use among Asian women. The risk factors that affect one group may not affect the entire group. This information is relevant in understanding how this information can be applied in the Andersen Model, which is explained in the next chapter.

Chapter 3: Andersen Model

This chapter provides an overview of the Andersen's Behavioral Model of Health Services Use (Andersen Model) that will be used as the theoretical framework for this dissertation. The chapter is organized as follows: an overview of the Andersen Model including a description of its development phases and components, applying the Andersen Model to study screening mammography utilization, and chapter summary.

THE ANDERSEN MODEL AND ITS DEVELOPMENT PHASES

For 45 years, the Andersen's Behavioral Model of Health Services Use has been frequently used as the theoretical framework for studying differences in health care access, outcomes, and quality (Babitsch, Gohl, & von Lengerke, 2012; Graves, 2009; Phillips et al., 1998). Embedded in the framework is the premise that that lack of timely access to health care services can potentially cause adverse health outcomes and ultimately result in death (Graves, 2009).

The Andersen Model has undergone five phases of development that have included modifications in response to the emerging issues in health policy and delivery of health care services, input and critiques from researchers, and new developments in health services research and medical sociology (Andersen, 2008). The initial Andersen Model used the family as the primary unit of analysis to define and measure health care access (Andersen, 1968). To account for the "potential heterogeneity of family members," the model shifted focus from the family to the individual (Andersen, 1968; Andersen, 1995). The latest phase of the Andersen Model incorporates both contextual and individual determinants.

Revisions to the model have resulted in additions to the model, but the basic tenet is unchanged. Health care utilization is still a function of predisposing, enabling, and need factors (Andersen, 1968; Andersen, 1995; Andersen, 2008). Given that the CHIS public use data does not include geographic identifiers for contextual study, an adaptation of the Phase 4 emerging model will be used for this dissertation.

Phase 1 (1960's)

The initial model was developed in the 1960's to aid in the understanding of why families use health services, to define and measure equitable health access, and to assist in developing policies to promote equitable health access (Andersen, 1968; Andersen, 1995; Andersen, 2008). Andersen (1995) defines access as the ability to utilize health services when and where they are most needed. A family's tendency to use health care services is determined by factors that would enable, impede or cause a family to seek out care (Andersen, 1968; Andersen, 1995). The model included predisposing characteristics, enabling resources, and need as factors predicting health services use.

Predisposing characteristics consist of demographic factors (e.g., age and gender), social structure factors, and health beliefs that predispose people to illnesses (Andersen, 1995). Demographic factors represent "biological imperatives" that explain the likelihood that a family would need health services (Andersen, 1995). Social structure factors determine the status of a person in their community, how they cope and command resources to cope with problems, and how healthy or unhealthy the physical environment is likely to be (Andersen, 1995; Andersen & Davidson, 2007). The traditional social factors are education, occupation, and ethnicity. The expanded measures may include social network and social interactions that facilitate or impede health services use

(Andersen & Davidson, 2007). Health beliefs help to explain how social structure might influence enabling resources, perceived need, and use (Andersen, 1995). Andersen (1995) explains that health beliefs are attitudes, values, and knowledge that people have about health and health services that may influence their perception of need and use of health services.

In order for health services use to take place, there must be personal and community enabling resources socially and geographically available (Andersen, 1995; Graves, 2009). Enabling resources are resources or means that enable or impede health services use. Income, insurance, regular source of care, and travel and waiting times are examples of enabling resources. At the community level, health personnel and facilities must be available where people live and work. If available, people must have the means and the knowledge of accessing and using those services.

One of the strongest determinants of health service use is need. Need factors are health conditions for which health services are sought (Shibusawa & Mui, 2010). Need is determined by perceived need or realized need (Andersen, 1995; Babitsch et al., 2012). Perceived need is defined by how people view and experience their own general health, functional state, and illness symptoms (Babitsch et al., 2012). Evaluated need is based on professional assessments and objective measurements of patients' health status and need for medical care. Both perceived and evaluated need can be altered. Perceived need for health care may be increased or decreased through health education or financial incentives (Andersen, 1995). Evaluated need can be altered through clinical guidelines. For example, the screening guidelines recommend mammography screening for all women aged 40 years and older every one to two years. Hence, this can increase realized need for screening mammography.

As stated earlier, one of the major goals of the original Andersen Model was to define and measure equitable access to health care. Andersen (2008) defines potential access as the presence of enabling resources while realized access is the actual use of services. Realized access indicators include utilization of physician, hospital, dental and other health services (Andersen & Davidson, 2007). There would be increased health services use if there were more enabling resources. Equitable and inequitable access is defined by the dominant predictors of realized access (Andersen, 1995). Equitable access occurs when predisposing demographic and need factors account for most of the variance in health care use. There is inequitable access when social structure (e.g., ethnicity), health beliefs, and enabling resources determine who gets care (Andersen, 1995; Andersen, 2008).

Phase 2 (1970's)

In Phase 2, health care system and consumer satisfaction were added as explicit outcomes of health services use (Aday & Andersen, 1974; Andersen, 1995; Andersen, 2008; Andersen, Kravits, & Anderson, 1975; Andersen & Newman, 1973). The health care system was added to recognize the importance of national health policy, the resources and organizations in the health care system that determine health care services, and the changing patterns of use over time (Andersen, 1995). Consumer satisfaction was added to recognize that services use is "a means to other ends and outcomes" (Aday & Andersen, 1974; Andersen, 1995; Andersen et al., 1975; Andersen & Newman, 1973). Consumer satisfaction refers to the attitudes toward the medical system of those who have sought care, i.e., users' satisfaction with the quantity or quality of care received (Aday & Andersen, 1974). Consumer satisfaction measures included convenience, availability, financing, provider characteristics and quality (Andersen, 1995). In addition to health care system and consumer satisfaction, the use of health services was expanded to include measures about type, site, purpose, and coordinated services received in an episode of illness (specific time interval) (Andersen, 1995).

Phase 3 (1980's-1990's)

The third phase was spurred by the recognition that health services maintain and improve population health (Andersen, 1995; Andersen, Davidson, & Ganz, 1994). During Phase 3, health behavior and health status were added. Specifically, perceived health status and evaluated health status were included as possible outcomes of satisfaction while the external environment and personal health practices were added as key inputs for evaluating health service utilization (Andersen, 1995; Andersen et al., 1994). The external environment included the physical, political and economic components as important inputs for understanding health services use. Personal health practices, such as diet, exercise and self-care, interact with the use of health services to influence health outcomes (Andersen, 2008). The inclusion of health status allowed for expansion of access measures and included new dimensions that are particularly important for health policy and health reform. Access is effective when health services use improves health status or consumer satisfaction (Andersen, 1995; Andersen, 2008). It is efficient when the health status or consumer satisfaction increases relative to the amount of health services consumed (Andersen, 1995; Andersen, 2008).

Phase 4 (1990's)

Feedback loops were added in Phase 4 to emphasize the dynamic and circulatory nature of health care use and includes health status outcomes (Andersen, 1995; Evans & Stoddart, 1990; Patrick et al., 1988). This model displays the multiple influences on health services' use and health status (Andersen, 1995). The feedback loops show that health outcome affects predisposing factors, perceived need for the services and health behavior (Andersen, 1995). The 1995 version of the Andersen Model (Phase 4) is the most frequently applied version in studies of health services utilization (Babitsch et al., 2012). A systematic review conducted by Babitsch et al. (2012) found that more than half of the studies conducted between 1998 and 2011 used the Phase 4 model.

Phase 5 (2000's)

The last phase of the Andersen Model took place in the 2000's and an additional type of health behavior was added, the process of medical care (Andersen, 2008). The process of medical care is the interaction between providers and patients in the delivery of medical care. Measures include patient counseling, test ordering, prescriptions, and quality of provider-patient communication (Andersen, 2008).

The Phase 5 model emphasized that health services use is best understood by focusing on both contextual and individual determinants (Andersen & Davidson, 2007). Contextual factors are measured at an aggregate level and include characteristics about the health organization, providers, and the community. The aggregate levels range from the family to the national health care system (Andersen & Davidson, 2007). Individuals are related to the contextual determinants through either membership (via a family, workgroup, provider institution or health plan), or residence (via neighborhood, community, metropolitan or national health system) (Andersen & Davidsen, 2007).

The Phase 5 Andersen Model suggests that contextual determinants are divided in the same way as individual determinants in determining access to health care services (Andersen, 2008; Andersen & Davidson, 2007). Predisposing factors are existing conditions that predispose people to use or not use services even though these conditions are not directly responsible for use. At the contextual level, demographic variables include age, gender and marital status of the community. Examples of social characteristics at the contextual level are educational level, ethnic and racial composition, proportion of recent immigrants, employment rate, and crime rate (Andersen & Davidson, 2007). These characteristics help to describe how supportive or detrimental the communities are where people live and work to their health and their access to health services. At the contextual level, enabling factors are defined by financing and organizational characteristics that facilitate or impede use of services. For example, financing characteristics include potentially available resources to pay for health services including per capita community income, and wealth; incentives to purchase or provide services such as rate of health insurance coverage, relative price of medical care and other goods and services; method of compensating providers; and per capita expenditures for health care services (Andersen & Davidson, 2007). Organization characteristics include the amount and distribution of health services facilities and personnel as well as how they are structured to offer health services (Andersen & Davidson, 2007). Structure includes the amount of services available in the community (i.e., ratios of physicians and hospital beds to population) and how medical care is organized or delivered (i.e., office hours and service locations, provider variety, utilization and quality control oversight, and outreach and education programs). Need factors are conditions that individuals or health care providers recognize as requiring medical treatment (Andersen & Davidsen, 2007). Environmental need characteristics include health-related measures of the physical environment (i.e., the quality of housing, water, and air), injury or death rate, and some population health indices (i.e., mortality, morbidity, and disability rates).

Application To Asian Americans and Health Services Use

Most health services studies are not based on theory (Painter et al., 2008). In a systematic review of 193 health behavior studies published between from 2000 and 2005, only 35.7% mentioned theory (Painter et al., 2008). Of the articles that mentioned theory, only 68.1% involved research informed by theory, 18.0% applied theory and the rest either tested theory (3.6%) or created theory (9.6%). Current research suggests that theoretically informed studies are more effective in changing health behavior (Noar & Zimmerman, 2005). Theories can provide a framework for understanding health behaviors and the context in which they occur.

Given that the determinants of mammography screening are complex (Freeman, 2008; Gomez et al., 2007), the Andersen Behavioral Model is an ideal framework for this study. From 1975 to 1995, at least 395 published articles drew from the Andersen Model, including 139 studies that specifically stated the use of the Andersen Model as the theoretical basis of their study of health services use (Phillips et al., 1998). A review by Babitsch et al. (2012) found 328 articles published in English or German between 1998 and March 2011 referencing the Andersen Model with only 16 using it as the theoretical basis of their study. Not only is the Andersen Model often used to guide research and evaluation studies on access to healthcare (Babitsch et al., 2012; Philips et al., 1998; Ricketts & Goldsmith, 2005), it explicitly focuses on factors that predict health services use. Even though other theories exist, they lack the components thought to be important in the research of health services use (Ricketts & Goldsmith, 2005). The specific phase of the Andersen Model that is used in a study is dependent on what factors are available for analysis. In several studies, more than one version of the model was used as the theoretical framework for their work.

The Andersen Model has been used to explain health care utilization in minority populations (Bradley et al., 2002; Choi, 2001; Jang et al., 2005; Kuo & Torres-Gil, 2001; Miltiades & Wu, 2008; Pourat et al., 1999; Pourat et al., 2000; Ryu et al., 2002; Shibusawa & Mui, 2008; Sohn & Harada, 2004). The Andersen Model has been applied to a broad range of health service sectors and diseases (Babitsch et al., 2012). Associations between the main factors of interest and the utilization of health care were found. The majority of the studies included age, marital status, gender/sex, education, and ethnicity as predisposing factors (Babitsch et al., 2012). Income and financial situation, health insurance, and having a usual source of care/family doctor were used as enabling factors. Most of the studies included evaluated health status and self-reported/perceived health as well as a wide variety of diseases as need factors.

The findings are inconsistent. The context of the studies reviewed and the characteristics of the study populations seem to have a strong impact on the existence, strength and direction of these associations. All of the studies explicitly employed the Andersen Model as the theoretical background, but the operationalization of the model varied (Babitsch et al., 2012). There are stark differences in how variables are categorized, especially for predisposing and enabling factors (Babitsch et al., 2012). According to Babitsch et al. (2012), these differing classifications suggest that certain variables play a dual role in health services use. This corresponds to the 2001 version of the Andersen Model. For example, the socioeconomic status of a neighborhood can either be seen as a predisposing factor (e.g., in terms of supply-induced demand effects) or as an enabling factor due to its association with individual and community income. Age and sex may be categorized as individual demographic predisposing factors and as proxies of need factors due to their associations with morbidity.

The Andersen Model has also been specifically reviewed on its application to health studies involving Asian and Pacific Islander Americans (Andersen et al., 1995). Andersen et al. (1995) found that the number of studies on Asians and Pacific Islanders has increased. Most of the studies have focused on population characteristics and evaluated or clinical outcomes. Relative to their population size, Filipinos and Koreans are understudied and studies regarding perceived health status and consumer satisfaction are small. Although a number of studies have applied the Andersen Model to explain health services utilization patterns among Asian Americans, they have been limited to specific older Asian subgroups (Choi, 2001; Jang et al., 2005; Kuo & Torres-Gil, 2001; Miltiades & Wu, 2008; Pourat et al., 1999; Pourat et al., 2000; Ryu et al., 2002; Shin et al., 2000; Shibusawa & Mui, 2008; Sohn & Harada, 2004). Similar to what is noted in the literature review by Babitsch et al. (2012), the studies of older Asian Americans also vary the use and classification of predisposing and enabling variables.

In all of the studies, the predisposing variables included age and gender while enabling variables included income and health insurance (Choi. 2001; Jang et al., 2005;

Kuo & Torres-Gil, 2001; Miltiades & Wu, 2008; Pourat et al., 1999; Pourat et al., 2000; Shin et al., 2000; Shibusawa & Mui, 2008; Sohn & Harada, 2004). Need factors included health status and some type of health condition. Education was categorized as either a predisposing variable (Jang et al., 2005; Kuo & Torres-Gil, 2001; Miltiades & Wu, 2008; Pourat et al., 2000; Pourat et al., 1999; Ryu et al., 2002) or as an enabling factor (Sohn & Harada, 2004). The same was true for English proficiency. English proficiency was categorized as a predisposing variable (Shibusawa & Mui, 2008; Shin et al., 2000) and as an enabling factor (Choi, 2001; Kuo & Torres-Gil, 2001). Marital status was included as a predisposing variable in some of the studies (Choi. 2001; Pourat et al., 1999; Pourat et al., 2000; Shin et al., 2000; Sohn & Harada, 2004). Race (Choi. 2001), family size (Ryu et al., 2002; Sohn & Harada, 2004), living arrangements (Pourat et al., 1999; Shibusawa & Mui, 2008), and acculturation measures, such as years since immigrated or years in U.S. (Kuo & Torres-Gil, 2001; Miltiades & Wu, 2008; Pourat et al., 1999; Sohn & Harada, 2004), and percent of lifetime in the U.S. (Shin et al., 2000), are categorized as predisposing variables in a few studies. To resolve the classification issues mentioned (Babitsch et al., 2012), strict adherence to the definitions of the variables provided by Andersen (1995) for the fourth phase of the development is followed.

SCREENING MAMMOGRAPHY UTILIZATION AND THE ANDERSEN MODEL

Andersen's Behavioral Model has been used extensively in studies investigating the use of health services. For this dissertation, screening mammography will be used as the outcome. The emerging model from Phase 4 is used to determine the individual and environmental factors that are driving the screening differences among U.S.-born and foreign-born Asian Americans. This Andersen Model was adapted to help guide hypotheses, determine which factors to include, and direct the analyses. Even though the Phase 5 Andersen Model is more expansive and includes contextual and individual determinants, the CHIS public use data used for this dissertation does not include sub-state geographic identifiers (e.g., county, city, and zip code) to allow for contextual study. These identifiers are removed to minimize the risk of indirect identification and increase data confidentiality. Confidential variables such as sexual behavior are also excluded.

According to Andersen (1968), the usage of health care services is dependent on predisposing, enabling, and need factors. Only by careful integration of cultural and structural variables could the Behavioral Model be used to best explain service utilization for ethnic minorities in their social contexts (Andersen, 1995). Various social, economic, cultural, geographical, psychosocial, and environmental factors have been shown to be associated with a woman's decision to have a mammography and adhere to the mammography screening guidelines (Vyas et al., 2012).

Several studies have documented the role of demographic characteristics as predictors of mammography use, such as older age (Borrayo et al., 2009; Coughlin et al., 2004; Rahman, Digman & Shelton, 2003; Meissner et al., 2007; Vyas et al., 2012), being married (Borrayo et al., 2009; Coughlin et al., 2004), being employed (Vyas et al., 2012), higher education level, access factors, such as higher income (Coughlin et al., 2004; Meissner et al., 2007; Rahman et al., 2003; Zapka et al., 1991), having health insurance (Rahman et al., 2003; Rakowski et al., 2006; Zapka et al., 1991), visit to primary care provider in the past year (Coughlin et al., 2004; Meissner et al., 2007; Zapka et al., 1991), and visit to an obstetrician/gynecologist in the past year (Frazier, Jiles & Mayberry, 1996; Schueler et al., 2008). Health-related behavioral factors that have been shown to predict mammography use include not smoking (Borrayo et al., 2009; Coughlin et al., 2004, Selvin & Brett, 2003, Rakowski et al., 2006), no alcohol consumption (Coughlin et al., 2004), having good to excellent self-reported health (Coughlin et al., 2004; Bobo et al., 2004), participating in other screening tests such as clinical breast exam (CBE), Pap test, cholesterol or blood pressure check (Coughlin et al., 2004; Vyas et al., 2012), and not being overweight to morbidly obese (Coughlin et al., 2004; Vyas et al., 2012). It is also important to account for personal and family medical history-related factors, such as having a family history of breast cancer (Borrayo et al., 2009; Meissner et al., 2007; Rahman et al., 2003), having had breast problems (Bobo et al., 2004; Zapka et al., 1991), and having had breast biopsy (Daly et al., 1996; Zografos et al., 2010). There are also psychosocial factors that can cause someone to get a mammography, such as having higher perceived risk of developing breast cancer (Katapodi et al., 2004; Lyttle & Stadelman, 2006), having knowledge of breast cancer and mammography screening (Lyttle & Stadelman, 2006; Magai et al., 2007; Vyas et al., 2012), and having positive views and beliefs about mammography screening (Magai et al., 2007).

Although these studies support that there are predictive factors for mammography adherence, most of the studies were limited to NHWs and African Americans. Research is lacking in studying how these factors are predictive of mammography adherence in Asian Americans. In addition, there is very little research examining how cultural factors (i.e., nativity, years in U.S., and English proficiency) may influence screening mammography among Asian Americans. The Andersen Model has been adapted to account for these factors. They will be categorized as social structure factors under predisposing variables. An overview of the included factors is displayed in Figure 3.1. A more detailed description of the variables is introduced in Chapter 4. An outline of the variables used in this study and their application to the Andersen Model are given below.

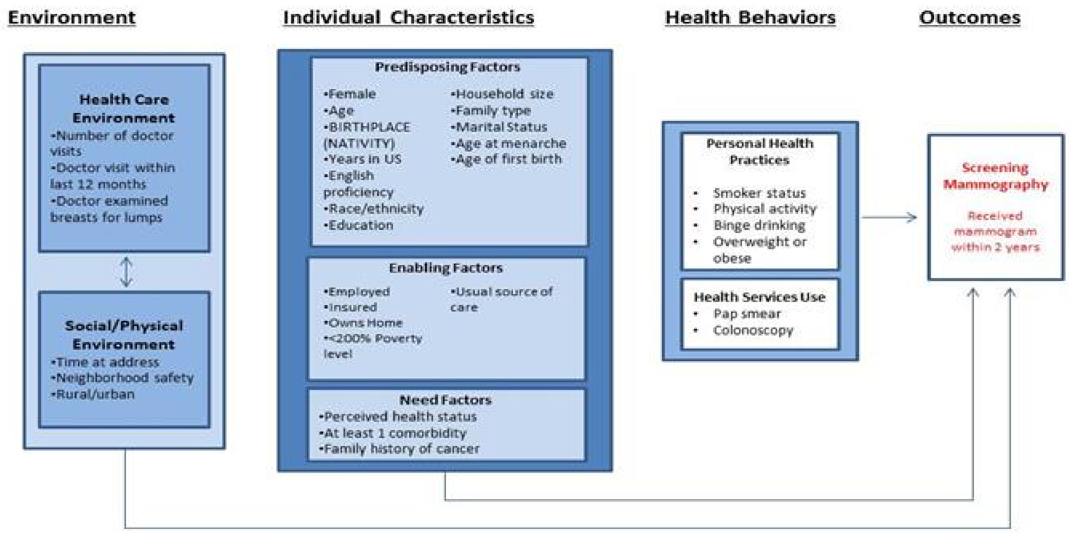


Figure 3.1: Conceptual model adapted from Andersen's Behavioral Model of Health Services Use Phase 4 Emerging Model

Predisposing Factors

Predisposing factors represent the tendency to utilize health care services. An individual's tendency to access health care is dependent on his/her demographics, social position, and beliefs that the health services are beneficial. The demographic factors include age and gender. Simply being a woman increases the risk for breast cancer (ACS, 2012a). Breast cancer is 100 times more common among women than men (ACS, 2013). Besides being female, age is the most important risk factor for both breast cancer and mammography screening. The social structure factors include education, race/ethnicity, cultural factors (i.e., nativity, years in the U.S., and English proficiency), household size, and marital status. Adherence with screening mammography guidelines was found to be associated with women's personal characteristics including race/ethnicity, older age , being married, and socioeconomic status, measured by educational level and community economic status (Borrayo et al., 2009; Coughlin et al., 2004; Rahman et al., 2003; Meissner et al., 2007; Vyas et al., 2012). Family structure (i.e., size) has been shown to negatively affect use of preventive services in Hispanics (Puschel et al., 2001). It is expected that it may show a similar effect among Asians given that the average Asian American household is 3.1 (Pew Research Center, 2012).

Efforts to increase adherence among minority populations must take into account cultural factors. Most Asian American adults are foreign born – 74.1% compared with 15.8% of the U.S. population overall (Pew Research Center, 2012). There is evidence that breast cancer risk rises after Asian women migrate to the U.S. rising by four to seven times higher than their home country (Ziegler et al., 1996). Over the course of several generations, there is shift in breast cancer incidence toward the rates of their adopted country (Gomez et al., 2010; Ziegler et al., 1993). The adoption of Western habits, both good and bad including cancer preventive screening, increases over time. Psychosocial factors, such as having higher perceived risk of developing breast cancer and knowledge about breast cancer and mammography screening (Katapodi et al., 2004; Lyttle & Stadelman, 2006; Magai et al., 2007; Vyas et al., 2012) may also increase over time. Positive views and beliefs about mammography increase the likelihood that a woman receives a mammogram (Magai et al., 2007).

The menstrual and reproductive factors shown to be associated with an increased risk of breast cancer include: earlier age at menarche, shorter menstrual cycle length, and later age at menopause (Kelsey, Gammon & John, 1993). These factors are important because they may increase lifetime exposure to estrogen. Age at menopause also affects mammographic density. The health belief factors (factors known to increase breast cancer risk) included in this study are age at menarche and age when their first child was born.

Enabling Factors

Enabling factors include resources found within the family (e.g., socioeconomic status, and residence) and the community (e.g., access to health care facilities), which cause an individual to utilize services because of its benefits. The enabling factors include employment status, home ownership, <200% of the federal poverty level, health insurance status (any type), and usual source of care. Cost is a common barrier to screening mammography among underserved women (McAlearneye et al., 2007). Low SES is a consistent marker for mammography underuse (Peek & Han, 2004). Women with lower SES are more likely to be uninsured and lack a usual source of care. Being employed and having a high income is positively associated with screening mammography adherence (Coughlin et al., 2004; Meissner et al., 2007; Rahman et al., 2003; Vyas et al., 2012; Zapka et al., 1991). Access to health care facilities is defined as having health insurance and usual source of care when you are sick or needing care. Health insurance status has been noted to have a consistently strong effect on the receipt of both early cancer detection and treatment services (Ayanian et al., 1993; Mandelblatt, Yabroff, & Kerner, 1999). Compared to women with private insurance, women without health insurance or covered by Medicaid had more advanced breast cancer (Ayanian et al., 1993).

Need Factors

Need is considered the most pressing and powerful predictor of using health care services. *Need based factors* are factors that affect the necessity to access health care services, i.e., individual, social, or clinically evaluated perceptions of need. The need factors are their perceived general health status, confirmation of one or more comorbidities (i.e., asthma, diabetes, high blood pressure or heart disease), and family history of cancer. Despite having similar or lower rates of chronic disease or health limitations, Asian Americans have lower self-reported health than non-Hispanic Whites (Meredith & Siu, 1995). Having a family history of breast cancer (Borrayo et al., 2009; Meissner et al., 2007; Rahman et al., 2003) and breast problems (Bobo et al., 2004; Daly et al., 1996; Zapka et al., 1991; Zografos et al., 2010) are major predictors of mammography use.

Social and Health Care Environment

Environmental variables include the health care delivery system, the external environment, and the community. There are two types of environments affecting individual-level characteristics and screening mammography in this study: the health care environment and the social/physical environment. The health care environment is captured by using the following variables: number of doctor visits within last year, doctor visit within last year, and doctor examined breasts for lumps in the last twelve months.

Access to physicians, specifically obstetricians/gynecologists, strongly influences mammography utilization. According to Schueler et al. (2008), not having a physician-recommended mammography (adjusted OR (AOR) = 0.16, 95% CI = 0.08-0.33), having no primary care provider (AOR = 0.41, 95% CI = 0.32-0.53), and not having visited a physician within the past year (AOR = 0.34, 95% CI =0.25-0.47) are powerful influences on mammography decision making. Although not as important as having access to a physician, physician specialty also had an impact on mammography use. Patients of physicians other than obstetricians/gynecologists were less likely to undergo screening (AOR = 0.46) (Schueler et al., 2008). Since geographical identifiers are not available, the social/physical environment is captured by their reported neighborhood characteristics: if they felt safe in their neighborhood, length of time at the current address in months, and if they live in a rural or urban zip code.

Health Behaviors

The Andersen Model uses health behavior as the intervening factor affecting mammography screening. Health behavior is divided into personal health practices and health services use. The personal health practices include smoker status, physical activity, binge drinking, overweight, and obese. Health-related behavioral factors that have been shown to predict mammography use include not smoking, no alcohol consumption, having good to excellent self-reported health, participating in other screening tests, and not being overweight to morbidly obese (Bobo et al., 2004; Borrayo et al., 2009; Coughlin et al., 2004; Rakowski et al., 2006; Selvin & Brett, 2003; Vyas et al., 2012). A systematic review of 221 studies published between 1988 and 2007 by Schueler et al. (2008) found that women who smoked consistently had lower rates of mammography use. This habit became more negatively associated with mammography use over time. In addition, drinking alcohol in any amount showed consistent modest effects. Health services use includes the receipt of prior cancer preventive screening. Past screening behavior (i.e., clinical breast examination, AOR = 9.5, 95% CI = 3.49-

23.98 and Pap test, AOR = 3.45, 95% CI =2.12-5.62) is strongly correlated with receipt of mammography (Schueler et al., 2008).

CHAPTER SUMMARY

Since its creation in 1968, the Andersen's Behavioral Model of Health Services Use has been used extensively in studies investigating health services utilization (Andersen, 2008; Babitsch et al., 2012). There are a complex set of social, economic, cultural and health system factors that determine mammography screening (Freeman, 2008; Gomez et al., 2007) and the Andersen Behavioral Model serves as an ideal framework for this study. The Andersen Model has evolved over time and undergone five phases of development.

Each phase of development has either expanded or added factors to the model as a result of changes in health policy and health services delivery, input and critiques from researchers, and new developments in health services research and medical sociology. In Phase 1 (1960's), the Andersen Model suggested that use of health services is a function of their predisposition to use services, factors which enable or impede use, and their need for care. In Phase 2 (1970's), the health care system and consumer satisfaction were added. During Phase 3 (1980's-1990's), health status (perceived and evaluated) was added as an outcome of health services use while the external environment and personal health practices were added as important inputs. In Phase 4 (1990's), feedback loops were added to emphasize the dynamic and recursive natural of a health services use. The feedback loops showed that health outcomes affect predisposing factors, perceived need for the services and health behavior. In Phase 5 (2000's), the process of medical care was added to health behavior and emphasis was placed on focusing on both contextual and individual characteristics in order to better understand health services use. While the revisions may have caused additions to the original model, the same principle is maintained. The actual use of health care services is still a function of three factors: predisposing, enabling and need. The Phase 4 Emerging Model is the most frequently applied version in studying health services use and will be used as the basis of this study (Babitsch et al., 2012).

The purpose of Chapter 3 is to provide background information on the application of the Andersen Model on the present research and how the present research will enrich what we know about mammography screening in racial/ethnic minorities. The Andersen Model has been used to explain health care utilization in minority populations. It has also been applied to study health services utilization among Asian Americans. Although all these studies use the Andersen Model as their theoretical framework for their study. The operationalization of the model has varied with stark differences in what variables are used and how they are classified. The discrepancy is in what variables are defined as predisposing and enabling factors. It has been noted that this may be a result of secondary data analyses where variables are limited for study. Since the 1995 version of the Andersen Model is the most frequently used version used in research and most applicable to the data available for this study, strict adherence to these definitions will be used to define the variables for this study (Andersen, 1995; Babitsch et al., 2012).

Chapter 4: Research Design and Methods

This chapter provides information concerning the study population, study design, study variables, and the research methods used to address the specific aims. The details include a description of the CHIS purpose and survey design, characteristics about the respondents, and the strengths and limitations of the data. The analysis plan provides explanations of the analytical techniques used to determine if screening mammography adherence rates vary across racial/ethnic groups and nativity (Aim I); determine the relationship between predisposing, enabling, and need factors on screening mammography adherence among Asian Americans and to determine if there are differences by nativity (Aim II); and determine if the effect of the health care and/or social environment on screening mammography among Asian Americans varies by nativity (Aim III).

Overview of the Data Source

Description of the California Health Interview Survey

The California Health Interview Survey (CHIS) is one of the largest health surveys in the United States. CHIS uses a telephone-based sampling frame to collect cross-sectional, population-based data on a variety of public health topics, including access to health care and health insurance coverage for California's diverse population. The survey has been conducted biennially since 2001 by the University of California, Los Angeles (UCLA) Center for Health Policy Research in collaboration with the California Department of Public Health, the California Department of Health Care Services, and the Public Health Institute. Westat has been conducting the data collection and the preparation of the methodological reports for each survey since its inception in 2001. Westat is a private firm that specializes in statistical research and large-scale sample surveys. Data for this project came from the California Health Interview Survey from 2001 to 2009. The data is publicly accessible online at http://www.chis.ucla.edu/. Although there were an extensive number of variables in the original data set, this study only pulled variables that followed the adapted Andersen Model and fulfilled demographic and socio-ecological background information on the respondents, as well as the multiple weighting variables necessary for analysis.

SAMPLE DESIGN AND DATA COLLECTION

The CHIS is designed to meet two objectives. The first objective is to provide estimates for counties and groupings of counties. The second objective is to provide estimates for California's overall population and its larger race/ethnic groups, as well as for several smaller ethnic groups. The CHIS employs a complex sample design to achieve these objectives. Table 4.1 provides an overview of when and how the CHIS survey data was collected. CHIS 2001 is the first year CHIS data was collected (CHIS, 2008 July). To help compensate for the increasing number of households without landline telephone service, a separate RDD sample was drawn of telephone numbers assigned to cellular service. Starting in 2007, the random-digit-dial sample included telephone numbers assigned to both landline and cellular services (CHIS, 2009). The CHIS 2009 cell-phone sample differed from the CHIS 2007 cell-phone sample in two major ways. First, all cell-phone sample cases were eligible for the extended interview regardless of the presence of a landline phone. Hence, the landline and cell samples overlap. This contrasts to CHIS 2007 when cell-phone cases with a landline telephone were screened out to limit the cell-phone sample to “cell-phone only” cases. For more information on data collection methods, go to http://healthpolicy.ucla.edu/chis/design/Pages/ methodology.aspx.

Table 4.1. Summary of CHIS survey data collection dates and methods.

Survey Year	**Dates survey collected**	**Method of survey collection**
CHIS 2001	11/00-10/01	Land RDD
CHIS 2003	08/03-2/04	Land RDD
CHIS 2005	7/05-4/06	Land RDD
CHIS 2007	07/07-03/08	Land and Cell RDD
CHIS 2009	09/09-04/10	Land and Cell RDD

Note: *Land,* landline. *Cell*, cell phone. *RDD*, random digit dial.

Table 4.2. Geographic sampling strata (California county and county group strata) used in 2005-2009 CHIS sample design

1. Los Angeles	7. Alameda	27. Shasta
1.1 Antelope Valley	8. Sacramento	28. Yolo
1.2 San Fernando Valley	9. Contra Costa	29. El Dorado
1.3 San Gabriel Valley	10. Fresno	30. Imperial
1.4 Metro	11. San Francisco	31. Napa
1.5 West	12. Ventura	32. Kings
1.6 South	13. San Mateo	33. Madera
1.7 East	14. Kern	34. Monterey
1.8 South Bay	15. San Joaquin	35. Humboldt
2. San Diego	16. Sonoma	36. Nevada
2.1 N. Coastal	17. Stanislaus	37. Mendocino
2.2 N. Central	18. Santa Barbara	38. Sutter
2.3 Central	19. Solano	39. Yuba
2.4 South	20. Tulare	40. Lake
2.5 East	21. Santa Cruz	41. San Benito
2.6 N. Inland	22. Marin	42. Colusa, Glen, Tehama
3. Orange	23. San Luis Obispo	43. Plumas, Sierra, Siskiyou,
4. Santa Clara	24. Placer	Lassen, Modoc, Trinity, Del Norte
5. San Bernardino	25. Merced	44. Mariposa, Mono, Tuolumne,
6. Riverside	26. Butte	Alpine, Amador, Calaveras, Inyo

Source: UCLA Center for Health Policy Research, 2009 California Health Interview Survey

For the 2001 and 2003 CHIS, the state was divided into 41 geographic sampling strata, which included 33-single-county strata and eight additional strata comprised of 25 primarily small counties. Within each geographic stratum, telephone numbers were sampled using a random-digit dial (RDD) method. Starting with the 2005 CHIS, a multistage sample design was used. Instead of using 41 geographic sampling strata, 44 geographic sampling strata were used including 41 single-county strata and 3 multi-county strata for the remaining 17 counties. Table 4.2 shows the 44 geographic sampling strata used for CHIS 2005 through 2009.

Areas with relatively higher concentrations of Koreans and Vietnamese were sampled at higher rates for increased precision of estimates. The oversamples were supplemented by telephone numbers of group-specific surnames (CHIS, 2007). Within each geographic stratum, households were selected through RDD. Within each household, one adult respondent (aged 18 years and over) was randomly selected. In addition, in those households with adolescents (ages 12-17) and/or children (under age 12), one adolescent was randomly selected for an interview and one child was selected; the most knowledgeable adult about the child's health completed the child interview.

Interviews have been conducted in five languages: English, Spanish, Chinese (Mandarin and Cantonese dialects), Vietnamese, and Korean. In 2001 CHIS, interviews were also conducted in Khmer (Cambodian), but dropped in future administrations. These interview languages were chosen based on analysis of 2000 Census data to identify the languages that would cover the majority of Californians in the CHIS sample that either did not speak English or did not speak English well enough to participate. Table 4.3 shows the adult interview time by study year. The average adult interview took about 35 minutes to complete ranging from 32 minutes in 2001 to 40 minutes in 2009. Interviews conducted in languages other than English generally took a little longer to complete. The variable for interview language was not available in the CHIS 2001 public-use file. Between 2003 and 2009, more than 6.8% of the adult interviews were conducted in a language other than English (n = 6,780). Specifically, 4.2% of the interviews were conducted in Spanish, 0.7% in Vietnamese, 0.9% in Korean, 0.4% in Cantonese, and 0.7% in Mandarin.

Table 4.3. Summary table of average adult interview time by study year

	Wave 1 2001	Wave 2 2003	Wave 3 2005	Wave 4 2007	Wave 5 2009	Average
Adult interview time (minutes)	**32**	**33**	**35**	**35**	**40**	**35**

To obtain adequate representation among the elderly and avoid any biases in population health estimates, proxy interviews are allowed for frail and ill persons over the age of 65 (CHIS, 2011 November). Frail and ill persons who are unable to complete the extended adult interview are re-contacted by interviewers and offered a proxy option. A reduced questionnaire was administered with questions identified as appropriate for proxy answer. In the data files, any question that is not administered in the proxy interviews is given a value of "-2." Since the proxy variable (PROXY) was not available for CHIS 2001 and CHIS 2003, it was imputed using two questions (AH22 for CHIS 2001 and BINGE for CHIS 2003) that had a given value of -2. AH22 asks if there was a delay or not able to get other medical care in the past 12 months and BINGE asks if binge drinking occurred in the past 30 days. A total of 344 CHIS adult interviews (0.3%) were completed by either a spouse/partner or adult child in the total sample. In the Asian sample, 26 CHIS adult interviews (0.3%) were completed by proxy.

Response Rates

The CHIS response rate is comparable to response rates of other scientific telephone surveys in California, such as the 2007 California Behavioral Risk Factor

Surveillance System (BRFSS) Survey. The overall response rate is a composite of the screener completion rate (i.e., success in introducing the survey to a household and randomly selecting an adult to be interviewed) and the extended interview completion rate (i.e., success in getting one or more selected persons to complete the extended interview). For example, the adult response rate for landline is the product of the screener completion rate for the landline sample and extended interview completion rate for the landline sample. Table 4.4 shows the adult response rate for both landline and cell RDD samples for 2001-2009 CHIS. More detailed information on response rates for each wave of the CHIS is available at http://healthpolicy.ucla.edu/chis/design/Pages/methodology.aspx.

Table 4.4. Summary of CHIS adult response rates.

Survey Year	**Landline Response Rate**	**Cell Response Rate**
CHIS 2001	63.7%	N/A
CHIS 2003	60.0%	N/A
CHIS 2005	54.0%	N/A
CHIS 2007	52.8%	52.0%
CHIS 2009	49.0%	56.2%

Data Weighting

The CHIS employs a two-stage geographically stratified random-digit-dial (RDD) sample design. Proper weighting and variance (or its square root – standard error) calculation of the estimates are required. Most statistical software packages calculate the variance by assuming that the data are from a simple random sample. This underestimates the variance of estimates produced from the CHIS complex sample design. The CHIS Public Use Files (PUFs) provide 80 replicate weights in addition to the final weight to accurately estimate variance without jeopardizing data confidentiality and respondent privacy. CHIS methodology reports the use of the "jackknife replication procedure." Jackknife replication is used to estimate the bias and standard error (variance) of a statistic when a random sample of observations is used to calculate it. There are two principal reasons for using jackknife replication to estimate variances for CHIS data – operational convenience and the ability to reflect all components of the design and estimation in the estimates of variability. Once replicate weights are constructed, remarkably estimates of sampling errors are computed. No specific care is needed for subgroups of interest, and no knowledge of the sample design is required. If an estimator is needed that was not previously considered, replication methods can be adapted to develop an appropriate estimate of variance. The second reason for using replication is probably more valuable. For example, both nonresponse and raking types of adjustments that were made to develop the CHIS 2005 analysis weights can affect the sampling errors of the estimates produced from the survey. The replicate weights prepared for CHIS reflect all such aspects of weighting.

Raking is used to calculate the weights for the CHIS PUFs. Raking is referred to as a multidimensional post stratification procedure because the weights are intrinsically post-stratified to one set of control totals (a dimension) (California Health Interview Survey, 2011). Then, the adjusted weights are post-stratified to another dimension. After all of the dimensions were adjusted, the process is repeated until the control totals for all the dimensions have been simultaneously satisfied (within a specified tolerance). The raking procedure used 11 raking dimensions, which include combinations of demographic variables (age, sex, race/ethnicity), geographic variables (county, Service Planning Area in Los Angeles County, and Health Region in San Diego County), household composition (presence of children and adolescents in the household), and socio-economic variables (home ownership and education). The socio-economic variables are included to reduce biases associated with excluding households without landline telephones from the sample frame.

Each of the weights fulfills a different function. The final weight (RAKEDW0) accounts for the sample selection probabilities and statistical adjustments for potential under coverage and non-response biases. Hence, the non-response bias is accounted by using the final raking weight. When this weight is applied, it ensures that estimates from the CHIS sample are an unbiased representation of the California population. The replicate weights (RAKEDW1– RAKEDW80) are specially designed for valid variance estimation in the absence of the geographical sample design information (excluded from the CHIS PUFs). These 80 different weights provide variance estimates computed with 80 replications. When using replicate weights in conjunction with the final weight, the estimates and their variance estimation are less biased. When only the final weight is applied, the variability is underestimated. For more detailed information on the weighting and variance and estimation for each survey, go to http://healthpolicy.ucla.edu/chis/design/Pages/ methodology.aspx.

Data Imputation

For nearly every variable, missing values have been replaced with imputed variables. The imputations are designed to enhance the analytic utility of the PUFs. This massive task is shared by both Westat and UCLA staff. Westat imputes missing values for a handful of variables used in the weighting process through two different imputation procedures while UCLA staff imputes values for nearly all other variables (CHIS, 2007).

In the first imputation technique, Westat assigns a completely random selection from the observed distribution of respondents. This method is employed only for variables where the percentages of items missing are remarkably small. The second imputation method is the hot deck imputation without replacement. In the “hot deck” approach, a value reported by a respondent for a particular question is assigned or donated to a similar person who did not respond to that item (CHIS, 2007). To carry out hot deck imputation, respondents to an item are grouped together to form a pool of donors, while the non-respondents are a grouped as the recipients. A recipient is matched to the subset pool of donors based on household and individual characteristics. A value for the recipient is then randomly imputed from one of the donors in the pool. Once a donor is used, it is removed from the pool of donors. Hot deck imputation was used to impute the same items (i.e., race, ethnicity, home ownership, and education).

The imputation process that is conducted by UCLA starts with data editing through logical or relational imputation (CHIS, 2007). For any missing value, a valid replacement value is sought based on the known values of the respondent or from another sample from the same household. For the remaining missing values, hierarchical sequential hot-deck imputation with donor replacement is used. Similar to the hot deck imputation employed by Westat, a missing value is assigned from another respondent with similar characteristics as defined by a set of control variables.

The control variables are ranked in order from the most to the least important. This procedure allows control variables to be dropped starting from the variable ranked least important if certain conditions are not met, e.g., minimum number of donors. Control variables are always included in the following order: gender, age group, race/ethnicity, poverty level (based on household income), educational attainment, and region (CHIS, 2007). Westat imputes gender, age, race/ethnicity and regions. Additional control variables are used depending on the nature of the imputed variables. Household income and educational attainment are imputed first in order to impute other variables. Household income is imputed using the hot-deck method within ranges from a set of auxiliary variables such as income range and/or poverty level. The imputation order of the other variables follows the sequence of the questionnaire. Once imputation is complete, logical checks and edits are performed to ensure consistency between the imputed (CHIS, 2007). Once a responding case is used as a donor, it is dropped from the donor pool preventing multiple use of one donor (CHIS, 2007).

LIMITATIONS OF THE CALIFORNIA HEALTH INTERVIEW SURVEY

The California Health Interview Survey is regarded as the largest state health survey in the nation covering a wide range of essential health topics from asthma, diabetes and obesity to immigrant health and health insurance coverage. However, it does have data limitations.

Multiple Variables for Race/Ethnicity

There are three race variables in the data set. As a result the racial/ethnic disparities trends may be reported differently across different studies depending on the definition used. For example, race is defined by the Census 2000 definition, the California Department of Finance definition and the UCLA CHPR definition. Since the raking weights used the California Department of Finance's population estimates, the California Department of Finance definition was utilized. Having different race definitions makes it harder to compare rates with other studies utilizing a different definition.

No Geographic Identifiers for Contextual Study

First, the PUFs do not allow for full contextual study of environmental factors. Sub-state geographic identifiers (e.g., county, city, and zip code) are excluded from the CHIS Public Use Files. Special permission must be granted to access the confidential information. This is why Phase 5 of the Andersen Model could not be used for this study. The Phase 5 model emphasized that health services use is best understood by focusing on both contextual and individual determinants. Examples of social characteristics at the community/county level that should be studied are educational level, ethnic and racial composition, proportion of recent immigrants, income level, and employment rate (Andersen & Davidson, 2007). These characteristics would help to describe how supportive or detrimental the communities are where people live and work to their health and their access to health services. In addition, financing and organization characteristics, including per capita community income, and wealth; incentives to purchase or provide services such as rate of health insurance coverage, relative price of medical care and other goods and services; method of compensating providers; amount and distribution of health care facilities; and per capita expenditures for health care services, would have provided insight into what health care services are available (Andersen & Davidson, 2007). Specifically, not having geographic identifiers hinders the analysis by not allowing us to determine access, i.e., nearest mammography facilities.

Inconsistent Measures

As in many national studies, the measurement of variables is not consistent in every wave of the CHIS. Some of the information that was crucial to the goals to this study was not obtained every survey year or coded as a different variable. This limitation posed a few problems for the analyses. First, study variables had to be compared across all survey years to determine the discrepancies and merged if possible. For example, the dependent variable, mammography adherence (MAM_SCRN) was available for 2003 - 2009 CHIS Surveys, but not 2001 CHIS Surveys. Using the same process as 2003-2009 CHIS, mammography adherence for 2001 CHIS was determined by combining two questions to impute the value: "Have you ever had a mammogram?" and among those who answered yes, "How long ago did you have your most recent mammogram?" Second, several variables were not collected for every wave. To resolve this issue, separate analyses were completed utilizing data only when data was complete. For example, age when their first child was born was only available for 2001 and 2009 CHIS. Hence, the analysis was limited to only those years the variable was available. Last, variables had to be recoded from separately coded variables. For example, the variable for usual source of care was not collected in the CHIS 2007, but available as two separate variables, AHUSUAL and USUAL, for the other study years. AHUSUAL and USUAL was combined into one variable for the data analysis. This may be a limitation to the study findings because the question may be worded differently.

STRENGTHS OF THE CALIFORNIA HEALTH INTERVIEW SURVEY

Despite the limitations mentioned above, there are several strengths that made CHIS PUFs an appropriate data set for this project. First, California is home to the largest Asian population (5.6 of the 17.3 million U.S. Asians live in California) (U.S. Census Bureau, 2011). It is also the first state to categorize Asian racial/ethnic group. In addition, CHIS serves as a great source to study screening mammography adherence among Asian Americans because of the oversampling of specific racial/ethnic groups. Second, the variables mentioned in the adapted Andersen Model are available for study. CHIS survey topics include information on individual health behaviors, health outcomes, and socio-demographic characteristics. Next, it has a higher survey completion rates compared to other data sets. Unlike other surveys where completion of 50% of the survey is considered as a successful completion, CHIS only counts surveys as complete when the respondent finishes at least 80% of the questionnaire. Third, missing values are imputed by the data managers. Logical checks and edits are performed after imputations to ensure consistency between the imputed and self-reported answers (CHIS, 2007). Missing data can be a serious impediment for data analysis. Analysis using only complete cases can bias the results and can lead to excluding a substantial proportion of the original sample. This in turn causes a substantial loss of precision and power.

Additionally, a variety of activities were implemented to encourage participation among sampled households and individuals as well as increase response rates. First, advance letters were sent out to all sampled telephone numbers for which an address could be located through reverse directory services. The letters included informational materials, a toll-free number that participants could call, and a special CHIS website designed to address respondent questions about the survey. The advance letters were meant to emphasize the importance and legitimacy of the CHIS. It detailed the survey's purpose and importance, emphasized government sponsorship of the survey, and assured potential respondents that their participation was entirely voluntary and that their confidentiality was protected. Response rates increased with an advance letter. For example, response rates for CHIS 2003 were about 9% higher in households that received an advance letter. Second, multiple attempts (at least 17 attempts if needed) were made to contact the sampled households over a wide range of time periods (days, evenings, weekends, etc.). Next, the interview times could be set by the respondents. There was a toll-free number that respondents could call to schedule a convenient interview appointment time. CHIS interviewers were trained and given refresher training on methods to avoid refusals and convert refusals. Only interviewers who had above average response rates were trained and allowed to conduct the refusal conversions. Multiple call attempts were made to contact sampled household members to complete the extended interviews. On average, 17 call attempts were made before a case was classified as a non-respondent (California Health Interview Survey, 2011).

Additional efforts were also made for those who could not complete the survey due to language barriers or physical health. Interviews were conducted in languages that covered a majority of California's population. Specially trained bilingual/bicultural interviewers were employed to conduct non-English interviews to make respondents more prone to completing the survey. Frail or ill respondents over the age of 65 could complete the interview by proxy.

STUDY POPULATION

Sample Size

Five waves of data (2001, 2003, 2005, 2007, and 2009) were used for analyses and treated as repeated cross-sections. Therefore, respondents who participated in any given wave were included in the analysis for that study year. Adults who complete at least 80% of the questionnaire (i.e., Section K - employment, income, poverty status, and food security) after all follow-up attempts were exhausted were counted as “complete.”

The sample used for this dissertation included female respondents aged 40 years and older at the time of the interview that did not have a history of breast cancer or missing data on birthplace or time in U.S, marital status, employment, usual source of care, smoking status, general health status, or cancer screening behavior. Previous diagnosis of breast cancer was based on the answer to the question if they had ever been told they had breast cancer (BRCAN for CHIS 2003-2009 and BRSTCNCR for CHIS 2001) or how first found out they had breast cancer (AB60). Women who have a history of breast cancer are more likely to receive mammograms than the general population. Their screening habits are likely influenced by their prior diagnoses and routine medical surveillance. As a result, they were removed from the sample. Respondents who were missing information on factors shown to be associated with mammography adherence were also excluded, i.e., marital status, employment, usual source of care, smoking status, general health status, and cancer screening behavior.

Table 4.5 provides the number of completed adult interviews and the age-eligible sample size by race/ethnicity for each CHIS wave. After applying the exclusion criteria, the total sample size for the analyses is 99,619. Sample sizes varied by study year. As stated earlier, race/ethnicity was determined using the California Department of Finance definition. Two of the racial/ethnic groups (i.e., Native American and other/mixed race) were collapsed into an “other” group in the total sample. A majority of the sample was non-Hispanic white (69.7%). For specific aim II and III analyses, the sample size was limited to respondents who self-identified themselves as Asian.

Table 4.5. Sample size by wave and race/ethnicity

	Wave 1 2001	Wave 2 2003	Wave 3 2005	Wave 4 2007	Wave 5 2009	Total
Adult Respondents	56,270	42,044	43,020	51,048	47,614	239,996
Female Respondents	32,894	24,567	25,548	30,541	28,186	141,736
Aged ≥ 40 at interview	21,647	16,629	18,545	24,060	23,025	103,906
No history of breast cancer	20,623	15,788	17,527	24,060	21,910	99,908
Mammogram status	20,587	15,788	17,527	24,060	21,910	99,872
Birthplace or time in U.S.	20,566	15,788	17,527	24,060	21,910	99,851
Marital status, employment, usual source of care, smoking, general health, or cancer screening history	20,402	15,720	17,527	24,060	21,910	99,619
Race/Ethnicity						
Hispanic	3,049	2,236	2,323	3,090	2,927	13,625
Non-Hispanic White	13,977	10,577	12,333	17,159	15,375	69,421
Non-Hispanic Black	948	1,029	763	1,189	951	4,880
Asian/Pacific Islander	1,566	1,341	1,510	1,859	2,077	8,353
Other single/multiple race	862	537	598	763	580	3,340
Total Adult Sample	**20,402**	**15,720**	**17,527**	**24,060**	**21,910**	**99,619**

Source: California Health Interview Survey (2001-2009) Public Use Files

Table 4.6. Asian sample size by wave and Asian subgroup

	Wave 1 2001	**Wave 2 2003**	**Wave 3 2005**	**Wave 4 2007**	**Wave 5 2009**	**Total**
Asian Subgroup						
Chinese	393	438	477	573	444	2,325
Japanese	177	182	191	281	207	1,038
Korean	254	192	255	310	477	1,488
Filipino	277	217	246	324	215	1,279
Vietnamese	232	136	165	144	488	1,165
Other Asian	233	176	176	227	246	1,058
Total Asian Sample	**1,566**	**1,341**	**1,510**	**1,859**	**2,077**	**8,353**

Source: California Health Interview Survey (2001-2009) Public Use Files

For specific aim II and III analyses, the sample size was limited to respondents who self-identified themselves as Asian (i.e., CHIS variable, SRAS = Chinese, Japanese, Korean, Filipino, Vietnamese or other Asian including mixed race). Table 4.6 provides the number of self-identified Asian interviews and the age-eligible sample size by Asian subgroup for each CHIS wave. After excluding self-reported Asian respondents who did not specify an Asian subgroup, the total Asian sample was 8,353.

STUDY VARIABLES

Table 4.7 displays the independent and dependent variables used in the analyses. The coding and definition for each variable is included, as well as the years that the variable was available for examination.

Table 4.7. Summary table of variables from the California Health Interview Survey used to examine screening mammography among women aged ≥ 40 years and older (2001-2009)

Variable (Year)	Definition
Dependent Variables	
Mammogram in past 2 years (2001-2009)	Coded 1 if the respondent had a mammogram in past 2 years, 0 if the respondent had a mammogram more than 2 years ago or never had a mammogram.
Independent Variables	
Predisposing Factors	
Female (2001-2009)	Coded 1 if the respondent was female and 0 if male.
U.S.-born (2001-2009)	Coded 1 if the respondent was born in the U.S. and 0 if born outside the U.S.
Time in US (2001-2009)	Combined U.S.-born and years living in U.S. Categorized as US born (ref), foreign-born living in US for ≥ 10 years, and foreign-born living in US for less than 10 years.
Age (2001-2009)	Respondents' self-reported age at the time of interview. Only those aged 40 or older included. Coded as continuous variable (range: 40-85) and categorized into three categories: ≤49, 50-64 and ≥ 65.
Race/ethnicity (2001-2009)	Used the 2001 California Department of Finance's definition of race.
Hispanic	Coded 1 if the respondent self-identified as Hispanic, 0 otherwise.
Non-Hispanic White (Ref)	Coded 1 if the respondent self-identified as non-Hispanic White, 0 otherwise.
Non-Hispanic Black	Coded 1 if the respondent self-identified as non-Hispanic Black, 0 otherwise.

Table 4.7 continued.

Variable (Year)	Definition
American Indian/Alaskan Native	Coded 1 if the respondent self-identified as American Indian/Alaska Native, 0 otherwise.
Asian/Pacific Islander	Coded 1 if the respondent self-identified as Asian or Native Hawaiian/Pacific Islander, 0 otherwise.
Other single/multiple race	Coded 1 if the respondent self-identified as other single race or multiple race, 0 otherwise.
Asian subgroups (2001-2009)	
Chinese	Coded 1 if the respondent self-identified as Chinese, 0 otherwise.
Japanese (Ref)	Coded 1 if the respondent self-identified as Japanese, 0 otherwise.
Korean	Coded 1 if the respondent self-identified as Korean, 0 otherwise.
Filipino	Coded 1 if the respondent self-identified as Filipino, 0 otherwise.
Vietnamese	Coded 1 if the respondent self-identified as Vietnamese, 0 otherwise.
Other Asian	Coded 1 if the respondent self-identified as Other Asian, 0 otherwise. Other Asian includes South Asians, Southeast Asians, other Asians and more than two Asian types.
Education (2001-2009)	Highest education completed. Categorized as less than H.S. diploma (ref), some college and more than college (4-year degree).
English use and proficiency (2001-2009)	Categorized as speaks English only (ref), speaks English very well or well or speaks English not well/not at all.
Household Size(2001-2009)	Coded as continuous variable (range: 1-10).
Married (2001-2009)	Coded 1 if the respondent was married (ref) or 0 if not married including separated, divorced, widowed or living with a partner.
Age when period started (2001, 2005-2009)	Respondent's age when period (menarche) started. Coded as a continuous and categorical variable (≤13, >13).
Age when first child was born (2001, 2005, 2009)	Respondent's age when the first child was born. Categorized as 10-18, 19-25 (Ref), 26-35, ≤36.
Enabling Factors	
Employed (2001-2009)	Current employment status. Coded 1 if the respondent had full-time, part-time employment or was employed but not at work. Coded 0 if unemployed.
Currently insured (2001-2009)	Coded 1 if the respondent had health insurance and 0 if had no health insurance.

Table 4.7 continued.

Variable (Year)	Definition
Owns Home (2003-2009)	Coded 1 if respondent owns a home and 0 if respondent rents or has other living arrangements.
≤200% Federal Poverty Level (2001-2009)	Coded 1 if respondent earns at or below the 200% poverty level (not poor), 0 otherwise.
Usual source of care (2001-2005, 2009)	Have a usual source of care when sick or needing health advice. Coded 1 if had a usual source of care, 0 otherwise.
Need Factors	
General health condition (2001-2009)	Would you say that in general your health is excellent, very good, good, fair or poor? Categorized as excellent (ref), very good, good, fair and poor.
Confirmation of ≥1 chronic disease (2001-2009)	Coded as 1 if the respondent had ever been told by a doctor that they had asthma, diabetes, high blood pressure, or heart disease. Coded 0 otherwise.
Family history of cancer (2001, 2009)	Has a mother or sister who has ever been diagnosed with cancer? Coded 1 if yes and 0 if no.
Health Care Environment	
Number of doctor visits within past year (2003-2009)	The number of visits to the doctor within the past year. Coded as a continuous variable.
Visited a doctor within last year (2003-2009)	Coded 1 if visited a doctor within the last year, 0 otherwise.
Doctor examined breasts for lumps in the past 12 months (2003, 2005, 2009)	Coded 1 if doctor examined breast for lumps within the past year, 0 otherwise
Social Environment	
How often feel safe in neighborhood (2005-2009)	Categorized as all of the time (ref), most of the time, some of the time, and none of the time.
Urban (2001-2009)	Coded 1 if respondent lived in urban zip code and 0 if not.
Length of time lived at current address (2003-2009)	Mean length of time that the respondent has lived at the current address in months. Coded as both continuous and categorical variable (<120 months, ≥120 months).

Table 4.7 continued.

Variable (Year)	Definition
Health Behaviors	
Personal Health Practices	
Obese (2001-2009)	Calculated with respondent's self-reported height and weight. BMI of ≥ 30.0 kg/m^2 considered obese.
Overweight (2001-2009)	Calculated with respondent's self-reported height and weight. BMI of 25.0-29.9 kg/m^2 considered overweight.
Normal weight (2001-2009)	Calculated with respondent's self-reported height and weight. BMI of 18.5-25.0 kg/m^2 considered normal weight.
Underweight (2001-2009)	Calculated with respondent's self-reported height and weight. BMI of <18.5 kg/m^2 considered underweight.
Binge Drinking (2001-2009)	Coded 1 if the respondent had more than 4 drinks in a single day in the past year, 0 otherwise.
Smoking Status (2001-2009)	Categorized as never smoker (ref), current smoker, and former smoker.
Physical Activity Level (2001-2009)	
Sedentary	Coded 1 if the respondent participates in no physical activity, 0 otherwise (participates in moderate or vigorous physical activity).
Health Services Use	
Receipt of prior preventive cancer screening (2001-2009)	Coded 1 if the respondent ever received colonoscopy and/or pap smear, 0 otherwise.

Dependent Variables

The main outcome for this study is self-reported adherence to mammography screening guidelines (*screening mammography adherence*) established by the 2002 USPSTF recommendation, which recommends mammography screening every one to two years for women 40 years and older (USPSTF, 2002, 2010). As stated earlier, this screening schedule is in general agreement with the ACS and NCCN recommendations as well as established goals for the CDC (for National Health Interview Survey, National Center for Health Statistics and the Behavioral Risk Factors Surveillance System) and

Healthy People 2010 and 2020. This is also consistent with the Medicare and Medicaid coverage for screening mammograms.

Similar to other studies, the dependent variable was dichotomized into adherent (=1) and non-adherent (= 0) respondents (Rahman et al., 2003; Vyas et al., 2012). Women who reported having a mammogram in the past one to two years were considered to be adherent while women who had never had a mammogram or had their last mammogram more than two years prior were considered non-adherent. This CHIS variable, MAM_SCRN, was available for 2003-2009 CHIS Surveys and determined by combining two questions: "Have you ever had a mammogram?" and among those who answered yes, "How long ago did you have your most recent mammogram?" The same procedure was utilized for CHIS 2001 using the same questions (AD14 and AD18).

Independent Variables

PREDISPOSING VARIABLES

The Phase 4 Andersen Model was used as the theoretical framework. *Predisposing factors* represent the tendency to utilize health care services. An individual's tendency to access health care is dependent on his/her demographics, social position, and beliefs that the health services are beneficial. The demographic factors include age and gender (female: yes/no). Age was self-reported at the time of the survey. It was coded both as a continuous and categorical variable (40-49, 50-64, ≥65).

The social structure factors include education (≤ high school (referent), some college, more than college), race/ethnicity (Hispanic, Non-Hispanic White (reference), Non-Hispanic Black, American/Indian/Alaska Native, Asian/Pacific Islander, and other/mixed race), Asian subgroup (Chinese, Japanese, Korean, Filipino, Vietnamese, and other/mixed Asian), cultural factors, household size, and marital status (married:

yes/no). Household size was a continuous variable with a range of 0 to 10. Household size was a proxy variable for the level of social support and the presence of additional resources (Pourat et al., 2010). The cultural factors included nativity, years in the U.S. and English proficiency. Nativity was determined by the question, "In what country were you born?" It was dichotomized as 1 for U.S.-born and 0 for foreign-born. Years in the U.S. was determined by the question, "About how many years have you lived in the U.S?" For CHIS 2001, it was coded as AHYRUS and for CHIS 2003-2009, it was coded as YRUS. The variables were combined as years in U.S. A variable for time in U.S. was created by combining nativity and years living in U.S. It was categorized as US born (reference), foreign-born living in US for ≥10 years, and foreign-born living in US for less than 10 years. Respondents were asked how well they spoke English. English proficiency was categorized as speaks English only (referent), speaks English very well or well or speaks English not well/not at all.

The health belief factors included in this study are age at menarche and age when the first child was born. Age of menarche was a continuous variable and was confirmed by the question, "How old were you when your periods of menstrual cycles {or moon} started?" Age when the first child was born was coded as a continuous variable in CHIS 2001 and 2009, but a categorical variable in CHIS 2005. The variable was determined by the question, "How old were you when your (first) child was born. For the analyses, age when the first child was born was categorized as 10-18, 19-25, 26-35, ≥ 36.

Past research has shown that adherence with screening mammography guidelines is associated with a woman's personal characteristics including race/ethnicity, older age , being married, and socioeconomic status, measured by educational level and community economic status (Borrayo et al., 2009; Coughlin et al., 2004; Rahman et al., 2003; Meissner et al., 2007; Vyas et al., 2012). For immigrants, some sociocultural factors are particularly relevant with respect to seeking preventive care. Low mammography use has been associated with low levels of education, inability to speak English, and low level of acculturation (Ho et al., 2005; McPhee et al., 1997). Family structure (i.e., large size ≥ 4) has been shown to negatively affect use of preventive services in Hispanics (Puschel et al., 2001). Since research has shown that menstrual and reproductive factors are associated with an increased risk of breast cancer (Kelsey et al., 1993), they were included in the adapted Andersen Model for this study. The adapted Andersen Model uses components of Phase 4 as mentioned in Chapter 3.

ENABLING VARIABLES

According to Andersen (1999), *enabling factors* include resources found within the family (e.g., socioeconomic status, education, and residence) and the community (e.g., access to health care facilities), which cause an individual to utilize services because of its benefits. For this study, the enabling factors include employment status (yes/no), health insurance (yes/no), home ownership (yes/no), living above the poverty level (≤200% of the federal poverty level (FPL)) (yes/no), and a usual source of care (yes/no). For CHIS 2001, employment status was determined by the question, “Are you currently working for an employer for wages?” For CHIS 2003-2009, employment was defined as working status. Respondents were coded that they were employed if they had full-time, part-time employment or were employed but not at work. Usual source of care was determined by the respondent’s answer to “Is there a place that you usually go to when you are sick or need advice about your health?” Health insurance status (INS for

CHIS 2003-2009 and INSURE for CHIS 2001) was coded 1 if they had any health insurance and 0 if had no health insurance. Home ownership was not collected in CHIS 2001. Home ownership (AK25) was determined by the question, "Do you own or rent your home?" It was coded 1 if the respondent owns the home and 0 if the respondent rents or has other living arrangements. Poverty level was coded 1 if respondent earns at or below the 200% poverty level and 0 if it was above the 200% poverty level. Living at or below the 200% federal poverty level translates to $22,980 for a single person and $47,100 for a family of four.

NEED VARIABLES

Need is considered the most pressing and powerful predictor of using health care services. *Need-based factors* are factors that affect the necessity to access health care services, i.e., individual, social, or clinically evaluated perceptions of need. The need factors include self-reported general health status, confirmation of one or more comorbidities (i.e., asthma, diabetes, high blood pressure or heart disease), and family history of cancer. To assess general health status, respondents were asked the following question, "Would you say that in general your health is excellent, very good, good, fair or poor? The variable about comorbidities combined several questions that asked if a doctor has ever told them that they had asthma, diabetes, high blood pressure or heart disease. Chronic disease was coded if they responded yes to 1 or more of the conditions. Family history of breast cancer was categorized as yes if the respondent reported having a mother or sister or relatives diagnosed with any type of cancer. This variable was only available for CHIS 2001 and 2009.

Social and Health Care Environment

Environmental variables include the health care delivery system, the external environment, and the community. There are two types of environments affecting individual level characteristics and mammography adherence in this study: health care environment and social/physical environment. The health care environment is captured by using the following variables: number of doctor visits within the last year, doctor visit within the last year (yes/no), and doctor examined breasts for lumps in the last twelve months (yes/no). The variable for doctor examining breasts for lumps in the past 12 months was only available for CHIS 2003, 2005, and 2009. The social environment variables include neighborhood safety, length of time at the current address in months and if they live in urban zip code (yes/no). Neighborhood safety was assessed by the question, "Do you feel safe in your neighborhood – all of the time, most of the time, some of the time or none of the time?" Length of time at the current address in months was a continuous variable that ranged from 1 to 1068 months. The variable was not collected for CHIS 2001. It was re-coded as a categorical variable for the multivariate analysis (≤120 months or >120 months). Urban was coded using the Office of Management and Budget's definition of Metropolitan Statistical Areas. They were coded as urban – yes or no.

Health Behaviors

Health behavior is divided into personal health practices and health services use. The personal health practices include smoker status, physical activity (sedentary: yes/no), binge drinking (yes/no), overweight (yes/no), and obese (yes/no). Smoker status was categorized as never smoker (reference), current smoker or past smoker. Respondents were coded as sedentary if they did not participate in any activity. Respondents were overweight if the calculated body mass index (BMI) from their self-reported height and weight was between 25.0 and 29.9. Respondents were obese if the calculated body mass index from their self-reported height and weight was $\geq$ 30.0 kg/m^2. Universal BMI criteria are not suitable among diverse Asian populations, because Asians show remarkably different obesity-related characteristics (Shiwaku et al., 2004). Asians have a higher percentage of body fat than do Europeans. They also have different BMI cutoffs. For example, the suggested cutoff for Asians for overweight is ≥23.0 for overweight and ≥25.0 for obese. As a result, obese and overweight were included into one category. Respondents were binge drinkers if they had 4 or more drinks in a single day. The health services use includes prior preventive cancer screening tests (yes/no), i.e., ever had a colonoscopy/sigmoidoscopy/fecal occult blood test in the past 5 years or ever had a pap smear test to check for cervical cancer. Pap smear was not collected for CHIS 2009.

ANALYSIS PLAN

Overall Approach

Descriptive analysis was used to show percentage distribution for predisposing, enabling, need, social/health care environment, and health behavior variables by year of study and nativity status. An independent t-test was used for continuous variables while a Pearson chi-square test was be used for categorical variables to assess differences in respondent characteristics and mammography adherence among foreign-born and U.S.-born Asians. Logistic regression was used to examine mammography adherence between U.S. and foreign-born Asians, when potential confounders were included. Guided by Andersen’s Behavioral Model of Health Services Use, the logistic regressions were adjusted for predisposing, enabling, need, and social/health care environmental factors, as well as two additional variables (year of data collection and health behaviors). The selected confounding variables were entered simultaneously into the regression analysis.

Before running the logistic regression analysis, assumptions of logistic regression were checked, including the nonexistence of empty (or particularly small) cells between the dependent variable and categorical predictors. These assumptions were met. Correlation matrices were used to check whether there was multicollinearity among variables and multivariate tables were used to see if the variables varied by study year. All analyses were adjusted for the complex survey design of the California Health Interview Survey using the given raking weights. Data were weighted to account for oversampling and post-stratification adjustments. All tests were 2-sided and *p-values* < .05 were considered significant. Statistical Analysis System (SAS: SAS Institute Inc., Cary, NC) version 9.2 was used for all of the data management and analyses.

Specific Aim I

To determine if screening mammography adherence rates vary across racial/ethnic groups and nativity

REPRESENTATIVE HYPOTHESES

1. Screening mammography adherence (mammogram within 2 years) will higher among non-Hispanic whites and lowest among Asian Americans.
2. Compared to U.S.-born Asian Americans, screening mammography adherence will be lower in foreign-born Asians Americans.

SPECIFIC AIM I ANALYSIS

Overall, the prevalence of mammography adherence by race/ethnicity and nativity was calculated for each wave. The SURVEYLOGISTIC procedure with jackknife replication and raking weights were used to test the association between race/ethnicity and screening mammography adherence over time. Jackknife replication is used to estimate the bias and standard error (variance) of a statistic when a random sample of observations is used to calculate it. Two sets of logistic regressions were run – one using the total population and one using the Asian population. Four models were conducted to determine the relationship between race/ethnicity and nativity on screening mammography. The models are shown below:

Representative Models:

Model 1: $Y_{\text{Screening mammography}}$ = study year +error

Model 2: $Y_{\text{Screening mammography}}$ = year +race/ethnicity or Asian subgroup + error

Model 3: $Y_{\text{Screening mammography}}$ = Model 2 + nativity status + error

Model 4: $Y_{\text{Screening mammography}}$: = Model 3+ age+ education + health behaviors +error

Model 1 provided an estimate of the unadjusted average biannual change in screening mammography rates across the population aged 40 years and older from 2001 to 2009. Model 2 adjusted for race/ethnicity and study year. Model 3 adjusted for nativity and all variables accounted in Model 2. Model 4 adjusted for age, education and health behaviors. As variables were entered into the model, changes in the strength, direction of influence, and significance of the linear trend variable were examined to determine to what extent the trend was attenuated or enhanced

Specific Aim II

To determine the relationship between predisposing, enabling, and need factors on screening mammography adherence among Asian Americans and to determine if there are differences by nativity.

Representative Hypotheses

1. The effect of individual characteristics on mammography adherence will vary between U.S.-born and foreign-born Asian American women for:
    a. ***Predisposing***: *age, race/ethnicity, household size, marital status, U.S.-born, years living in the U.S, age at menarche, age of first birth, level of English proficiency;*
    b. ***Enabling factors***: *employment, insured, usual source of care;*
    c. ***Need factors****: general health condition and more than 1 chronic condition.*

Representative Models:

Model 1: $Y_{\text{Screening mammography}}$ = year+ error

Model 2: $Y_{\text{Screening mammography}}$ = Model 1+ *predisposing* + error

Model 3: $Y_{\text{Screening mammography}}$ = Model 2 + *enabling* + error

Model 4: $Y_{\text{Screening mammography}}$ = Model 3 + *need* + error

Model 5: $Y_{\text{Screening mammography}}$ = Model 4 + *health behaviors* + error

Specific Aim II Analysis

The SURVEYLOGISTIC procedure with jackknife replication and raking weights were used to test the association between predisposing, enabling and need factors and mammography adherence over time in U.S. and foreign-born Asians. Five models were conducted to determine the relationship between predisposing, enabling and need factors on screening mammography adherence among U.S. and foreign-born Asian Americans. Each of the categorical factors was put into the model simultaneously. Since not all of the variables were collected each survey year, three sets of logistic regressions were run –

one with CHIS 2001-2009 with complete data, one with CHIS 2001 and CHIS 2009 and one with CHIS 2005 and CHIS 2009.

Model 1 includes year of study. Model 2 includes the *predisposing variables* (i.e., time in U.S., race/ethnicity, education, household size, and English proficiency) along with the variables in Model 1. Model 3 includes the *enabling variables* (i.e., employment status, health insurance status, home ownership, living at or below 200% poverty level, and usual source of care) along with the variables in Model 2. Model 4 includes *need variables* (i.e., self-reported general health status, confirmation of one or more chronic conditions and family history of breast cancer). To test for interaction effects between nativity and Asian subgroup, additional weighted logistic regression analyses were completed stratifying the sample by nativity for each set of logistic regressions.

Specific Aim III

To determine if the effect of the health care and/or social environment on mammography adherence among Asian Americans varies by nativity.

REPRESENTATIVE HYPOTHESES

1. The effect of the environmental variables will vary between U.S-born and foreign-born Asian women.
    a. Health care environment: Mammography will be higher for women who have seen her doctor within the last year and had her breasts examined for lumps.
    b. Social environment: Mammography will be higher for women who have lived at her address for more than 120 months and feel safe in her neighborhood.

Representative Models:

Model 1: $Y_{\text{Screening mammography}}$: = year+ + error

Model 1: $Y_{\text{Screening mammography}}$: = year+ health care environment + error

Model 2: $Y_{\text{Screening mammography}}$: = Model 1+ social environment + error

Model 3: $Y_{\text{Screening mammography}}$: = Model 2 + age + Asian subgroup+ error

SPECIFIC AIM III ANALYSIS

The SURVEYLOGISTIC procedure with jackknife replication was used to test the association between social/health care environment and mammography adherence over time in U.S. and foreign-born Asians. Four models were conducted to determine the relationship between the social and health care environment on mammography adherence among U.S. and foreign-born Asian Americans.

Model 1 includes year of study. Model 2 includes the health care environment factors (i.e., number of doctor visits within past year, visited doctor during past 12 months, and doctor examined breasts for lumps past 12 months) along with study year. Model 3 includes the social environment factors (i.e., feel safe in the neighborhood, urban zip code, length of time lived at current address in months) along with the variables in Model 2. Model 4 includes age and Asian subgroup along with the variables in Model 2.). To test for interaction effects between nativity and Asian subgroup, additional weighted logistic regression analyses were completed stratifying the sample by nativity for each set of logistic regressions.

Chapter 5: Specific Aim I Results

Chapters 5 through 7 detail the results of analyses used to address Specific Aims I, II, and III. The purpose of Specific Aim I was to determine if screening mammography adherence rates vary across racial/ethnic groups and nativity. ***Screening mammography adherence*** was defined as the self-reported receipt of screening mammography in the past two years for women aged 40 years and older. The first hypothesis (IA) was that screening mammography adherence would be higher among non-Hispanic whites and lower among Asian Americans. The second hypothesis (IB) was that screening mammography adherence would be lower in foreign-born Asians than U.S-born Asians. The results are presented in several sections. First, the descriptive statistics are presented for the total population and the Asian population. Next, population estimates of receiving a mammogram within the last two years are presented by study year. Last, multivariate logistic regression analyses are presented to determine whether including age, race/ethnicity, nativity, education, and health behavior variables attenuate screening mammography adherence.

DESCRIPTIVE STATISTICS

Total Population

Table 5.1a shows the sample size for the total population by race/ethnicity and nativity. The CHIS sample is representative of California's non-institutionalized population living in households. The total sample included 99,619 women aged 40 to 85 years old. For sample size for each survey wave, refer to Table A.1 in the Appendix. The overall prevalence of screening mammography adherence was 78.4%. Non-Hispanic

Whites made up the largest proportion of the sample followed (n = 69,421; 69.7%) by Hispanics (n = 13,625; 13.7%) and AAPI (n = 8,353; 8.4%). U.S.-born females made up 80% of the total sample. In all racial/ethnic groups except Hispanics and AAPI, more women were born in the U.S. than outside the U.S. The opposite is true for Hispanics and AAPI. More than half of the Hispanic women (54.4%) were born outside the U.S. and 80.2% of AAPI women were foreign-born. Table 5.1b shows the screening mammography adherence rates by nativity. Screening mammography adherence varied by nativity with rates lower among foreign-born than U.S.-born (73.9% versus 79.5%).

Table 5.1a. Sample size by race/ethnicity and nativity in the California Health Interview Survey, 2001-2009 (n = 99,619).

	Total Population		***U.S.-Born***		***Foreign-Born***	
	n	*%*	*n*	*%*	*n*	*%*
Sample Size	99,619	100.0%	79,668	80.0%	19,951	20.0%
Race/Ethnicity						
Hispanic	13,625	13.7%	6,210	7.8%	7,415	37.2%
Non-Hispanic White	69,421	69.7%	63,886	80.2%	5,535	27.7%
Non-Hispanic Black	4,880	4.9%	4,645	5.8%	235	1.2%
Asian/Pacific Islander	8,353	8.4%	1,652	2.1%	6,701	33.6%
Other single/multiple race	3,340	3.4%	3,275	4.1%	65	0.3%

Note: Asian/Pacific Islander includes Asians, Pacific Islanders, and mixed Asians. Other race includes other single races and multiple races.

Table 5.1b. Screening mammography adherence by nativity in the California Health Interview Survey, 2001-2009 (n = 99,619).

	Total Population		***U.S.-Born***		***Foreign-Born***	
	n	*%*	*n*	*%*	*n*	*%*
Outcomes						
Mammogram within 2 years	78,057	78.4%	63,306	79.5%	14,751	73.9%

SAMPLE CHARACTERISTICS FOR THE TOTAL POPULATION

Table 5.2 presents the weighted descriptive characteristics of the total population by nativity. For changes in the population characteristics by survey year, refer to Table A.2 in the Appendix. Results were obtained separately using CHIS 2001-2009 data files.

The standard errors accounted for the complex sample design by using the replicate weights. The average age of the sample was 59.7 ± 13.0 years with U.S-born females older than foreign-born females. The mean age of U.S.-born respondents was 60.5 ± 13.0 years and the mean age of foreign-born respondents was 56.4 ± 12.4 years.

After applying the replicate weights, the screening mammography adherence rate for the total population was 77.3%. The sample characteristics varied by nativity with screening mammography rates higher among U.S.-born respondents than foreign-born respondents (78.8% versus 73.8%). Eighty-nine percent of the foreign-born population had lived in the U.S. for more than 10 years. More than half (57.6%) of the total population had either some college or more than a 4-year degree. More than half of the foreign-born females (57.3%) had less than a high school education. More than half of the study population (52.6%) was overweight or obese (BMI ≥ 25.0). Although U.S.-born respondents had higher screening mammography adherence, they also had higher prevalence of bad health behaviors. For example, U.S.-born respondents had a higher percentage of being overweight or obese (53.3% versus 50.8%) or binge drinkers (11.5% versus 5.7%). U.S.-born respondents had double the percent of former and current smokers compared to foreign-born respondents. Foreign-born respondents had a higher percentage of being sedentary (39.6% versus 31.3%) and received cancer prevention services less often than U.S.-born respondents (43.1% versus 60.9%).

Table 5.2. Weighted trends in descriptive characteristics in Californian women aged ≥ 40 years by nativity, California Health Interview Survey (2001-2009) (n = 99,619).

Year	**Total (n = 99, 619)**				**U.S. Born (n = 79,668)**				**Foreign Born (n= 19,951)**			
	N	Weighted n	%	SE	n	Weighted n	%	SE	n	Weighted n	%	SE
Outcomes												
Mammogram within 2 years	77,959	28,959,042	77.3	0.3	63,208	20,605,489	78.8	0.3	14,751	8,353,553	73.8	0.5
Demographics												
Race/ethnicity			.									
Hispanic	13,625	8,351,322	22.3	0.2	6,210	3,120,035	11.9	0.2	7,415	5,231,287	46.2	0.5
Non-Hispanic White	69,421	21,085,768	56.3	0.2	63,886	19,166,156	73.3	0.2	5,535	1,919,612	17.0	0.3
Non-Hispanic Black	4,880	2,403,908	6.4	0.1	4,645	2,262,675	8.7	0.1	235	141,233	1.2	0.2
Asian/Pacific Islander	8,353	4,844,422	12.7	0.2	1,652	850,556	3.3	0.1	6,701	3,993,866	35.3	0.4
Other Race	3,340	777,185	1.6	0.0	3,275	744,336	2.8	0.1	65	32,849	0.3	0.1
Time in US												
U.S. Born	79,668	26,143,758	69.8	0.2	79,668	26,143,758	100.0	0.0	-	-	-	-
Foreign-born living in U.S. for ≥ 10 years	18,131	10,123,340	27.0	0.2	-			-	18,131	10,123,340	89.4	0.3
Foreign-born living in U.S. for < 10 years	1,820	1,195,506	3.2	0.1	-			-	1,820	1,195,506	10.6	0.3
Age												
40-49	26,995	13,283,912	35.5	0.1	19,602	8,482,127	32.4	0.2	7,393	4,801,785	42.4	0.5
50-64	38,029	14,172,835	37.8	0.1	30,779	10,085,064	38.6	0.2	7,250	4,087,771	56.1	0.5
≥65	34,595	10,005,859	26.7	0.1	29,287	7,576,568	29.0	0.1	5,308	2,429,291	21.5	0.3
Education												
≤ H.S. Diploma	34,223	15,892,523	42.4	0.2	24,687	9,403,913	36.0	0.2	9,536	6,488,610	57.3	0.5
Some college	30,371	9,882,930	26.4	0.2	26,296	8,107,068	31.0	0.2	4,075	1,775,862	15.7	0.4
≥ College (4 yr. degree)	35,025	1,687,151	31.2	0.2	26,685	8,632,778	33.0	0.2	6,340	3,054,373	27.0	0.4

Table 5.2 continued.

Year	Total (n = 99, 619)				U.S. Born (n = 79,668)				Foreign Born (n= 19,951)			
	N	Weighted n	%	SE	n	Weighted n	%	SE	n	Weighted n	%	SE
Health Behaviors												
Underweight (BMI <18.5)	2,558	891,608	2.4	0.1	1,914	578,410	2.2	0.1	644	313,198	2.8	0.2
Normal (18.5≤ BMI <25.0)	45,550	16,606,330	44.3	0.2	35,809	11,502,183	44.0	0.3	9,741	5,104,147	45.1	0.5
Overweight or Obese (BMI ≥ 25.0)	50,849	19,686,936	52.6	0.2	41,562	13,931,714	53.3	0.3	9,287	5,755,222	50.8	0.5
Missing BMI	662	268,730	0.7	0.0	383	122,451	0.5	0.0	279	146,279	1.3	0.1
Binge drinking	9,825	3,651,759	9.8	0.2	8,526	3,003,447	11.5	0.2	1,299	648,312	5.7	0.2
Former smoker	30,198	9,721,698	26.0	0.2	26,679	8,126,525	31.1	0.2	3,519	1,595,173	14.1	0.4
Current smoker	12,248	3,665,674	11.5	0.2	10,816	3,593,355	13.7	0.2	1,432	72,319	6.4	0.3
Sedentary	26,167	10,278,728	33.9	0.3	19,910	6,609,931	31.3	0.2	6,257	3,668,797	39.6	0.6
Prior cancer prevention health service use	61,826	20,781,492	55.5	0.2	52,330	15,909,105	60.9	0.2	9,496	4,872,387	43.1	0.6

Note: Prior cancer prevention health service use includes a colonoscopy or a pap smear. SE, standard error.

Asian Population

Table 5.3a shows the sample size by Asian subgroup and nativity. Sample size for the Asian population for each survey wave is included in Table A.1 in the Appendix. The AAPI sample included 8,353 women between the ages of 40 and 85 years old. Foreign-born Asians made up 80.2% of the sample. The overall prevalence of screening mammography was 72.3%. In all of the Asian subgroups except Japanese, more Asians were born outside the U.S. than in the U.S. Table 5.3b shows the screening mammography adherence rates by nativity. Screening mammography was higher among U.S.-born Asians than foreign-born (81.2% versus 77.8%).

Table 5.3a. Sample size by study year, Asian subgroup, and nativity in the California Health Interview Survey, 2001-2009 (n = 8,353).

	Asian Population		***U.S.-Born***		***Foreign-Born***	
	n	*%*	*n*	*%*	*n*	*%*
Sample Size	8,353	100.0%	1,652	19.8%	6,701	80.2%
Asian Subgroups						
Chinese	2,325	27.8%	418	25.3%	1,907	28.5%
Japanese	1,038	12.4%	722	43.7%	316	4.7%
Korean	1,488	17.8%	43	2.6%	1,445	21.6%
Filipino	1,279	15.3%	155	9.4%	1,124	16.8%
Vietnamese	1,165	13.9%	1	0.1%	1,164	17.4%
Other Asian	1,058	12.7%	313	18.9%	745	11.1%

Note: Other Asian race includes other single Asian races and multiple race Asians.

Table 5.3b. Screening mammography adherence by nativity in the California Health Interview Survey, 2001-2009 (n = 8,353).

	Asian Population		***U.S.-Born***		***Foreign-Born***	
	n	*%*	*n*	*%*	*n*	*%*
Outcomes						
Mammogram within 2 years	6,039	72.3%	1,341	81.2%	4,698	77.8%

SAMPLE CHARACTERISTICS FOR THE ASIAN POPULATION

The weighted descriptive characteristics for the Asian population by nativity are presented in Table 5.4. The average age of the Asian sample was 56.4 ± 12.1 years. Similar to the patterns seen in the total population, U.S-born Asians were older than foreign-born Asians and had higher rates of screening mammography. The mean age of U.S.-born respondents was 58.1 ± 13.4 years and the mean age of foreign-born respondents was 56.0 ± 11.8 years. The screening mammography rate for U.S.-born Asians was 81.2% and 71.8% for foreign-born Asians. More than 82.4% of the Asian females were foreign-born with 85.4% living in the U.S. for more than 10 years. The Asian sample was highly educated, with 44.6% having a 4-yearr college education or higher. Education varied by nativity. More foreign-born Asians had a 4-year college education or higher compared to U.S.-born Asians (45.1% versus 42.6%).

Overall, Asian Americans were healthy. About two-thirds of the Asian females were of normal weight with a BMI between 18.5 and 25.0 (64.5%) and less than a third were overweight or obese (30.5%). Despite the fact that a small percentage of Asian Americans were binge drinkers (3.9%) or current smokers (4.6%), 37.8% did not participate in physical activity. In addition, less than half (46.5%) had ever received cancer preventive services. The health behaviors varied by nativity. U.S.-born Asians had a higher percentage of being overweight or obese, binge drinkers, and former or current smokers compared to foreign-born Asians. U.S.-born Asians also had a higher rate of receiving cancer preventive services (58.9% versus 43.9%).

Table 5.4. Weighted trends in descriptive characteristics in Asian women aged ≥ 40 years by nativity, California Health Interview Survey (2001-2009) (n = 8,353).

Variables	Total (n = 8,353)				U.S. Born (n = 1,652)				Foreign Born (n= 6,701)			
	n	Weighted n	%	SE	n	Weighted n	%	SE	n	Weighted n	%	SE
Outcomes												
Mammogram within 2 years	6,039	3,559,216	73.5	0.7	1,341	690,853	81.2	1.4	4,698	2,868,363	71.8	0.8
Demographics												
Asian Subgroup												
Chinese	2,325	1,388,905	28.7	0.7	418	170,531	20.0	1.1	1,907	1,218,374	30.5	0.8
Japanese	1,038	561,768	11.6	0.4	722	390,253	45.9	1.8	316	171,515	4.3	0.3
Korean	1,488	473,474	9.8	0.4	43	12,562	1.5	0.3	1,445	460,911	11.5	0.4
Filipino	1,279	1,314,183	27.1	0.7	155	116,231	13.7	1.4	1,124	1,197,952	30.0	0.8
Vietnamese	1,165	484,913	10.0	0.5	1	36	0.0	0.0	1,164	484,877	12.1	0.6
Other Race	1,058	621,178	12.8	0.5	313	160,942	18.9	1.4	745	460,236	11.5	0.5
Time in US												
U.S. Born	1,652	850,556	17.6	0.5	1,652	850,556	100.0	0.0	-	-	-	-
Foreign-born living in U.S. for ≥ 10 years	5,785	3,410,559	70.4	0.6	-	-	-	-	5,785	3,410,559	85.4	0.7
Foreign-born living in U.S. for < 10 years	916	583,306	12.0	0.6	-	-	-	-	916	583,306	14.6	0.7
Age												
40-49	3,007	1,825,950	37.7	0.7	555	323,003	38.0	1.7	2,452	1,502,947	37.6	0.7
50-64	3,175	1,787,125	36.9	0.6	593	250,398	29.4	1.7	2,582	1,536,727	38.5	0.7
≥65	2,171	1,231,347	25.4	0.3	504	277,155	32.6	1.7	1,667	954,192	23.9	0.5
Education												
≤ H.S. Diploma	2,913	1,810,010	37.4	0.8	359	250,544	29.5	1.7	2,554	1,559,466	39.0	0.9
Some college	1,623	872,730	18.0	0.7	491	237,898	28.0	1.5	1,132	634,832	15.9	0.7
≥ College (4 yr. degree)	3,817	2,161,682	44.6	0.8	802	362,114	42.6	1.8	3,015	1,799,568	45.1	0.9

Table 5.4 continued.

Variables	Total (n = 8,353)				U.S. Born (n = 1,652)				Foreign Born (n= 6,701)			
	n	Weighted n	%	SE	n	Weighted n	%	SE	n	Weighted n	%	SE
Health Behaviors												
Underweight (BMI <18.5)	426	220,376	4.5	0.3	54	27,239	3.2	0.6	372	193,137	4.8	0.4
Normal (18.5≤ BMI <25.0)	5,545	3,125,748	64.5	0.9	976	493,364	58.0	1.7	4,569	2,632,384	65.9	1.0
Overweight or Obese (BMI ≥ 25.0)	2,334	1,478,703	30.5	0.8	615	327,042	38.5	1.7	1,719	1,151,661	28.8	0.9
Missing BMI	48	19,594	0.4	0.1	7	2,910	0.3	0.2	41	16,684	0.4	0.1
Binge drinking	366	187,585	3.9	0.3	105	50,220	5.9	0.8	261	137,365	3.4	0.3
Former smoker	813	416,549	8.6	0.4	361	156,384	18.4	1.1	452	260,165	6.5	0.5
Current smoker	395	224,032	4.6	0.3	151	85,974	10.1	1.1	244	138,058	3.5	0.4
Sedentary	2,559	1,489,800	37.8	1.0	389	212,841	31.0	1.8	2,170	1,276,959	39.2	1.1
Prior cancer prevention health service use	3,954	2,252,752	46.5	0.8	995	501,120	58.9	1.7	2,959	1,751,632	43.9	0.9

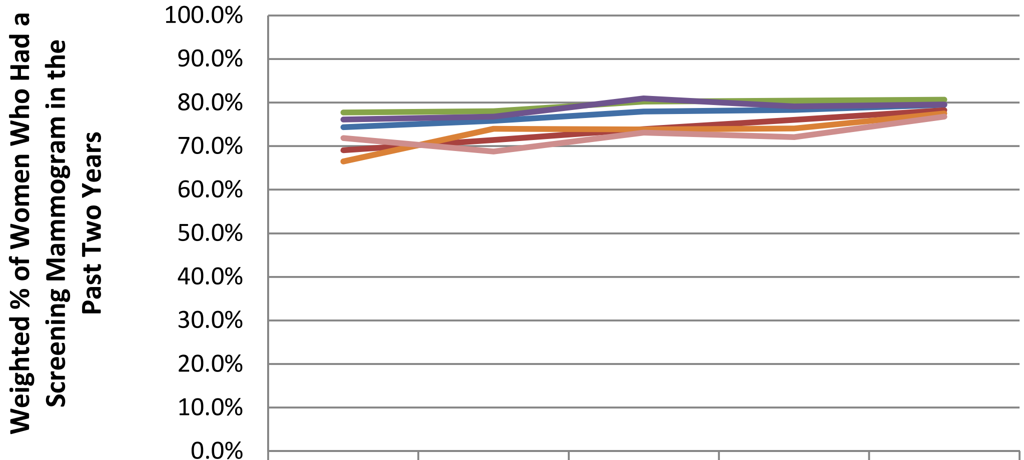
Note: Prior cancer prevention health service use includes previous receipt of a colonoscopy or a pap smear. SE, standard error.

SPECIFIC AIM I RESULTS

Population Estimates of Receiving a Screening Mammogram in the Past Two Years

TOTAL POPULATION

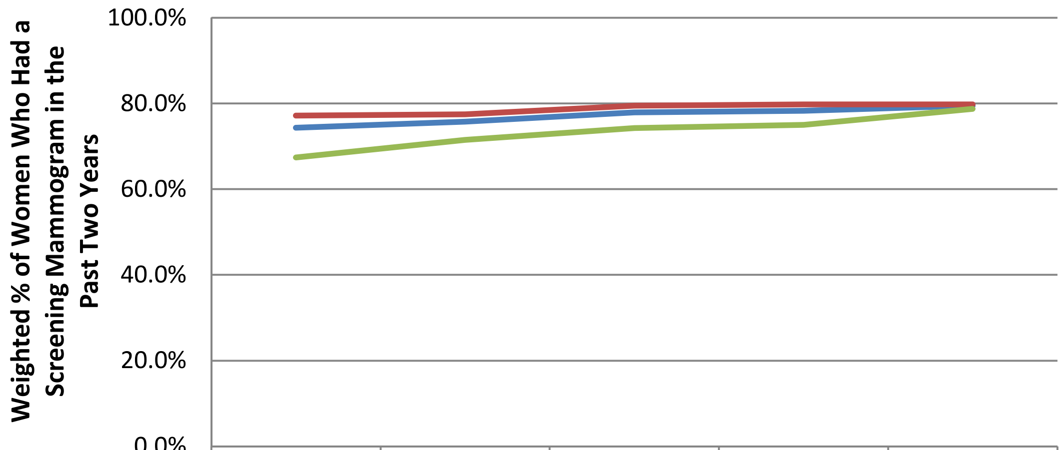
From 2001 to 2009, the percentage of California women receiving a mammogram in the past two years (*screening mammography adherence*) increased. This trend varied over time, race/ethnicity, and nativity. Figure 5.1 shows the weighted percentage of California women aged 40 years and older who reported having screening mammography in the past two years by race/ethnicity and study year. Overall, the screening mammography adherence rate increased from 74.3% in 2001 to 79.5% in 2009. This exceeds the HP2010 target of 70%. For all racial/ethnic groups, the largest gain occurred between 2001 and 2005. Between 2001 and 2009, the rates of screening mammography among different racial/ethnic groups grew closer. Asian/Pacific Islander women had the greatest gain (+11.2%) and non-Hispanic White women had the smallest gain (+2.9%) in screening mammography adherence. Non-Hispanic White women had the highest percentage of screening mammography adherence for all survey years except 2005. In 2005, non-Hispanic Black women had the highest prevalence of screening mammography adherence. Screening mammography adherence was lowest among Asian/Pacific Islander and other women.



	2001	2003	2005	2007	2009
Total Population	74.3%	75.8%	77.9%	78.3%	79.5%
Hispanic	69.1%	71.4%	73.9%	76.1%	78.2%
Non-Hispanic White	77.7%	78.0%	80.2%	80.4%	80.6%
Non-Hispanic Black	76.1%	76.8%	81.0%	79.1%	79.6%
Asian/Pacific Islander	66.5%	74.0%	73.8%	74.0%	77.5%
Other Race/Multiple Race	71.9%	68.8%	73.1%	72.1%	76.7%

Figure 5.1. Weighted percentage of women aged ≥ 40 years who had screening mammography in the past two years by race/ethnicity and study year, California Health Interview Survey (2001-2009) (n = 99,619).

Figure 5.2 shows the weighted percentage of women aged over 40 years old who had screening mammography in the past two years by nativity and study year. For all study years, the rate of screening mammography was higher among U.S.-born women than foreign-born women. In U.S.-born women, screening mammography adherence increased from 77.2% in 2001 to 79.8% in 2009. In foreign-born women, screening mammography adherence increased from 67.4% to 78.8%. The largest gain in screening mammography adherence occurred between 2001 and 2005 in both U.S.-born and foreign-born women. Between 2001 and 2009, the percentage of U.S.-born women and foreign-born women having screening mammography in the past two years converged. In 2001, 74.3% of U.S.-born women had screening mammography compared to 67.4% of foreign-born women. In 2009, the rates were closer in proximity. About 80% of U.S.-born women had screening mammography in the past two years while the screening mammography adherence rate was 78.8% for foreign-born women. Since there were population changes in nativity between 2001 and 2009, they may have attributed to the rates becoming closer (Table A.1). The percentage of foreign-born women who lived in the U.S. for more than 10 years increased during this time period (25.4% in 2001 versus 29.4% in 2009) and acculturated individuals are more likely to be mammography adherent.



	2001	2003	2005	2007	2009
Total Population	74.3%	75.8%	77.9%	78.3%	79.5%
U.S. Born	77.2%	77.5%	79.5%	79.8%	79.8%
Foreign-born	67.4%	71.5%	74.3%	75.0%	78.8%

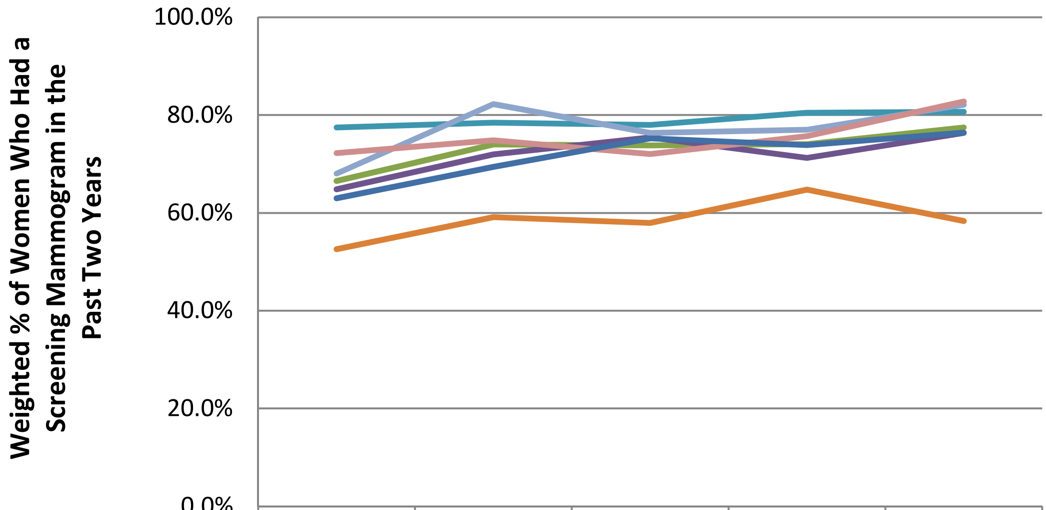
Figure 5.2. Weighted percentage of women aged ≥ 40 years who had screening mammography in the past two years by nativity and study year, California Health Interview Survey (2001-2009) (n = 99,619).

ASIAN POPULATION

From 2001 to 2009, the percentage of Asian women in California receiving screening mammography in the past two years increased. This trend varied over time, race/ethnicity, and nativity. Figure 5.3 shows the weighted percentage of Asian women aged 40 years and older who had screening mammography in the past two years. Regardless of Asian subgroup, screening mammography adherence increased in all Asian subgroups over time. Screening mammography adherence increased by 11 percentage points from 66.5% in 2001 to 77.5% in 2009. Between 2001 and 2009, Korean women had the largest gain in screening mammography adherence (+13.2%) and Japanese women had the smallest gain (+2.6%). Japanese women had the highest rate of screening mammography adherence in 2001 (77.6%) while Vietnamese women had the highest rate in 2009 (82.8%). Of all Asian subgroups, Filipino women had the lowest rate of screening mammography adherence. Screening mammography adherence spiked for Japanese, Filipino, Korean, and Vietnamese in 2003 and subsequently dropped in 2005. The increased rate may be the result of the 2002 USPSTF recommendation and targeted interventions. For Chinese and other Asian women, screening mammography adherence spiked in 2005 and decreased in 2007.

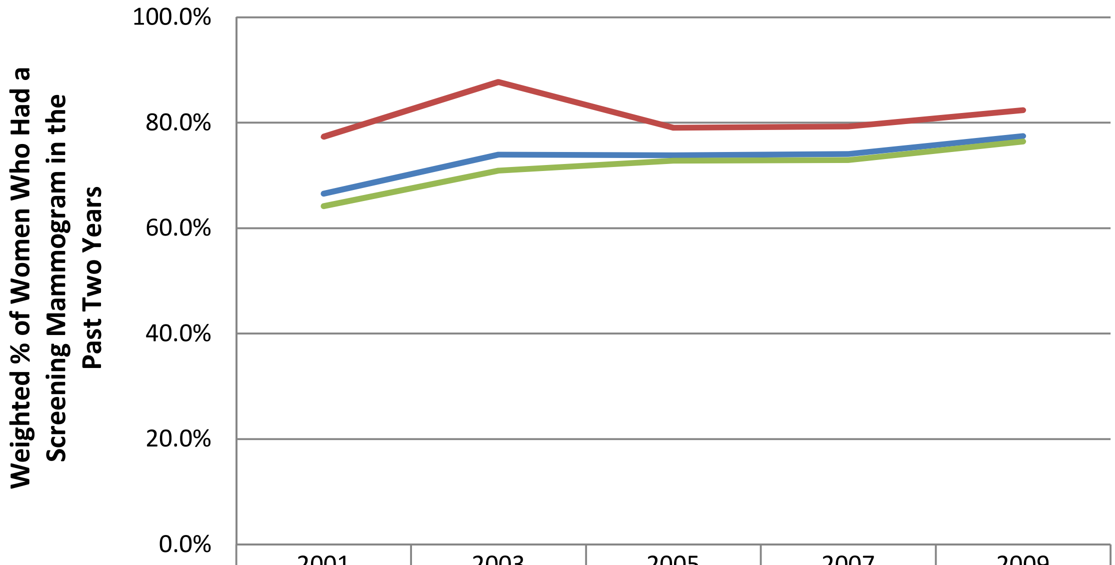
Figure 5.4 shows the weighted percentage of Asian women over 40 years old who had screening mammography in the past two years by nativity and study year. Screening mammography adherence was higher among U.S.-born Asians than foreign-born Asians. Over time, the screening mammography adherence rates came closer in proximity. In 2003, there was a spike in screening mammography adherence in both U.S. and foreign-born Asian women. As stated earlier, the rate increase may be a result of the 2002

USPSTF screening recommendation and targeted interventions. In 2005, the rate decreased for U.S born women, but increased for foreign-born women. The rate decrease may be a result of the population change in the sample in 2005 (Table A.2). Compared to 2001, the U.S.-born population dropped from 71.0% to 69.7% and the Asian population increased from 12.3% to 13.4% in 2005. In 2007, the rate decreased for foreign-born women, but increased for U.S.-born women.



	2001	2003	2005	2007	2009
Total Asian	66.5%	74.0%	73.8%	74.0%	77.5%
Chinese	64.8%	72.0%	75.4%	71.3%	76.4%
Japanese	77.4%	78.5%	78.0%	80.5%	80.6%
Filipino	52.5%	59.1%	58.0%	64.7%	58.3%
Korean	68.0%	82.2%	76.4%	77.0%	82.1%
Vietnamese	72.2%	74.8%	72.0%	75.7%	82.8%
Other Asian/Multiple Race	63.0%	69.4%	75.2%	73.8%	76.4%

Figure 5.3. Weighted percentage of Asian women aged ≥ 40 years who had screening mammography in the past two years by Asian subgroup and study year, California Health Interview Survey (2001-2009) (n = 8,353).



	2001	2003	2005	2007	2009
Total Asian Population	66.5%	74.0%	73.8%	74.0%	77.5%
U.S.-Born	77.3%	87.7%	79.0%	79.3%	82.4%
Foreign-born	64.2%	70.9%	72.8%	72.9%	76.4%

Figure 5.4. Weighted percentage of Asian women aged ≥ 40 years who had screening mammogram in the past two years by nativity and study year, California Health Interview Survey (2001-2009) (n = 8, 353)

Correlations and Multivariate Associations

Correlations between screening mammography adherence, demographic variables (i.e., race/ethnicity, age, education) and nativity for the total population are shown in Table 5.5. Race/ethnicity was negatively associated with screening mammography except for American Indians/Alaska Natives and AAPI. Nativity was negatively associated with screening mammography in the total population. Age and education were positively associated with screening mammography in the total population.

Table 5.5. Correlations between screening mammography adherence and race/ethnicity in a sample California women aged 40 years and older from the California Health Interview Survey (2001-2009) (n = 99,619).

	1	2	3	4	5	6	7	8	9
1-Study Year	1.00								
2-Hispanic	**-0.02**	1.00							
3-Non-Hispanic Black	**-0.01**	**-0.09**	1.00						
4-AI/AN	0.00	**-0.04**	**-0.02**	1.00					
5-AAPI	**0.02**	**-0.12**	**-0.07**	**-0.03**	1.00				
6-Other	**-0.03**	**-0.07**	**-0.04**	**-0.02**	**-0.05**	1.00			
7-U.S.-born	**-0.01**	**-0.03**	**0.09**	**0.04**	**-0.46**	**0.06**	1.00		
8-Age categories	**0.12**	**-0.15**	**-0.02**	-0.01	**-0.06**	**-0.01**	**0.12**	1.00	
9-Education	**0.08**	**-0.23**	**-0.02**	**-0.03**	**0.03**	**-0.02**	**0.10**	**-0.13**	1.00

Note: Bolded numbers indicate statistical significance at p-value <0.05. AI/AN, American Indian or Alaska Native. AAPI, Asian American/Pacific Islander.

Table 5.6. Correlations between screening mammography adherence and Asian subgroup and nativity in a sample California women aged 40 years and older, California Health Interview Survey (2001-2009) (n = 8,353).

	1	2	3	4	5	6	7	7	9
1-Study Year	1.00								
2-Chinese	**-0.04**	1.00							
3-Korean	**0.06**	**-0.29**	1.00						
4-Filipino	**-0.06**	**-0.26**	**-0.20**	1.00					
5-Vietnamese	**0.07**	**-0.25**	**-0.19**	**-0.17**	1.00				
6-Other Asian	**-0.03**	**-0.24**	**-0.18**	**-0.16**	**-0.15**	1.00			
7-U.S.-born	**-0.03**	**-0.03**	**0.20**	**0.08**	**-0.20**	**0.09**	1.00		
8-Age categories	**0.08**	-0.02	**0.03**	-0.01	-0.01	**-0.09**	**0.04**	1.00	
9-Education	**0.07**	**0.02**	**-0.04**	**0.17**	**-0.28**	**0.07**	**0.09**	**-0.22**	1.00

Note: Bolded numbers indicate statistical significance at p-value <0.05.

Correlations between screening mammography adherence, demographic variables (i.e., race/ethnicity, age, education) and nativity for the Asian population are shown in Table 5.6. Compared to Japanese, being Korean or Vietnamese was positively associated with screening mammography. However, being Chinese, Filipino and other Asian were negatively associated with being screening mammography adherent. Similar to the pattern seen in the total population, nativity was negatively associated with being screening mammography adherent while age and education was positively associated.

Table 5.7. Multivariate associations between sample characteristics and screening mammography adherence among California female respondents aged 40 years and older by survey year, California Health Interview Survey (2001- 2009) (n = 99,619).

Study Year	**2001** n = 20,566		**2003** n = 15,788		**2005** n = 17,527		**2007** n = 24,060		**2009** n = 21,910	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Race/Ethnicity										
Non-Hispanic White	1.00		1.00		1.00		1.00		1.00	
Hispanic	0.99	0.85-1.14	1.04	0.90-1.20	0.93	0.80-1.09	0.98	0.80-1.20	1.12	0.87-1.45
Non-Hispanic Black	1.05	0.87-1.27	1.04	0.83-1.31	1.18	0.93-1.50	1.02	0.79-1.30	0.95	0.62-1.45
Asian/Pacific Islander	**0.75**	0.63-0.91	1.07	0.89-1.27	**0.79**	0.64-0.97	0.87	0.69-1.10	0.81	0.60-1.08
Other	**0.79**	0.63-0.99	0.76	0.56-1.02	0.78	0.55-1.09	**0.74**	0.58-0.95	0.81	0.58-1.13
Nativity										
U.S. Born	1.00		1.00		1.00		1.00		1.00	
Foreign-Born	0.88	0.76-1.01	0.87	0.75-1.01	0.78	0.90-1.17	0.96	0.81-1.15	1.10	0.89-1.36
Age										
40-49	1.00		1.00		1.00		1.00		1.00	
50-64	**1.73**	1.55-1.93	**1.58**	1.39-1.80	**1.59**	1.36-1.85	**1.38**	1.19-1.59	**1.28**	1.09-1.50
≥65	1.08	0.96-1.23	1.08	0.91-1.29	0.99	0.85-1.17	**0.71**	0.60-0.84	**0.69**	0.57-0.83
Education										
Less than high school	**0.74**	0.67-0.83	**0.79**	0.67-0.93	**0.78**	0.68-0.91	**0.76**	0.66-0.87	**0.51**	0.47-0.71
Some college	**0.86**	0.76-0.98	0.93	0.80-1.07	**0.84**	0.73-0.97	**0.85**	0.75-0.95	**0.56**	0.47-0.68
>4-year college	1.00		1.00		1.00		1.00		1.00	
Body Mass Index (BMI)										
Underweight (BMI <18.5)	**0.65**	0.48-0.89	**0.65**	0.47-0.90	0.83	0.61-1.13	**0.52**	0.38-0.70	**0.51**	0.36-0.73
Normal (18.5≤ BMI <25.0)	1.00		1.00		1.00		1.00		1.00	

Table 5.7 continued.

Study Year	**2001** n = 20,566		**2003** n = 15,788		**2005** n = 17,527		**2007** n = 24,060		**2009** n = 21,910	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Overweight or Obese (BMI ≥ 25.0)	**1.13**	1.02-1.25	0.99	0.88-1.10	1.09	0.96-1.23	**1.13**	1.01-1.28	1.15	1.00-1.33
Missing BMI	0.82	0.64-1.04	-	-	-	-	-	-	-	-
Sedentary	**0.79**	0.70-0.89	-	-	**0.76**	0.66-0.88	**0.72**	0.62-0.84	0.85	0.73-1.00
Binge Drinking	0.96	0.80-1.16	1.05	0.83-1.31	1.08	0.88-1.13	1.11	0.95-1.30	0.82	0.64-1.05
Smoking Status										
Never smoke	1.00		1.00		1.00		1.00		1.00	
Past smoker	1.02	0.92-1.13	1.11	0.99-1.24	0.97	0.86-1.10	1.11	0.97-1.26	1.02	0.86-1.22
Current smoker	**0.58**	0.51-0.66	**0.62**	0.54-0.72	**0.61**	0.53-0.70	**0.54**	0.46-0.63	**0.73**	0.58-0.93
Unknown	0.50	0.20-1.24	-	-	-	-				
Prior cancer preventive services	**2.86**	2.53-3.23	**2.79**	2.49-3.13	**2.95**	2.60-3.35	**3.34**	2.94-3.80	**3.79**	3.23-4.44

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. CHIS 2003 did not collect information on the sedentary variable. AOR, adjusted odds ratio. CI, confidence intervals. Bolded and shaded numbers indicate statistical significance at p>0.05.

Table 5.8. Multivariate associations between sample characteristics and screening mammography adherence among Asian female respondents aged 40 years and older by survey year, California Health Interview Survey (2001- 2009) (n = 8,353).

Study Year	**2001** n = 1,566		**2003** n = 1,341		**2005** n = 1,510		**2007** n = 1,859		**2009** n = 2,077	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Asian Subgroup										
Chinese	0.81	0.44-1.50	1.49	0.81-2.74	1.31	0.69-2.50	0.70	0.41-1.20	1.16	0.56-2.38
Japanese	1.00		1.00		1.00		1.00		1.00	
Korean	**0.46**	0.23-0.91	1.26	0.56-2.81	0.69	0.36-1.32	0.55	0.29-1.05	0.54	0.25-1.19
Filipino	0.83	0.44-1.56	**3.42**	1.70-6.85	0.99	0.49-1.97	0.70	0.41-1.20	1.33	0.61-2.87
Vietnamese	1.27	0.68-2.37	**2.44**	1.09-5.47	1.29	0.58-2.88	0.88	0.41-1.86	2.06	0.66-6.45
Other Asian	0.62	0.33-1.18	1.47	0.77-2.82	1.13	0.51-2.54	0.60	0.31-1.15	0.91	0.46-1.83
Nativity										
U.S. Born	1.00		1.00		1.00		1.00		1.00	
Foreign-Born	0.66	0.40-1.10	**0.30**	0.18-0.52	0.85	0.50-1.45	0.98	0.63-1.52	0.73	0.39-1.38
Age										
40-49	1.00		1.00		1.00		1.00		1.00	
50-64	**1.42**	1.01-2.01	**1.75**	1.17-2.63	**1.79**	1.23-2.61	0.99	0.67-1.47	0.82	0.49-1.37
≥65	0.78	0.05-1.21	1.34	0.83-2.16	0.92	0.57-1.50	**0.49**	0.29-0.81	0.66	0.35-1.22
Education										
Less than high school	0.86	0.62-1.19	0.88	0.61-1.28	**0.59**	0.39-0.87	0.83	0.57-1.21	**0.45**	0.24-0.84
Some college	0.93	0.63-1.37	0.95	0.54-1.69	0.84	0.57-1.24	0.86	0.56-1.32	0.73	0.40-1.33
>4-year college	1.00		1.00		1.00		1.00		1.00	

Table 5.8 continued.

Study Year	2001 n = 1,566		2003 n = 1,341		2005 n = 1,510		2007 n = 1,859		2009 n = 2,077	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Body Mass Index (BMI)										
Underweight (BMI <18.5)	0.55	0.23-1.30	0.68	0.24-1.81	0.72	0.40-1.31	0.64	0.37-1.08	0.67	0.29-1.53
Normal (18.5≤ BMI <25.0)	1.00		1.00		1.00		1.00		1.00	
Overweight or Obese(≥ 25.0)	1.05	0.72-1.52	0.96	0.64-1.69	1.16	0.76-1.77	**1.63**	1.11-2.40	**1.66**	1.03-2.68
Missing BMI	0.72	0.25-2.11	-	-	-	-	-	-	-	-
Sedentary	**0.72**	0.54-0.97	-	-	**0.63**	0.45-0.87	0.66	0.42-1.04	**0.54**	0.34-0.87
Binge Drinking	2.08	0.73-5.93	1.48	0.62-3.54	0.52	0.20-1.35	0.84	0.43-1.64	**0.45**	0.21-0.94
Smoking Status										
Never smoke	1.00		1.00		1.00		1.00		1.00	
Past smoker	0.76	0.45-1.27	1.03	0.54-2.00	1.01	0.56-1.82	1.14	0.56-2.32	1.26	0.58-2.72
Current smoker	0.63	0.31-1.26	0.89	0.41-1.93	**0.52**	0.30-0.89	0.87	0.38-2.00	1.33	0.44-3.96
Prior cancer preventive services	**3.58**	2.44-5.24	**3.21**	2.23-4.61	**3.58**	2.39-5.36	**3.36**	2.37-4.75	**3.02**	1.84-4.98

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. The variable for sedentary was not collected in CHIS 2005. AOR, adjusted odds ratio. CI, confidence intervals. Bolded and shaded numbers indicate statistical significance at p>0.05.

Table 5.7 shows the multivariate associations between screening mammography adherence, demographic variables (i.e., race/ethnicity, nativity, age, education), and health behaviors for the total population by survey year. The associations varied by survey year. For all survey years, screening mammography adherence was increased if they had prior receipt of cancer preventive services. Screening mammography adherence also increased if the female participants were between 50 and 60 years of age and had some college education for all survey years but 2003. Screening mammography adherence was decreased if they had less than a high school education and were current smokers.

Table 5.8 shows the multivariate associations between screening mammography adherence, demographic variables (i.e., race/ethnicity, nativity, age, education), and health behaviors for the Asian population by survey year. The associations varied by survey year. For all survey years, screening mammography adherence was positively associated with prior receipt of cancer preventive services. Being Korean and Vietnamese was significant in 2003 because of different collection methods to adjust for issues with the 2001 sample. For more information, refer to http://healthpolicy.ucla.edu/chis/design/Documents/reweight_summary_chis01_010106.pdf.

Multivariate Analyses

OVERVIEW

Multivariate logistic regression models were estimated to test for the prevalence of mammography adherence after adjusting for changes in age, race/ethnicity nativity, and health behaviors of the population. Statistical tests for adjusted trends are based on the logistic regression models estimated from all years of data combined. The key explanatory variable is a linear trend variable that takes the value of 1 in 2001 and increases by 1 for each subsequent survey year, with a maximum of 5 in 2009. Quadratic and cubic specifications of the trend variable were tested, and they were not statistically significant after adjusting for age, gender, and design effects. All analyses adjusted for the complex survey design of the CHIS by using the raking weights. The purpose of Specific Aim I was to determine if screening mammography adherence rates vary across racial/ethnic groups and nativity. Hypothesis IA was that screening mammography adherence would be higher among non-Hispanic whites and lower among Asian Americans. Hypothesis IB was that mammography adherence would be lower in foreign-born Asians than U.S-born Asians.

RESULTS OF MULTIVARIATE ANALYSIS

Table 5.9 shows the multivariate trend analyses for screening mammography adherence for the total population (n = 99,619). The base model adjusting for survey year showed an increase in screening mammography adherence, amounting to an average increase of 8.0% between survey years (AOR = 1.08, 95% CI = 1.05-1.10). Adjusting for race/ethnicity (Model 2) did not reduce the screening mammography adherence trend. Model 2 shows that screening mammography adherence is associated with race/ethnicity. Compared to non-Hispanic Whites, screening mammography adherence was lower among Hispanics (AOR = 0.73, 95% CI = 0.69-0.78), Asians/Pacific Islanders (OR = 0.71, 95% CI = 0.66-0.76), and other race or mixed race (AOR = 0.68, 95% CI = 0.60-0.76). In Model 3, the addition of nativity did not change the biannual increase of screening mammography adherence. It did diminish the effects of race/ethnicity on screening mammography adherence. Compared to U.S.-born females, foreign-born females were 13% less adherent (AOR = 0.87, 95% CI = 0.80-0.93).

The addition of age, education and health behaviors in Model 4 diminished the effect of race/ethnicity and survey year on screening mammography adherence, and removed the effect of nativity. There was an average increase of 3.0% in screening mammography between survey years (AOR = 1.03, 95% CI = 1.04-1.12). Compared to non-Hispanic Whites, screening mammography adherence decreased by 19% if they were Asian/Pacific Islander (AOR = 0.81, 95% CI = 0.73-0.92) and 23% if they were other or mixed race (AOR = 0.77, 95% CI = 0.63-0.87). Being between the ages of 50 and 64 years old, overweight or obese, and prior receipt of cancer preventive services are positively associated with screening mammography adherence. Being over the age of 65 years old, less than a college education, underweight, missing BMI, sedentary lifestyle, and current smoker was negatively associated with screening mammography adherence. Compared to females aged 40 to 49 years old, the likelihood of being screening mammography adherent increased by 49% for females aged 50 to 64 years (AOR = 1.49, 95% CI = 1.40-1.60) and decreased by 14% for females over 65 years old (AOR = 0.86, 95% CI = 0.79-0.93). Compared to females with a college education, the AOR for being screening mammography adherent is 0.71 for those with less than a high school diploma (95% CI = 0.66-0.91) and 0.76 for those with some college education (95% CI = 0.71-0.82). Women who were overweight or obese were 12% more likely to be screening mammography adherent (AOR = 1.12, 95% CI = 1.06-1.19) compared to normal weight women. However, underweight women were 39% less likely to be adherent (AOR = 0.61, 95% CI = 0.52-0.72). Compared to females who never smoked, current smokers was 39% less likely to receive screening mammography in the past two years (AOR = 0.61, 95% CI 0.56-0.67). Prior receipt of cancer preventive services increased the odds of being screening mammography adherent by 3.19 (95% CI = 2.98-3.41).

Table 5.10 shows the multivariate trend analyses for mammography adherence among the Asian female respondents (n = 8,353). Adjusting for survey year in Model 1 showed an increase in screening mammography adherence, amounting to 12.0% on average between survey years (AOR = 1.12, 95% CI = 1.06-1.18). Study year may be a proxy variable indicating increased acculturation, i.e., more years living in the U.S. Adding Asian subgroup into Model 2 did not reduce the screening mammography adherence biannual trend, but showed that screening mammography adherence is associated with Asian subgroup. Compared to Japanese females, the likelihood of screening mammography adherence was lower among Chinese (AOR = 0.68, 95% CI = 0.54-0.0.86), Koreans (OR = 0.38, 95% CI = 0.29-0.50), and other Asian or mixed race females (AOR = 0.68, 95% CI = 0.53-0.88). The addition of nativity in Model 3 did not diminish the biannual increase of screening mammography adherence. However, it did diminish the effect of being Korean on screening mammography adherence by 137% changing the AOR from 0.38 to 0.52 (95% CI = 0.39-0.70). Being Chinese or other Asian was no longer associated with screening mammography. Foreign-born Asians were 40% less likely to be screening mammography adherent than U.S.-born Asians (95% CI = 0.48-0.76).

The addition of age, education and health behaviors in Model 4 diminished the effect of survey year on screening mammography adherence and removed the effect of nativity. There was an average increase of 8.0% between survey years (95% CI = 1.01-

1.15). Compared to Japanese, screening mammography adherence decreased by 43% if they were Korean (AOR = 0.57, 95% CI = 0.40-0.81). Age, education, and body mass index were associated with being adherent. Compared to females aged 40 to 49 years old, the likelihood of being adherent increased by 24% for females aged 50 to 64 years (AOR = 1.24, 95% CI = 1.01-1.52) and decreased by 29% for females over 65 years old (AOR = 0.71, 95% CI = 0.56-0.90). Compared to Asian with more than college education, women with less than a high school education were 34% less likely to screening mammography adherent (AOR = 0.66, 95% CI = 0.52-0.84). Women who were overweight or obese were 35% more likely to be adherent (AOR = 1.35, 95% CI = 1.10-1.66) compared to normal weight women. Being overweight and obese may be increasing screening adherence in Asians because they are more likely to have comorbidities. Their comorbidities may cause them to visit a health care provider more often. As a result, they may be more likely to be screened. However, underweight women were 33% less likely to be adherent (AOR = 0.67, 95% CI = 0.49-0.93) and less likely to visit their doctor for other ailments. Sedentary women were 33% less likely to be screening mammography adherent compared to physically active women (AOR = 0.67, 95% CI = 0.56-0.82). Prior receipt of cancer preventive services increased the odds of being screening mammography adherent by 3.18 (95% CI = 2.66-3.81).

Table 5.9. Odds ratios for prevalence of having screening mammogram within past 2 years among female respondents aged 40 years and older, California Health Interview Survey (2001-2009) (n = 99,619)

Variable	**Model 1**		**Model 2**		**Model 3**		**Model 4***	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	**1.08**	1.05-1.10	**1.08**	1.06-1.10	**1.08**	1.06-1.10	**1.03**	1.04-1.12
Race/Ethnicity								
Non-Hispanic White			1.00		1.00		1.00	
Hispanic			**0.73**	0.69-0.78	**0.79**	0.73-0.86	1.00	0.83-1.01
Non-Hispanic Black			0.94	0.85-1.05	0.94	0.84-1.05	1.05	0.89-1.18
Asian/Pacific Islander			**0.71**	0.66-0.76	**0.79**	0.73-0.86	**0.81**	0.73-0.92
Other			**0.68**	0.60-0.76	**0.67**	0.60-0.76	**0.77**	0.63-0.87
Nativity								
U.S.-Born					1.00		1.00	
Foreign-Born					**0.87**	0.80-0.93	1.00	0.91-1.09

*Model 4 adjusts for age, education, and health behaviors. Health behaviors include body mass index, sedentary lifestyle, binge drinking, smoking status, and prior receipt of cancer prevention health services, i.e., pap smear or colonoscopy.

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR = adjusted odds ratios. CI = confidence intervals. Bolded and shaded numbers indicate statistical significance at p- value <0.05.

Table 5.10. Odds ratios for prevalence of having screening mammogram within past 2 years among Asian respondents aged 40 years and older, California Health Interview Survey (2001-2009) (n = 8,353)

Variable	**Model 1**		**Model 2**		**Model 3**		**Model 4***	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	**1.12**	1.06-1.18	**1.12**	1.06-1.18	**1.12**	1.06-1.18	**1.08**	1.01-1.15
Asian Subgroup								
Japanese			1.00		1.00		1.00	
Chinese			**0.68**	0.54-0.86	0.91	0.70-1.16	0.95	0.71-1.28
Korean			**0.38**	0.29-0.50	**0.52**	0.39-0.71	**0.57**	0.40-0.81
Filipino			0.89	0.68-1.18	1.21	0.90-1.60	0.91	0.65-1.28
Vietnamese			0.82	0.60-1.12	1.14	0.80-1.64	1.28	0.82-1.99
Other Asian			**0.68**	0.53-0.88	0.84	0.64-1.12	0.82	0.59-1.13
Nativity								
U.S.-Born					1.00		1.00	
Foreign-Born					**0.60**	0.48-0.76	0.78	0.60-1.02

*Model 4 adjusts for age, education, and health behaviors. Health behaviors include body mass index, sedentary lifestyle, binge drinking, smoking status, and prior receipt of cancer prevention health services, i.e., pap smear or colonoscopy.

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. Other Asian includes other single Asian races and mixed Asian. AOR = adjusted odds ratios. CI = confidence intervals. Bolded and shaded numbers indicate statistical significance at p- value <0.05.

To test for interaction effects between nativity and Asian subgroup, additional weighted logistic regression analyses were completed stratifying the sample by nativity. Table 5.11 summarizes the odds ratios for screening mammography adherence among Asian female respondents by nativity after adjusting for age, education, and health behaviors. For both U.S.-born and foreign-born Asian females, survey year was positively associated with screening mammography. Being Korean was negatively associated with screening mammography only if foreign-born (AOR = 0.51; 95% CI = 0.34-0.76). Specifically, Korean women were 49% less likely to be mammography adherent than Japanese women.

Table 5.11. Summary of odds ratios for screening mammography adherence among Asian female respondents aged 40 years and older by nativity, California Health Interview Survey (2001-2009) (n = 8,353).

Variable	**All Asians* (n = 8,353)**		**U.S.-Born Asians* (n = 1,652)**		**Foreign-Born Asians* (n = 6,701)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	**1.08**	1.01-1.15	**1.06**	0.91-1.23	**1.08**	1.00-1.16
Asian Subgroup						
Japanese	1.00		1.00		1.00	
Chinese	0.95	0.71-1.28	0.96	0.60-1.55	0.88	0.58-1.32
Korean	**0.57**	0.40-0.81	1.85	0.46-7.33	**0.51**	0.34-0.76
Filipino	0.91	0.65-1.28	1.59	0.76-3.34	0.81	0.52-1.18
Vietnamese	1.28	0.82-1.99	N/A	N/A	1.16	0.70-1.93
Other Asian	0.82	0.59-1.13	0.77	0.43-1.38	0.78	0.52-1.18
Nativity						
U.S. Born	1.00		-	-	-	-
Foreign-Born	0.78	0.60-1.02	-	-	-	-

*All models adjust for age, education, and health behaviors. Health behaviors include body mass index, sedentary lifestyle, binge drinking, smoking status, and prior receipt of cancer prevention health services, i.e., pap smear or colonoscopy.

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. Other Asian includes other single Asian races and mixed Asian. AOR = adjusted odds ratios. CI = confidence intervals. Bolded and shaded numbers indicate statistical significance at p- value <0.05. N/A, only included 1 U.S.-born Vietnamese. Results did not change when removed subject.

A sensitivity analysis was conducted to see if the presence of a chronic condition would impact the results for both the total population and the Asian population. Respondents with a chronic condition have a higher likelihood of visiting their doctor for their condition as well as more interactions with the health care environment. Similar results were seen when removing females with at least one chronic condition (n = 47,758). After adjusting for age, education, health behaviors and prior receipt of cancer preventive services in the total sample, screening mammography was positively associated with study year (AOR = 1.03, 95% CI = 1.00-1.06). Screening mammography was negatively associated with being Asian American/Pacific Islander (AOR = 0.76, 95% CI = 0.67-0.86) or other race (AOR = 0.79, 95% CI = 0.64-0.98). Comparable results were seen when analyzing the total population by nativity.

Removing Asian females with at least one chronic condition showed similar results. For all Asian females (n= 4,548), screening mammography adherence is positively associated with receiving prior cancer preventive services (AOR = 3.04, 95% CI = 2.35-3.95). Screening mammography adherence was negatively associated with being Korean (AOR = 0.47, 95% CI = 0.32-0.68), having less than a high school education (AOR = 0.61, 95% CI = 0.46-0.81), being sedentary (AOR (0.70, 95% CI =0.54-0.91), and being a current smoker AOR = 0.57, 95% CI 0.35-0.94). The same results were seen when conducting the analysis by nativity.

Table 5.12 summarizes the hypotheses and results for Specific Aim I. Specific Aim I was to determine if screening mammography adherence rates vary across racial/ethnic groups and nativity. Hypothesis IA was that screening mammography adherence would be higher among non-Hispanic whites and lower among Asian

Americans. This multivariate analysis supports the first hypothesis. From the total sample analysis, we can conclude that screening mammography adherence varies across race/ethnicity. Screening mammography adherence is higher in non-Hispanic Whites. Although it was statistically lower in Asians and Pacific Islanders, the lowest rate was among other race. Hypothesis IB was that screening mammography adherence would be higher among U.S. born Asians. Screening mammography was not statistically significantly lower among foreign-born Asians after adjusting for age, education and health behaviors.

Table 5.12. Summary of Specific Aim I hypotheses that examine the relationship between screening mammography adherence, race/ethnicity and nativity, and whether hypotheses were supported, not supported or partially supported.

Specific Aim I Hypotheses	OR (95% CI)	Reference	Outcome
IA. Screening mammography adherence would be higher in non-Hispanic Whites and lower in Asians/Pacific Islanders	Non-Hispanic Whites: 1.00 Asians/Pacific Islanders: 0.81 (0.73-0.92) Other: 0.77 (0.63-0.87)	Table 5.9	PS
IB Screening mammography will be lower among foreign-born-Asians than U.S.-born Asians	U.S.-Born: 1.00 Foreign-Born: 0.78 (0.60-1.02)	Tables 5.10, 5.11	NS

Note: PS = Partially Supported, NS = Not Supported, and S = Supported.

Table 5.12 summarizes the hypotheses and results for Specific Aim I. Specific Aim I was to determine if screening mammography adherence rates vary across racial/ethnic groups and nativity. Hypothesis IA was that screening mammography adherence would be higher among non-Hispanic whites and lower among Asian Americans. This multivariate analysis supports the first hypothesis. From the total sample analysis, we can conclude that screening mammography adherence varies across

race/ethnicity. Screening mammography adherence is higher among non-Hispanic Whites. Although it was statistically lower in Asians and Pacific Islanders, the lowest rate was among other race. Hypothesis IB was that screening mammography adherence would be higher among U.S. born Asians. Screening mammography was not statistically significantly lower among foreign-born Asians after adjusting for age, education and health behaviors.

SPECIFIC AIM I SUMMARY

The goal of Specific Aim I was to determine if screening mammography adherence among women aged 40 years and older in California varied by race/ethnicity and nativity and to explore the contributions of health behavior variables to changes in prevalence over time. The outcome of interest was *screening mammography adherence*, defined as self-report of having a mammogram in the past two years. The results from Specific Aim I provide a conservative estimate of the changes in screening mammography adherence in California women aged 40 years and older from 2001 to 2009.

Results show an upward trend in the prevalence of screening mammography adherence from 2001-2009. Overall, the population estimates of California women who reported having a screening mammogram in the past two years increased from 74.3% in 2001 to 79.5% in 2009. This exceeds the HP2010 target of 70%. Non-Hispanic White women had the highest percentage of women reporting that they had a screening mammogram in the past two years in 2001 (77.7%) and the highest percentage of women reporting mammography adherence in 2009 (80.6%). Asians had the lowest reported percentage (66.4%) in 2001, but American Indian/Alaska Native women had the lowest rate of mammography adherence (74.3%) in 2009. Between 2001 and 2009, the rates of mammography adherence among different racial/ethnic groups grew closer.

In summary, the multivariate results partially supported the two hypotheses. After adjusting for age, nativity, race/ethnicity and health behaviors, the results of the multivariate analyses partially support Hypothesis IA. Hypothesis IA posited that screening mammography adherence would be higher among non-Hispanic Whites and lower among Asians/Pacific Islanders. Screening mammography adherence was highest in non-Hispanic Whites. Even after adjusting for age, education and health behaviors, screening mammography was lower in Asians/Pacific Islanders than non-Hispanic Whites (AOR = 0.81, 95% CI = 0.73-0.92. However, the lowest screening mammography rates were among the other group (AOR = 0.77, 95% CI = 0.63-0.87).

In the total population, screening mammography adherence was positively associated with survey year (AOR = 1.03, 95% CI = 1.04-1.12), being between the ages of 50 and 64 years old (AOR = 1.49, 95% CI = 1.40-1.60), overweight or obese (AOR = 1.12, 95% CI = 1.06-1.19), and prior use of cancer preventive health services (AOR = 3.19, 95% CI = 2.98-3.41). Screening mammography adherence was negatively associated with being Asian/Pacific Islander (AOR = 0.81, 95% CI = 0.73-0.92), other or mixed race (AOR = 0.77, 95% CI = 0.63-0.87), over 65 years old (AOR = 0.86, 95% CI = 0.79-0.93), education less than high school (AOR = 0.71) or some college (AOR = 0.76) compared to a college degree, underweight (AOR = 0.61, 95% CI = 0.52-0.72) and current smokers (AOR = 0.61, 95% CI 0.56-0.67). .

Hypothesis IB posted that screening mammography adherence will be higher among U.S. born Asians than foreign-born Asians. This was not supported by the multivariate analysis. The adjusted odds ratio of screening mammography adherence among Asians was higher among U.S.-born Asians than foreign-born Asians (AOR = 0.78, 95% CI = 0.60-1.02), but was not statistically significant after adjusting for age, education and health behaviors. In the Asian population, screening mammography adherence was positively associated with study year (AOR = 1.08, 95% CI = 1.01-1.15), aged 50 to 64 years (AOR = 1.24, 95% CI = 1.01-1.52), being overweight or obese (AOR = 1.35, 95% CI = 1.10-1.66) and prior use of cancer preventive health services (AOR = 3.18, 95% CI = 2.66-3.81). Screening mammography adherence in Asians was negatively associated with being Korean (AOR = 0.57, 95% CI = 0.40-0.81), over 65 years old (AOR = 0.71, 95% CI = 0.56-0.90), less than high school education (AOR = 0.66, 95% CI = 0.52-0.84), underweight (AOR = 0.67, 95% CI = 0.49-0.93), and sedentary (AOR = 0.67, 95% CI = 0.56-0.82). When separating the Asian sample by nativity, survey year was positively associated with screening mammography for both U.S.-born and foreign-born Asian females. Being Korean was negatively associated with screening mammography in foreign-born Asians (AOR = 0.51; 95% CI = 0.34-0.76).

Chapter 6: Specific Aim II Results

Chapter 6 details the results of the analyses used to address Specific Aim II. The purpose of Specific Aim II is to determine the relationship between predisposing, enabling, and need factors on screening mammography adherence among Asian Americans and to determine if there are differences by nativity. It was hypothesized the effect of individual characteristics on screening mammography adherence will vary between U.S.-born and foreign-born Asian Americans. Specifically, the pertinent ***predisposing variables*** would include age, race/ethnicity, household size, marital status, U.S.-born, age at menarche, age of first birth, and level of English proficiency (IIA). The relevant ***enabling factors*** would include employment, any type of health insurance and a usual source of care (IIB). The related ***need factors*** would include general health condition and at least 1 or more chronic conditions (IIC). First, descriptive statistics are provided for the Asian sample population by nativity and screening mammography adherence. Second, disparity distributions are provided by nativity, Asian subgroup and age group. Last, logistic regressions were performed to analyze the relationship between predisposing, enabling and need factors among adherent and non-adherent Asian women.

DESCRIPTIVE STATISTICS

Sample Distributions by Screening Mammography Adherence

The Asian sample included 8,353 Chinese, Japanese, Korean, Filipino, Vietnamese, and other Asian or multiple race females aged 40 years and older at the time of interview. More than a quarter of the population reported not receiving a screening mammography within the past two years (n = 2,314, 27.7%). Table 6.1 reports the predisposing factors that were significantly different between Asian women who were adherent and non-adherent to screening mammography guidelines. All of the predisposing factors were statistically significant at $p < 0.05$ except age when their first child was born. Adherent women were older and had a slightly smaller household size. A higher percentage of adherent women were born in the U.S. (22.2% versus 13.4%), aged 50-64 (41.5% versus 28.9%), have more than a college degree (47.3% versus 41.6%), and had their first child later in life (≥ 36). Compared to adherent Asian women, non-adherent women had a higher percentage being between 40 and 49 years old (44.5% versus 32.8%), had less than a high school education (39.5% versus 33.1%), not married (40.0% versus 34.4%), spoke English not well or not at all (46.7% versus 32.3%), had their period earlier in life (age 6-12) and their first child between 19-35 years old.

Table 6.2 reports the enabling factors that were significantly different between Asian women who were adherent and non-adherent to mammography screening guidelines. All of the enabling factors were statistically significant at $p<0.05$. A higher percentage of -adherent Asian women are employed (52.3% versus 46.6%), currently insured (91.3% versus 77.6%), owned a home (58.3% versus 45.5%), and have usual source of care (72.1 versus 64.9%) compared to non-adherent women. Non-adherent women have a higher percentage of women living below 200% of the poverty level (45.4 versus 32.3%).

Table 6.1. Predisposing characteristics of Asian women aged ≥ 40 years by self-reported screening mammography status, California Health Interview Survey (2001-2009) (n = 8,353).

Predisposing Variables	Adherent (n=6,039)		Non-Adherent (n=2,314)		Chi-square/ T-test	p-value
	n	%	n	%		
Time in US					198.143	<0.0001
U.S. Born	1341	22.2	311	13.4		
Foreign-born living in U.S. for ≥ 10 years	4192	69.4	1593	68.8		
Foreign-born living in U.S. for < 10 years	506	8.4	410	17.7		
Age					134.718	<0.0001
40-49	1978	32.8	1029	44.5		
50-64	2507	41.5	668	28.9		
≥65	1554	25.7	617	26.7		
Mean Age	56.7 ± 11.5		55.6 ± 13.6		424.400	<0.0001
Race/ethnicity					192.614	<0.0001
Chinese	1712	28.4	613	26.5		
Japanese	818	13.6	220	9.51		
Korean	865	14.3	623	26.9		
Filipino	970	16.1	309	13.4		
Vietnamese	890	14.7	275	11.9		
Other Asian	784	13.0	274	11.8		
Education					31.781	<0.001
≤ H.S. Diploma	1999	33.1	914	39.5		
Some college	1186	19.6	437	26.9		
≥ College (4 yr. degree)	2854	47.3	963	41.6		
Household Size (mean ± SD)	2.7 ± 1.4		2.8 ± 1.5		173.400	<0.0001
Married	3963	65.6	1389	60.0	22.771	<0.0001
English use and proficiency					167.671	<0.0001
Speaks English only	1620	26.8	403	17.4		
Speaks English very good or Well	2471	40.9	831	35.9		
Speaks English not well or not at all	1948	32.3	1080	46.7		
Age when period started					27.215	<0.0001
6-12	3633	60.2	1472	63.6		
<13	1395	23.1	414	17.9		
Missing/Don't Know/Refused	1011	16.7	428	18.5		
Age when first child was born					5.553	0.3522
No child	589	9.8	214	9.3		
10-18	119	2.0	54	2.3		
19-25	1177	19.5	484	20.9		
26-35	1575	26.1	618	26.7		
≥36	227	3.8	75	3.2		
Missing or not collected	2352	39.0	869	37.6		

Table 6.2. Enabling characteristics of Asian women aged ≥ 40 years by self-reported screening mammography status, California Health Interview Survey (2001-2009) (n = 8,353).

Enabling Variables	Adherent (n=6,039)		Non-Adherent (n=2,314)		Chi-square/ T-test	p-value
Employed					21.223	<0.0001
Yes	3156	52.3	1079	46.6		
No	2883	47.7	1235	53.4		
Currently insured					287.013	<0.0001
Yes	5514	91.3	1796	77.6		
No	525	8.7	518	22.4		
Own home					110.848	<0.0001
Yes	3519	58.3	1052	45.5		
No	1473	24.4	743	32.1		
Missing or not collected	1047	17.3	519	22.4		
< 200% Poverty level					124.135	<0.0001
Yes	1951	32.3	1050	45.4		
No	4088	67.7	1264	54.6		
Have usual source of care					218.201	<0.0001
Yes	4353	72.1	1501	64.9		
No	302	5.0	338	14.6		
Missing or not collected	1384	22.9	475	20.5		

Table 6.3 reports the need factors and health behaviors that were statistically significant between adherent and non-adherent Asian women. Compared to adherent Asian women, a higher percentage of non-adherent women rated their health from poor to good, had at least one or more chronic conditions (47.6% versus 40.3%), had a family history of cancer (16.0% versus 13.0%), and reported having a colonoscopy or pap smear (55.3% versus 26.6%). In terms of health behaviors, adherent Asian women had a higher percentage of not being sedentary (66.4% versus 56.0%), never smokers (85.7% versus 85.2%) or past smokers (10.7% versus 7.8%), and not binge drinkers (96.0% versus 94.7%).

Table 6.3. Need and health behavior characteristics of Asian women aged ≥ 40 years by self-reported screening mammography status, California Health Interview Survey (2001-2009) (n = 8,353).

Need and Health Behavior Variables	**Adherent (n=6,039)**		**Non-Adherent (n=2,314)**		**Chi-square/ T-test**	**p-value**
Need Factors						
General health condition					27.277	<0.0001
Excellent	853	14.1	300	13.0		
Very Good	1524	25.2	496	21.4		
Good	1863	30.9	733	31.7		
Fair	1272	21.1	518	22.4		
Poor	527	8.7	267	11.5		
≥1 chronic condition					35.335	<0.0001
Yes	2872	47.6	933	40.3		
No	3167	52.4	1381	59.7		
Family history of breast cancer					19.705	<0.0001
Yes	963	16.0	300	13.0		
No	1644	27.2	723	31.2		
Missing or not collected	3432	56.8	1291	55.8		
Health Behaviors						
Obese					4.346	0.0371
Yes	441	7.3	139	6.0		
No	5598	92.7	2175	94.0		
Overweight					8.269	0.0040
Yes	1316	21.8	438	18.9		
No	4723	78.2	1876	81.1		
Binge drinking					6.044	0.0140
Yes	244	4.0	122	5.3		
No	5793	96.0	2192	94.7		
Smoking status					46.998	<0.0001
Never smoked	5174	85.7	1971	85.2		
Former smoker	632	10.5	181	7.8		
Current smoker	233	3.9	162	7.0		
Sedentary					64.201	<0.0001
Yes	1710	33.7	849	44.0		
No	3371	66.4	1082	56.0		
Prior cancer prevention health service use					550.979	<0.0001
Yes	3338	55.3	616	26.6		
No	2701	44.7	1698	73.4		

Chronic condition included self-report of doctor-diagnosis of at least one of the following: asthma, diabetes, high blood pressure or heart disease.

Sample Distributions by Nativity

A total of 6,039 Asian women were adherent to the screening mammography guidelines. More than two-thirds of the population was born outside the U.S. (n= 4,698, 77.8%). Table 6.4 reports the predisposing variables that were statistically different (p-value< 0.05) between U.S. and foreign-born Asian women who were adherent to the mammography screening guidelines. The average age of a U.S. Asian woman was 56.1 ± 11.0 while the average of a foreign-born Asian woman was 58.7 ± 12.9. A higher percentage of U.S.-born adherent women than foreign-born adherent women were English proficient (80.4% versus 11.5%). Compared to U.S.-born adherent women, a higher percentage of foreign-born adherent women were married (68.8% versus 54.4%), had at least a college degree (46.5% versus 21.1%), started their period early (age 6-12) (64.4% versus 45.3%) and had their first child between 26 and 35 years old (27.8% versus 19.9%).

Table 6.5 reports the enabling variables that were statistically different between U.S. and foreign-born Asian women who were adherent to the mammography screening guidelines. All of the enabling variables were statistically different at p-value < 0.05 between U.S.-born and foreign-born Asian women adherent to the screening mammography guidelines except being employed. Compared to U.S.-born adherent Asian women, a lower percentage of foreign-born adherent women were insured (88.5% versus 97.6%), owned a home (55.1% versus 69.4%), and had no usual source of care (21.9% versus 2.1%).

Table 6.4. Predisposing characteristics of screening mammography adherent Asian women aged ≥ 40 years by nativity, California Health Interview Survey (2001-2009) (n = 6,039).

Year	**U.S. Born (n = 1,341)**		**Foreign-Born (n = 4,698)**		**Chi-square/ T-test**	**p-value**
	N	%	N	%		
Age					32.8480	<0.0001
40-49	404	30.1	1574	33.5		
50-64	511	38.1	1996	42.5		
≥65	426	31.8	1128	24.0		
Mean Age	58.7 ± 12.9		56.1 ± 11.0		383.08	<0.0001
Race/ethnicity					1689.9076	<0.0001
Chinese	347	25.9	1365	29.1		
Japanese	592	44.2	226	4.8		
Korean	33	2.5	832	17.7		
Filipino	130	9.7	840	17.9		
Vietnamese	1	0.1	889	18.9		
Other Asian	238	17.8	546	11.6		
Education					154.5309	<0.0001
≤ H.S. Diploma	283	49.9	1716	36.5		
Some college	389	29.0	797	17.0		
≥ College (4 yr. degree)	669	21.1	2185	46.5		
Household Size (mean ± SD)	2.3 ± 1.2		2.8 ± 1.4		147.64	<0.0001
Married	730	54.4	3233	68.8	95.6191	<0.0001
English use and proficiency					2581.2588	<0.0001
Speaks English only	1078	80.4	542	11.5		
Speaks English very good or well	255	19.0	2216	47.2		
Speaks English not well or not at all	8	0.6	1940	41.3		
Age when period started					203.1215	<0.0001
6-12	607	45.3	3026	64.4		
<13	492	36.7	903	19.2		
Missing/Don't Know/Refused	242	18.1	769	16.4		
Age when first child was born					100.9233	<0.0001
No child	182	13.6	407	8.7		
10-18	50	3.7	69	1.5		
19-25	210	15.7	967	20.6		
26-35	267	19.9	1308	27.8		
≥36	47	3.5	180	3.8		
Missing	585	43.6	1767	37.6		

Table 6.5. Enabling characteristics of screening mammography adherent Asian women aged ≥ 40 years by nativity, California Health Interview Survey (2001-2009) (n = 6,039).

Year	U.S. Born (n = 1,341)		Foreign-Born (n = 4,698)		Chi-square/ T-test	p-value
Enabling Factors						
Employed					0.1297	0.7187
Yes	695	51.8	2461	52.4		
No	646	48.2	2237	47.6		
Currently insured					86.3893	<0.0001
Yes	1309	97.6	4205	88.5		
No	32	2.4	493	10.5		
Own home					146.4212	<0.0001
Yes	930	69.4	2589	55.1		
No	161	12.0	1312	27.9		
Missing	250	18.6	797	17.0		
< 200% Poverty level					228.3180	<0.0001
Yes	205	15.3	1746	37.2		
No	1136	84.7	2952	62.8		
Have usual source of care					39.7166	<0.0001
Yes	956	71.3	3397	72.3		
No	28	2.1	274	21.9		
Missing	357	26.6	1027	5.8		

Table 6.6 reports the need and health behavior variables that were statistically different between U.S. and foreign-born Asian women who were adherent to the screening mammography guidelines. All of the variables were statistically different between the two groups at p-value< 0.05. Compared to foreign-born adherent women, a higher percentage of U.S.-adherent women rated their health as excellent (20.7% versus 12.3%) or very good (35.1% versus 22.4%), had at least one or more chronic conditions (54.2% versus 45.7%), and had a family history of breast cancer (20.7% versus 14.6%). In terms of health behaviors, foreign-born adherent women had better health habits. They had a higher percentage of never smoking (90.3% versus 69.5%) and lower percentage of being obese (5.8% versus 12.8%), overweight (20.8% versus 25.1%), and

binge drinking (3.4% versus 6.3%). U.S.-born adherent women had a higher percentage of receiving cancer preventative services (66.5% versus 52.1%).

Table 6.6. Need and health behavior characteristics of screening mammography adherent Asian women aged ≥ 40 years by nativity, California Health Interview Survey (2001-2009) (n = 6,039).

Year	**U.S. Born (n = 1,341)**		**Foreign-Born (n = 4,698)**		**Chi-square/ T-test**	**p-value**
Need Factors						
General health condition					257.5388	<0.0001
Excellent	277	20.7	576	12.3		
Very Good	471	35.1	1053	22.4		
Good	399	29.8	1464	31.2		
Fair	149	11.1	1123	23.9		
Poor	45	3.4	482	10.3		
≥1 chronic condition*					30.6175	<0.0001
Yes	727	54.2	2145	45.7		
No	614	45.8	2553	54.3		
Family history of breast cancer					80.1971	<0.0001
Yes	277	20.7	686	14.6		
No	245	18.3	1399	29.8		
Missing	819	61.1	2613	55.6		
Health Behaviors						
Obese					75.6129	<0.0001
Yes	171	12.8	270	5.8		
No	1170	87.3	4428	94.3		
Overweight					11.2751	0.0008
Yes	337	25.1	979	20.8		
No	1004	74.9	3179	79.2		
Binge drinking					23.5230	<0.0001
Yes	85	6.3	159	3.4		
No	1255	93.7	4538	96.6		
Smoking status					369.2960	<0.0001
Never smoked	932	69.5	4242	90.3		
Former smoker	306	22.8	326	6.9		
Current smoker	103	7.7	130	2.8		
Sedentary					31.0100	<0.0001
Yes	297	26.7	1413	35.6		
No	816	73.3	2555	64.4		
Missing						
Prior cancer prevention health service use					88.1456	<0.0001
Yes	892	66.5	2446	52.1		
No	449	33.5	2252	47.9		

Year	U.S. Born (n = 1,341)	Foreign-Born (n = 4,698)	Chi-square/ T-test	p-value

*Chronic condition included self-report of doctor-diagnosis of at least one of the following: asthma, diabetes, high blood pressure or heart disease.

SPECIFIC AIM II RESULTS

The goal of Specific Aim II was to determine the relationship between predisposing, enabling, and need factors on mammography adherence among U.S.-born and foreign-born Asian Americans. Previous research has shown that a woman's decision to have a mammography and adhere to the mammography screening guidelines is guided by various social, economic, cultural, geographical, psychosocial, and environmental factors (Vyas et al., 2012). According to Andersen (1968), the usage of health care services is dependent on predisposing, enabling, and need factors. Therefore, it was hypothesized that the effect of individual characteristics on screening mammography adherence will vary between U.S.-born and foreign-born Asian American women, in regards to predisposing, enabling, and need factors. Specifically, the pertinent *predisposing variables* would include age, race/ethnicity, household size, marital status, U.S.-born, and level of English proficiency. The relevant *enabling factors* would include employment, any type of health insurance and usual source of care. The related *need factors* include general health condition and at least 1 chronic condition.

DISPARITIES IN THE PREVALENCE OF SCREENING MAMMOGRAPHY ADHERENCE

Racial/ethnic disparities in screening mammography adherence were evident in the sample. Figures 6.1, 6.2, and 6.3 display the percentage of Asian women aged 40 years and older who adhere to screening mammography guidelines by nativity, race/ethnicity, and age group. Prevalence estimates are weighted and shown for using CHIS 2001 and CHIS 2009 data.

There were substantial differences in mammography adherence among U.S.-born and foreign-born Asians. Figure 6.1 shows the prevalence of screening mammography adherence was 64.2% among foreign-born Asians compared to 77.3% among U.S.-born Asians in 2001. In 2009, the screening mammography rate was 76.4% for foreign-born Asians and 82.4% for U.S.-born Asians. From 2001 to 2009, the difference in screening mammography adherence narrowed between U.S.-born and foreign-born Asians. In addition, screening mammography adherence remained higher among U.S.-born Asians.

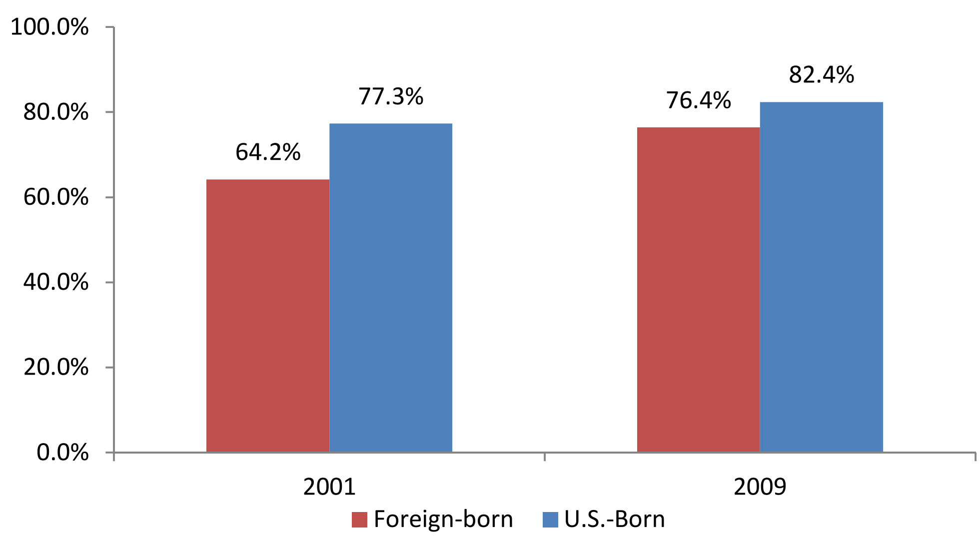


Figure 6.1. Percent of Asians aged 40 years and older who had a screening mammogram within the past two years by nativity, California Health Interview Survey 2001 and 2009 (n = 8,353).

Figure 6.2 shows the prevalence of screening mammography adherence by Asian subgroup. In 2001, only two Asian subgroups met the HP2010 objective of 70% getting a screening mammogram in the past two years. In 2009, all Asian subgroups except Filipinos achieved the HP2010 objective. The magnitude of the differentials declined considerably between 2001 and 2009, primarily due to large increases in screening mammography adherence among Japanese, Chinese, Koreans, Vietnamese and other

Asians. Although the disparity narrowed over time, the prevalence of screening mammography adherence remained higher among Japanese respondents and lower among Filipino respondents. In 2009, screening mammography adherence rates among Japanese, Koreans, and Vietnamese were similar.

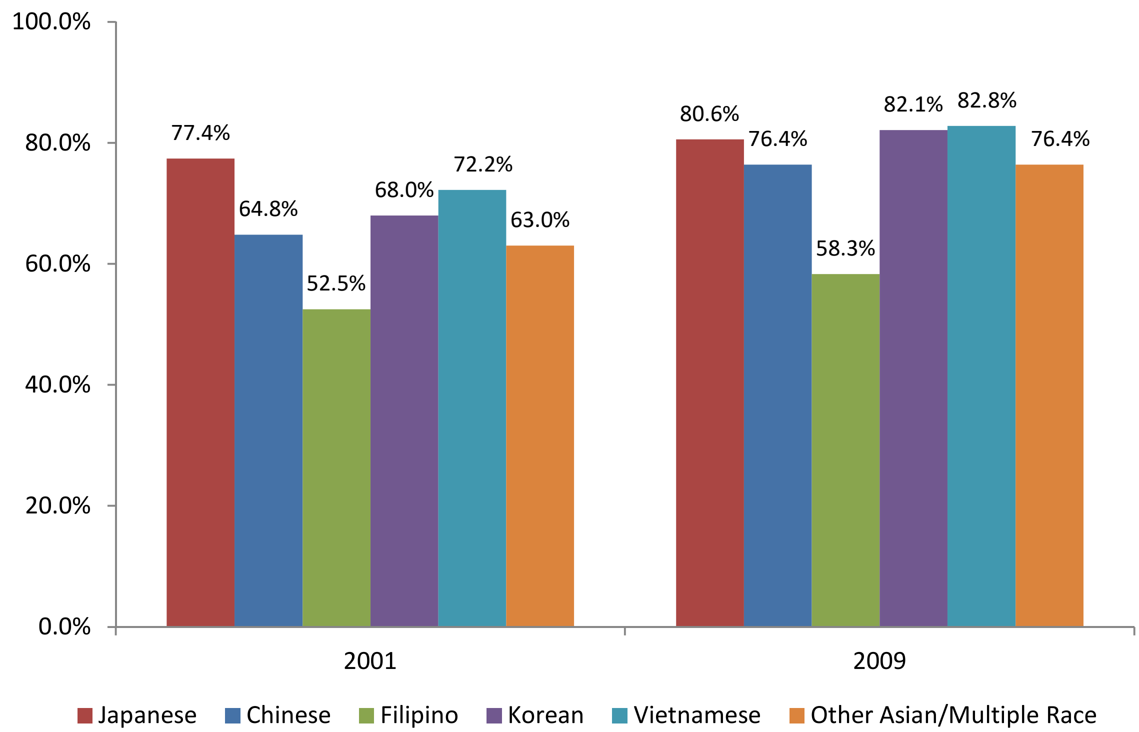


Figure 6.2. Percent of Asians aged 40 years and older who had a screening mammogram within the past two years by race/ethnicity, California Health Interview Survey 2001 and 2009 (n = 8,353).

Disparities in screening mammography adherence exist among different age groups. Figure 6.3 shows the weighted percentage of Asian women who reported receiving a screening mammogram in the past two years. In 2001, screening mammography was higher in Asian adults over 50 years old. The screening mammography adherence rate was 74.5% among Asians aged 50 to 64 years old and 65.1% among Asians aged 65 years and older in 2001 compared to 61.0% among Asians aged 40 to 49 years old. The magnitude of the differentials between the different age groups declined between 2001 and 2009. The disparity declined by 5.9 percentage points between Asian females aged 40-49 and Asian females aged 50-64, and 2.0 percentage points between Asian females aged 40-49 and Asian females over 65 years old.

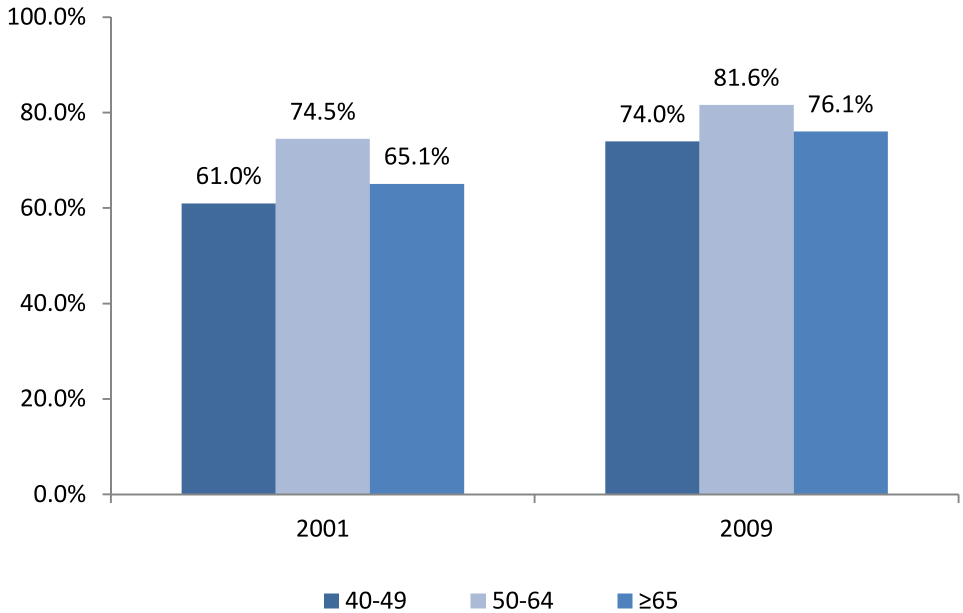


Figure 6.3. Percent of Asians aged 40 years and older who had a screening mammogram within the past two years by age group, California Health Interview Survey 2001 and 2009 (n = 8,353).

Correlations and Multivariate Associations

Correlations between screening mammography adherence and each of the predictor variables (predisposing, enabling, and need factors) are shown in Tables 6.7 to 6.9. Table 6.7 shows that study year, self-reported age, U.S. born, being Filipino or Vietnamese, and being married were positively correlated with screening mammography adherence. Being Korean, having less than a high school education, larger household size, and not speaking English only were negatively correlated with screening mammography adherence. The enabling factors that are associated with screening mammography are shown in Table 6.8. Being employed and having insurance and usual source of care was positively associated with screening mammography. Home ownership was negatively associated with screening mammography. Table 6.9 shows the positive and negative correlations between screening mammography and need factors. General health condition was positively associated with screening mammography while not having a chronic condition was negatively associated with screening mammography.

Table 6.10 shows the multivariate associations between screening mammography adherence, predisposing, enabling, and need variables by survey year. All of the models were adjusted for health behaviors. The predisposing, enabling, need and health behavior variables associated with screening mammography adherence varied by survey year. The predisposing variables that were associated with screening mammography for 2001 and 2009 were having no children. Across all survey years, the enabling variables that were consistently associated screening mammography adherence were not having health insurance or usual source of care. Having a colonoscopy or Pap smear increased the odds of being screening mammography adherent across all survey years (results not shown).

Table 6.7. Correlations between screening mammography adherence and predisposing variables in Asian women aged 40 years and older from the California Health Interview Survey (2001-2009) (n = 8,353).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1-Mammography adherence	1.00															
2-Study year	**0.07**	1.00														
3-Self-reported age	**0.04**	**0.09**	1.00													
4-U.S. Born	**0.10**	**-0.03**	**0.07**	1.00												
5-Chinese	0.02	**-0.04**	**-0.02**	**-0.03**	1.00											
6-Korean	**-0.15**	**0.06**	**0.03**	**-0.20**	**-0.29**	1.00										
7-Filipino	**0.03**	**-0.06**	-0.02	**-0.08**	**-0.26**	**-0.20**	1.00									
8-Vietnamese	**0.04**	**0.07**	**-0.03**	**-0.20**	**-0.25**	**-0.19**	**-0.17**	1.00								
9-Other Asian	0.02	**-0.03**	**-0.10**	**0.09**	**-0.24**	**-0.18**	**-0.16**	**-0.15**	1.00							
10-Less than high school	**-0.06**	**-0.05**	**0.22**	**-0.14**	-0.02	**0.06**	**-0.16**	**0.29**	**-0.08**	1.00						
11-Some college	0.01	**-0.03**	0.01	**0.13**	-0.01	**-0.06**	0.01	**-0.06**	**0.03**	**-0.36**	1.00					
12-Household size	**-0.05**	-0.03	**-0.42**	**-0.14**	-0.02	**-0.07**	**0.06**	**0.14**	**0.03**	-0.01	**-0.04**	1.00				
13- Married	**0.05**	0.01	**-0.30**	**-0.12**	**0.04**	**0.03**	-0.01	-0.00	0.00	-0.08	-0.04	0.41	1.00			
14-English proficiency	**-0.14**	0.01	**0.10**	**0.59**	**0.07**	**0.28**	**0.18**	**0.30**	**-0.18**	**0.39**	**-0.12**	**0.09**	**0.05**	1.00		
15-Age when first period started >13	-0.02	**-0.38**	0.01	0.02	**0.05**	**-0.05**	**0.01**	0.01	**-0.05**	**0.03**	0.02	0.00	-0.02	-0.01	1.00	
16-No child	0.01	-0.01	**-0.06**	**0.08**	0.01	**-0.06**	0.02	**-0.02**	**0.02**	-0.09	0.00	**-0.19**	**-0.17**	**-0.12**	**-0.13**	1.00
17-Age when first child is born	0.02	**-0.02**	-0.01	**0.09**	**0.07**	**-0.08**	**0.04**	**-0.13**	0.01	**-0.08**	0.01	**-0.14**	**-0.11**	**0.14**	**0.43**	**0.34**

Note: Bolded numbers indicate statistical significance at p-value <0.05.

Table 6.8. Correlations between screening mammography adherence and enabling variables in Asian women aged 40 years and older from the California Health Interview Survey (2001-2009) (n = 8,353).

	1	2	3	4	5	6	7
1-Mammography adherence	1.00						
2-Study year	**0.07**	1.00					
2-Employed	**0.05**	-0.00	1.00				
3-Insured	**0.19**	0.01	0.00	1.00			
4-Owns home	**-0.06**	**-0.73**	**-0.04**	0.00	1.00		
5-<200% poverty level	-0.12	**-0.03**	**-0.28**	**-0.15**	**0.04**	1.00	
6-Usual source of care	**0.03**	**0.30**	0.01	0.02	**-0.26**	**-0.07**	1.00

Note: Bolded numbers indicate statistical significance at p-value <0.05.

Table 6.9. Correlations between screening mammography adherence and need variables in Asian women aged 40 years and older from the California Health Interview Survey (2001-2009) (n = 8,353).

	1	2	3	4	5
1-Mammography adherence	1.00				
2-Study year	0.07	1.00			
3-General health condition	**-0.05**	**0.04**	1.00		
4-No chronic condition	**0.07**	**0.04**	**0.29**	1.00	
5-No family history of cancer	0.01	**-0.06**	**-0.05**	-0.00	1.00

Note: Bolded numbers indicate statistical significance at p-value <0.05.

Table 6.10. Multivariate associations between predisposing, enabling, and need factorsand screening mammography adherence among Asian female respondents aged 40 years and older by survey year, California Health Interview Survey (2001, 2005, 2009) (n = 5,153).

Variables	**2001*** n = 1,566		**2005*** n = 1,510		**2009*** n = 2,077	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Predisposing Variables						
Age 40-49	1.00		1.00		1.00	
Age 50-64	1.45	1.00-2.10	**1.97**	1.34-2.90	1.27	0.74-2.19
Age≥65	0.62	0.37-1.03	0.98	0.51-1.86	1.02	0.43-2.41
U.S. Born	1.00		1.00		1.00	
Foreign-Born	0.67	0.37-1.21	0.99	0.56-1.76	0.91	0.40-2.04
Chinese	1.02	0.55-1.91	1.29	0.63-2.61	0.92	0.38-2.23
Japanese	1.00		1.00		1.00	
Korean	0.70	0.34-1.45	0.87	0.42-1.78	0.63	0.26-1.51
Filipino	**0.94**	0.72-0.90	1.02	0.49-2.14	1.00	0.34-2.89
Vietnamese	**2.19**	1.04-4.62	1.55	0.66-3.68	2.19	0.61-7.90
Other Asian	0.73	0.36-1.48	1.20	0.52-2.78	0.64	0.27-1.53
Less than high school	1.11	0.76-1.62	0.63	0.38-1.04	0.81	0.42-1.54
Some college	1.02	0.67-1.55	0.87	0.55-1.38	1.13	0.65-1.96
>4-year college	1.00		1.00		1.00	
Household size	**0.80**	0.72-0.90	0.96	0.81-1.13	1.09	0.94-1.28
Married	0.78	0.57-1.08	**0.52**	0.35-0.76	**0.40**	0.24-0.66
Not married	1.00		1.00		1.00	
Speaks English only	1.17	0.74-1.84	0.84		0.79	0.38-1.64
Speaks English very well or well	0.57	0.45-1.27	0.75	0.48-1.47	0.89	0.38-2.06
Speaks English not well or not at all	1.07	0.73-1.57	0.94	0.37-1.53	0.79	0.44-1.41
Age of first period started >13	0.60	0.31-1.18	-	-	0.01	<0.001-0.16
Unknown age of first period	**0.55**	0.33-0.90	1.30	0.73-2.32	**3.02**	1.54-5.91
No child	0.61	0.27-1.39	**3.23**	1.40-7.43	1.00	
First child when 10-18	1.00		1.00		0.61	0.26-1.42
First child when 19-25	0.79	0.56-1.10	0.97	0.67-1.41	1.00	
First child when <26						
Enabling Variables	1.00		1.00		1.00	
Employed	0.85	0.61-1.20	1.11	0.74-1.66	1.18	0.70-2.00
Unemployed	1.00		1.00		1.00	
Insured	1.00		1.00		1.00	
Uninsured	**0.41**	0.26-0.62	**0.55**	0.34-0.89	**0.36**	0.18-0.71
Owns home	-	-	1.00		1.00	
Does not own home	-	-	0.92	0.66-1.30	**0.55**	0.32-0.94

Table 6.10 continued.

Variables	2001* n = 1,566		2005* n = 1,510		2009* n = 2,077	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
≥ 200% federal poverty level	1.00		1.00		1.00	
<200% federal poverty level	0.79	0.56-1.12	0.99	0.71-1.39	1.15	0.65-2.02
Usual source of care	1.00		1.00		1.00	
No usual source of care	**0.37**	0.23-0.62	**0.50**	0.31-0.83	**0.22**	0.12-0.40
Need Factors						
Excellent health condition	1.00		1.00		1.00	
Very good health condition	1.22	0.79-1.91	1.43	0.82-2.50	1.83	0.77-4.37
Good health condition	1.36	0.83-2.21	1.30	0.74-2.29	1.02	0.51-2.04
Fair health condition	1.00	0.57-1.74	**2.01**	1.01-3.98	0.87	0.36-2.09
Poor health condition	1.25	0.61-2.60	1.07	0.48-2.42	0.88	0.31-2.53
≥ 1 chronic condition	1.00		1.00		1.00	
No chronic condition	1.10	0.79-1.52	0.93	0.66-1.30	**0.56**	0.32-0.99
Family history of cancer	1.00		1.00		1.00	
No family history of cancer	0.82	0.60-1.13	-	-	**1.48**	1.03-2.12
Unknown family history of cancer	0.80	0.19-3.33	-	-	-	-

Note:*All of the models were adjusted for health behaviors, i.e., body mass index, sedentary lifestyle, binge drinking, smoking status and prior cancer prevention health service use (i.e., colonoscopy or Pap smear). Bolded and shaded numbers indicate statistical significance at p-value <0.05.

Multivariate Analyses

Multivariate logistic regression models were estimated to test for the prevalence of mammography adherence after adjusting for predisposing, enabling, and need, and health behaviors of the population. As stated in Chapter 4, some variables were not collected at each wave. As a result, three sets of logistic regressions were run – one using all CHIS data, one using CHIS 2001 and CHIS 2009, and one using CHIS 2005 and CHIS 2009 data. To test for interaction effects between nativity and Asian subgroup, additional weighted logistic regression analyses were completed stratifying the sample by nativity for each set of logistic regressions. Five models were run, but only the final models are shown in Tables 6.11 through 6.13. The base model adjusts for the study year. Model 2 adjusts for predisposing variables, e.g., age, time in U.S., Asian subgroup, education, household size, marital status, and English use and proficiency. Enabling factors (e.g., employment, any type of health insurance, and living at or below 200% of the federal poverty level) were adjusted in Model 3. Model 4 adjusts for need factors (e.g., self-rated general health and having 1 or more chronic conditions). Model 5 adjusts for health behaviors.

ANALYSES OF ALL CHIS DATA

Table 6.11 shows the multivariate trend analyses for mammography adherence among the Asian female respondents aged 40 years and older (n = 8,353) for all years of the CHIS data by nativity. The following variables were not included in the first set of logistic regressions because they were not collected every survey wave: age when period started, age when first child was born, home ownership, usual source of care, and family history of breast cancer. For all Asians, screening mammography was associated with study year, *predisposing variables* (i.e., age, being Vietnamese, household size, not being married, and speaking English not well or not at all), one *enabling factor* (i.e., being uninsured), one *need factor* (i.e., no chronic condition), and *health behaviors* (i.e., being obese or overweight, sedentary, and prior receipt of cancer prevention health services).

Between survey years, there was an average biannual increase of 8.0% in screening mammography (95% CI = 1.01-1.16). This may indicate that the population is becoming more acculturated, i.e., more years living in the U.S., and more likely to be screened. Compared those aged 40 to 49 years old, the odds of screening mammography was increased by 31% if they were between 50 and 64 years old (95% CI = 1.07-1.61) and decreased by 30% if they were over 65 years old (95% CI = 0.50-0.96). The odds of screening mammography were decreased by 30% if they spoke English not well or not at all compared to someone who spoke English only (95% CI = 0.50-0.98) and 60% if they were uninsured (95% CI = 0.32-0.50). Being Vietnamese increased the odds of being screening adherent by 80% (95% CI = 1.11-2.92) compared to being Japanese. The odds were also increased if they were obese or overweight compared to normal weight (AOR = 1.33, 95% CI = 1.07-1.64) and received cancer preventive services (AOR = 2.90, 95%CI 2.41-3.49). The likelihood of being screening adherent decreased by 25% for those with no chronic condition (95% CI 0.60-0.92) and had a sedentary lifestyle (95% CI = 0.62-0.92).

There was an interaction effect between nativity and Asian subgroup. Separating the sample by nativity removed some of the effects of predisposing, enabling and need factors on screening mammography. For both U.S.-born and foreign-born Asians, being uninsured (*predisposing variable*), being obese or overweight (*health behaviors*), and prior receipt of cancer prevention health services (*health behaviors*) were associated with screening mammography. Prior receipt of cancer prevention health services increased screening mammography by almost three-fold. For foreign-born Asians, three additional *predisposing factors* (i.e., being Vietnamese, household size and not being married), one *need factor* (i.e., no chronic condition), and two *health behaviors* (i.e., being underweight and being sedentary) were associated with screening mammography.

Table 6.11. Summary table of odds ratios for prevalence of having a screening mammogram within past 2 years among U.S.-born Asian female respondents aged 40 years and older, California Health Interview Survey (2001-2009) (n = 8,353).

Variable	**CHIS 2001-2009 (n = 8,353)**		**U.S. Born (n= 1,652)**		**Foreign-Born (n = 6,701)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	**1.08**	1.01-1.16	1.07	0.91-1.25	1.08	1.00-1.17
Predisposing Variables						
40-49 years	1.00		1.00		1.00	
50-64 years	**1.31**	1.07-1.61	1.23	0.74-2.04	**1.34**	1.07-1.66
≥65 years	**0.70**	0.50-0.96	0.52	0.22-1.25	0.74	0.51-1.05
US-Born	1.00		--	--	--	--
Foreign-Born	0.93	0.67-1.29	--	--	--	--
Chinese	1.08	0.78-1.49	0.97	0.60-1.57	1.08	0.71-1.64
Japanese	1.00		1.00		1.00	
Korean	0.80	0.54-1.19	1.93	0.43-8.67	0.78	0.51-1.19
Filipino	0.90	0.64-1.28	1.68	0.79-3.58	0.89	0.58-1.36
Vietnamese	**1.80**	1.11-2.92	N/A	N/A	**1.79**	1.07-3.00
Other Asian	0.90	0.64-1.28	0.83	0.47-1.47		
≤ High school	0.84	0.63-1.12				
Some college	0.88	0.70-1.09				
≥ College (4 yr. degree)	1.00		1.00		1.00	
Household Size (mean ± SD)	**0.91**	0.84-0.97	0.88	0.75-1.02	**0.91**	0.84-0.98
Not married	**0.55**	0.43-0.70	0.82	0.57-1.18	**0.51**	0.39-0.67
Speaks English only	1.00		1.00		1.00	
Speaks English very or well	0.90	0.67-1.22	0.57	0.32-1.03	1.07	0.78-1.48
Speaks English not well or not at all	**0.70**	0.50-0.98	0.56	0.08-4.25	0.81	0.58-1.13
Enabling Factors						
Employed	1.00		1.00		1.00	
Unemployed	0.93	0.78-1.11	1.43	0.80-2.57	0.88	0.71-1.08
Insured	1.00		1.00		1.00	
Uninsured	**0.40**	0.32-0.50	**0.14**	0.06-0.31	**0.42**	0.33-0.53
≤ 200% poverty level	1.00		1.00		1.00	
> 200% Poverty level	0.99	0.80-1.24	1.36	0.73-2.57	0.98	0.76-1.25

Table 6.11 continued.

Variable	CHIS 2001-2009 (n = 8,353)		U.S. Born (n= 1,652)		Foreign-Born (n = 6,701)	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Need Factors						
Excellent health	1.00		1.00		1.00	
Very good health	1.14	0.83-1.55	1.02	0.55-1.89	1.11	0.78-1.58
Good health	0.98	0.73-1.31	1.35	0.65-2.83	0.89	0.65-1.21
Fair health	1.00	0.72-1.38	2.19	0.88-5.47	0.87	0.61-1.24
Poor health	0.85	0.58-1.24	1.00	0.26-3.96	0.75	0.47-1.20
≥ 1 chronic condition	1.00		1.00		1.00	
No chronic condition	**0.75**	0.60-0.92	0.97	0.60-1.55	**0.70**	0.55-0.88
Health Behaviors						
Underweight (BMI ≤ 18.49)	0.74	0.52-1.04	1.42	0.46-4.42	**0.68**	0.48-0.98
Normal Weight (18.5≤ BMI ≤ 25)	1.00		1.00		1.00	
Obese or Overweight (BMI ≥ 25)	**1.33**	1.07-1.64	**1.61**	1.01-2.58	**1.31**	1.04-1.65
Missing BMI	0.73	0.30-1.76	1.39		0.69	0.25-1.90
Sedentary	**0.75**	0.62-0.92	0.78	0.51-1.19	**0.74**	0.61-0.91
Binge Drinker	0.67	0.44-1.03	0.98	0.42-2.27	0.61	0.36-1.02
Never smoke	1.00		1.00		1.00	
Past Smoker	0.97	0.71-1.32	0.93	0.47-1.84	0.92	0.65-1.31
Current Smoker	0.82	0.54-1.23	0.67	0.35-1.28	0.95	0.56-1.63
Prior cancer prevention health service use	**2.90**	2.41-3.49	**3.53**	1.97-6.32	**2.85**	2.31-3.53

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR, adjusted odds ratio. CI, confidence intervals. Chronic conditions include asthma, diabetes, high blood pressure and heart disease. Bolded and shaded numbers indicate statistical significance at p-value <0.05. N/A given Vietnamese only had 1 U.S.-born.

ANALYSES OF CHIS 2001 AND CHIS 2009 DATA

Table 6.12 shows the multivariate trend analyses for mammography adherence among the Asian female respondents for CHIS 2001 and 2009 and includes all variables of interest except home ownership. Home ownership was not collected in 2001. For all Asians (n = 3,643), screening mammography was associated with the following variables: study year; *predisposing variables*: being Vietnamese, not being married, and missing or unknown age of first period; *enabling factors*: being uninsured and having no usual source of care; and *health behaviors*: being obese or overweight, sedentary, and prior receipt of cancer prevention health services.

Between 2001 and 2009, the odds of being screening mammography adherence increased by 11% (95% CI = 1.02-1.21). The odds of being screening mammography adherent was increased if they were 50 to 64 years old compared to 40 to 49 years old (AOR = 1.37, 95% CI = 1.00-1.88). The odds of being screening mammography adherent was increased if they were Vietnamese compared to Japanese (AOR = 2.50, 95% CI = 1.14-5.47) and obese or overweight compared to normal weight (AOR = 1.37, 95% CI = 1.05-1.79). In addition, prior receipt of cancer prevention health services increased the likelihood of getting a screening mammogram in the past two years by 2.6 times (95% CI = 1.87-3.64). Being unmarried (AOR = 0.51, 95% CI = 0.36-0.72) and unknown age of their first period (AOR = 0.37, 95% CI = 0.18-0.76) was negatively associated with the likelihood of having screening mammography in the past two years. The likelihood of being adherent was decreased by 59% if they were uninsured (95% CI = 0.27-0.62) compared to someone who had insurance. The likelihood of being adherent also decreased by 71% if they had no usual source of care compared to someone who had usual source of care (95% CI = 0.20-0.42). Compared to physically active females, sedentary females were 26% less likely of being screening mammography adherent (95% CI =0.56-0.98).

Stratifying the sample showed that predisposing, enabling and need factors varied by nativity. For U.S.-born Asians, screening mammography was associated with study year; being Vietnamese, household size, not being married, age of their first period >13, and their first child being born at age 10 to 18 years; having no usual source of care as an *enabling factor*; and being sedentary and prior receipt of cancer prevention health services as *health behaviors*. For foreign-born Asians, screening mammography was associated with study year; not being married, unknown age of their first period, and their first child being born at age 10 to 18 years as *predisposing variables*; having no usual source of care as an *enabling factor*; and being obese or overweight, being sedentary and prior receipt of cancer prevention health services as *health behaviors*. Study year may be a proxy variable indicating increased acculturation, i.e., more years living in the U.S. Need factors were not associated with screening mammography in any of the analyses.

ANALYSES OF CHIS 2005 AND CHIS 2009 DATA

Table 6.13 shows the odds ratios for prevalence of having a screening mammogram within past 2 years among Asian female respondents aged 40 years and older for CHIS 2005 and 2009 and includes all variables of interest except family history of cancer. Questions about family history of cancer were not collected in 2005. For all Asians (n = 3,643), screening mammography was associated with the following variables: *predisposing variables*: age (50-64 years), not being married, and having no children; *enabling factors*: being uninsured and having no usual source of care; and *health behaviors*: being sedentary and prior receipt of cancer prevention health services. More predisposing and enabling factors were predictive of being adherent than need. The odds of being screening mammography adherent was increased if they were between 50 and 64 years old versus 40 to 49 years old (AOR = 1.55, 95% CI = 1.14-2.12), had no children versus having their first child when they were between 19 and 25 years old (AOR = 1.57, 95% CI= 1.01-2.44), and received a colonoscopy or Pap smear (AOR =

2.61, 95% CI = 1.95-3.49). The odds of being screening mammography adherent was decreased if they were unmarried (AOR = 0.46, 95% CI = 0.33-0.65), uninsured (AOR = 0.51, 95% CI 0.34-0.76), had no usual source of care (AOR = 0.68, 95% CI = 0.51-0.89), and were sedentary (AOR = 0.68, 95% = 0.51-0.89).

Stratifying the sample by nativity showed that there was an interaction effect - the association between screening mammography and individual factors (predisposing, enabling and need) varied by nativity. For both U.S.-born and foreign-born Asians, screening mammography was associated with being uninsured, having no usual source of care, and having prior receipt of cancer prevention services, i.e., colonoscopy or Pap smear. Among U.S.-born Asians, screening mammography adherence was increased if they rated their health very good (AOR = 3.03, 95% CI = 1.26-7.30) or fair (AOR = 5.32, 95% CI = 1.15-24.58) and had a colonoscopy or Pap smear (AOR 6.77, 95% CI = 2.72-16.87). It was decreased if they were uninsured (AOR = 0.11, 95% CI = 0.03-0.47) and had no usual source of care (AOR = 0.13, 95% CI = 0.04-0.41). For foreign-born Asians, the odds of being screening adherent were decreased of they did not know their age of menarche (AOR = 0.01, 95% CI = <0.001-0.10), were uninsured (AOR = 0.55, 95% CI = 0.36-0.85, had no usual source of care (AOR = 0.31, 95% CI = 0.20-0.47). It was increased by 60% for those between 50 and 64 years old compared to those 40 to 49 years old (AOR = 1.60, 95% CI = 1.13-2.27) and by more than double if they had a colonoscopy or Pap smear (AOR = 2.40, 95% CI = 1.74-3.31). These rates may be a result of increased acculturation and living in the U.S. for a longer period of time.

Table 6.12. Summary table of odds ratios for prevalence of having a screening mammogram within past 2 years among U.S.-born Asian female respondents aged 40 years and older, California Health Interview Survey (2001, 2009) (n = 3,643).

Variable	**CHIS 2001, 2009 (n = 3,643)**		**U.S. Born (n= 655)**		**Foreign-Born (n = 2,988)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	**1.11**	1.02-1.21	1.09	0.90-1.32	**1.11**	1.01-1.23
Predisposing Variables						
40-49 years	1.00		1.00		1.00	
50-64 years	**1.37**	1.00-1.88	1.11	0.39-3.15	1.39	0.99-1.96
≥65 years	0.82	0.52-1.30	0.38	0.12-1.25	0.97	0.56-1.67
US-Born	1.00		-	-	-	-
Foreign-Born	0.71	0.43-1.16	-	-	-	-
Chinese	1.17	0.71-1.94	0.82	0.32-2.09	0.80	0.43-1.50
Japanese	1.00		1.00		1.00	
Korean	0.80	0.44-1.46	0.26	0.04-1.52	0.57	0.28-.16
Filipino	1.07	0.60-1.90	1.85	0.26-13.03	0.65	0.34-1.24
Vietnamese	**2.50**	1.14-5.47	N/A	N/A	1.78	0.76-4.15
Other Asian	0.86	0.50-1.46	0.73	0.26-2.07	0.55	0.27-1.10
≤ High school	0.87	0.56-1.35	0.73	0.26-2.05	0.85	0.51-1.41
Some college	0.99	0.70-1.40	0.91	0.46-1.81	1.01	0.68-1.49
≥ College (4 yr. degree)	1.00		1.00		1.00	
Household Size (mean ± SD)	0.92	0.84-1.01	**0.78**	0.62-0.99	0.99	0.85-1.04
Not married	**0.51**	0.36-0.72	0.74	0.35-1.55	**0.48**	0.33-0.70
Speaks English only	1.00		1.00		1.00	
Speaks English very or well	0.97	0.62-1.54	0.73	0.27-1.96	1.10	0.66-1.81
Speaks English not well or not at all	0.81	0.49-1.32	0.34	<0.001- >999.99	0.90	0.53-1.54
Age when first period started >13	0.99	0.70-1.38	**2.57**	1.06-6.21	0.78	0.54-1.14
Unknown age of first period	**0.37**	0.18-0.76	0.25	0.06-1.05	**0.37**	0.18-0.78
No children	1.12	0.76-1.65	0.73	0.24-2.29	1.22	0.79-1.89
First child born between 10-18	0.67	0.37-1.24	**5.59**	1.03-30.46	**0.43**	0.22-0.84
First child born between 19-25	1.00		1.00		1.00	
First child born after 26	0.94	0.68-1.28	0.62	0.26-1.46	1.04	0.73-1.50
Enabling Factors						
Employed	1.00		1.00		1.00	
Unemployed	1.01	0.78-1.32	2.17	0.82-5.71	1.22	0.66-1.17

Table 6.12 continued.

Variable	CHIS 2001-2009 (n = 3,643)		U.S. Born (n= 655)		Foreign-Born (n = 2,988)	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Insured	1.00		1.00		1.00	
Uninsured	**0.41**	0.27-0.62	0.29	0.05-1.52	0.88	0.66-1.17
≤ 200% poverty level	1.00		1.00		1.00	
> 200% Poverty level	0.95	0.68-1.33	1.54	0.63-3.74	0.88	0.59-1.31
Usual source of care	1.00		1.00		1.00	
No usual source of care	**0.29**	0.20-0.42	**0.16**	0.04-0.63	**0.28**	0.18-0.43
Need Factors						
Excellent health	1.00		1.00		1.00	
Very good health	1.40	0.88-2.24	1.31	0.44-3.94	1.43	0.82-2.47
Good health	1.04	0.69-1.56	1.21	0.41-3.57	0.92	0.58-1.45
Fair health	0.85	0.54-1.35	1.39	0.34-5.60	0.73	0.45-1.20
Poor health	0.86	0.49-1.52	1.62	0.30-8.86	0.74	0.41-1.33
≥ 1 chronic condition	1.00		1.00		1.00	
No chronic condition			1.71	0.81-3.61	0.71	0.49-1.03
No chronic condition	0.81	0.58-1.12	1.00		1.00	
Family history of cancer	1.00		1.92	0.88-4.23	0.99	0.73-1.24
No family history of cancer	1.10	0.86-1.40	2.66	0.09-77.55	1.52	0.35-6.65
Missing family history of cancer	1.33	0.33-5.33	1.00		1.00	
No chronic condition	0.81	0.58-1.12	1.31	0.44-3.94	1.43	0.82-2.47
Health Behaviors			1.21	0.41-3.57	0.92	0.58-1.45
Underweight (BMI ≤ 18.49)	0.70	0.39-1.27	0.53	0.09-3.17	0.72	0.39-1.31
Normal Weight (18.5≤ BMI ≤ 25)	1.00		1.00		1.00	
Obese or Overweight (BMI ≥ 25)	**1.37**	1.05-1.79	**1.99**	1.03-3.84	1.32	0.97-1.79
Missing BMI	0.71	0.29-1.75	2.37	0.01-710.55	0.70	0.26-1.90
Sedentary	**0.74**	0.56-0.98	0.73	0.39-1.38	**0.72**	0.53-0.98
Binge Drinker	0.76	0.40-1.46	1.06	0.25-4.47	0.66	0.31-1.42
Never smoke	1.00		1.00		1.00	
Past Smoker	0.90	0.56-1.45	0.99	0.42-2.32	0.67	0.40-1.14
Current Smoker	0.74	0.41-1.31	0.83	0.27-2.59	0.60	0.29-1.23
Prior cancer prevention health service use	**2.61**	1.87-3.64	**4.52**	1.87-10.95	**2.58**	1.77-3.77

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR, adjusted odds ratio. CI, confidence intervals. Chronic conditions include asthma, diabetes, high blood pressure and heart disease. Bolded and shaded numbers indicate statistical significance at p-value <0.05. N/A, only included 1 U.S.-born Vietnamese.

Table 6.13. Summary table of odds ratios for prevalence of having a screening mammogram within past 2 years among U.S.-born Asian female respondents aged 40 years and older, California Health Interview Survey (2005, 2009) (n = 3,587).

Variable	**CHIS 2005, 2009 (n = 3,587)**		**U.S. Born (n= 625)**		**Foreign-Born (n = 2,962)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	1.06	0.90-1.25	1.32	0.93-1.87	1.04	0.87- 1.24
Predisposing Variables						
40-49 years	1.00		1.00		1.00	
50-64 years	**1.55**	1.14-2.12	1.63	0.60-4.41	**1.60**	1.13-2.27
≥65 years	1.02	0.61-1.72	0.74	0.18-3.15	1.09	0.61-1.92
US-Born	1.00		-	-	-	-
Foreign-Born	0.95	0.61-1.49	-	-	-	-
Chinese	1.19	0.70-2.03	0.69	0.28-1.72	1.33	0.65-2.73
Japanese	1.00		1.00		1.00	
Korean	0.80	0.45-1.41	0.21	0.03-1.55	0.83	0.41-1.69
Filipino	1.00	0.55-1.80	1.35	0.26-6.98	1.01	0.50-2.07
Vietnamese	1.77	0.90-3.47	N/A	N/A	1.85	0.85-4.03
Other Asian	0.95	0.52-1.71	0.94	0.38-2.36	0.95	0.46-1.97
≤ High school	0.68	0.45-1.00	0.34	0.13-0.87	0.65	0.42-1.01
Some college	0.88	0.64-1.21	1.24	0.56-2.76	0.75	0.51-1.09
≥ College (4 yr. degree)	1.00	1.00	1.00		1.00	
Household Size (mean ± SD)	1.00	0.89-1.13	1.04	0.70-1.57	1.00	0.90-1.13
Not married	**0.46**	0.33-0.65	0.48	0.20-1.14	0.46	0.33-0.67
Speaks English only	1.00		1.00		1.00	
Speaks English very or well	0.79	0.50-1.25	0.60	0.24-1.53	0.87	0.50-1.52
Speaks English not well or not at all	0.76	0.47-1.24	0.38	0.05-2.70	0.84	0.49-1.44
Age when first period started >13	0.93	0.62-1.39	1.19	0.54-2.66	0.86	0.55-1.36
Unknown age of first period	**0.02**	0.00-0.39	0.03	<0.001-1.22	**0.01**	<0.001-0.10
No children	**1.57**	1.01-2.44	1.51	0.45-5.04	1.53	0.93-2.51
First child born between 10-18	1.26	0.66-2.42	4.65	0.10-54.65	0.89	0.45-1.75
First child born between 19-25	1.00		1.00		1.00	
First child born after 26	0.98	0.72-1.33	0.47	0.17-1.29	1.02	0.74-1.40

Table 6.13 continued.

Variable	CHIS 2005, 2009 (n = 3,587)		U.S. Born (n= 625)		Foreign-Born (n = 2,962)	
Enabling Factors						
Employed	1.00		1.00		1.00	
Unemployed	1.12	0.81-1.55	1.68	0.59-4.83	1.12	0.78-1.60
Insured	1.00		1.00		1.00	
Uninsured	**0.51**	0.34-0.76	**0.11**	0.03-0.47	**0.55**	0.36 -0.85
Owns home	1.00		1.00			
Does not own home	0.76	0.57-1.01	1.02	0.42-2.50	0.73	0.54-0.98
≤ 200% poverty level	1.00		1.00		1.00	
> 200% Poverty level	1.09	0.80-1.48	2.12	0.77-5.85	1.03	0.74-1.44
Has usual source of care	1.00		1.00		1.00	
No usual source of care	**0.31**	0.21-0.46	**0.13**	0.04-0.41	**0.31**	0.20-0.47
Need Factors						
General health condition						
Excellent	1.00		1.00		1.00	
Very good	1.46	0.89-2.40	**3.03**	1.26-7.30	1.15	0.65-2.02
Good	1.08	0.67-1.76	1.90	0.66-5.47	0.86	0.52-1.43
Fair	1.25	0.71-2.19	**5.32**	1.15-24.58	0.92	0.52-1.65
Poor	0.88	0.48-1.64	0.93	0.12-7.12	0.70	0.34-1.41
≥ 1 chronic condition	1.00		1.00		1.00	
No chronic condition	0.77	0.55-1.08	1.43	0.60-3.41	0.69	0.47-1.00
Health Behaviors						
Underweight (BMI ≤ 18.49)	0.83	0.49-1.43	1.42	1.06-123.42	0.71	0.42-1.21
Normal Weight (18.5≤ BMI ≤ 25)	1.00		1.00		1.00	
Obese or Overweight (BMI ≥ 25)	1.27	0.90-1.79	3.23	1.41-7.43	1.08	0.76-1.54
Sedentary	**0.68**	0.51-0.89	0.47	0.22-1.00	0.69	0.51-0.95
Binge Drinker	0.57	0.31-1.04	1.05	0.18-6.11	0.57	0.28-1.13
Never smoke	1.00		1.00		1.00	
Past Smoker	1.10	0.69-1.74	0.99	0.43-2.30	1.06	0.62-1.83
Current Smoker	0.76	0.42-1.36	0.94	0.26-3.45	0.65	0.29-1.47
Prior cancer prevention health service use	**2.61**	1.95-3.49	**6.77**	2.72-16.87	**2.40**	1.74-3.31

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR, adjusted odds ratio. CI, confidence intervals. Chronic conditions include asthma, diabetes, high blood pressure and heart disease. Bolded and shaded numbers indicate statistical significance at p-value <0.05., N/A, only included 1 U.S.-born Vietnamese.

Comparison of Analyses

Table 6.14 compares multivariate analyses for screening mammography adherence among the Asian female respondents for the different sample populations. The predisposing, enabling and need factors associated with screening mammography varied according to the variables used. In all the analyses, more predisposing variables were predictive of screening mammography than enabling and need variables. Prior receipt of cancer prevention services and being sedentary were associated with screening mammography in all the analyses.

When using all CHIS data (CHIS 2001-2009), study year, five *predisposing* factors (age, being Vietnamese, household size, not being married, and speaking English not well or not at all), one *enabling factor* (not having health insurance), one *need factor* (no chronic condition), and three *health behaviors* (being obese or overweight, being sedentary and prior receipt of cancer prevention health services) were associated with screening mammography. Being overweight and obese may be increasing screening adherence in Asians because they are more likely to have comorbidities. Their comorbidities may cause them to visit a health care provider more often. As a result, they may be more likely to be screened. When age of menarche, age of first born, usual source of care, and family history of cancer were accounted in the second multivariate analysis (CHIS 2001 and CHIS 2009), the associations between screening mammography and individual factors changed. Age (≥ 65), household size, speaking English not well or not at all, and having no chronic condition were no longer associated with screening mammography. However, unknown age of menarche (AOR = 0.37, 95% CI = 0.18-0.76) and having no usual source of care became negatively associated with screening mammography. Having no usual source of care decreased the odds of being screening adherent by 61% (AOR = 0.29, 95% CI = 0.20-0.42) compared to someone with usual source of care.

The associations between screening mammography and individual factors also changed in the third analysis using CHIS 2005 and CHIS 2009 data. In the third multivariate analysis, home ownership was added to the model and family history of cancer was removed. Compared to the analysis using CHIS 2001 and 2009, age (50-64) and having no children became associated with screening mammography. Study year, being Vietnamese, and being overweight or obese were no longer associated with screening mammography. The individual factors that were still associated with the likelihood of being screening adherent were age 50-64 (*predisposing),* not being married (*predisposing*), unknown age of menarche (*predisposing*), being uninsured (*enabling)*, having no usual source of care (*enabling)*, being sedentary (*health behavior*) and prior receipt of a colonoscopy or Pap smear (*health behavior*). No need factors were associated with screening mammography.

Two sensitivity analyses were conducted using CHIS 2001 through CHIS 2009 data to see if the results would change. First, multivariate logistic regression models were run with all CHIS data including predisposing, enabling and need factors that were not collected. The results are shown in Table A.2. They were similar to the results using only complete data for CHIS 2001 through CHIS 2009, except that some of the missing variables (i.e., age of their first period, home ownership and usual source of care) were associated with screening mammography and study year was not associated with screening mammography. The relevant *predisposing variables* included age (50-64)

(AOR = 1.35, 95% CI = 1.11-1.64), being Vietnamese (AOR = 1.70, 95% CI = 1.05-2.75), household size (AOR = 0.92, 95% CI = 0.87-0.97), unmarried (AOR = 0.56, 95% CI = 0.0.44-0.70), and missing age of their first period (AOR = 0.31, 95% CI = 0.14-0.68). In terms of enabling factors, being uninsured (AOR = 0.50, 95% CI = 0.39-0.64), no home ownership (AOR = 0.77, 95% CI = 0.62-0.96), and no usual source of care (AOR = 0.33, 95% CI = 0.25-0.45) were negatively associated with screening mammography. The only *need factor* associated with screening mammography is the presence of a chronic condition. Compared to those with at least one chronic condition, a woman with no chronic condition was 23% less likely to be adherent to screening mammography guidelines.

Using only complete data from CHIS 2001 through CHIS 2009, additional analyses were conducted to see if removing subjects with at least one chronic condition or those who had prior receipt of cancer preventive services would impact the findings. Respondents with a chronic condition have a higher likelihood of visiting their doctor for their condition. Likewise, respondents who previously received cancer preventive services are more likely to visit the doctor for other services. After removing females with a chronic condition or prior receipt of cancer preventive services, the final sample included 2,776 females aged 40 years and older. Study year increased the odds of being screening mammography adherent by four-fold (AOR = 4.19, 95% CI = 1.31-13.41). The pertinent predisposing variables were being Vietnamese (AOR = 2.08, 95% CI =1.00-4.30) and being unmarried (AOR = 0.64, 95% CI = 0.44-0.94). Age was no longer associated with screening mammography. The pertinent enabling factors were being unemployed (AOR = 0.74, 95% CI =0.57-0.96), uninsured (AOR = 0.34, 95% CI = 0.23-

0.51) and living above 200% of the federal poverty level (AOR = 1.48, 95% CI = 1.02-2.14). No need factors were associated with screening mammography.

Table 6.14. Comparison table of odds ratios for prevalence of having a screening mammogram within past 2 years among Asian female respondents aged 40 years and older using different survey samples and variables, California Health Interview Survey.

Variable	**CHIS 2001-2009 (n = 8,353)**		**CHIS 2001, 2009 (n = 3,643)**		**CHIS 2005, 2009 (n = 3,587)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	**1.08**	1.01-1.16	**1.11**	1.02-1.21	1.06	0.90-1.25
Predisposing Variables						
40-49 years	1.00		1.00		1.00	
50-64 years	**1.31**	1.07-1.61	**1.37**	1.00-1.88	**1.55**	1.14-2.12
≥65 years	**0.70**	0.50-0.96	0.82	0.52-1.30	1.02	0.61-1.72
US-Born	1.00		1.00		1.00	
Foreign-Born	0.93	0.67-1.29	0.71	0.43-1.16	0.95	0.61-1.49
Chinese	1.08	0.78-1.49	1.17	0.71-1.94	1.19	0.70-2.03
Japanese	1.00		1.00		1.00	
Korean	0.80	0.54-1.19	0.80	0.44-1.46	0.80	0.45-1.41
Filipino	0.90	0.64-1.28	1.07	0.60-1.90	1.00	0.55-1.80
Vietnamese	**1.80**	1.11-2.92	**2.50**	1.14-5.47	1.77	0.90-3.47
Other Asian	0.90	0.64-1.28	0.86	0.50-1.46	0.95	0.52-1.71
≤ High school	0.84	0.63-1.12	0.87	0.56-1.35	0.68	0.45-1.00
Some college	0.88	0.70-1.09	0.99	0.70-1.40	0.88	0.64-1.21
≥ College (4 yr. degree)	1.00		1.00		1.00	
Household Size (mean ± SD)	**0.91**	0.84-0.97	0.92	0.84-1.01	1.00	0.89-1.13
Not married	**0.55**	0.43-0.70	**0.51**	0.36-0.72	**0.46**	0.33-0.65
Speaks English only	1.00		1.00		1.00	
Speaks English very or well	0.90	0.67-1.22	0.97	0.62-1.54	0.79	0.50-1.25
Speaks English not well or not at all	**0.70**	0.50-0.98	0.81	0.49-1.32	0.76	0.47-1.24
Age when first period started >13	-	-	0.99	0.70-1.38	0.93	0.62-1.39
Unknown age of first period	-	-	**0.37**	0.18-0.76	**0.02**	0.00-0.39
No children	-	-	1.12	0.76-1.65	**1.57**	1.01-2.44
First child born between 10-18	-	-	0.67	0.37-1.24	1.26	0.66-2.42
First child born between 19-25	-	-	1.00		1.00	
First child born after 26	-	-	0.94	0.68-1.28	0.98	0.72-1.33
Enabling Factors						
Employed	1.00		1.00		1.00	
Unemployed	0.93	0.78-1.11	1.01	0.78-1.32	1.12	0.81-1.55

Table 6.14 continued.

Variable	CHIS 2001-2009 (n = 8,353)		CHIS 2001, 2009 (n = 3,643)		CHIS 2005, 2009 (n = 3,587)	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Insured	1.00		1.00		1.00	
Uninsured	**0.40**	0.32-0.50	**0.41**	0.27-0.62	**0.51**	0.34-0.76
≤ 200% poverty level	1.00		1.00		1.00	
> 200% Poverty level	0.99	0.80-1.24	0.95	0.68-1.33	0.76	0.57-1.01
Has usual source of care	-	-	1.00		1.00	
No usual source of care	-	-	**0.29**	0.20-0.42	**0.31**	0.21-0.46
Need Factors						
General health condition						
Excellent	1.00		1.00		1.00	
Very good	1.14	0.83-1.55	1.40	0.88-2.24	1.46	0.89-2.40
Good	0.98	0.73-1.31	1.04	0.69-1.56	1.08	0.67-1.76
Fair	1.00	0.72-1.38	0.85	0.54-1.35	1.25	0.71-2.19
Poor	0.85	0.58-1.24	0.86	0.49-1.52	0.88	0.48-1.64
≥ 1 chronic condition	1.00		1.00		1.00	
No chronic condition	**0.75**	0.60-0.92	0.81	0.58-1.12	0.77	0.55-1.08
Family history of cancer	-	-	1.00		-	-
No family history of cancer	-	-	1.10	0.86-1.40	-	-
Missing family history of cancer	-	-	1.33	0.33-5.33	-	-
Health Behaviors						
Underweight (BMI ≤ 18.49)	0.74	0.52-1.04	0.70	0.39-1.27	0.83	0.49-1.43
Normal Weight (18.5≤ BMI ≤ 25)	1.00		1.00		1.00	
Obese or Overweight (BMI ≥ 25)	**1.33**	1.07-1.64	**1.37**	1.05-1.79	1.27	0.90-1.79
Missing BMI	0.73	0.30-1.76	0.71	0.29-1.75	-	-
Sedentary	**0.75**	0.62-0.92	**0.74**	0.56-0.98	**0.68**	0.51-0.89
Binge Drinker	0.67	0.44-1.03	0.76	0.40-1.46	0.57	0.31-1.04
Never smoke	1.00		1.00		1.00	
Past Smoker	0.97	0.71-1.32	0.90	0.56-1.45	1.10	0.69-1.74
Current Smoker	0.82	0.54-1.23	0.74	0.41-1.31	0.76	0.42-1.36
Prior cancer prevention health service use	**2.90**	2.41-3.49	**2.61**	1.87-3.64	**2.61**	1.95-3.49

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR, adjusted odds ratio. CI, confidence intervals. Chronic conditions include asthma, diabetes, high blood pressure and heart disease. Bolded and shaded numbers indicate statistical significance at p-value <0.05. – indicates variable was not collected.

Table 6.15 summarizes the hypotheses and results for Specific Aim II. The purpose of specific Aim II was to determine if the effect of predisposing, enabling, and need factors on screening mammography adherence varies among U.S.-born and foreign-born Asian Americans. The results of the multivariate analysis partially support the hypotheses for Specific Aim II. More predisposing variables than enabling and need factors were associated with screening mammography adherence. When using all CHIS data, only one *enabling factor* (health insurance) and one *need factor* (chronic condition) were associated with screening mammography. There were five *predisposing* factors (age, being Vietnamese, household size, not being married, and speaking English not well or not at all) associated with screening mammography. Age when menarche (first period) started, age when their first child was born, home ownership, usual source of care, and family history of breast cancer were not included in the first multivariate analysis. When age of menarche, age of first born, usual source of care, and family history of cancer were accounted in the second multivariate analysis (CHIS 2001 and CHIS 2009), the associations between screening mammography and individual factors changed. They also changed in the third multivariate analysis (CHIS 2005 and CHIS 2009) when home ownership was added and family history of cancer was removed.

The multivariate analyses support the first and second hypotheses. Age (50-64 years) and being unmarried was supported by all three multivariate analyses (CHIS 2001-2009, CHIS 2001 and 2009, CHIS 2005 and 2009). Race/ethnicity was only associated with the first two analyses (CHIS 2001-2009, CHIS 2001 and 2009). Specifically, being Vietnamese increased the chance of being adherent by two-fold. In terms of enabling factors, having no insurance and no usual source of care was negatively associated with screening mammography (CHIS 2001, 2009 and CHIS 2005, 2009). Hypothesis IIC was not supported – no need factors were associated with screening mammography after accounting for the additional predisposing (age of menarche, age when first child was born) and enabling variables (home ownership and usual source of care).

Table 6.15. Summary of Specific Aim II hypotheses that examine the relationship between predisposing, enabling and need factors and screening mammography, and whether hypotheses were supported, not supported or partially supported.

Specific Aim II Hypotheses	OR (95% CI)			Reference	Outcome
IIA.		2001, 2009	2005, 2009		
Pertinent predisposing variables would include age, race/ethnicity, household size, marital status, U.S.-born, and level of English proficiency.	Age (50-64):	1.37 (1.00-1.88)	1.55 (1.14-2.12)	Tables 6.11- 6.14	PS
	Vietnamese:	2.50 (1.14-5.47)	1.77 (0.90-3.47)		
	Household size:	0.92 (0.84-1.01)	1.00 (0.89-1.13)		
	Not married:	0.51 (0.36-0.72)	0.46 (0.33-0.65)		
	Foreign-born:	0.71 (0.43-1.16)	0.95 (0.61-1.49)		
	English not well or not at all:	0.81 (0.49-1.32)	0.76 (0.47-1.24)		
IIB					
Enabling factors would include employment, any type of health insurance and a usual source of care.	Unemployed:	1.01 (0.78-1.32)	1.12 (0.81-1.55)	Tables 6.11- 6.14	PS
	No health insurance	0.41 (0.27-0.62)	0.51 (0.34-0.76)		
	No usual source of care	0.29 (0.20-0.42)	0.31 (0.21-0.46)		
IIC					
Need factors would include general health condition and ≥1 chronic condition.	General Health			Tables 6.11- 6.14	NS
	Fair:	0.85 (0.54-1.35)	1.25 (0.71-2.19)		
	Poor:	0.86 (0.49-1.52)	0.88 (0.48-1.64)		
	Chronic Condition:	0.81 (0.58-1.12)	0.77 (0.55-1.08)		

Note: PS = Partially Supported, NS = Not Supported, and S = Supported.

SPECIFIC AIM II SUMMARY

Previous research has shown that a woman's decision to have a mammography and adhere to the mammography screening guidelines is guided by various factors. According to Andersen Model (1968), the usage of health care services is dependent on *predisposing*, *enabling*, and *need factors*. The goal of Specific Aim II was to determine the relationship between *predisposing*, *enabling*, and *need factors* on mammography adherence among Asian Americans and to determine if there are differences by nativity.

For this study, the *predisposing variables* included age, nativity status, Asian subgroup, education, household size, marital status, level of English proficiency, age of first period, and age when first child was born. The *enabling factors* included employment status, health insurance status, living at or below 200% of the federal poverty level and usual source of care. The *need factors* included general health condition, 1 or more chronic conditions, and family history of cancer. The *health behaviors* include body mass index, sedentary lifestyle, binge drinker, smoking status and prior receipt of cancer preventive services. It was hypothesized that the effect of individual characteristics on mammography adherence will vary between U.S.-born and foreign-born Asian American women, in regards to predisposing, enabling, and need factors. Specifically, the pertinent ***predisposing variables*** would include age, race/ethnicity, household size, marital status, U.S.-born, and level of English proficiency (Hypothesis IIA). The relevant ***enabling factors*** would include employment, any type of health insurance and a usual source of care (Hypothesis IIB). The related ***need factors*** include general health condition and ≥ 1 chronic condition (Hypothesis IIC).

The sample distributions by screening mammography status (Tables 6.1-6.3) showed that the *predisposing*, *enabling*, and *need factors* varied among women who were adherent and non-adherent to the screening mammography guidelines. The adherent group had a higher percentage of being older, foreign-born, and smaller household. A higher percentage of Asian women who reported screening mammography adherence if they are employed, currently insured, owned a home, and have usual source of care.

Predisposing, enabling, and *need factors* varied among U.S.-born and foreign-born Asian women. Non-adherent women have a higher percentage of women living below 200% of the poverty level. Figures 6.1 through 6.3 show that screening mammography adherence varied by nativity, Asian subgroup, and age group.

The results for Specific Aim II were somewhat mixed and depended on the survey sample used and what variables were adjusted in the models. Since some variables were not collected at each wave, multiple logistic regressions were created to determine which predisposing, enabling, need, and health behaviors were associated with mammography adherence for all Asians, U.S.-born Asians, and foreign-born Asians. All of logistic regressions partially supported Hypotheses IIA and IIB. Predisposing factors more than enabling and need factors predicted screening mammography.

When using all CHIS data, only one *enabling factor* (health insurance) and one *need factor* (chronic condition) were associated with screening mammography. Five *predisposing* factors (age, being Vietnamese, household size, not being married, and speaking English not well or not at all) associated with screening mammography. When age of menarche, age of first born, usual source of care, and family history of cancer were accounted in the second multivariate analysis (CHIS 2001 and CHIS 2009), the associations between screening mammography and individual factors changed. Age (≥ 65), household size, speaking English not well or not at all, and having no chronic condition were no longer associated with screening mammography. However, unknown age of menarche (AOR = 0.37, 95% CI = 0.18-0.76) and having no usual source of care became negatively associated with screening mammography. Having no usual source of care decreased the odds of being screening adherent by 61% (AOR = 0.29, 95% CI = 0.20-0.42) compared to someone with usual source of care.

The associations also changed in the third multivariate analysis (CHIS 2005 and CHIS 2009) when home ownership was added and family history of cancer was removed. Compared to the analysis using CHIS 2001 and 2009, age (50-64) and having no children became associated with screening mammography. Study year, being Vietnamese, and being overweight or obese were no longer associated with screening mammography. The individual factors that were still associated with the likelihood of being screening adherent were age 50-64 (*predisposing),* not being married (*predisposing*), unknown age of menarche (*predisposing*), being uninsured (*enabling)*, having no usual source of care (*enabling)*, being sedentary (*health behavior*) and prior receipt of a colonoscopy or Pap smear (*health behavior*).

In summary, no *need factors* were associated with screening mammography when accounting for the additional *predisposing* (age of menarche, age when first child was born) and *enabling* variables (home ownership and usual source of care). Age (50-64 years) and being unmarried was associated with screening mammography in all three analyses (CHIS 2001-2009, CHIS 2001 and 2009, CHIS 2005 and 2009). Race/ethnicity was only associated with the first two analyses (CHIS 2001-2009, CHIS 2001 and 2009). Specifically, being Vietnamese increased the chance of being adherent by two-fold. In terms of *enabling factors*, having no insurance and no usual source of care was negatively associated with screening mammography (CHIS 2001, 2009 and CHIS 2005, 2009).

Chapter 7: Specific Aim III Results

Chapter 7 details the results of the analyses for Specific Aim III. The purpose of Specific Aim III was to determine if the effect of the health care and/or social environment on screening mammography adherence rates in Asian women varies by nativity. ***Screening mammography adherence*** is defined as the self-reported receipt of screening mammography in the past two years. The health care environment variables included the number of doctor visits in the past year, a doctor visit in the past 12 months, and a breast examination for lumps by a doctor in the past 12 months. The social environment variables comprised of feeling safe in the neighborhood, living in an urban zip code, and the length of time in months that they were living at their current address.

The effect of the environmental variables is hypothesized to vary between U.S.-born and foreign-born Asian women. The first hypothesis (IIIA) is that screening mammography adherence would be higher among Asian women who have seen their doctor and had their breasts examined for lumps by a doctor in the past 12 months. The second hypothesis (IIIB) is that screening mammography adherence would be higher for Asian women who lived at their current address for more than 120 months and felt safe in their neighborhood. The results are presented in two sections. First, descriptive statistics on the social and health care environment are provided. Second, logistic regressions are performed to analyze the relationship between screening mammography adherence, the social and health care environment, and nativity.

DESCRIPTIVE STATISTICS

Given that the same variables were not collected at each wave, the data analysis for Specific Aim III only included survey years with complete data on the social and health care environment (CHIS 2005 and CHIS 2009). For example, urban zip code is collected for all survey years. However, none of the health care or social environment variables (except urban zip code) are collected for CHIS 2001, feeling safe in the neighborhood was not collected in CHIS 2003, and a breast examination for lumps by a doctor in the past 12 months was not collected for CHIS 2007. The CHIS 2005 and CHIS 2009 sample included 3,587 Asian females aged 40 to 85 years old. The mean age of the sample is 56.8 ± 12.2 years. The screening mammography adherence rate is 73.9%. The average number of doctor visits in the past year is 3.2 ± 2.7 (range: 0-10) and the average length of time living at their current address is 137.8 ± 127.1 months (range: 4-840 months).

Sample Distributions of the Social and Health Care Environment Variables by Screening Mammography Adherence

Table 7.1 shows that the social and health care environment variables were significantly different between adherent and non-adherent Asian women (p-value <0.05). Asian women who were adherent to the 2002 USPSTF screening mammography guidelines were older. The mean age of adherent women is 57.0 ± 11.5 years while the mean age of non-adherent women is 56.0 ± 13.7 years. Compared to non-adherent women, adherent women had more exchanges with a doctor. Specifically, adherent women had a higher percentage of visiting the doctor in the past 12 months (89.4% versus 68.4%) and an increased number of doctor visits in the past year (3.5 ± 2.7 versus

2.5 ± 2.8). Adherent women also had a higher percentage of breast examinations for lumps than non-adherent women (80.9% versus 30.5%). A higher percentage of adherent women felt safe in their neighborhood all or most of the time. Adherent and non-adherent women had similar percentages for living in an urban zip code, but different lengths of residency. On average, adherent women lived at their current address for a longer time period than non-adherent women – a difference of almost 39 months.

Table 7.1. Social/health care characteristics of Asian women aged ≥ 40 years by self-reported screening mammography adherence, California Health Interview Survey (2005, 2009) (n = 3,587).

Variable	**Adherent (n = 2,650)**		**Non-Adherent (n = 937)**		**p-value**
	n	%	n	%	
Age (mean ± SD)	57.0 ± 11.5		56.0 ± 13.7		0.0252
Health care environment					
Number of doctor visits within past year (mean ± SD)	3.5 ± 2.7		2.5 ± 2.8		<0.0001
Visited doctor during past 12 months					<0.0001
Yes	2369	89.4%	641	68.4%	
No	281	10.6%	293	31.6%	
Doctor examined breasts for lumps in past 12 months					<0.0001
Yes	2145	80.9%	286	30.5%	
No	505	19.1%	651	69.5%	
Social environment					
Feel safe in the neighborhood					<0.0001
All or most of the time	2409	90.9%	818	87.3%	
Some of the time	178	6.7%	77	8.2%	
None of the time	30	1.1%	18	1.9%	
Missing	33	1.3%	24	2.6%	
Urban					<0.0001
Yes	2617	98.8%	927	98.9%	
No	33	1.3%	10	1.1%	
Length of time lived at current address in months (mean ± SD)	147.9 ± 129.3		109.4 ± 115.9		<0.0001

Note: SD, standard deviation.

Sample Distributions of Social and Health Care Environment Factors by Nativity

Table 7.2 reports the social and health care characteristics by nativity. There are more foreign-born respondents than U.S.-born respondents in this sample (about 5:1). All of the social and health care environment variables were significantly different between U.S.-born and foreign-born Asian women (p-value <0.05), except number of doctor visits in the past year. On average, U.S.-born Asian women were older than foreign-born Asian women. The mean age of U.S.-born women is 58.0 ± 13.5 years while the mean age of foreign-born women is 56.5 ± 11.8 years. While U.S.-born and foreign-born Asians had about the same number of doctor visits in the past year, U.S.-born women had a higher percentage of visiting the doctor (88.0% versus 83.1%) and having a breast examination for lumps by a doctor in the past 12 months (73.0% versus 66.7%). A higher percentage of U.S.-born Asians felt safe in their neighborhood all or most of the time compared to foreign-born Asians (94.1% versus 89.1%). A higher percentage of foreign-born Asian women lived in an urban zip code (99.1% versus 97.4%). U.S.-born and foreign-born Asian women differed in lengths of residency. On average, U.S.-born Asian women lived at their current address for a considerably longer time period (76.6% longer) than foreign-born Asian women. The mean length of time that U.S.-born women lived at their current address is 214.7 ± 173.2 months. The mean length of time that foreign-born women lived at their current address is 121.6 ± 108.3 months.

Table 7.2. Social/health care characteristics of Asian women aged ≥ 40 years by nativity, California Health Interview Survey (2005, 2009) (n = 3,587).

Variable	U.S.-Born (n = 625)		Foreign-Born (n = 2,962)		p-value
	n	%	n	%	
Age (mean ± SD)	58.0 ± 13.5		56.5 ± 11.8		0.0051
Health care environment					
Number of doctor visits within past year (mean ± SD)	3.4 ± 2.8		3.2 ± 2.7		0.1086
Visited doctor during past 12 months					
Yes	550	88.0%	2460	83.1%	<0.0001
No	75	12.0%	502	17.0%	
Doctor examined breasts for lumps in past 12 months					
Yes	456	73.0%	1975	66.7%	<0.0001
No	169	27.0%	987	33.3%	
Social environment					
Feel safe in the neighborhood					
All or most of the time	588	94.1%	2639	89.1%	<0.0001
Some of the time	20	3.2%	235	7.9%	
None of the time	5	0.8%	43	1.5%	
Missing	12	1.9%	45	1.5%	
Urban					
Yes	609	97.4%	2935	99.1%	<0.0001
No	16	2.6%	27	0.9%	
Length of time lived at current address in months (mean ± SD)	214.7 ± 173.2		121.6 ± 108.3		<0.0001

Note: SD, standard deviation

Sample Distributions of Social and Health Care Environment Factors among Adherent Women by Nativity

As Table 7.3 displays, the social and health care characteristics among screening mammography adherent Asian women varied by nativity. All of the social and health care environment variables were significantly different between U.S.-born and foreign-born adherent women (p-value <0.05), except number of doctor visits in the past year. The average number of doctor visits in the past year was slightly higher among U.S.-born adherent Asian women than foreign-born adherent women (3.6 ± 2.7 versus 3.4 ± 2.7). The percentages of having visited the doctor (92.3% versus 88.7%) and having a doctor examine breasts for lumps (82.0% versus 80.7%) were higher among U.S.-born adherent women. A higher percentage of U.S.-born adherent women felt safe in their neighborhood all or most of the time (95.3% versus 89.9%). Foreign-born adherent women had a higher percentage of living in an urban zip code than U.S.-born adherent women (99.1% versus 97.2%). On average, U.S.-born adherent women lived 91 months longer at their current address than foreign-born adherent women (221.5 ± 171.3 months versus 130.5 ± 110.3 months).

Table 7.3. Social/health care characteristics of adherent Asian women aged ≥ 40 years by nativity, California Health Interview Survey (2005, 2009) (n = 2,650).

Variable	**U.S. Born (n = 506)**		**Foreign-Born (n = 2,144)**		p-value
	n	%	n	%	
Age (mean ± SD)	58.3 ± 12.9		56.7 ± 11.2		0.0050
Health care environment					
Number of doctor visits within past year (mean ± SD)	3.6 ± 2.7		3.4 ± 2.7		0.1086
Visited doctor during past 12 months					<0.0001
Yes	467	92.3%	1902	88.7%	
No	39	7.7%	242	11.3%	
Doctor examined breasts for lumps in past 12 months					<0.0001
Yes	415	82.0%	1730	80.7%	
No	91	18.0%	414	19.3%	
Social environment					
Feel safe in the neighborhood					<0.0001
All or most of the time	482	95.3%	1927	89.9%	
Some of the time	13	2.6%	165	7.7%	
None of the time	4	0.8%	26	1.2%	
Missing	7	1.4%	26	1.2%	

Table 7.3 continued.

Variable	U.S. Born (n = 506)		Foreign-Born (n = 2,144)		p-value
	n	%	n	%	
Urban					<0.0001
Yes	492	97.2%	2125	99.1%	
No	14	2.8%	19	0.9%	
Length of time lived at current address in months (mean ± SD)	221.5 ± 171.3		130.5 ± 110.3		<0.0001

Note: SD, standard deviation.

SPECIFIC AIM III RESULTS

The goal of Specific Aim III was to determine if the effect of the health care and/or social environment on screening mammography adherence varies among U.S.-born and foreign-born Asian Americans. It is hypothesized that the effect of the social and health care environment on screening mammography adherence would vary between U.S.-born and foreign-born Asian American women. Hypothesis IIIA is that mammography adherence would be higher among Asian women who have seen their doctor within the last year and had their breasts examined for lumps. Hypothesis IIIB is that mammography adherence would be higher for Asian women who have lived at their current address for more than 120 months and felt safe in their neighborhood. A correlation matrix is constructed to describe the relationship between screening mammography adherence and each of the predictor variables (social/health care environment variables and nativity). Weighted multivariate logistic regression analyses were used to assess the hypotheses.

Correlations and Multivariate Associations

Correlations between screening mammography adherence, the social and health care environment, and nativity are shown in Table 7.4. Study year, number of doctor visits, doctor visit, breast examination, time at current address and nativity were positively correlated with screening mammography adherence. Neighborhood safety was negatively correlated with screening mammography adherence.

Table 7.4. Correlations between screening mammography adherence and social/health care environment in a sample of Asian women aged 40 years and older from the California Health Interview Survey (2005, 2009) (n = 3,587).

	1	2	3	4	5	6	7	8	9
1-Screening mammography	1.00								
2-Study Year	**0.05**	1.00							
3-Number of Doctor Visits	**0.15**	0.01	1.00						
4-Doctor Visit	**0.25**	0.00	**0.51**	1.00					
5-Breast Examination	**0.47**	0.00	**0.15**	**0.03**	1.00				
6-Neighborhood Safety	**-0.05**	**-0.09**	0.01	-0.01	-0.02	1.00			
7-Urban	-0.01	0.00	0.00	0.02	-0.02	-0.03	1.00		
8-Time at Current Address	**0.13**	**0.10**	**0.03**	**0.09**	**0.06**	**-0.05**	0.02	1.00	
9-Nativity	**0.07**	-0.05	0.32	**0.05**	**0.05**	0.01	**-0.06**	**0.28**	1.00

Note: Bolded numbers indicate statistical significance at p-value <0.05.

Table 7.5 shows the multivariate associations between screening mammography adherence, demographic variables, and the social and health care environment by survey year. One sample characteristic remained consistent between CHIS 2005 and CHIS 2009 – a doctor examining breasts for lumps in the past 12 months was associated with higher odds of screening mammography. In 2005, being between the ages of 50 and 64 years old was associated with higher odds of screening mammography adherence (AOR = 2.52, 95% CI = 1.68-3.77) while being Korean was associated with lower odds of screening mammography adherence (AOR = 0.43, 95% CI = 0.20-0.93). In 2009, feeling safe in the neighborhood all or most of the time was associated with higher odds of screening mammography (AOR = 4.51, 95% CI = 1.08-18.92). Yet, feeling safe in the neighborhood was not associated with screening mammography adherence in 2005.

Table 7.5. Multivariate associations between demographic variables, the social and health care environment and screening mammography adherence among Asian female respondents aged 40 years and older by survey year, California Health Interview Survey (2005, 2009) (n = 3,587)

Study Year	**2005** n = 1,510		**2009** n = 2,077	
	AOR	95% CI	AOR	95% CI
Health Care Environment				
Number of doctor visits within past year	1.07	0.98-1.16	1.11	0.98-1.25
Visited doctor during past 12 months	1.26	0.79-2.01	1.56	0.84-2.91
Doctor examined breasts for lumps in past 12 months	**9.26**	6.56-13.06	**5.47**	3.24-9.23
Social Environment				
Feel safe in the neighborhood				
All or most of the time	1.34	0.44-4.11	**4.51**	1.08-18.92
Some of the time	0.99	0.28-3.47	3.57	0.67-19.02
None of the time	1.00		1.00	
Missing			0.07	0.00-2.84
Urban	1.01	0.24-4.24	0.56	0.09-3.63
Time at current address ≥ 120 months	0.97	0.63-1.50	1.66	0.93-2.96
Demographics				
Age				
40-49	1.00		1.00	
50-64	**2.52**	1.68-3.77	1.15	0.59-2.27
≥65	1.50	0.93-2.43	0.94	0.50-1.77
Asian Subgroup				
Chinese	0.81	0.40-1.65	0.93	0.41-2.11
Japanese	1.00		1.00	
Korean	**0.43**	0.20-0.93	0.54	0.24-1.22
Filipino	0.59	0.27-1.31	1.14	0.45-2.88
Vietnamese	0.59	0.26-1.37	1.96	0.59-6.55
Other Asian	0.84	0.34-2.10	0.85	0.40-1.80
Nativity				
U.S. Born	1.00			
Foreign-Born	0.71	0.40-1.26	0.76	0.35-1.64

Multivariate Analyses

Table 7.6 shows the weighted multivariate logistic regression analyses investigating the relationships between screening mammography adherence and the social and health care environment. Model 1 adjusts for study year and indicates that study year is not associated with the increase in screening mammography adherence between survey years (AOR = 1.11; 95 % CI = 0.96-1.28). Model 2 adjusts for the health care environment variables. In this model, Asian women who visited their doctor in the past 12 months and had a doctor examine their breasts for lumps had higher odds of screening mammography adherence. Compared to women who did not see their doctor in the past 12 months, Asian women who visited their doctor were 50% were more likely to be screening mammography adherent (AOR= 1.50; 95% CI = 1.01-2.24). Women who had their breasts examined by a doctor for lumps were seven times more likely to get a screening mammogram in the past two years than those who did not (AOR = 7.02, 95% CI = 5.18-9.51).

After adding the social environment variables into the model (Model 3), doctor examining breasts for lumps remained significant (AOR = 6.92; 95% CI = 5.02-9.53). However, visiting the doctor during the past year did not (AOR = 1.44; 95% CI = 0.96-2.19). Asian women who felt safe in their neighborhood all or most of time (AOR = 2.50, 95% CI = 1.04-6.06) and lived at their current address for more than 120 months (AOR = 1.51; 95%CI =1.10-2.07) had a higher likelihood of being screening mammography adherent. When adjusting for age, Asian subgroup, and nativity in Model 4, screening mammography adherence is associated with age (50-64), being Korean, missing neighborhood safety, and having a doctor examine breasts for lumps. Compared to women aged 40 to 49 years old, women aged 50 to 64 years old were 71% more likely to be screening mammography adherent (AOR = 1.71; 95% CI = 1.11-2.62). Compared to Japanese respondents, Korean women were 52% less likely to screening mammography adherent (AOR = 0.48; 95% CI = 0.27-0.84). The results show that the health care environment is associated with mammography adherence. Specifically, women who had their breasts examined by a doctor in the past 12 months were 6.79 times more likely to get a screening mammogram in the past 2 years than those who did not (95% CI = 4.93-9.34). To test for interaction effects between nativity and Asian subgroup, additional weighted logistic regression analyses were completed stratifying the sample by nativity.

Table 7.7 summarizes the odds ratios for screening mammography adherence. The effect of the social and health care environment on screening mammography adherence varied among U.S.-born and foreign-born Asians. For all Asians regardless of nativity (n = 3,587), screening mammography adherence is positively associated with having a breast examination for lumps by a doctor in the past 12 months and being between the ages of 50 and 64 years old. Being Korean is negatively associated with screening mammography. For U.S.-born Asians (n = 625), women aged 50 to 64 years who received a breast examination for lumps by a doctor had higher odds of being screening mammography adherent. For foreign-born Asians (n = 2,962), women aged 50 to 64 years who visited a doctor during the past 12 months and received a breast examination for lumps by a doctor had higher odds of being screening adherent. Among the foreign-born, the odds of being screening adherent is lower in Koreans.

Table 7.6. Odds ratios for prevalence of having screening mammogram within past 2 years among Asian female respondents aged ≥ 40 years using social and health care environment, California Health Interview Survey (2005, 2009) (n = 3,587)

Variable	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	1.11	0.96-1.28	1.13	0.95-1.33	1.13	0.95-1.35	1.13	0.95-1.36
Health Care Environment								
Number of doctor visits within past year			1.07	1.00-1.15	1.08	1.00-1.16	1.08	1.00-1.17
Visited doctor during past 12 months			**1.50**	1.01-2.24	1.44	0.96-2.17	1.40	0.93-2.10
Doctor examined breasts for lumps in past 12 months			**7.02**	5.18-9.51	**6.92**	5.02-9.53	**6.79**	4.93-9.34
Social Environment								
Feel safe in the neighborhood								
All or most of the time					**2.51**	1.04-6.06	2.08	0.82-5.29
Some of the time					1.99	0.70-5.65	1.57	0.53-4.67
None of the time					1.00		1.00	
Missing					0.05	0.00-1.32	**0.03**	<0.001-0.98
Urban					0.69	0.16-2.92	0.69	0.14-3.32
Time at current address ≥ 120 months					**1.51**	1.10-2.07	1.30	0.92-1.85
Age								
40-49							1.00	
50-64							**1.71**	1.11-2.62
≥65							1.19	0.80-1.77
Asian Subgroup								
Chinese							0.86	0.51-1.45
Japanese							1.00	
Korean							**0.48**	0.27-0.84
Filipino							0.79	0.42-1.47
Vietnamese							1.02	0.49-2.10
Other Asian							0.82	0.45-1.48
Nativity								
U.S. Born							1.00	
Foreign-Born							0.77	0.47-1.25

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR - Adjusted odds ratio. CI - Confidence intervals. Bolded and shaded numbers indicate statistical significance at p>0.05.

Table 7.7. Summary of odds ratios for screening mammography adherence among Asian female respondents aged 40 years and older by nativity and social/health care environment, California Health Interview Survey (2005, 2009) (n = 3,587).

Variable	**All Asians (n = 3,587)**		**U.S.-Born Asians (n = 625)**		**Foreign-Born Asians (n = 2,962)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	1.13	0.95-1.36	1.12	0.80-1.55	1.14	0.94-1.39
Health Care Environment						
Number of doctor visits within past year	1.08	1.00-1.17	1.13	0.97-1.31	1.07	0.98-1.16
Visited doctor during past 12 months	1.40	0.93-2.10	0.87	0.26-2.95	**1.63**	1.04-2.56
Doctor examined breasts for lumps in past 12 months	**6.79**	4.93-9.34	**4.28**	1.98-9.29	**7.59**	5.35-10.76
Social Environment						
Feel safe in the neighborhood						
All or most of the time	2.08	0.82-5.29	0.76	<0.001->999	2.11	0.80-5.59
Some of the time	1.57	0.53-4.67	0.26	<0.001->999	1.79	0.57-5.59
None of the time	1.00		1.00		1.00	
Missing	**0.03**	<0.001-0.98	0.02	<0.001->999	0.01	<0.001-0.13
Urban	0.69	0.14-3.32	1.98	0.05-83.98	0.46	0.09-2.30
Time at current address ≥ 120 months	1.30	0.92-1.85	1.03	0.44-2.41	1.36	0.92-2.01
Demographics						
Age						
40-49	1.00		1.00		1.00	
50-64	**1.71**	1.11-2.62	**3.03**	1.28-7.19	**1.63**	1.03-2.59
≥65	1.19	0.80-1.77	1.40	0.50-3.91	1.23	0.82-1.84
Asian Subgroup						
Chinese	0.86	0.51-1.45	0.63	0.26-1.55	0.92	0.48-1.74
Japanese	1.00		1.00		1.00	
Korean	**0.48**	0.27-0.84	0.40	0.08-1.96	**0.49**	0.24-0.97
Filipino	0.79	0.42-1.47	1.21	0.34-4.38	0.73	0.37-1.47
Vietnamese	1.02	0.49-2.10	N/A	N/A	1.03	0.48-2.24
Other Asian	0.82	0.45-1.48	0.85	0.30-2.42	0.82	0.39-1.75
Nativity						
U.S. Born	1.00		-	-	-	-
Foreign-Born	0.77	0.47-1.25	-	-	-	-

Note: Odds ratios are from weighted logistic regression models adjusted for the complex survey design of the CHIS. AOR, adjusted odds ratio. CI, confidence intervals. Bolded and shaded numbers indicate statistical significance at p>0.05. N/A, only 1 U.S.-born Vietnamese. Results did not change when removing the one U.S.-born Vietnamese.

Two sensitivity analyses were conducted to see if the presence of a chronic condition or receipt of a colonoscopy or Pap smear would impact the results. Respondents with a chronic condition have a higher likelihood of visiting their doctor for their medical condition and have more interactions with the health care environment. Likewise, respondents who previously received cancer preventive services are more likely to visit the doctor for other services and undergo screening mammography.

Removing Asians with at least one chronic condition showed similar results in regards to health care environment for all Asians (n = 1,958), but differing results for U.S.-born and foreign-born Asians. For Asian females, screening mammography adherence is positively associated with having a breast examination for lumps by a doctor in the past 12 months (AOR = 6.06, 95% CI = 3.83-9.60) as well as the number of doctor visits in the past year (AOR = 1.11, 95% CI = 1.01-1.22). For foreign-born Asians (n = 1,662), screening mammography adherence is positively associated with having a breast examination for lumps by a doctor in the past 12 months (AOR = 6.85, 95% CI = 4.38-10.70) and living at current address for more than 120 months (AOR = 1.86, 95% CI = 1.08-3.20). For U.S.-born Asians (n = 296), having a breast examination by a doctor in the past 12 months was not associated with screening mammography (AOR = 3.819, 95% CI = 0.87-16.75). However, being between 50 and 64 years old increased screening mammography adherence by four-fold (AOR = 4.06, 95% CI =1.05-15.65) compared to those between 40 and 49 years old.

Removing Asian females who reported having a colonoscopy or Pap smear showed similar results in regards to health care environment, but no associations with the social environment. For all Asians (n = 1,726), having a breast examination for lumps by a doctor was positively associated with screening mammography adherence (AOR = 6.81, 95% CI = 4.69-9.87). For U.S.-born Asians (n = 236), having a breast examination by a doctor in the past 12 months was *not* associated with screening mammography (AOR = 3.48, 95% CI = 1.11-10.86). For foreign-born Asians (n = 1,490), screening mammography adherence is positively associated with the number of doctor visits (AOR = 1.82, 95% CI = 1.06-3.11) and having a breast examination for lumps by a doctor in the past 12 months (AOR = 7.83, 95% CI = 5.23-11.72).

Table 7.8. Summary of Specific Aim III hypotheses that examine the relationship between social and health care environment and nativity, and whether hypotheses were supported, not supported or partially supported.

Specific Aim III Hypotheses	OR (95% CI)	Reference	Outcome
IIIA.			
Screening mammography will be higher for women who seen her doctor	All: 1.40 (0.93-2.10) U.S.-Born: 0.87 (0.26-2.95) Foreign-Born:1.63 (1.04-2.56)	Table 7.6, 7.7	PS
Screening mammography will be higher for women who had her breasts examined for lumps	All: 6.79 (4.93-9.34) U.S.-Born: 4.28 (1.98-9.29) Foreign-Born: 7.59 (5.35-10.76)	Tables 7.6, 7.7	S
IIIB			
Screening mammography will be higher for women who have lived at her address for more than 120 months	All: 1.30 (0.92-1.85) U.S.-Born: 1.03 (0.44-2.41) Foreign-Born: 1.36 (0.92-2.01)	Tables 7.6, 7.7	NS
Screening mammography will be higher for women who feel safe in her neighborhood	All: 2.08 (0.82-5.29) U.S.-Born: 0.76 (<0.001->999) Foreign-Born: 2.11 (0.80-5.51)	Tables 7.6, 7.7	NS

Note: PS = Partially Supported, NS = Not Supported, and S = Supported.

Table 7.8 summarizes the hypotheses and results for Specific Aim III. Specific Aim III was to determine if the effect of the health care and/or social environment on screening mammography adherence varies among U.S.-born and foreign-born Asian

Americans. The results of the multivariate analysis partially support the hypotheses for Specific Aim III. The health care environment is positively associated with mammography adherence regardless of nativity (Hypothesis IIIA) – specifically, having a doctor examine breasts for lumps in the past 12 months. Doctor visits were positively associated with screening mammography adherence in foreign-born Asians only. Conversely, there is no evidence to support that the social environment (i.e., feeling safe in the neighborhood length of time at their current residence, and urban zip code) were associated with screening mammography adherence (Hypothesis IIIB).

SPECIFIC AIM III SUMMARY

Previous research has shown that a woman's decision to have a mammography and adhere to the mammography screening guidelines may be guided by various factors, including the social and health care environment. The goal of Specific Aim III was to determine if the effect of the health care and/or social environment on screening mammography adherence varied by nativity. The social and health care characteristics varied by screening mammography adherence and nativity (Tables 7.1 and 7.2). Adherent Asian women had more exchanges with the health care environment than non-adherent women (i.e., number of doctor visits, doctor visits and a doctor examining breasts for lumps in the past 12 months) (Table 7.1). Adherent Asian women also had a higher proportion who felt safe in their neighborhood all or most of the time and lived at their current address longer (≥ 10 years). U.S.-born Asian women had higher rates of doctor visits in the past 12 months and having a doctor examining their breasts for lumps (Table 7.2). They also had a higher proportion who felt safe in the neighborhood all or most of the time. A higher percentage of foreign-born Asian women lived in an urban zip code and lived at their current address for a shorter time.

As summarized in Table 7.8, the results for Specific Aim III are mixed. Hypothesis IIIA is partially supported by the multivariate analysis. For both U.S.-born and foreign-born Asians, the odds of screening mammography adherence is increased among women aged 50 to 64 who had their breasts examined for lumps by a doctor in the past 12 months. The likelihood of being screening mammography adherent among women who had their breasts examined for lumps is 4.28 for U.S.-born Asians (95% CI = 1.98-9.29) and 7.59 for foreign-born Asians (95% CI = 5.35-10.76). Regardless of nativity, the AOR for screening mammography adherence is 6.79 (95% CI = 4.93-9.34) for Asian women who had their breasts examined for lumps by a doctor in the past 12 months. For foreign-born Asians, screening mammography adherence is increased by 63% for women who visited their doctor within the last year (AOR = 1.63, 95% CI = 1.04-2.56). Hypothesis IIIB is not supported by the multivariate logistic regression analysis. There is no evidence to support that the social environment (i.e., feeling safe in the neighborhood, urban zip code or length of time at current residence for more than 120 months) is associated with screening mammography adherence.

This chapter has illustrated that the effect of the health care and social environment on mammography adherence varied among U.S.-born and foreign-born Asian Americans. For both U.S.-born and foreign-born Asians, screening mammography adherence is associated with health care environment, but not the social environment. Specifically, it is positively associated with a doctor examining breasts for lumps in the past 12 months. A breast examination by a doctor increased the likelihood of being screening mammography adherent for both groups. The likelihood of being screening mammography adherent also increased for women aged 50 to 64 years old and decreased for Korean descent.

Chapter 8: Discussion

Chapter 8 discusses the results for Specific Aims I, II, and III. This dissertation sought to (1) document the health disparities that exist in mammography adherence and (2) determine the influence of individual and environmental factors that are driving the mammography adherence differences between U.S. and foreign-born Asian Americans in California. ***Screening mammography adherence*** is defined as receipt of a screening mammogram in the past two years. First, the findings are interpreted in the context of research concerning mammography adherence among minority populations in the United States. Second, the implications of the research are considered. Third, the strengths and limitations of the project are critically reviewed. Last, possible avenues for future research are discussed.

AIM I – MAMMOGRAPHY ADHERENCE BY RACE/ETHNICITY AND NATIVITY

Summary of Results

Two hypotheses were tested to determine if screening mammography adherence rates vary across racial/ethnic groups and nativity. The first hypothesis (IA) was that screening mammography adherence would be higher among non-Hispanic whites and lower among Asian Americans. The second hypothesis (IB) was that screening mammography adherence would be lower in foreign-born Asians than U.S-born Asians.

The total sample included 99,619 women aged 40 to 85 years old with the overall screening mammography adherence rate of 78.4%. Non-Hispanic Whites made up the largest proportion of the sample followed (n = 69,421; 69.7%) by Hispanics (n = 13,625; 13.7%) and Asians/Pacific Islanders (n = 8,353; 8.4%). U.S.-born females made up 80%

of the sample. In all racial/ethnic groups except Hispanics and AAPI, more women were born in the U.S. than outside the U.S. The opposite is true for Hispanics and AAPI. More than half of the Hispanic women (54.4%) were born outside the U.S. and 80.2% of AAPI women were foreign-born. Screening mammography adherence varied by nativity with rates lower among foreign-born than U.S.-born respondents (73.9% versus 79.5%).

Descriptive results showed considerable increases in mammography adherence among women aged 40 years and older in California (Tables A.1, 5.1-5.2). This trend varied over time, race/ethnicity, nativity and age group (Figures 5.1-5.4). The composition of the female respondents changed considerably between 2001 and 2009 in terms of *predisposing factors*. In 2009, there was a higher percentage of female respondents who were aged 50-64 years old; foreign-born living in the U.S. for more than 10 years; self-identified as Hispanic, Black or Asian/Pacific Islander; more educated; had a smaller household size; married; and less likely to speak English only. Female respondents were having children later (>26 years versus between age 19-25). The socioeconomic composition (*enabling factors*) also changed between 2001 and 2009 with more employed females, more home ownership, decrease in living at or below 200% of the poverty level, and decrease in health care access (health insurance and usual source of care). There were also changes in *need factors*. A higher percentage of female respondents reported having good to excellent health despite higher rates of chronic diseases and family history of breast cancer. Health behaviors changed between 2001 and 2009. Even though the use of cancer preventive health services improved, there was an increase in risky behaviors. More female respondents were obese or overweight and binge drinkers.

In the total population, the multivariate logistic regression analyses showed an upward trend (+7.9%) in the prevalence of screening mammography adherence from 2001 to 2009, independent of changes in racial/ethnic distribution and nativity status. After adjusting for age, education and health behaviors, screening mammography adherence was reduced to an annual increase of 2.8%. Screening mammography adherence in the total population was positively associated with study year (AOR = 1.03, 95% CI = 1.04-1.12), age 50 to 64 years old (AOR = 1.49, 95% CI = 1.40-1.60), being overweight or obese (AOR = 1.12, 95% CI = 1.06-1.19), and prior use of cancer preventive health services (AOR = 3.19; 95% CI = 2.98-3.41). Screening mammography adherence was negatively associated with being Asian/Pacific Islander (AOR = 0.81, 95% CI = 0.73-0.92) or other/mixed race (AOR = 0.77, 95% CI = 0.63-0.87), age 65 years and older (AOR = 0.86, 95% CI = 0.79-0.93), having less than high school education (AOR = 0.71, 95% CI = 0.66-0.91) or some college (AOR = 0.76, 95% CI = 0.71-0.82), being underweight (AOR = 0.61, 95% CI = 0.52-0.72) and current smoker (AOR = 0.61, 95% CI = 0.56-0.67). The results support the first hypothesis. Screening mammography was higher among non-Hispanic Whites and lower among Asians/Pacific Islanders (AOR = 0.81, 95% CI = 0.73-0.92) (Table 5.12) even after adjusting for age, education and health behaviors. However, the other or mixed group had the lowest screening mammography rates (AOR = 0.77, 95% CI = 0.63-0.87) compared to NHWs.

There was also upward trend in the prevalence of screening mammography adherence in the Asian population from 2001 to 2009, regardless of Asian subgroup and nativity status. After adjusting for age, education, and health behaviors, the screening mammography adherence rate fell from an annual increase of 11.7% to 7.7%. In the multivariate analysis, screening mammography adherence in Asians was positively associated with study year (AOR = 1.08, 95% CI = 1.01-1.15), age 50 to 64 years old (AOR = 1.24, 95% CI = 1.01-1.52), being overweight or obese (AOR = 1.35, 95% CI = 1.10-1.66), and prior use of cancer preventive health services (AOR = 3.18, 95% CI = 2.66-3.81). Screening mammography adherence was negatively associated with being Korean (AOR = 0.57, 95% CI = 0.40-0.81), age 65 years and older (AOR = 0.71, 95% CI = 0.56-0.90), less than a high school education (AOR = 0.66, 95% CI = 0.52-0.84), being underweight (AOR = 0.67, 95% CI = 0.49-0.93) and having a sedentary lifestyle (AOR = 0.67, 95% CI = 0.56-0.82). Stratifying the Asian sample by nativity status showed that study year and prior receipt of cancer preventive services increases the likelihood of screening mammography in both U.S.-born and foreign-born Asians. Study year may indicate increased acculturation for foreign-born Asians, i.e., more years living in the U.S. More acculturated Asians are more likely to be screened. For foreign-born Asians, screening mammography was also associated with being Korean, age (50-64 years), education (less than high school or some college), being underweight or overweight/obese, and prior receipt of cancer preventive services. The multivariate results do not support the second hypothesis. Nativity status was not statistically significant between U.S.-born and foreign-born Asians (Table 5.12).

Interpretations of Findings

Overall, the descriptive results indicate that the prevalence of screening mammography is increasing among women aged 40 years and older in California. This trend was seen in both samples. However, this is not consistent with the national mammography adherence rate. According to the Healthy People 2010 Final Review, mammography screening rates did not change between 1998 and 2008 (Centers for Disease Control and Prevention, n.d.; National Center for Health Statistics, 2012). In both years, 67% of women aged 40 and over had received a mammogram within the past 2 years. California's mammography prevalence exceeds the HP2010 goal of 70%. The prevalence of screening mammography in California ranges from 74.3% in 2001 to 79.5% in 2009. This implies that intervention activities may be occurring in California that may attribute to the higher screening rates. It also may be the result of how the survey information is collected. Unlike other national surveys (e.g., National Health Interview Survey) that are conducted in-person, CHIS is a telephone survey and women with telephones are more likely to report a recent mammogram (Jackson et al., 2009).

Additionally, the higher prevalence may be ascribed to changing demographics and health behaviors. The increase in mammography adherence suggests that the recent changes in demographics and health behaviors may have been positive for mammography adherence in California. As shown in Table A.1, the composition of the sample has been changing. Each survey year includes more respondents who are from a minority group, in the optimum age range for screening (50-64 years old), and foreign-born living in the U.S. for ≤ 10 years. Compared to women aged 40 to 49 years old, women aged 50 to 64 years old are more likely to be adherent while women over the age of 65 are less likely to be adherent. These differences in screening mammography may be due to controversies about when to start and stop mammograms, different cultural beliefs or lack of knowledge about mammography or breast cancer.

In both samples (total and Asian populations), screening mammography was positively associated with study year, age 50 to 64 years old, being overweight and obese and having prior cancer preventive health services. Given that Asians who are overweight and obese are more likely to have comorbidities, it is expected that they would visit a health care provider for those conditions. As a result, they may be more likely to be screened. Screening mammography was negatively associated with specific minority groups (AAPI and other in the total sample and Korean in the Asian sample), being over the age of 65 years old, less than a high school education, and being sedentary. This suggests that adherence rates are higher in those who are more aware about breast cancer prevention and risks and find a medical need to be screened. In addition, health behaviors may affect the relationship between screening mammography adherence and race/ethnicity.

The multivariate results showed that screening mammography rates were lowest for AAPI and other or mixed race women. Reasons for lower screening rates among minority populations are complex (Adler & Rehkopf, 2008; Freeman, 2008; Gomez et al., 2007; Kagawa-Singer et al., 2010; Kandula et al., 2006; Vyas et al., 2012). The factors do not just include the social determinants of health, such as education, occupation, social status, housing, the availability of quality services, health literacy, and degree of integration into a community social network (Adler & Rehkopf, 2008; Freeman, 2008; Gomez et al., 2007; Kagawa-Singer et al., 2010). Issues such as the meaning of cancer, the invasiveness of the screening test itself, and the significance and different meanings of the particular body part targeted for screening vary across cultures and may account for lower screening rates (Kagawa-Singer et al., 2010).

Cultural beliefs and practices may influence the risk factors for breast cancer and shape the existential and experiential meaning of the cancer. Cancer is a stigmatized disease in Asian culture. Unless there is a specific need or symptomology, Asians do not visit the doctor (Nguyen et al., 2002; Tang et al., 2000). The focus is more on crisis instead of prevention. The prevention strategies that are emphasized in the Asian community are those that can be done on one's own. Examples include maintaining a good diet, achieving good spiritual balance (yin and yang theory or Ayuverdic principle), and consuming herbs that promote health (Kagawa-Singer, 2001; Tang et al., 2000). Asian women often de-emphasize and sacrifice their own needs for those of their family (Ashing-Giwa et al., 2004; Kagawa-Singer et al., 2010). They do not want to burden the family with their needs (Tam Ashing, et al., 2003). A cancer diagnosis not only affects them, but their entire social structure and standing. Many Asian women feel stressed and upset about their partners' and family's expectations that they continue the same role and function as before they had cancer (Ashing-Giwa et al., 2004). Later-stage cancer diagnosis in Asians is also attributed to cultural barriers, such as a belief that male physicians should not examine female body parts that should only be touched by their husbands (Kagawa-Singer et al., 2010). Asian females only receive cancer screenings when they know why the screening is necessary and that it will be done in a respectful and professional manner (Nguyen et al., 2002). Positive views and beliefs about mammography increase the likelihood that a woman receives a mammogram (Magai et al., 2007).

Nativity and years in the United States may be markers of cultural differences that impact breast cancer disparities and screening behaviors (Kandula et al., 2006). Attachment to the Eastern view of care is strongly related to a woman's educational level. Foreign-born Asians may believe that cancer screening is in response to symptoms rather than tests that are used prior to the development of symptoms. Women who are more educated have less attachment to the Eastern view of care and hence, more likely to be screening mammography adherent. Screening has been shown to be higher in Chinese women who are more educated and grasp a better understanding of Western preventive care, diagnosis and treatment (Wang et al., 2009). Those who intended to receive mammograms were employed, held less Eastern views, and higher knowledge and perceived susceptibility (Wang et al., 2009).

Comparison to Previous Research

It was hypothesized that screening mammography adherence would be higher among non-Hispanic whites and lower among Asian Americans (IA). Compared to NHWs, screening mammography rates were lower among Asians/Pacific Islanders (AOR = 0.81, 95% CI = 0.73-0.92) and the other or mixed race group (AOR = 0.77, 95% CI = 0.63-0.87) even after adjusting for age, education and health behaviors. The results partially supported this hypothesis and were similar to previous findings (Centers for Disease Control and Prevention, 2010; Goel et al., 2003). Research suggests that health status and screening practices vary by nativity (Escheverria & Carrasquillo, 2006). Racial/ethnic groups that are comprised largely of foreign-birth individuals have lower screening rates than non-Hispanic Whites (Babey et al., 2003; Billmeier & Dallo, 2011; Goel et al., 2003). Clarifying the relationship between race/ethnicity and foreign birth may help identify specific barriers faced by these at-risk populations and create opportunities to intervene and improve health.

Screening mammography is vital to the early detection and treatment of breast cancer. Yet, minority groups consistently have lower screening rates than NHWs (Babey et al., 2003; Miller et al., 2008). These differences persist even when comparing racial/ethnic groups with the same income level or same type (or lack of) health insurance (Babey et al., 2003; Goel et al., 2003). In this study, Asian Americans/Pacific Islanders and other race exhibited lower screening rates compared to NHWs. Past research has shown that these ethnic/racial differences are due to a complex set of social, economic, cultural and health system factors (Adler & Rehkopf, 2008; Freeman, 2008; Gomez et al., 2007; Kagawa-Singer et al., 2010; Kandula et al., 2006; Vyas et al., 2012). Some of these factors were tested in the analysis for Specific Aim II.

The second hypothesis (IB) was that screening mammography adherence would be lower in foreign-born Asians than U.S-born Asians. The existing research on screening mammography and nativity is limited. Inconsistent results have been found among previous studies in regards to the relationship between acculturation and breast cancer screening (Billmeier & Dallo, 2011; Blackwell, Martinez, & Gentleman, 2008; Escheverria & Carasquillo, 2006; Goel et al., 2003; Rodriguez et al.,, 2005). Lower levels of mammography screening have been observed among immigrant females (Billmeier & Dallo, 2011; Carrasquillo & Pati, 2004; Escheverria & Carasquillo, 2006; Goel et al., 2003; Rodriguez et al., 2005; Swan et al., 2003). In crude models of studies that showed significant findings, foreign-born women were less likely to report mammography use in the past two years when compared to U.S.-born women (Billmeier & Dallo, 2011; Escheverria & Carasquillo, 2006; Goel et al., 2003; Rodriguez et al.,, 2005). Adjustment for demographic, socioeconomic, health insurance, and access to care eliminated the significant results and produced mixed findings. A study by Somkin et al. (2004) in California found that sociodemographic and access to care characteristics accounted for a large proportion of the screening mammography disparities observed among Latina and Chinese women. Other studies showed no significant relationship between nativity status and mammography use in minority women (Blackwell et al., 2008; Lee et al., 2013). In a study of Chinese, Korean, and Filipino women, Lee et al. found that multiple acculturation measures, i.e., SL-ASIA, the American cluster, length of residency, and age at arrival, were significantly associated with mammogram use in the past two years after adjusting for age. The association decreased significantly after adjusting for access to health care variables and became non-significant after adjusting for all covariates.

Consistent with prior studies (Billmeier & Dallo, 2011, Escheverria & Carasquillo, 2006; Goel et al., 2003; Lee et al., 2013; Rodriguez et al., 2005), the initial analysis for this study confirmed that foreign-born women were significantly less likely to report screening mammography use in the past 2 years when compared with U.S.-born women. This was true for the total population sample (AOR = 0.87; 95% CI = 0.80-0.93) and the Asian sample (AOR = 0.60; 95% CI = 0.48-0.76). However, the results were attenuated and non-significant after adjustment for demographic variables, such as age and education, and health behaviors. Therefore, the results did not support the second hypothesis. Screening mammography was not statistically significantly lower in foreign-born Asians than U.S.-born Asians after adjusting for age, education and health behaviors. Consistent with other studies, screening mammography was associated with being overweight or obese and participating in other screening tests (Schueler et al., 2008).

AIM II– MAMMOGRAPHY ADHERENCE BY PREDISPOSING, ENABLING AND NEED FACTORS

Summary of Results

The goal of Specific Aim II was to determine the relationship between *predisposing*, *enabling*, and *need factors* on screening mammography adherence among Asian Americans and to determine if there are nativity differences. It was hypothesized that the effect of individual characteristics on screening mammography will vary between U.S.-born and foreign-born Asian American women, in regards to predisposing, enabling, and need factors. Specifically, the pertinent *predisposing variables* would include age, race/ethnicity, household size, marital status, U.S.-born, and level of English proficiency (Hypothesis IIA). The relevant *enabling factors* would include employment, any type of health insurance and a usual source of care (Hypothesis IIB). The related *need factors* would include general health condition and ≥ 1 chronic condition (Hypothesis IIC).

The sample distributions showed that screening mammography varied by nativity, Asian subgroup, and age group. The descriptive results show that predisposing, enabling, and need factors varied among women who were adherent and non-adherent to mammography screening guidelines. The adherent group tended to be older, foreign-born, and have a smaller household. A higher percentage of Asian women reported screening mammography adherence if they were employed, currently insured, owned a home, and have a usual source of care. Non-adherent women have a higher percentage of women living below 200% of the poverty level. Predisposing, enabling, and need factors also varied among U.S. and foreign-born Asian women. A higher percentage of foreign-born women were younger, more educated, married, and less proficient in English. They also had a higher percentage of having their period at younger age, employed, uninsured, and living at or below 200% poverty level. The factors also varied among U.S.-born and foreign-born adherent Asian women.

The results for Specific Aim II were mixed. The results depended on the survey sample used and what variables were included. Since some variables were not collected at each wave, multiple logistic regressions were created to determine which predisposing, enabling, need, and health behaviors were associated with mammography adherence for all Asians, U.S.-born Asians, and foreign-born Asians. All of logistic regressions partially supported Hypotheses IIA and IIB. *Predisposing factors* more than *enabling* and *need* factors predicted screening mammography.

When using all CHIS data with only complete data, age (*predisposing*), being Vietnamese (*predisposing*), household size (*predisposing*), not being married (*predisposing*), and speaking English not well or not at all (*predisposing*), health insurance (*enabling factor*) and chronic condition (*need factor*) were associated with screening mammography. When age of menarche, age when their first child was born, usual source of care, and family history of cancer were accounted in the second multivariate analysis (CHIS 2001 and CHIS 2009), the associations between screening mammography and individual factors changed. Age (≥ 65), household size, speaking English not well or not at all, and having no chronic condition were no longer associated with screening mammography. However, unknown age of menarche (AOR = 0.37, 95% CI = 0.18-0.76) and having no usual source of care became negatively associated with screening mammography. Having no usual source of care decreased the odds of being screening adherent by 61% (AOR = 0.29, 95% CI = 0.20-0.42) compared to someone with usual source of care. The associations in the third analysis (CHIS 2005 and CHIS

2009) when home ownership was added and family history of cancer was removed. Compared to the analysis using CHIS 2001 and 2009, age (50-64) and having no children became associated with screening mammography. Study year, being Vietnamese, and being overweight or obese were no longer associated with screening mammography. Individual factors still associated with the likelihood of being screening adherent included age 50 to 64 (*predisposing),* being unmarried (*predisposing*), unknown age of menarche (*predisposing*), being uninsured (*enabling)*, no usual source of care (*enabling)*, sedentary (*health behavior*), and prior receipt of cancer preventive services (*health behavior*).

In summary, the hypotheses for Specific Aim II are partially supported by the multivariate analyses. No *need factors* were associated with screening mammography when accounting for additional *predisposing* (age of menarche, age when their first child was born) and *enabling* factors (home ownership and usual source of care). In all analyses (CHIS 2001-2009, CHIS 2001 and 2009, CHIS 2005 and 2009), the relevant factors included age and marital status (*predisposing factors*) and being uninsured (*enabling factor).* Age (50-64 years) and prior receipt of colonoscopy or Pap smear were positively associated with screening mammography in all analyses (CHIS 2001-2009, CHIS 2001 and 2009, CHIS 2005 and 2009). Being unmarried, uninsured, and sedentary was negatively associated with screening mammography. Study year, Asian subgroup (*predisposing)*, and being obese or overweight (*health behaviors*) were positively associated with screening mammography in two analyses (CHIS 2001-2009, CHIS 2001 and 2009). Not knowing the age of their first period and no usual source of care (*predisposing factors)* were negatively associated with screening mammography in the last two analyses (CHIS 2001, 2009 and CHIS 2005, 2009). The results were consistent in that a woman's decision to have a mammography and adhere to the mammography screening guidelines is guided by predisposing, enabling, need, and health behaviors. When accounting for most of the predisposing, enabling and need factors (CHIS 2001, 2005 and CHIS 2005, 2009), screening mammography was associated with age (50-64) (*predisposing*), not being married (*predisposing*), unknown age of first period (*predisposing*), being uninsured (*enabling*), no usual source of care (*enabling*), being sedentary (health behaviors) and prior receipt of cancer prevention health services (health behaviors).

Individual factors also varied among U.S.-born and foreign-born Asians when accounting for most of the predisposing, enabling and need factors (CHIS 2001, 2005 and CHIS 2005, 2009). When accounting for all variables except home ownership (CHIS 2001, 2009), screening mammography in U.S.-born Asians was associated with being Vietnamese, household size, being unmarried, aged when first period started (<13), age when their first child was born, no usual source of care, being obese or overweight, being sedentary and prior receipt of cancer preventive services. For U.S.-born Asians in the CHIS 2005, 2009 sample (home ownership removed and family history of cancer added), screening mammography was associated with being uninsured, no usual source of care, very good or fair health rating, and prior receipt of cancer preventive services. For foreign-born Asians in the CHIS 2001, 2009 sample, screening mammography was associated with not being married, unknown age of first period, first child being born between age 10-18, no usual source of care, sedentary lifestyle, and prior receipt of cancer preventive services. For foreign-born Asians in the CHIS 2005, 2009 sample, screening mammography was associated with age (50-64), unknown age of first period, being uninsured, no usual source of care, and prior receipt of cancer preventive services.

Interpretations of Findings

Overall, the results were consistent in that a woman's decision to have a mammography and adhere to the mammography screening guidelines is guided by predisposing, enabling, and health behaviors. The results partially supported the hypotheses for Specific Aim II. For Asian American women, screening mammography was associated with *predisposing* and *enabling* factors, but not *need factors* after adjusting for individual sociodemographic factors and health behaviors. In all three analyses (CHIS 2001-2009; CHIS 2001, 2009; CHIS 2005 and 2009), age (50-64 years) (*predisposing*), marital status (*predisposing*), being uninsured *(enabling*), being sedentary (health behavior) and prior receipt of cancer prevention health services (*health behavior*) were associated with screening mammography. Age (50-64 years) and prior receipt of colonoscopy or Pap smear were positively associated with screening mammography while being unmarried, uninsured, and sedentary was negatively associated with screening mammography. When adjusting for more predisposing variables (i.e., age of first menarche and age when first child is born) and enabling factors (usual source of care and/or home ownership) in the second and third analyses, unknown age of first menarche and no usual source of care to become negatively associated with screening mammography. The addition of age of first period (predisposing), age when first child was born (predisposing) and family history of cancer (need) in the second analysis (CHIS 2001, 2009) made being obese or overweight positively associated with screening mammography. This is not consistent with past research where not being overweight or morbidly obese was predictive of mammography use (Bobo et al., 2004; Borrayo et al., 2009, Coughlin et al., 2004; Rakowshi et al., 2006; Selvin & Brett, 2003; Vyas et al., 2012).

As stated in Chapter 3, need is one of the strongest determinants of health service use. Need is typically predetermined by existing health conditions because of the perceived need or the realized need to seek care (Shibusawa & Mui, 2010). Yet, the results of this study do not support the importance of need to screening mammography in Asians. In general, Asian women have less knowledge about their own bodies and lack awareness about the benefits of screening and early detection for breast cancer. Since there is no immediate need (i.e., symptoms), many Asians do not get cancer screening tests.

Given that most U.S. Asians are foreign-born (ratio of 5:1), their individual beliefs about cancer screening and prevention may differ from those born in the U.S. Many Asian women rely on both Western and alternative medicine (e.g. shark fin and herbs) to maintain their health. In addition, the family is prioritized in AAPI families over one's health. This is especially true for those of lower socioeconomic status and uninsured (Tam Ashing et al., 2003). These women are more concerned about supporting their families than seeking early care. Additionally, foreign-born individuals are more likely to encounter barriers related to health care access (e.g. lack of insurance or usual source of care) (Thamer & Rhinehart, 1998; Ku & Mutani, 2001). Foreign birth and limited English proficiency are associated with poor health communications, language barriers (Jacobs et al., 2005), and lower rates of health insurance (Thamer et al. 1997).

Cultural traits such as traditional health beliefs and lack of preventive care orientation are significant barriers to care in Asians.

As shown in the results, being uninsured and no usual source of care was negatively associated with screening mammography. Those lacking insurance are less likely to be adherent because of access issues or education about the need for biannual mammograms. Past research has shown that markers of health care access, e.g., insurance and usual source of care, were associated with the likelihood that someone would receive a physician recommendation for a specific test or procedure (Escheverria & Carasquillo, 2006). High income was positively associated with physician recommendation and testing. However, individuals with inadequate health insurance coverage were less likely to be tested because their doctor was less likely to make a recommendation. Physicians are reluctant to discuss testing options with patients who may be unable to pay or provide coverage for tests. As a result, these patients have fewer visits to their doctor for routine checkups, less communication with their doctors and be less educated about breast cancer prevention.

Comparison to Previous Research

As stated earlier, few studies have looked at predisposing, enabling, and need factors and how they are associated with mammography adherence, especially among Asians Americans. Factors associated with health care access, such as health insurance, income, and percentage of minority populations, are important determinants of cancer screening services (Coughlin et al., 2008). Women who have greater access to health care are more likely to have recent screening tests (Coughlin et al., 2008; O'Malley et al., 2001; Selvin & Brett, 2003). Having had a recent physician visit or usual source of care is also predictive of screening adherence (Zapka et al., 2002).

Marital status was another key factor influencing mammography adherence in this study. This is consistent with the result of previous research (Elder et al., 1991; Lim, 2010). Given marital status is significantly related to an intimate relationship with a partner, body image, and sexual intercourse, it is expected that it would be associated with mammograms and pap smears. Nevertheless, it would be important to encourage unmarried women from all Asian subgroups to obtain mammograms.

Screening mammography was positively associated with prior receipt of cancer preventive services. This supports previous research that the physician-patient relationship is associated with receipt of clinical preventive services (Parchman & Burge, 2003). Asians are not proactive about seeking health care and put Doctors are viewed as authority figures and a breast exam is likely to increase the likelihood of being screened. It may imply that the respondent becomes more aware of the cancer prevention.

Though several factors were not significantly associated with adherence behavior, such as household size, level of English proficiency, employment, general health condition, family history of cancer, the results of this study support the prediction model that was adapted. Previous research has shown that positive family history was considered as 'cue to action' in health behavior. However, several study findings support an alternative explanation. Family history of breast cancer might increase fear of getting breast cancer. Hence, it may be a psychological factor that inhibits women from having mammogram. In many studies, positive results for cancer and anxiety about procedures were negative influencing factors.

AIM III –MAMMOGRAPHY ADHERENCE BY SOCIAL AND HEALTH CARE ENVIRONMENT

Summary of Results

The purpose of Specific Aim III was to determine if the effect of the health care and/or social environment on screening mammography adherence rates in Asian women varies by nativity. Screening mammography adherence was expected to be higher in women who have seen her doctor within the last year and had their breasts examined for lumps by a doctor in the past 12 months (Hypothesis IIIA). Hypothesis IIIB is that screening mammography adherence would be higher for Asian women who lived at their current address for more than 120 months and felt safe in their neighborhood.

The descriptive results showed that social and health care environment variables varied by self-reported screening mammography adherence and nativity among Asian women in California. The social and health care characteristics also varied by nativity among adherent Asian women. The social and health care environment variables were all statistically different between adherent and non-adherent Asian women. Compared to non-adherent Asian women, adherent women were older and visited a doctor during the past 12 months. A higher percentage of adherent women visited their doctor more times within the past year, had a doctor examine their breasts for lumps, felt safe in their neighborhood all or most of the time, and lived at their current address for a longer period of time. More non-adherent women lived in an urban neighborhood than adherent women. When comparing U.S.-born and foreign-born Asian women, the same patterns were observed. However, number of doctor visits was not statistically different between U.S.-born and foreign-born Asians. Compared to foreign-born Asians, a higher percentage of U.S.-born women were older, visited their doctor within the past year, had a doctor examine their breasts for lumps, felt safe in their neighborhood all or most of the time, and lived at their current address for a longer period of time. More foreign-born Asian women lived in an urban neighborhood than U.S.-born Asians. The comparison of adherent U.S.-born and foreign-women showed that the social and health care characteristics were statistically different between the two groups for all variables except number of doctor visits in the past year. U.S. born adherent women were older, had more doctor visits in the past year, visited the doctor during the past 12 months, and had a doctor examine their breasts for lumps in the past 12 months. They also felt safe in their neighborhood all or most of the time, and lived at their current address for a longer length of time. A higher percentage of foreign-born adherent women lived in an urban zip code than U.S.-born adherent women.

The results of the multivariate analyses are mixed. Hypothesis IIIA is partially supported by the multivariate analysis. For both U.S.-born and foreign-born Asians, the odds of screening mammography adherence is increased among women who had their breasts examined for lumps by a doctor in the past 12 months. The likelihood of being screening mammography adherent among women who had their breasts examined for lumps is 4.28 for U.S.-born Asians (95% CI = 1.98-9.29) and 7.59 for foreign-born Asians (95% CI = 5.35-10.76). For all Asian women, the AOR for screening mammography adherence is 6.79 (95% CI = 4.93-9.34). In terms of sociodemographic characteristics, age (50-64 versus 40-49) increased the likelihood of being screening mammography adherent by 71% (AOR = 1.71, AOR = 1.11-2.62) while being Korean decreased the likelihood of being screening mammography adherent by 52% (AOR 0.48, 95% 0.27-0.84). The factors affecting screening mammography varied among U.S.-born and foreign-born Asians. Visiting a doctor during the past 12 months was only statistically significant in foreign-born Asians. For foreign-born Asians, screening mammography adherence is increased by 63% for women who visited their doctor within the last year (AOR = 1.63, 95% CI = 1.04-2.56). Hypothesis IIIB is not supported by the multivariate logistic regression analysis. There is no evidence to support that the social environment (i.e., feeling safe in the neighborhood, urban zip code or length of time at current residence for more than 120 months) is associated with screening mammography adherence.

Interpretations of Findings

Overall, the effect of the health care environment on screening mammography adherence was more evident than the effect of the social environment. The study results reflected the importance of the health care environment on screening mammography adherence in Asian women. For both U.S.-born and foreign-born Asians, screening mammography adherence was higher among women who had their breasts examined for lumps by a doctor in the past 12 months. Doctor examining breasts for lumps is positively associated with mammography adherence. This supports previous research that the physician-patient relationship is associated with receipt of clinical preventive services (Babey et al., 2003; Brawarsky, Brooks, Mucci & Wood, 2004; Parchman & Burge, 2003). The role of doctors in ensuring appropriate screening is critical. Several studies have shown that a physician recommendation is one of the strongest independent predictors of a person’s decision to have a cancer screening test (Burack & Liang, 1987; Coughlin et al., 2005; Lerman et al.,1990; Nguyen & McPhee, 2003; Zapka et al., 1991). Since doctors are viewed as authority figures, a doctor’s recommendation or exam will increase the likelihood of being screened. Mammography is an expensive procedure that is usually performed by referral to specialized medical center, where verification of reimbursement is often needed (Escheverria & Carasquillo, 2006). Concerns about insurance coverage and reimbursement have previously been cited as barriers to physician recommendation. A physician may be reluctant to discuss cancer screening if the patient is unable to pay. Even with a doctor's recommendation, there is no guarantee they will get screened. Many Asians rely on word-of-mouth and prayer rather than their doctors' recommendations (Tam Ashing et al., 2003).

In general, Asian women have less knowledge about their own bodies and lack awareness about the benefits of screening and early detection for breast cancer. This may be due to cultural taboos against talking about or touching one's body which often result in the avoidance of self-exams and cancer screenings (Ashing-Giwa et al., 2004). Many believe that breast cancer ultimately leads to breasts loss, cancer is contagious and that breast trauma (such as pressure or ''bumping'' of the breasts) or the use of wired bras will lead to breast cancer (Tam Ashing et al., 2003). Care is often delayed in Asian women. The lack of symptoms and pain implies good health and no immediate need to get screened. Many Asian women rely on both Western and alternative medicine (e.g. shark fin and herbs) to maintain their health. In addition, the family is prioritized in AAPI families over one's health. This is especially true for those of lower socioeconomic status and uninsured (Tam Ashing et al., 2003). These women are more concerned about supporting their families than seeking early care. They worry about the financial and emotional burden. Since religion and spirituality play an important role of Asian women's experiences with cancer, they may perceive the outcome of their illness as being in God's hands. They hold a strong belief in the power of prayer and may place more importance on spirituality than on health care providers. Asian women who are more acculturated are more aware of the benefits of screening and early detection and have better access to care.

The multivariate results showed no effect of neighborhood safety, urban environment or length of residency on screening mammography adherence among Asian respondents. This effect may be an artifact of the study population. The Asian population responding to the 2005 and 2009 California Health Interview Survey was largely urban (98.8%). This means only 1.2% of Asians lived in rural zip codes. Since so few Asians lived in rural zip codes, I was unable to estimate rural-urban differences among adherent and non-adherent women. There were also differences in the study population by survey year that may have led to no effect of the social environment on screening mammography. For example, the multivariate associations between the social and health care environment variables and screening mammography adherence were different between CHIS 2005 and CHIS 2009 (Table 7.5). For example, the likelihood of being screening mammography adherent was increased if they had a doctor examine breasts for lumps in the past 12 months and aged 50 to 64 years old, but decreased if they were Korean in the CHIS 2005 sample. In the CHIS 2009 sample, a doctor examining breasts for lumps in the past 12 months and feeling safe in the neighborhood all or most of the time increased the likelihood of being screening mammography adherent.

Sensitivity analyses were conducted to clarify the results and aid in the interpretation of the results. Respondents were removed if they had ≥1 chronic condition or received a colonoscopy or Pap smear. The results were similar in regards to the health care environment when removing Asians with ≥1 chronic condition, but differing for U.S.-born and foreign-born Asians. Screening mammography adherence was positively associated with having a breast examination for lumps by a doctor in the past 12 months for all Asians and foreign-born Asians, but not associated with screening mammography in U.S.-born Asians. Number of doctor visits in the past year was positively associated with screening mammography in all Asians. Living at the current address for more than 120 months was positively associated with screening mammography in foreign-born Asians and age (50-64) increased screening mammography adherence by four-fold in U.S.-born Asians. Removing Asians females who had prior cancer preventive services showed similar results as the original sample. There were similar results in regards to the health care environment (i.e., doctor examining breasts for lumps in the past 12 months), but no associations with the social environment.

Comparison to Previous Research

As stated earlier, cancer is stigmatized disease in Asian culture and Asian women do not visit the doctor unless there is a need or symptomology. Asian American women are not proactive about seeking medical care on their own (Tam Ashing et al., 2003). Cancer is viewed as a death sentence by the Asian American community. Strong spiritual beliefs are held that the diagnosis is something that is willed by God or that the outcome is in God's control. A provider recommendation is one of the major predictors influencing receipt of cancer screening services (Ashley-Giwa et al., 2004; Babey et al., 2003; Parchman & Burge, 2004; Tam Ashley et al., 2003).

A physician-patient relationship is associated with receipt of clinical preventive services in Asians (Brawarsky et al., 2004; Parchman & Burge, 2003). For both U.S.-

born and foreign-born Asians, screening mammography adherence was higher among women who had their breasts examined for lumps by a doctor in the past 12 months. Doctor examining breasts for lumps is positively associated with screening mammography adherence. Research has shown that as the length of the patient-provider relationship increases so do the patient reports of accumulated knowledge, communication, and trust in their provider (Parchman & Burge, 2004). The level of communication between the patient and provider are predictive of trust and trust is predictive of the receipt of clinical preventive services. Less acculturated women depend on their doctor for treatment decisions. As shown in Tam Ashley et al. study (2003), Asian women will comply with their doctor's advice and decisions.

Regardless of nativity, prior receipt of cancer prevention services and doctor examining breasts for lumps was positively associated with screening mammography adherence. Perhaps, these access indicators may collectively impact mammography use above and beyond acculturation in Asian Americans and moderate the impact of acculturation on screening mammography adherence. In this study, screening mammography adherence was lower among U.S.-born Asians when they spoke English very good or well compared to U.S.-born Asians who only spoke English. Prior receipt of cancer prevention services may also indicate increased knowledge about cancer and better access to health care services. Asian women who request screening mammography are more likely to receive it (Hawley, Earp, O'Malley & Ricketts, 2000; Maxwell, Bastani & Ward, 1997)

In regards to the social environment, compliance and non-compliance with preventive measures have been linked to more social ties. The links between social support, positive health outcomes, well-being and quality of life have been established (Katapodi et al., 2002; House, Landis & Uberson, 1988; Salonen et al., 2013). Those with more social and community ties report lower morbidity and mortality rates than those who lack social support. Social support may influence how stressful events seem, influence the appraisals of coping options, and directly impact health behaviors (Belgrave & Lewis, 1994; Katapodi et al., 2002; Komproe, Rijken, Ros, Winnubst, & Hart, 1997). Having strong social networks may promote cancer screening participating among underserved minority women (Suarez et al., 2000). Group norms may influence their beliefs and increase the likelihood they use these services. (Benjamins et al., 2004). Women are more influenced to have more positive health behaviors when they have adequate supportive relationships (Molinari, Ahern, & Hendryx, 1998). For example, social support was significantly associated with appointment keeping behavior and adherence to health activities in patients with diabetes (Belgrave & Lewis, 1994). Hence, it was hypothesized that the same pattern would exist for breast cancer screening. Women who feel safe in their neighborhood all or most of the time and lived at their current residence for more than 120 months would be expected to be more adherent. The results did not support this hypothesis.

STRENGTHS AND LIMITATIONS

Study Strengths

The CHIS is one of the largest health surveys in the U.S. It provides information on the general California population as well as local-level information. The CHIS conducts interviews every two years and multiple years of data are available. It is designed to meet state and local needs for population-based health data for policy analysis, development, and advocacy; services and program planning; and research. CHIS contains information on wide variety of health topics, including individual health behaviors, access to health care and health insurance coverage, health outcomes, and socio-demographic characteristics. Notably, CHIS contains variables from the adapted Andersen Model that are available for study.

This is one of the few studies that have characterized the predictors of self-reported screening mammography adherence among Asian women and determine if the predictors vary by nativity. The present study shows that it is possible to examine the association between the constructs of the adapted Andersen Model (i.e. predisposing, enabling, need, and social/health care environment) and screening mammography adherence. These variables were used in the present study to characterize the predisposing, enabling, need, health behaviors, and social/health care environment factors affecting screening mammography adherence among respondents from 2001 to 2009 and to account for observed disparities.

The California Health Interview Survey provides data on public health indicators (HP2010 objectives). Many of the standardized questions are drawn from the National Health Interview Survey, which provides a national benchmark for many variables. Core topics, (e.g., demographics, health status, chronic health conditions, health behaviors, health access, utilization, and insurance) are fielded every CHIS cycle to ensure the ability to measure trends over time. Since 2005, a new questionnaire component was instituted with topics varying every CHS cycle. Additional topics are added to address new emerging public health concerns (e.g., diet, physical activity, cancer screening, family cancer history, discrimination, neighborhood safety).

The California Health Interview Survey is the largest multi-ethnic, multi-linguistic health surveys in the United States. The survey has been culturally adapted for and translated into several languages: Spanish, Chinese (Mandarin and Cantonese dialects), Korean, Vietnamese, and Khmer/Cambodian (in 2001 only). As a result, more individuals who are not English proficient are included. Designed to track the health status and disparities among California's diverse racial and ethnic groups, the sample size of the overall survey is sufficient to allow for different racial/ethnic subgroup analyses.

California has the most racially, ethnically, and linguistically diverse population in the nation. California is home to the largest Asian population (5.6 of the 17.3 million U.S. Asians live in California) (U.S. Census Bureau, 2011). It is also the first state to categorize Asian racial/ethnic group. The large sample of minority women, especially Hispanics and AAPIs, available from the CHIS is a major strength of this study in terms of statistical power. CHIS data can help enrich our understanding of the factors associated with screening mammography among minority groups and show how screening adherence can be improved. This is particularly important in the present study of U.S.-born and foreign-born Asians.

Study Limitations

Although this study offers important contributions to the literature, it does have important limitations. First, there are important limitations that affect external validity, especially generalizability of the findings. The results are only generalizable to the non-institutionalized population in California. The survey sample does not include an institutionalized population or people without telephones. Some of the American Indian/Alaska Native tribes and other subpopulations have very small sample sizes, which only allow for minimal analyses. Despite having a higher survey completion rate than other national surveys (80% compared to 50%) and implementing a variety to activities to encourage participation among sampled households and individuals, the survey response rate is low.

Second, caution should be used in interpreting the study findings. The U.S.-born Vietnamese population was included in the analysis (n=1) and could bias the results regarding Asian subgroups and create unstable estimates for other subgroups when left in. Perhaps they should have been left out of the analysis. Additionally, the data is cross-sectional and does not allow for establishing causality. The independent and dependent variables are measured at the same point in time. It is not possible to determine the direction of the association, i.e., if the exposure preceded the outcome and is therefore a potential cause of outcome. The sizeable power of the minority sample can also mean the small differences may be found that are statistically significant.

In addition, the study relied on self-reported mammography adherence. This may differ inherently from mammography screening information obtained from medical records. There is the potential for recall and social desirability bias. The same bias may apply to all the other variables of interest that were self-reported. Moreover, mammography use may have been overestimated as previous studies have reported (Mandelblatt et al., 2009; Vacek, Mickey & Worden, 1997). People tend to over report their use of mammography and underreport the time since their last mammogram leading to self-report bias. No assessment of breast cancer risk can be made. Respondents were not asked whether their mammogram was for diagnostic or primarily screening reasons. Although the sample comes from a diverse set of Asians in California, the sample may not reflect important characteristics of other Asian Americans and should not be interpreted as representative of all Asian Americans. Given that the data was collected in California, the high mammography adherence rates observed may have been influenced by the state awareness programs or funded programs that provide eligible women with low or free exams. Women in other states may not have the same screening programs available to them.

Fourth, the present study did not provide detailed information about why Asian women did or did not have a recent mammogram even though it was available in the PUFs. In order to understand the impetus behind why women get screened, it is important to assess if it is cost or access. Other conceptualizations of health care access have been expanded to include the acceptability, cost and proximity to the health care services (Guargliardo, 2004). Provider supply and facilities with mammography capability was not available for study.

Next, there are multiple variables for race and ethnicity. As a result, the racial/ethnic disparities may be reported differently across different studies depending on the definition used. The CHIS PUFs includes three race/ethnicity variables: U.S. Census, California Department of Finance/Office of Management and Budget (DOF/OMB), and UCLA – CHPR. The U.S. Census classification defines Latino/a ethnicity and race as separate variables that are not mutually exclusive and allows for the reporting of multiple races. The California DOF/OMB classification combines race and Latino ethnicity into a single race measure and includes a multiple race category. Any mention of Latino ethnicity is classified as single race Latino. The UCLA/CHPR classification is similar to the DOF/OMB classification except that it uses the "most identify" information to separate reports of Latino ethnicity and one or more racial groups or reports multiple race. It does include a multiple race category for those who identify as multi-racial or do not "most identify" with one particular group. The race/ethnicity variable that is used depends on the group or groups of interests, comparisons between certain groups and sample size. For this study, the California Department of Finance definition was utilized because the raking weights used the California Department of Finance's population estimates.

Sixth, the PUFs does not allow for full contextual study of environmental factors. Sub-state geographic identifiers (e.g., county, city, and zip code) and confidential variables such as sexual behavior are excluded from the CHIS Public Use Files. Special permission must be granted to access the confidential information. Social characteristics (e.g., educational level, ethnic and racial composition, proportion of recent immigrants, income level, and employment rate at the county level) (Andersen & Davidson, 2007) may help to describe how supportive or detrimental the communities are where people live and work and access to health services. In addition, financing and organization characteristics provide insight into what health care services are available in their communities (Andersen & Davidson, 2007).

Last, the measurement of variables is not consistent in every wave. As stated above in the strengths, additional topics were included across CHIS waves. Some of the information that was important to the goals to this study was not obtained every survey year or coded as a different variable. For example, mammography adherence (MAM_SCRN) was available for CHIS 2003 -2009, but had to be imputed for CHIS 2001. Using the same process as CHIS 2003-2009, mammography adherence was determined by combining two questions to impute the value: “Have you ever had a mammogram?” and among those who answered yes, “How long ago did you have your most recent mammogram?” To resolve the issue of unavailable values (i.e., not collected in certain years), separate analyses were completed utilizing data only when data was complete. For example, age of menarche was only available for 2001, 2005, 2007, and 2009 CHIS waves while age when first child was born was only available for 2001 and 2009 CHIS. Age of menarche was used in the data analysis using combined data from 2001, 2005, 2007, and 2009 CHIS. Age when first child was born using combined data from 2001 and 2009 CHIS. Additionally, variables had to be recoded from separately coded variables. For example, usual source (AHUSUAL and USUAL) were combined into one variable for the data analysis.

POSSIBLE AVENUES FOR FUTURE RESEARCH

The most important task of future research is to use future waves of the CHIS and as well as apply the principal components of this study to a national data set, such as the National Health Interview Survey. CHIS data is only generalizable to California. In order to fully understand about screening mammography adherence in U.S. Asians and the effect of predisposing, enabling, need, and social/ health care environment, the results have be replicable. Before firm conclusions may be drawn about screening mammography adherence, it is important to replicate the results with other data sources and analytical methodologies. In addition, efforts should be made to monitor future mammography adherence rates, especially as the population ages and as access changes due to the Affordable Care Act. Screening mammography may change as educational status increases, population changes in the general population and in racial/ethnic subgroups, and as changes occur in health status and medical care. There were also sufficient differences in screening mammography adherence among U.S.-born and foreign-born Asians to justify further study by type of health insurance, type of usual source of care, and past health care utilization and access.

Having any type of health insurance and usual source of care were major predictors for screening mammography adherence. Health insurance was a predictor of mammography adherence in U.S.-born Asians while usual source of care was a predictor of mammography adherence in all Asians regardless of nativity. Additional analysis is needed to understand how the type of health insurance and/or usual source of care may influence mammography adherence rates differentially. CHIS asks that the type of health insurance that respondents have, e.g., private insurance through current or former employer or union; through school/professional association/trade group or other organization; purchased directly from health plan, Medicare, MEDI-CAL, Healthy Families, etc. Each type of insurance (i.e., none, private, public – Medicare or Medicaid) represents the comprehensiveness of the benefits and the level of restrictions that are imposed on specific health services (Pourat et al., 2010). Compared to private insurers, public insurers, such as Medicaid, offer lower provider reimbursement, limit benefits, and have stricter service authorization requirements than private insurers.

Other studies have shown that having a usual source of care may determine cancer screening among Asian Americans (Kagawa-Singer et al., 2007; Pourat, Ponce, & Wyn, 2007). Since the type of usual source of care (i.e., none, private doctor/HMO, clinic/hospital) may influence mammography adherence, it represents the extent and quality of services provided in different settings. It should be included in future research.

Compared to private settings, public clinics usually have longer wait times, shorter appointments, rotating clinical staff, and fewer resources.

Because of the importance of the health care environment in predicting screening mammography in Asians, future research could examine how past experiences with health providers are associated with adherence. For example, CHIS 2009 asks specific questions about health care utilization and access. Respondents are asked if they have a main health care provider, if they ever phone or e-mail their doctor's office with a medical question, if anyone at their doctor's office helps coordinate their care, if they had a hard time understanding the doctor, the language that the doctor spoke to them, if the respondent and their doctor spoke different languages, if they needed someone to help them understand the doctor, if they delayed getting a prescription, why they delayed the prescription, and if they delayed getting medical care that they felt they needed. Research has shown that past experiences may reflect previous success in accessing needed health care services and receiving satisfactory care as well as impact willingness to seek and receive future health care services (Anderson & Davidson, 2007; Brach, Fraser & Paez, 2005). Any delays in obtaining care may help explain disparities in cancer screening (Blackman & Masi, 2006; Pourat et al., 2010). The ability to communicate with health care providers and finding satisfactory providers may indicate having found culturally and linguistically appropriate providers. Research has shown that access to culturally concordant care may be more important than access to care (McPhee, 2002; Nguyen et al., 2002). It is expected that delays or difficulty finding satisfactory and/or culturally and linguistically appropriate providers will reduce the likelihood of mammography adherence. Likewise, positive ratings of past care will increase the likelihood of screening mammograms.

CONCLUSIONS

Despite the benefit of screening mammography, more than one-quarter of the population remains unscreened. The purpose of this project was to investigate screening mammography adherence among California women aged 40 years and older from 2001 to 2009. In doing so, the project aimed to compare screening mammography adherence rates in California by race/ethnicity and nativity, determine whether predisposing, enabling, need, health behaviors, and social/health care environment contributed or attenuated the observed disparities in Asians, and examined if the disparities varied by nativity (Figure 3.1). The theoretical model (Andersen Model) fit the data and addressed the explanatory factors. Overall, mammography adherence is higher in Californians than the national average. The prevalence of mammography adherence increased over time from 74.3% in 2001 to 79.5% in 2009. Since this rate exceeds the HP2010 target of 70%, it implies that more prevention strategies might be in place in California to improve access for vulnerable populations. This might not be true for the rest of the country.

The descriptive results showed that the rate of mammography adherence among different racial/ethnic groups grew closer over time. Non-Hispanic White women had the highest percentage of women reporting that they had a screening mammogram in the past two years in 2001 and 2009. Asian/Pacific Islander women had the lowest rate in 2001, but the greatest gain in mammography adherence between 2001 and 2009. The descriptive results also exhibited that the mammography adherence between U.S.-born and foreign-born Asians grew closer between 2001 and 2009. More U.S.-born women are mammography adherent than foreign-born women.

For the total population, screening mammography adherence was positively associated with study year, being between the ages of 50 and 64 years, being overweight or obese, prior receipt of cancer prevention health services. Screening mammography adherence was negatively associated with being AAPI or other race, aged 65 years or older, having less than a high school education or some college, being underweight, and current smoker. Demographic and health behavior changes in the population may be impacting screening mammography adherence. Since the number of foreign-born and minority groups are increasing, insurance rates will decrease and affect screening mammography adherence. When stratifying the Asian population by nativity, the same patterns persisted in regards to age, education and health behaviors. However, being Korean was negatively associated with screening mammography among foreign-born Asians. Koreans are more likely to be uninsured because of their employment in a small business or ownership of a small business (Asian & Pacific Islander American Health Forum, 2012).

Individual factors, i.e., predisposing, enabling and need, associated with screening mammography adherence varied between U.S.-born and foreign-born Asians. After adjusting for additional *predisposing* (age of menarche, age when their first child was born) and *enabling* (home ownership and usual source of care) factors in the CHIS 2001, 2009 sample and the CHIS 2005, 2009 samples, no *need factors* and more *predisposing* than *enabling* factors were associated screening mammography. In all analyses (CHIS 2001-2009, CHIS 2001 and 2009, CHIS 2005 and 2009), the relevant factors included age and marital status (*predisposing factors*) and being uninsured (*enabling factor)* included being uninsured. In all analyses (CHIS 2001-2009, CHIS 2001 and 2009, CHIS 2005 and 2009), age (50-64 years) and prior receipt of colonoscopy or Pap smear were positively associated with screening mammography while being unmarried, uninsured, and sedentary was negatively associated with screening mammography. Study year, Asian subgroup (*predisposing)*, and being obese or overweight (*health behaviors*) were positively associated with screening mammography in two analyses (CHIS 2001-2009, CHIS 2001 and 2009). Not knowing the age of their first period and no usual source of care (*predisposing factors)* were negatively associated with screening mammography in the last two analyses (CHIS 2001, 2009 and CHIS 2005, 2009).

In the analysis of social and health care environment factors, screening mammography adherence in all Asians was associated with a doctor examining breasts for lumps in the past 12 months, age 50 to 64 years old and being Korean. In both U.S.-born and foreign-born Asians, screening mammography was associated with doctor examining breast for lumps in the past 12 months and age 50 to 64 years old. For foreign-born Asians, screening mammography adherence was also associated with visiting the doctor during the past 12 months and being Korean. Koreans are more likely to be uninsured because many are employed in or own small business (Asian & Pacific Islander American Health Forum, 2012).

Predisposing, enabling, health behaviors and health care environment have a strong influence on adherence to screening mammography guidelines. The results of this study should be interpreted cautiously. Further study is needed as more appropriate data becomes available. Specifically, how health care access and past experiences with the health care environment can affect mammography utilization. Adherence to the recommended screening guidelines is paramount to the early detection of breast cancer. Hence, understanding the factors associated with screening mammography adherence is an important element toward the improvement of preventive measures for the reduction of breast cancer mortality and morbidity.

Breast cancer screening educational programs targeting Asian women are likely to be successful if we acknowledge women's cultural views related to non-adherence to cancer screening and include messages that counter those cultural barriers. For instance, Asian women have a fatalistic view of cancer. Asian women need to be empowered to take charge of their breast health. Likewise, health care providers should be sensitive to possible cultural barriers of their Asian patients, especially those who are older immigrants, and address their specific concerns that keep them from getting mammograms. In addition, culturally appropriate educational materials in multiple languages, such as brochures, videos, booklets, and displays, need to be readily available in clinics, hospitals, libraries, and mass media to provide accessible information to older Asian women with limited English ability.

Appendix A

Supplemental Tables

Table A.1. Weighted trends in demographic, socioeconomic, and health behavior variables in California women aged ≥ 40 years by study year and nativity, California Health Interview Survey (2001-2009).

Year	**2001 (n=20,402)**		**2003 (n = 15,720)**		**2005 (n = 17,527)**		**2007 (n=24,060)**		**2009 (n=21,910)**	
	n (%)	SE	n (%)	SE	n (%)	SE	n (%)	SE	n (%)	SE
Outcomes										
Mammogram within 2 years	154,60 (74.33)	0.42	12,028 (75.78)	0.45	13,840 (77.91)	0.51	19,087 (78.33)	0.46	17,544 (79.49)	0.69
Predisposing Variables										
Time in US										
U.S. Born	16,432 (71.03)	0.42	12,553 (71.06)	0.46	14,009 (69.65)	0.53	19,591 (69.59)	0.50	17, 083 (67.97)	0.69
Foreign-born living in U.S. for ≥ 10 years	3, 541 (25.35)	0.44	2,831 (25.53)	0.52	3,181 (26.97)	0.51	4,102 (27.38)	0.49	4,476 (29.41)	0.72
Foreign-born living in U.S. for < 10 years	429 (3.62)	0.20	336 (3.42)	0.24	337 (3.38)	0.21	367 (3.03)	0.19	351 (2.62)	0.30
Age										
40-49	6,971 (37.20)	0.23	4,956 (36.94)	0.25	5,158 (36.66)	0.24	5,476 (33.85)	0.30	4,434 (33.23)	0.37
50-64	7,244 (35.46)	0.22	5,962 (36.55)	0.28	6,851 (36.76)	0.25	9,348 (39.20)	0.27	8,624 (40.52)	0.33
≥65	6,184 (27.34)	0.14	4,802 (26.52)	0.14	5,518 (26.57)	0.12	9,236 (26.95)	0.06	8,852 (26.25)	0.13

Table A.1 continued.

Year	2001 (n=20,402)		2003 (n = 15,720)		2005 (n = 17,527)		2007 (n=24,060)		2009 (n=21,910)	
Race/ethnicity										
Hispanic	3,049 (20.80)	0.31	2,236 (21.74)	0.33	2,323 (21.92)	0.29	3,090 (22.85)	0.39	2,927 (23.79)	0.54
Non-Hispanic White	13,977 (58.57)	0.37	10,577 (56.42)	0.37	12,333 (56.73)	0.34	17,159 (55.85)	0.44	15,375 (54.32)	0.47
Non-Hispanic Black	948 (6.28)	0.19	1,029 (6.87)	0.17	763 (6.08)	0.18	1,189 (6.24)	0.19	951 (6.63)	0.31
American Indian/Alaskan Native	142 (0.75)	0.05	126 (0.79)	0.06	136 (0.67)	0.05	208 (0.88)	0.06	174 (0.72)	0.07
Asian/Pacific Islander	1,483 (11.99)	0.25	1,286 (12.47)	0.26	1,432 (13.21)	0.29	1,780 (12.56)	0.31	2,015 (13.09)	0.43
Other Race	803 (1.61)	0.09	466 (1.71)	0.08	540 (1.38)	0.08	634 (1.63)	0.09	468 (1.45)	0.12
Education										
≤ H.S. Diploma	8,148 (43.77)	0.38	5,673 (42.50)	0.48	5,876 (43.59)	0.42	7,692 (42.52)	0.42	6,834 (40.06)	0.69
Some college	6,285 (28.34)	0.39	4,899 (28.04)	0.43	5,278 (26.07)	0.44	7,359 (24.89)	0.38	6,550 (25.10)	0.62
≥ College (4 yr. degree)	5,969 (27.89)	0.34	4,148 (29.46)	0.44	6,373 (30.34)	0.42	9,009 (32.59)	0.39	8,526 (34.84)	0.66
Household Size (mean ± SD)	2.33±1.38		2.28±1.37		1.70±1.44		2.12±1.26		1.72±1.43	
Married	9,830 (57.42)	0.38	7,486 (57.05)	0.55	8,457 (57.08)	0.53	11,265 (60.61)	0.53	10,472 (60.78)	0.67
English use and proficiency										
Speaks English only	15,577 (66.68)	0.42	11,749 (65.46)	0.42	13,440 (66.01)	0.44	19,110 (66.99)	0.51	16,805 (65.97)	0.62
Speaks English very or well	2,981 (18.10)	0.38	2,607 (19.26)	0.43	2,685 (19.51)	0.42	3,384 (19.24)	0.41	2,969 (18.86)	0.58

Table A.1 continued.

Year	2001 (n=20,402)		2003 (n = 15,720)		2005 (n = 17,527)		2007 (n=24,060)		2009 (n=21,910)	
Speaks English not well or not at all	1,844 (15.22)	0.36	1,364 (15.29)	0.43	1,402 (14.48)	0.41	1,566 (13.77)	0.44	2,136 (15.17)	0.54
Age when period started (mean±SE)	12.14±4.02		-	-	12.88±4.94		12.81±2.47		12.82±2.26	
Age when first child was born										
No child	3,215 (13.70)	0.32	-	-	3,175 (15.82)	0.38	-	-	3,876 (14.48)	0.46
10-18	2,648 (14.16)	0.35	-	-	1,851 (12.25)	0.36	-	-	2,232 (12.32)	0.64
19-25	9,106 (44.65)	0.48	-	-	7,189 (42.03)	0.55	-	-	9,030 (39.64)	0.69
26-35	4,729 (24.45)	0.41	-	-	4,556 (26.01)	0.46	-	-	5,809 (28.62)	0.58
≥36	632 (3.03)	0.14	-	-	756 (3.89)	0.20	-	-	963 (4.95)	0.25
Enabling Factors										
Employed	8,852 (44.44)	0.43	7,785 (49.27)	0.48	9,261 (54.42)	0.45	11,582 (53.51)	0.48	9,734 (51.76)	0.68
Currently insured	18,669 (89.61)	0.29	14,469 (89.34)	0.35	16,160 (89.84)	0.33	22,431 (89.88)	0.44	20,203 (88.33)	0.58
Own home	-	-	11,383 (67.20)	0.41	12,927 (72.02)	0.43	17,886 (72.02)	0.42	16,382 (73.06)	0.61
< 200% Poverty level	6,903 (35.50)	0.48	4,378 (32.57)	0.52	4,505 (30.41)	0.54	6,132 (29.01)	0.50	6,330 (30.74)	0.74
Have usual source of care	19,156 (93.21)	0.21	14871 (93.49)	0.30	16,622 (94.06)	0.27	-	-	20,475 (92.43)	0.33

Table A.1 continued.

Year	2001 (n=20,402)		2003 (n = 15,720)		2005 (n = 17,527)		2007 (n=24,060)		2009 (n=21,910)	
Need Factors										
General health condition										
Excellent	3,833 (17.79)	0.30	3,150 (18.69)	0.42	3,696 (18.72)	0.42	4,525 (17.48)	0.40	4,208 (18.44)	0.48
Very Good	6,391 (29.82)	0.44	4,808 (28.06)	0.43	5,481 (29.37)	0.47	7,598 (29.68)	0.41	7,155 (30.13)	0.56
Good	5,610 (27.96)	0.42	4,185 (27.12)	0.46	4,518 (26.57)	0.42	6,781 (28.87)	0.45	5,960 (29.78)	0.68
Fair	3,236 (17.81)	0.35	2,511 (18.58)	0.43	2,701 (18.22)	0.41	3,638 (17.51)	0.45	3,255 (16.46)	0.49
Poor	1,332 (6.61)	0.28	1,066 (7.54)	0.32	1,131 (7.13)	0.25	1,518 (6.46)	0.26	1,332 (5.18)	0.31
At least 1 chronic condition, i.e., asthma, diabetes, high blood pressure, heart disease	9,923 (47.50)	0.43	7,865 (48.29)	0.55	8,754 (48.72)	0.51	13,302 (51.60)	0.55	12,122 (51.19)	0.65
Family history of breast cancer	2,036 (9.35)	0.27	-	-	-	-	-	-	2,710 (10.84)	0.37
Health Behaviors										
Obese	4,284 (21.21)	0.41	3,465 (22.53)	0.38	3,707 (22.73)	0.47	5,320 (22.78)	0.40	4,779 (23.71)	0.58
Overweight	5,900 (29.12)	0.44	4,557 (29.42)	0.54	5,038 (28.87)	0.42	7,285 (30.58)	0.54	6,514 (31.27)	0.64
Binge drinking	1,006 (4.57)	0.21	673 (4.26)	0.22	1,394 (7.32)	0.27	3,450 (14.36)	0.35	3,302 (16.40)	0.65
Former smoker	6,111 (26.58)	0.41	4,650 (26.09)	0.53	5,434 (26.52)	0.41	7,395 (25.32)	0.39	6,608 (25.41)	0.62

Table A.1. continued.

Year	2001 (n=20,402)		2003 (n = 15,720)		2005 (n = 17,527)		2007 (n=24,060)		2009 (n=21,910)	
Current smoker	3,021 (13.23)	0.30	2,117 (12.52)	0.39	2,199 (11.78)	0.36	2,671(10.57)	0.33	2,240 (10.02)	0.39
Sedentary	6,941 (37.94)	0.45	8,978 (53.03)	0.50	6,748 (41.58)	0.46	3,871 (16.79)	0.47	8,607 (40.56)	0.65
Prior cancer prevention health service use	10,957 (50.04)	0.44	14,213 (89.43)	0.42	10,634 (54.97)	0.55	15,928 (57.90)	0.47	15,329 (60.11)	0.56
Health care environment										
# of doctor visits within past year (mean ± SE)	-	-	3.81±2.82		3.71±2.83		3.73±2.81		3.74±2.79	
Visited doctor during past 12 months	-	-	14,213 (89.43)	0.42	15,715 (88.61)	0.35	21,743 (89.37)	0.32	19,701 (88.39)	0.52
Doctor examined breasts for lumps past 12 months	-	-	10,438 (65.45)	0.53	13,035 (74.02)	0.59	-	-	15,789 (73.94)	0.66
Social environment										
Feel safe in the neighborhood (all or most of the time)	-	-	-	-	16,221 (90.94)	0.33	22,905 (93.48)	0.32	20,589 (92.35)	0.34
Urban	17,390 (95.99)	0.05	14,106 (96.02)	0.07	16,050 (97.17)	0.06	22,118 (97.23)	0.06	20,647 (97.34)	0.07
Mean length of time lived at current address in months (mean±SE)	-	-	167.29±153.76		166.17±155.48		187.76±164.50		198.08±165.45	

Table A.2. Summary table of odds ratios for prevalence of having a screening mammogram within past years among female respondents aged 40 years and older (includes missing/unavailable values), California Health Interview Survey (2001-2009).

Variable	**CHIS 2001-2009 (n = 8,353)**		**U.S. Born (n= 1,652)**		**Foreign-Born (n = 6,701)**	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Year Trend	1.12	0.53-2.38	2.50	0.55-11.37	1.12	0.48-2.62
Predisposing Variables						
40-49 years	1.00		1.00		1.00	
50-64 years	**1.35**	1.11-1.64	1.59	0.93-2.71	**1.35**	1.09-1.67
≥65 years	0.72	0.52-1.00	0.80	0.34-1.86	0.75	0.52-1.08
US-Born	1.00		--	--	--	--
Foreign-Born	0.94	0.68-1.29	--	--	--	--
Chinese	1.05	0.75-1.45	0.84	0.50-1.40	1.05	0.69-1.59
Japanese	1.00		1.00		1.00	
Korean	0.80	0.54-1.19	1.57	0.33-7.60	0.77	0.50-1.18
Filipino	0.92	0.65-1.23	1.33	0.64-2.73	0.86	0.57-1.32
Vietnamese	**1.70**	1.05-2.75	N/A	N/A	**1.70**	1.02-2.85
Other Asian	0.84	0.59-1.20	0.70	0.37-1.33	0.88	0.59-1.33
≤ High school	0.85	0.64-1.13	**0.42**	0.24-0.72	0.90	0.66-1.24
Some college	0.90	0.72-1.12	0.84	0.51-1.38	0.89	0.70-1.14
≥ College (4 yr. degree)	1.00		1.00		1.00	
Household Size (mean ± SD)	**0.91**	0.87-0.97	0.95	0.79-1.14	**0.91**	0.84-0.98
Not married	**0.56**	0.44-0.70	**1.04**	0.68-1.60	**0.52**	0.40-0.67
Speaks English only	1.00					
Speaks English very or well	0.91	0.67-1.23	0.57	0.31-1.03	1.07	0.77-1.48
Speaks English not well or not at all	0.75	0.54-1.04	0.60	0.17-2.13	0.85	0.60-1.20
Age when first period started >13	0.87	0.68-1.12	**1.08**	0.67-1.74	0.84	0.64-1.11
Missing/unknown age of first period	**0.31**	0.14-0.68	**0.13**	0.03-0.57	**0.41**	0.20-0.81
No children	1.10	0.78-1.54	0.98	0.44-2.19	1.13	0.78-1.65
First child born between 10-18	0.97	0.60-1.57	6.05	1.67-21.89	0.66	0.40-1.10
First child born between 19-25	1.00		1.00	1.00	1.00	
First child born after 26	0.93	0.74-1.18	**0.50**	0.27-0.91	1.03	0.80-1.32
Enabling Factors						
Employed	1.00		1.00		1.00	

Table A.2 continued.

Variable	CHIS 2001-2009 (n = 8,353)		U.S. Born (n= 1,652)		Foreign-Born (n = 6,701)	
Unemployed	0.97	0.82-1.16	1.50	0.80-2.79	0.91	0.74-1.12
Insured	1.00		1.00		1.00	
Uninsured	**0.50**	0.39-0.64	**0.14**	0.07-0.30	**0.52**	0.41-0.68
Owns home	1.00		1.00		1.00	
Does not own home	**0.77**	0.62-0.96	0.61	0.34-1.10	0.79	0.62-1.00
Missing home ownership	1.00	0.05-19.62	26.23	0.06->999.99	0.97	0.03-27.58
≤ 200% poverty level	1.00		1.00		1.00	
> 200% Poverty level	0.95	0.76-1.18	1.48	0.83-2.66	0.91	0.71-1.17
Has usual source of care	1.00		1.00		1.00	
No usual source of care	**0.33**	0.25-0.45	**0.15**	0.06-0.37	**0.34**	0.24-0.46
Missing usual source of care	0.63	0.30-1.32	0.27	0.06-1.22	0.62	0.26-1.46
Need Factors						
General health condition						
Excellent	1.00		1.00		1.00	
Very good	1.13	0.83-1.54	1.06	0.58-1.97	1.06	0.75-1.51
Good	1.01	0.75-1.36	1.39	0.69-2.79	0.90	0.66-1.22
Fair	1.04	0.76-1.43	2.34	0.87-6.24	0.88	0.62-1.25
Poor	0.87	0.61-1.26	1.02	0.23-4.53	0.76	0.49-1.19
≥ 1 chronic condition	1.00		1.00		1.00	
No chronic condition	**0.77**	0.62-0.95	1.03	0.60-1.77	**0.71**	0.56-0.90
Family history of cancer	1.00		1.00		1.00	
No family history of cancer	1.09	0.87-1.38	2.18	1.05-4.52	0.99	0.73-1.33
Missing family history of cancer	1.19	0.28-5.15	6.64	0.37-120.12	1.15	0.22-2.90
Health Behaviors						
Underweight (BMI ≤ 18.49)	0.72	0.52-1.01	1.98	0.61-6.47	**0.68**	0.48-0.95
Normal Weight (18.5≤ BMI ≤ 25)	1.00		1.00		1.00	
Obese or Overweight (BMI ≥ 25)	**1.33**	1.08-1.64	**1.76**	1.08-2.85	**1.30**	1.03-1.65
Missing BMI	0.70	0.30-1.64	1.06	0.2-60.23	0.72	0.28-1.83
Sedentary	**0.73**	0.60-0.89	**0.64**	0.42-0.99	**0.73**	0.59-0.90
Binge Drinker	0.72	0.46-1.11	1.20	0.56-2.59		
Never smoke	1.00		1.00		1.00	
Past Smoker	0.97	0.72-1.31	1.00	0.55-1.82	0.91	0.64-1.29
Current Smoker	0.79	0.52-1.19	0.64	0.29-1.41	0.91	0.53-1.56

Table A.2 continued.

Variable	**CHIS 2001-2009 (n = 8,353)**		**U.S. Born (n= 1,652)**		**Foreign-Born (n = 6,701)**	
Prior cancer prevention health service use	**2.76**	2.27-3.36	**3.45**	2.00-5.94	**2.72**	2.17-3.40

Note: Odds ratios are from weighted logistic regression models aTable A.2 continued.djusted for the complex survey design of the CHIS. Bolded and shaded numbers indicate statistical significance at p-value<0.05.
AOR, adjusted odds ratio. CI, confidence intervals. Chronic conditions include asthma, diabetes, high blood pressure and heart disease.

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Vita

Thuy Quynh "Quynh" Ngoc Do was born on February 14, 1979 in Bao Loc, Vietnam to Chinh Thanh Do and Gam Thi Nguyen. She immigrated to the U.S. after spending several months in a Singapore refugee camp. She grew up in the Washington, DC area. She is the eldest of four daughters. She received her Bachelors of Science in Biology from Virginia Commonwealth University in May 2001. She received her Master of Public Health from Virginia Commonwealth University in August 2005. She moved to Galveston, TX in August 2009 to pursue a PhD in Population Health Sciences through the Department of Preventive Medicine and Community Health at the University of Texas Medical Branch (UTMB). Prior to coming to UTMB, she worked as a public health consultant in the areas of substance abuse, mental health, occupational health, minority health, health communications, health promotion, and juvenile justice.

Her research interests include cancer health disparities and the factors affecting health services use. She is particularly interested in the effect of social networks, cultural values, and immigrant experience and acculturation on service utilization. She would like to combine her research interests with her interest in health policy to determine how research findings can inform interventions and laws. Quynh has gained valuable research experience while pursuing graduate study at UTMB. She served as a Predoctoral Fellow in the Sealy Center on Aging for two years. She has served as a Presidential Scholars Mentor. She was awarded the 2012-2013 Houston-Galveston Albert Schweitzer Fellowship and developed and implemented a bimonthly educational curriculum for underserved elementary students to promote a healthy lifestyle and increase physical activity. Quynh is also the recipient of the 2013-2014 Hispanic-Serving Health Professions Schools' Hispanic Health Services Research Scholars Program. She has presented at national conferences including the American Public Health Association annual meetings and the American Association for Cancer Research's Conference on the Science of Cancer Health Disparities in Racial/Ethnic Minorities and the Medically Underserved. While in graduate school, Quynh has been active in many student organizations. She was very active in the Public Health Organization (Chair), Preventive Medicine and Community Health Graduate Student Organization (Chair), Graduate Student Organization (Department Representative), UTMB Student Government Association (Senator and Senate Chair), Honor Pledge Committee (SGA Representative), Yearbook (Co-Chair), The Wave newsletter (Editor), SIGHT, and Students Together for Service (Treasurer).

Education

B.S. Biology, May 2001, Virginia Commonwealth University, Richmond, VA.
M.P.H., May 2005, Virginia Commonwealth University, Richmond, VA.

Publications

Do, T.N., Nam, S. (2011). Knowledge, Awareness and Medical Practices of Asian Americans/Pacific Islanders on Chronic Hepatitis B Infection: Review of Current Psychosocial Evidence. *Health and Social Welfare Review,* 31 (3), 341-364.

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Permanent address: 1410 Quiet Green Court, Houston, TX 77042

This dissertation was typed by ThuyQuynh Do