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Essays on Immigration-Related Disparities in Health Behavior and Health Care Utilization

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ESSAYS ON IMMIGRATION-RELATED DISPARITIES IN HEALTH BEHAVIOR AND HEALTH CARE UTILIZATION

by

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ESSAYS ON IMMIGRATION-RELATED DISPARITIES IN HEALTH BEHAVIOR AND HEALTH CARE UTILIZATION

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University of Nebraska, 2016

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The number of immigrants in the United States has recently been increasing significantly. Immigrants may experience some worse health outcomes than natives, due to substantial legal and socioeconomic barriers. Many immigration-related disparities in health behavior and health care utilization still remain unexplored. This dissertation comprises of 3 independent studies examining such disparities across immigration status, including (1) E-cigarette use and acculturation effects; (2) Cancer-related office-based medical provider visits among cancer patients; and (3) Potentially preventable emergency department visits.

Two nationally representative data sources included National Health Interview Survey and Medical Expenditure Panel Survey. We categorized the respondents into three immigration groups based on their place of birth and citizenship, including US native, naturalized citizen, and noncitizen. Univariate analyses described the distributions of outcome variables and covariates by immigration status, with t-test and Pearson χ^2 test to identify statistically significant differences. Multivariate regressions, including lo-

gistic and generalized linear models, were performed to adjust for demographic characteristics, socioeconomic status, health care need, and health behavior etc. Nonlinear Fairlie decomposition and propensity score matching method were further adopted to measure covariates' contributions to the disparities, and reduce potential selection bias, respectively. Stata 14.0 SE was used to adjust for the complex survey design, and we considered a p-value of less than 0.05 as statistical significance.

We found (1) Noncitizens had about 55% lower odds of ever or current use of e-cigarettes than US natives, and highly acculturated immigrants were more likely to try e-cigarettes; (2) Among cancer patients, noncitizens had significantly fewer cancer-related office-based medical provider visits than US natives, however, there was no difference in annual expenditures; (3) Noncitizens were significantly less likely than US natives to have preventable ED visits, and more than 50% of the difference was attributable to race/ethnicity, lack of insurance, and usual source of care; the disparity between naturalized citizens and natives was smaller. Our research suggests that culturally-sensitive health education intervention programs and community health workers may be needed to reduce immigration-related disparities in health behavior and health care utilization.

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LIST OF ABBREVIATIONS

NHIS	National Health Interview Survey
MEPS	Medical Expenditure Panel Survey
NCHS	National Center for Health Statistics
CDC	Centers for Disease Control and Prevention
AHRQ	Agency for Healthcare Research and Quality
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
ED	Emergency Department
ACSC	Ambulatory Care-Sensitive Condition
PQI	Prevention Quality Indicator
FPL	Federal Poverty Line
OOP	Out-of-Pocket
CCC	Clinical Classification Code
CI	Confidence Intervals
AOR	Adjusted Odds Ratios
AIRR	Adjusted Incidence Rate Ratio
PSM	Propensity Score Matching
PRWORA	Personal Responsibility of Work Opportunity Reconciliation Act
EMTALA	Emergency Medical Treatment and Labor Act
ACA	Affordable Care Act

CHAPTER 1: INTRODUCTION

The number of immigrants in the United States has been increasing significantly in recent years. They are foreign-born without US citizenship at birth, and emigrate to this country for better job opportunities, high-quality education, and a safety issue in their host countries, etc. According to the statistics from the 2013 American Community Survey (ACS) released by the Census Bureau, the population of immigrants residing in the US had reached 41.3 million by July 2013, with an increase of about 1.4 million during the past three 3 years. (Camarota & Zeigler, 2014) With Mexicans being the largest population, the number of immigrants from other parts of the world also start to grow substantially, such as South & East Asia, Caribbean, and Middle East etc. (Camarota & Zeigler, 2014) Although immigrants only account for 13% of total population, they contribute approximately 15% to US annual economic output, including wages, salary and proprietors' income. (Costa, Cooper, & Shierholz, 2014)

Prior research has suggested immigrants may experience worse health outcomes than natives, although they are often observed to be younger and healthier – "Healthy Immigrant Effect". (Fennelly, 2007) Singh and Miller reported that Asian immigrants had lower life expectancy and higher mortality rates for stomach, liver and cervical cancer. (Singh & Miller, 2004) Wilson and colleagues found that immigrants might have worse vision acuity as compared to US natives without realizing it. (Wilson et al., 2014) A national study revealed that a higher proportion of immigrant parents considered their children's health as fair or poor. (Huang, Yu, & Ledsky, 2006) There has been also

mixed evidences of immigrant adolescents' use of drugs. (Cristini, Scacchi, Perkins, Bless, & Vieno, 2015) These health problems may possibly result from their underutilization of health services. For example, US-born Mexicans in California visited physicians 1.6 times more than undocumented ones within a year. (Ortega et al., 2007) They are also found to be less likely to have annual optometric services and cancer screenings. (De Alba, Hubbell, McMullin, Sweningson, & Saitz, 2005; Echeverria & Carrasquillo, 2006; Wilson, Wang, & Stimpson, 2015)

Such disparities may be attributable to many barriers to care immigrants are facing as they live in a different country. (Derose, Escarce, & Lurie, 2007) In fact, anti-immigration attitude in US changed over time, peaking at the event of September 11 attacks. (Muste, 2013) Recently, economic concerns about immigration are overwhelming. The US public starts to worry about immigrants' increasing job competition against natives and overutilization of health care resources. (Costa et al., 2014; Davis, 2016; Muste, 2013) Although there is a lack of evidences, the government still implement policies to set legal barrier to care among immigrants. For instance, the 1996 Personal Responsibility and Work Opportunity Reconciliation Act limited new immigrants' access to federally funded health programs. The recent Affordable Care Act also deprives undocumented immigrants of purchasing health insurance coverage from exchange markets.

Immigrants are also confronted with socioeconomic barriers to health care. They tend to have lower income levels, educational attainment, lack of health insurance coverage and a usual source of care. (Derose et al., 2007) Ku and colleagues found noncitizens

and their children were less likely to have Medicaid or employment-based health insurance and limited access to needed care. (Ku & Matani, 2001) Children born in immigrant families were twice as likely to report no usual source of care as US counterparts. (Huang et al., 2006) Immigrants are also experiencing culture shock during acculturation process. (Berry, 1997) Low English proficiency may limit their communication with between physicians and their ability to obtain the health resources they need. They may also encounter discrimination from health care providers and systems. (Keller, Silberberg, Hartmann, & Michener, 2010)

Many immigration-related disparities in health behavior and health care utilization still remain unexplored. The dissertation comprises of 3 independent studies examining these issues. I am using two nationally representative datasets, including National Health Interview Survey and Medical Expenditure Panel Survey. The first paper, to our knowledge, is the first to characterize differences in e-cigarette use among adults across immigration status, including naturalized citizens, noncitizen residents, and US natives. It also explores the impact of acculturation on e-cigarette use among foreign-born immigrants. Acculturation is measured by length of stay in US and English language proficiency. For the second paper, I am investigating whether naturalized citizens and noncitizens with cancer tend to underutilize office-based physician visits for treatment and follow-up than US natives. The last paper will study if immigrants are more likely than US natives to experience preventable emergency room visits related to ambulatory care-sensitive conditions defined by Agency for Healthcare Research and Quality's Prevention

Quality Indicators. Those medical events could be prevented to reduce costs if better primary care was provided to immigrants. This dissertation will address these research gaps, produce scientific evidences to policy making, and ultimately improve access to health care among immigrants.

CHAPTER 2: EXAMINING E-CIGARETTE USE BY IMMIGRATION STATUS AND ACCULTURATION EFFECTS AMONG ADULT IMMIGRANTS

INTRODUCTION

E-cigarettes, which are battery-powered devices that vaporize a liquid solution to deliver nicotine to users, have increased substantially in popularity in recent years within the United States. (Rahman, Hann, Wilson, & Worrall-Carter, 2014) Total advertising expenditures on e-cigarettes in 2012 nearly tripled as compared to the previous year, and they have been marketed as "healthier" than tobacco use, socially-acceptable in public environment, and helpful to smoking cessation. (Kim, Arnold, & Makarenko, 2014; Paradise, 2014; Protano, Di Milia, Orsi, & Vitali, 2015; Tan & Bigman, 2014) Awareness of e-cigarettes in the wider population has grown substantially, in fact, the proportion of US adults reporting ever using e-cigarettes increased from 3.3% to 8.5% during 2010-2013. (Boyle et al., 2015; Choi & Forster, 2013; Giovenco, Lewis, & Delnevo, 2014; King, Patel, Nguyen, & Dube, 2015; Pearson, Richardson, Niaura, Vallone, & Abrams, 2012; Regan, Promoff, Dube, & Arrazola, 2011; Schmidt, Reidmohr, Harwell, & Helgerson, 2014; Tan & Bigman, 2014; Zhu et al., 2013) Among smokers, more than one out of three have tried e-cigarettes. (King et al., 2015) Annual e-cigarette sales more than doubled from 2012 to 2013, reaching approximately $640 million, but total sales may be even greater when taking online sellers into consideration. (Giovenco, Hammond, Corey, Ambrose, & Delnevo, 2014; Loomis et al., 2016; Yamin, Bitton, & Bates, 2010)

However, a number of concerns have been raised about e-cigarette use. For example, they are not regulated by the Food and Drug Administration, and there is debate over their long-term safety. (Gualano et al., 2014; Odum, O'Dell, & Schepers, 2012; Oh & Kacker, 2014; Orr, 2014; Pisinger & Døssing, 2014; Protano et al., 2015; Rahman et al., 2014; Rom, Pecorelli, Valacchi, & Reznick, 2015; Voigt, 2015) Use of e-cigarettes among adolescents may also be increasing in the US. (Barrington-Trimis et al., 2015; Camenga et al., 2015; Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2015; Krishnan-Sarin, Morean, Camenga, Cavallo, & Kong, 2015; Leventhal et al., 2015; Lippert, 2015; Pentz et al., 2015; Porter et al., 2015; Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015; Roditis & Halpern-Felsher, 2015) One study reported an increasing trend of using e-cigarettes among high school students in Florida. (Porter et al., 2015) Another study in California showed that high school students may have increased their likelihood of starting tobacco use after experimental use of e-cigarettes. (Leventhal et al., 2015) Research also shows that younger age groups are more likely to try e-cigarette products compared to older groups. (Coleman et al., 2015; Giovenco, Lewis, et al., 2014) Non-Hispanic whites are more likely than other race/ethnic groups to report having used e-cigarettes. (Dutra & Glantz, 2014; Giovenco, Lewis, et al., 2014) Given the recent introduction of this product into the US market in 2004, there has been limited research into the pattern of consumption by population groups.

Several studies have examined tobacco use within immigrant populations. Prior research suggests immigrants are significantly less likely to use tobacco compared to US natives, although these differences vary by sex and country of origin. (Acevedo-Garcia,

Pan, Jun, Osypuk, & Emmons, 2005; Almeida, Johnson, Matsumoto, & Godette, 2012; Bosdriesz et al., 2013; Kaplan et al., 2014; Maher et al., 2005; Salas-Wright, Vaughn, Clark, Terzis, & Córdova, 2014; Tong et al., 2012; Wilkinson et al., 2005) For example, a study by Acevedo-Garcia and colleagues reported that immigrants had 40% lower odds of smoking daily compared to US natives. (Acevedo-Garcia et al., 2005) Others have investigated smoking behavior and how acculturation shapes it among immigrant populations. The likelihood of smoking among immigrants also increases with acculturation level measured by length of US residency and language, etc. (Kaplan et al., 2014; Koya & Egede, 2007; Li & Wen, 2013; Rodriquez, Stoecklin-Marois, Hennessy-Burt, Tancredi, & Schenker, 2015) One study showed the odds of smoking were 39% higher for immigrants with 15 or more years of residency compared to those with less than 10 years of residency in the US. (Koya & Egede, 2007) Bennett and colleagues found that lower income Blacks with high proficiency in English were 1.6 times more likely to smoke cigarettes than those with low-moderate proficiency. (Bennett et al., 2008) However, the impact of acculturation may vary by sex, and females are more sensitive to acculturation than males in increasing odds of smoking. (Kaplan et al., 2014)

A recent paper investigated e-cigarettes use by citizenship status among adolescents in California. (Alcalá, Albert, & Ortega, 2016) However, to our knowledge, there has been no prior study examining e-cigarette use by immigration status and acculturation effects among adults nationwide, and thus it remains unclear if prior findings on immigrants' tobacco smoking behavior are applicable to e-cigarette use, considering

consumers' sensitivity to its pricing and sale channels are different from those of combustible cigarettes. (Huang, Tauras, & Chaloupka, 2014; Yamin et al., 2010) To address this gap, we used nationally representative data to characterize differences in the use of e-cigarettes between noncitizens, naturalized citizens and US natives. We also compared the likelihood of e-cigarette use across immigrants by tobacco smoking status, and further measured the association between acculturation and use of e-cigarettes among naturalized citizen and noncitizen immigrants.

LITERATURE REVIEW

Several studies have documented differences in tobacco use between immigrants and US natives. (Bosdriesz et al., 2013; Kaplan et al., 2014; Tong et al., 2012) For example, Bosdriesz et al. examined differences in smoking between US immigrants, their home countries, and US population using the 2006-2007 Tobacco Use Supplement to the Current Population Survey (TUS- CPS) and the 2002-2005 World Health Survey. This study included respondents from 15 countries across the world, such as Ethiopia, Brazil, China, and Russia etc. The researchers also examined the effects of gender, age when first arrived in the United States and educational attainment on smoking behavior. They found immigrants were significantly less likely than both the US-born and their home country respondents to currently smoke. Higher education level might increase odds of smoking among immigrants towards US natives. Age when immigrated to US was not associated with tobacco use. Most previous literature examined this topic only in South

American countries or areas with Hispanic / Latino populations, while this was a world-wide scope study comparing immigrants and population from their host countries. However, most results were not multivariate-adjusted. (Bosdriesz et al., 2013)

Tong and colleagues extracted data from Mexican National Comorbidity Survey and US Collaborative Psychiatric Epidemiology Survey to study smoking initiation, persistence, and tobacco consumption among Mexican-Origin populations in both Mexico and United States. Four groups were included in this study, including Mexicans with no migrants in family, Mexicans with immigration experience or immigrants in family, Mexican-origin US immigrants, and US-born Mexicans. They found that immigrants had lower odds of initiating smoking and being persistent smokers than Mexican residents with previous immigration experience or immigrants in family, similar to the study by Bosdriesz and colleagues. (Bosdriesz et al., 2013) Also, US-born daily smokers consumed more cigarettes each day than Mexican residents with previous immigration experience or immigrants in family. However, the study did not control for socioeconomic status and other related covariates, such as length of stay in US. (Tong et al., 2012)

More studies have investigated relationship between tobacco use and acculturation among US immigrants. (Acevedo-Garcia et al., 2005; Allen et al., 2014; Almeida et al., 2012; Bennett et al., 2008; Gorman, Lariscy, & Kaushik, 2014; Jones, Pezzi, Rodriguez-Lainz, & Whittle, 2016; Kopak, 2013; Koya & Egede, 2007; Leung, 2014; Li & Wen, 2013; Maher et al., 2005; Parker, Solberg, Foldes, & Walker, 2010; Rodriquez et al., 2015; Wilkinson et al., 2005) For instance, Kaplan and colleagues investigated variations in

smoking behaviors among US Hispanic/Latino population across country of origin. They used data from the 2008-2011 cross-sectional Hispanic Community Health Study/Study of Latinos collected in four major US cities, including Bronx NY, Chicago IL, Miami FL, and San Diego CA. Total 16,322 adults aged 18-75 years old responded to this survey. Both tobacco use and attempts to quit were studied across gender and country. The researchers used the Short Acculturation Scale for Hispanic (SASH), based on language and socialization preferences, to measure the degree of acculturation among immigrants. They found that Puerto Rico and Cuba had the highest prevalence of current smoking, while Dominica had the lowest. High acculturation was associated with tobacco use, especially among women. However, this study did not report multivariate-adjusted results of association between country of origin and smoking, and did not differentiate naturalized citizens and noncitizen, either. (Kaplan et al., 2014)

Rodriquez et al. examined the effect of acculturation on very light smoking among Latinos using both 2007-2008 National Health and Nutrition Examination Survey and 2009 California Health Interview Survey. Smoking less than 5 cigarettes a day was considered as very light smoking in this study. Length of stay in US (less than 5, 5-9, 10-14, and 15 years or longer) and preferred language spoken at home (Spanish, both Spanish and English, and English) were used as indicators for acculturation level. Multivariate logistic regression models adjusted for other covariates, including age, gender, marital status, and education. They found being Mexico immigrants and shorter length of stay in the United States were associated with higher odds of being lighter smokers. This

study suggested longitudinal data to draw stronger causal relationship in future research. (Rodriquez et al., 2015)

Allen and colleagues conducted a self-administered survey of 828 low-income residents aged 16-64 in the greater Boston area, to examine how acculturation influences their health behaviors. The study performed latent class analyses based on languages spoken, daily preferred language, native language, age of US entry and number of schooling years in US. The analyses categorized all the respondents into four groups of different acculturation levels, from lowest "non-US-born, non-English speakers with no US education" to highest "the US-born". The path model in this study showed acculturation itself significantly increased the probability of current smoking among low-income residents, rather than through social or contextual factors, such as social support, perceived stress, or discrimination etc. However, it was a city-level study with limited generalizability. Future research is warranted to further investigate hidden mechanisms through which acculturation influences smoking behavior. (Allen et al., 2014)

Gorman et al. examined acculturation effects on smoking behavior stratified by gender among Asians in the United States. They used data from the 2002-2003 National Latino and Asian American study, including 1,634 Asian adult immigrants. Acculturation considered immigrants' relationship to both the US and host country (frequency of visiting their own country), and language preference, and proficiency. Multivariate regression models adjusting for socioeconomic status, stress etc. showed that females were less likely to be current smokers than males. Prevalence of smoking behaviors increased

with longer length of stay in US among Asian immigrants. However, gender-stratified models showed that females were more sensitive to acculturation in terms of increasing their probability of being a current smoker. This is a national representative study comprehensively controlling for multiple social factors, such as family cohesion, attendance at religious services, etc. However, it did not contain legal status in the research, which may significantly influence acculturation process. (Gorman et al., 2014)

Almeida and colleagues collected health behavior information, including marijuana, tobacco and alcohol use, through a survey of 1,485 public high school students in Boston area. Those students had immigration background, and were categorized into four groups based on generation and length of stay in US, including first generation with length of stay 4 years or less, first generation with length of stay greater than 4 years, second generation and third generation or higher. Gender-stratified regression models found different patterns in acculturation effects on tobacco use. The probability of tobacco use did not increase as acculturation increased among girls, such as longer length of stay. While among boys, both new immigrants and second generation had lower odds of using tobacco as compared to third generation. It seemed that girls experienced quicker acculturation than boys in term of increasing unhealthy behaviors. However, this study was not nationally representative, and did not include US white as reference. (Almeida et al., 2012)

Given an increasing trend of e-cigarettes in US, a recent article by Alcalá et al. examined use of E-cigarette products among US adolescents by using 2014 California

Health Interview Survey consisting of 1,052 children aged 12-17. E-cigarette ever use was measured by race, US citizenship, and preferred language at home. The researchers found around 10% of adolescents reported they had used e-cigarettes. US citizens and those who spoke English at home were more likely to ever use E-cigarettes. A conclusion thus was made that acculturation was positively associated with e-cigarette use. This was the first study published to investigate differences in E-cigarette use between US natives and immigrants, as well as acculturation effect measured by preferred language home. However, it was a state-level study, and only covered adolescent population, thus the results may not be generalized to nationwide.

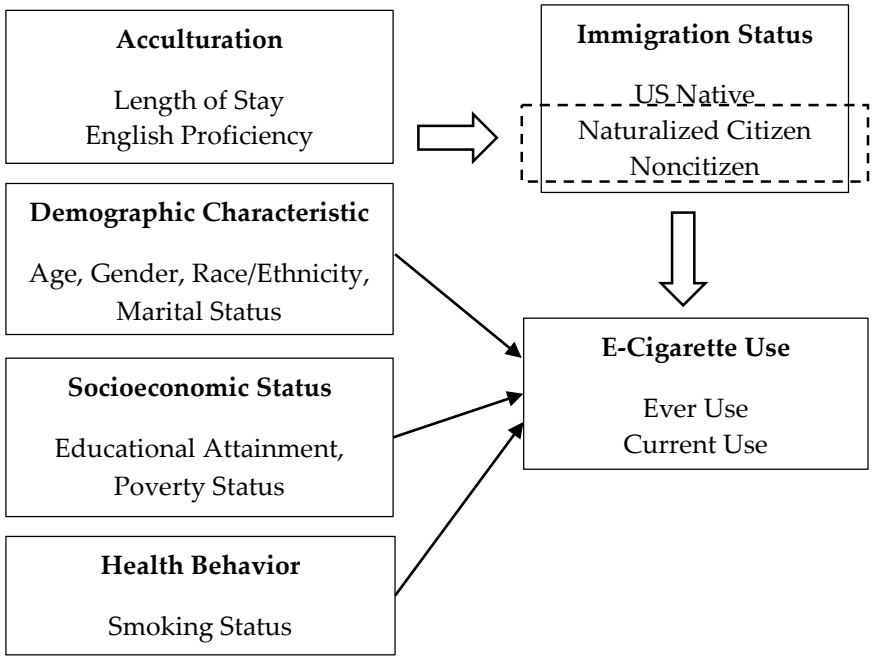
THEORY

Based on Redfield, Linton, and Herskovits' definition, "acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact with subsequent changes in the original culture patterns of either or both groups." (Redfield, Linton, & Herskovits, 1936) Immigrants from other parts of the world, after arriving in the United States, may start to adopt local mainstream behavior practices while lose some from their host countries. This process can be influenced by media, peer pressure, neighborhood, and school education etc., also depends on immigrants' ability to adapt to new environment. For example, English proficiency not only is an indicator of acculturation level, but also a bridge between origin culture and new culture where immigrants are immersed. Well-spoken

English can help US immigrants better and more interact with their surroundings and new friends, eventually achieve high level of acculturation.

Much prior literature has shown acculturation effects on health care and behaviors among immigrants. For example, Gorman and colleagues found that length of stay in US was positively associated with higher rates of smoking behaviors among Asian immigrants, especially among females. (Gorman et al., 2014) High school students with immigration background were less likely than US natives to have substance abuse problems, such as marijuana and alcohol use. (Jones et al., 2016) Ivanov et al. reported that high English proficiency and longer length of stay in US significantly increased probability of breast cancer self-exam and mammogram among female immigrants and refugees in Greensboro. (Ivanov, Hu, & Leak, 2010). Our conceptual framework investigating E-cigarette use across immigration status and acculturation effects is given in Figure 1.

Figure 1 Conceptual Framework of E-Cigarette Use among Immigrants



METHODS

Data and Sample

Cross-sectional data from the 2014 National Health Interview Survey (NHIS) were used to measure prevalence of e-cigarette use by immigration status. 2014 is the first survey year in which the NHIS asked questions associated with e-cigarettes use among survey respondents. The NHIS is an ongoing, nationally representative annual survey with a multistage area probability design, maintained by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC). It surveys the civilian noninstitutionalized population with oversampling of race/ethnic minority populations. The NHIS collects comprehensive information through in-person household interviews, including demographic characteristics, socioeconomic status, medical conditions, health behaviors, and access to care. The dataset originally consisted of 36,697 respondents aged 18 years and older. After we excluded observations with missing values (6.4% of the original sample), our final analytical sample size was 34,357.

Measures

Two outcome variables of interest in our study were the prevalence of ever and currently using e-cigarettes based on NHIS self-reported data. Respondents were asked during household interviews, "Have you ever used an e-cigarette, even one time?". We categorized those who answered "yes" to this question as e-cigarette ever users. The NHIS then continued to ask "Do you now use e-cigarettes?" among respondents who reported having used e-cigarettes at least once before. Possible answers included "every

day", "some days", and "not at all". Those reporting use as "every day" or "some days" were categorized as current users of e-cigarettes.

We used two variables (place of birth and current citizenship status) from NHIS to categorize all respondents into three immigration groups: US native, naturalized citizen, and noncitizen. Persons born in the United States were defined as US natives. Those who were not born within the United States but had US citizenship were defined as naturalized citizens; otherwise, they were defined as noncitizens.

Immigrant acculturation was measured by English language proficiency and length of stay in the US. (Bennett et al., 2008; Koya & Egede, 2007) NHIS interviewers evaluated respondents' English proficiency as "very well", "well", "not well", and "not at all" at the end of each survey. We categorized those with "very well" and "well" into a high English proficiency group, and those reporting "not well" and "not at all" into a low proficiency group. Length of stay in years in the US was categorized into three groups: 0-4, 5-9, and 10 years and above.

Demographic and socioeconomic control variables in this study included age in years (18-39, 40-59, and 60 and above), sex, race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic Other), educational attainment (less than high school, high school, and some college and above), marital status (married vs. non-married), and poverty status (family income less than 100% federal poverty line (FPL) vs. at least 100% FPL). We also included traditional cigarette smoking status as a covariate, because e-cigarette use may substitute for tobacco use. Respondents who had

smoked less than 100 cigarettes in their entire life were defined as nonsmokers. Other respondents were then defined as current or former smokers, depending on if they reported regularly using tobacco products. These control variables are consistent with prior studies examining cigarette use. (Acevedo-Garcia et al., 2005; Borges et al., 2009)

Statistical Analyses

We performed univariate analyses to characterize the distribution of all variables of interest and covariates, stratified by immigration status. The Pearson χ^2 test was used to measure if disparities in prevalence of e-cigarette use were significant across US natives, naturalized citizens, and noncitizens. We then used multivariate logistic regression models to examine the associations between e-cigarette use and immigration status among all the respondents. The associations were further examined stratified by current cigarette smokers, former smokers, and nonsmokers. We also examined country of origin among immigrants as potential confounding factors in e-cigarette use. We finally measured the association between e-cigarette use and two acculturation measures, including language proficiency and length of stay. Separate models were further estimated to examine sex-stratified acculturation effects. Statistical Software Package Stata 14.0 SE (StataCorp, College Station, TX) was used to adjust for the complex survey design of the NHIS in all analyses using survey weights. We considered a p-value of less than 0.05 as statistical significance.

RESULTS

Descriptive statistics of NHIS adult respondents' demographic characteristics, socioeconomic status, and smoking status are shown in Table 1. Of the 34,357 respondents in our sample, 81.8% (28,094) were US natives, 9.3% (3,187) were naturalized citizens, and the rest (3,076) were noncitizen residents. Noncitizens were younger, as 53.5% of noncitizens were 18-39 years old, compared to 38.4% among US natives and 27.2% among naturalized citizens. More than six in ten (62.2%) of noncitizens were of Hispanic-origin. Noncitizens were also more likely to be less educated and have family income under the federal poverty line than US natives and naturalized citizens. In contrast, US natives and naturalized citizens were similar in terms of socioeconomic status, including educational attainment and poverty status. For smoking status, both naturalized citizens and noncitizens were less likely to be current and former smokers, and more likely to be nonsmokers, as compared to US natives. For instance, 18.3% (95% CI 17.6%-19.0%) of US natives were current smokers, while the proportions of naturalized citizens and noncitizen were only 9.8% (95% CI 8.4%-11.4%) and 10.0% (95% CI 8.8%-11.2%), respectively. Among immigrants, naturalized citizens had substantially longer lengths of stay in the US and higher English proficiency than noncitizen residents. Of naturalized citizens, 92.4% had been living in the United States for over ten years versus 64.6% for noncitizens; 83.2% were categorized into the high English proficiency group, significantly higher than 56.5% for noncitizens.

Table 1 Percentage Distribution of Demographic Characteristics, Socioeconomic Status, Tobacco Smoking Behavior, and Acculturation for Adult Respondents by Immigration Status, NHIS 2014

	US Native	Naturalized Citizen	Noncitizen	P-Value
Length of Stay in US (yrs)				
0-4	N/A	2.0 [1.4, 2.8]	18.0 [16.1, 20.0]	<0.001
5-9	N/A	5.6 [4.6, 6.9]	17.4 [15.6, 19.3]	
10 and Above	N/A	92.4 [90.9, 93.7]	64.6 [62.1, 67.1]	
English Spoken				
High English Proficiency	N/A	83.2 [81.7, 84.6]	56.5 [54.1, 59.0]	<0.001
Low English Proficiency	N/A	16.8 [15.4, 18.3]	43.5 [41.0, 45.9]	
Age (yrs)				
18-39	38.4 [37.4, 39.3]	27.2 [25.1, 29.3]	53.5 [50.8, 56.1]	<0.001
40-59	34.3 [33.5, 35.2]	42.6 [40.2, 45.1]	37.2 [34.8, 39.6]	
60 and Above	27.3 [26.4, 28.2]	30.3 [28.2, 32.2]	9.4 [8.1, 10.8]	
Gender				
Male	48.1 [47.2, 48.9]	48.2 [45.8, 50.6]	52.0 [49.7, 54.2]	0.009
Female	51.9 [51.1, 52.8]	51.8 [49.4, 54.2]	48.0 [45.8, 50.3]	
Race/Ethnicity				
Non-Hispanic White	76.0 [75.2, 76.8]	26.9 [24.7, 29.2]	12.8 [11.2, 14.6]	<0.001
Non-Hispanic Black	12.4 [11.8, 13.1]	8.5 [7.3, 9.9]	5.4 [4.5, 6.5]	
Hispanic	8.0 [7.5, 8.5]	35.3 [33.1, 37.7]	62.2 [59.7, 64.6]	
Non-Hispanic Others	3.6 [3.3, 3.9]	29.2 [27.0, 31.6]	19.6 [17.7, 21.6]	
Education Attainment				
Less than high school	3.1 [2.8, 3.3]	12.1 [10.8, 13.6]	31.4 [29.1, 33.8]	<0.001
High school	33.5 [32.6, 34.4]	25.8 [23.8, 27.8]	31.6 [29.4, 34.0]	
Some college and above	63.5 [62.6, 64.4]	62.1 [59.8, 64.3]	36.9 [34.6, 39.4]	
Marital Status				
Married	51.0 [50.1, 52.0]	64.2 [61.9, 66.4]	61.5 [59.2, 63.8]	<0.001
Non-Married	49.0 [48.0, 49.9]	35.8 [33.6, 38.1]	38.5 [36.2, 40.8]	
Poverty				
Less than 100% FPL	12.2 [11.6, 12.9]	14.4 [12.9, 16.0]	28.1 [25.9, 30.4]	<0.001
100% FPL and Above	87.8 [87.1, 88.4]	85.6 [84.0, 87.1]	71.9 [69.6, 74.1]	
Smoking Status				
Non-Smoker	58.2 [57.4, 59.0]	72.8 [70.5, 74.9]	77.0 [75.1, 78.8]	<0.001
Current smoker	18.3 [17.6, 19.0]	9.8 [8.4, 11.4]	10.0 [8.8, 11.2]	
Former smoker	23.5 [22.8, 24.2]	17.5 [15.8, 19.3]	13.0 [11.5, 14.7]	

E-cigarette and other tobacco product use by immigration status is shown in Figure 2 and 3. Among all respondents, 12.9% had tried e-cigarettes at least once, and 3.8%

were currently using them when surveyed. Naturalized citizens and noncitizen residents were close in terms of prevalence of e-cigarette current use (1.8% vs. 1.1%) and ever use (6.1% vs. 5.3%); both were significantly lower than US natives (current use, 4.3%; ever use, 14.4%). We also found similar results for use of non-cigarette tobacco products (US native 26.0%, Naturalized citizen 13.0%, Noncitizen 9.6%) and smokeless tobacco products (US native 12.8%, Naturalized citizen 3.6%, Noncitizen 1.6%) by immigration status.

Figure 2 Likelihood of E-cigarette Use by Immigration Status, NHIS 2014

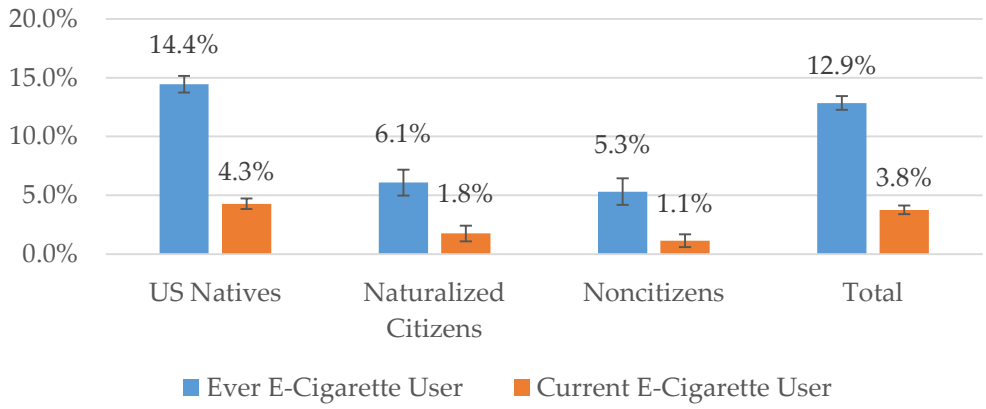


Figure 3 Likelihood of Non-cigarette and Smokeless Tobacco Products Use by Immigration Status, NHIS 2014

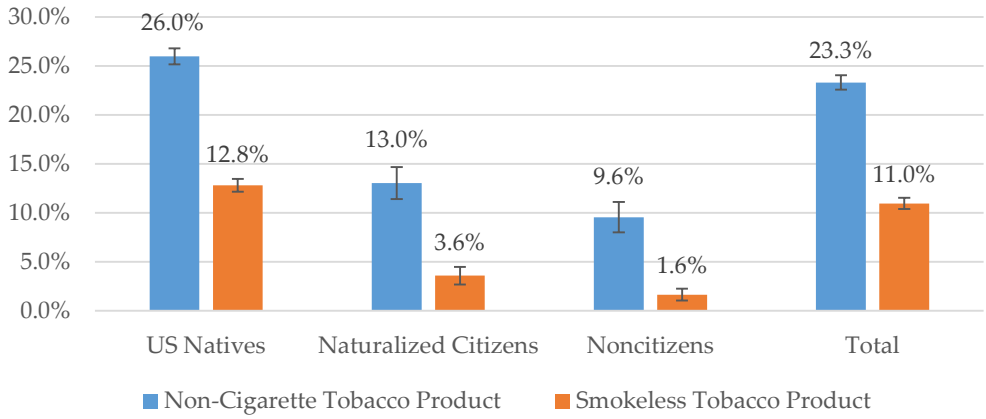


Table 2 presents the association between e-cigarette use and immigration status using multivariate logistic regression modeling. Adjusted odds ratios (AOR) and 95% confidence intervals (CIs) are reported, with US natives being the reference group for immigration status. After controlling for demographics, socioeconomic status, and cigarette smoking status, naturalized citizens (AOR 0.62, 95% CI 0.47-0.83) and noncitizens (AOR 0.45, 95% CI 0.33-0.62) had lower odds than US natives of ever use e-cigarettes. For current e-cigarette use, differences between naturalized citizens and US natives were not significant. However, noncitizens had lower odds of current use of e-cigarettes compared to US natives (AOR 0.45, 95% CI 0.24-0.84). In addition, older age groups, non-Hispanic black, Hispanic, and being married were associated with lower likelihood of using e-cigarettes, while those with higher education and a history of tobacco use were more likely to use e-cigarettes. We also examined country of origin (US vs. Mexico, Central American, Caribbean Islands vs. other), and found that immigrants from Mexico, Central American, Caribbean Islands were less likely to ever (AOR 0.54, 95% CI 0.37-0.78) and currently use (AOR 0.37, 95% CI 0.19-0.75) than US natives (Table A1). Other country of origin was only associated with lower odds of ever using e-cigarettes (AOR 0.65, 95% CI 0.50-0.85), rather than current use (AOR 0.82, 95% CI 0.54-1.24).

Table 2 Multivariate Logistic Regression Estimates of the Association between E-cigarette Use and Immigration Status, NHIS 2014

	Ever used E-Cigarette	Current using E-Cigarette
Immigration Status		
US natives	Ref	Ref
Naturalized citizen	0.62** [0.47, 0.83]	0.72 [0.46, 1.11]
Noncitizen	0.45*** [0.33, 0.62]	0.45* [0.24, 0.84]
Age (yrs)		

18-39	Ref	Ref
40-59	0.37*** [0.32, 0.43]	0.70*** [0.57, 0.85]
60 and Above	0.16*** [0.13, 0.19]	0.37*** [0.28, 0.49]
Gender		
Male	Ref	Ref
Female	0.89 [0.78, 1.01]	0.91 [0.74, 1.13]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.34*** [0.28, 0.41]	0.42*** [0.31, 0.57]
Hispanic	0.80* [0.65, 0.98]	0.82 [0.57, 1.18]
Non-Hispanic Others	0.86 [0.67, 1.11]	0.79 [0.53, 1.17]
Education Attainment		
Less than high school	Ref	Ref
High school	1.76*** [1.35, 2.30]	1.47 [0.96, 2.23]
Some college and above	1.98*** [1.54, 2.55]	1.64* [1.08, 2.50]
Marital Status		
Non-Married	Ref	Ref
Married	0.63*** [0.56, 0.72]	0.71*** [0.59, 0.86]
Poverty		
100% FPL and Above	Ref	Ref
Less than 100% FPL	0.88 [0.74, 1.03]	0.97 [0.77,1.24]
Smoking Status		
Non-Smoker	Ref	Ref
Current smoker	30.80*** [25.70, 36.90]	40.60*** [27.20, 60.60]
Former smoker	6.15*** [5.16, 7.33]	11.3*** [7.80, 16.30]

* P<.05, ** P<.01, *** P<.001

We further examined multivariate-adjusted associations between e-cigarette use and immigration stratified by cigarette smoking status (Table 3, See details in Table A2). Most differences between US natives and naturalized citizens were not statistically significant after adjusting for all covariates. However, naturalized citizens were less likely to have ever used e-cigarettes than US natives among nonsmokers (AOR 0.47, 95% CI 0.28-0.79). Among current smokers, noncitizens were less likely than US natives to be e-cigarette ever users (AOR 0.35, 95% CI 0.24-0.51) and current users (AOR 0.40, 95% CI

0.20-0.82). Noncitizens who were nonsmokers had substantially lower odds of being e-cigarette current users than US natives (AOR 0.09, 95% CI 0.02-0.54).

Table 3 Multivariate Regression-Adjusted Odds Ratios of E-cigarette Use by Immigration Status among Adult Respondents with Different Smoking Status, NHIS 2014

	Current Smoker	Former Smoker	Non-Smoker
Ever used E-Cigarettes			
US native	Ref	Ref	Ref
Naturalized citizen	0.68 [0.45, 1.02]	0.85 [0.51, 1.41]	0.47** [0.28, 0.79]
Noncitizen	0.35*** [0.24, 0.51]	0.56* [0.32, 0.97]	0.61 [0.35, 1.04]
Current using E-Cigarettes			
US native	Ref	Ref	Ref
Naturalized citizen	0.65 [0.36, 1.15]	1.35 [0.69, 2.63]	0.42 [0.10, 1.82]
Noncitizen	0.40* [0.20, 0.82]	1.26 [0.43, 3.69]	0.09** [0.02, 0.54]

* P<.05, ** P<.01, *** P<.001; covariates included age in years (18-39, 40-59, and 60 and above), sex, race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic Other), educational attainment (less than high school, high school, and some college and above), marital status (married vs. non-married), and poverty status (family income less than 100% federal poverty line (FPL) vs. at least 100% FPL), and smoking history (nonsmoker, current smoker, and former smoker)

Table 4 presents the association between e-cigarette use and acculturation among US immigrants using multivariate logistic regression models. Compared to having a length of stay between 0-4 years, having a length of stay of 5-9 years (AOR 2.08, 95% CI 1.13-3.85) and 10 years and above (AOR 2.04, 95% CI 1.20-3.48) increased the odds of ever using e-cigarettes, but the impact of higher English language proficiency on E-cigarettes among immigrants was not statistically significant (AOR 1.75, 95% CI 0.94-3.25). However, the results for current use of e-cigarettes were not statistically significant. The models excluding length of stay in US showed immigrants with high English proficiency were 1.88 times more likely than those with low English proficiency to ever use E-ciga-

rettes. (Table A3). Sex-stratified models showed that length of stay was significantly positively associated with ever using e-cigarettes among females (AOR: 5-9 years 4.42, 95% CI 1.67-11.70; 10 years and above 4.92, 95% CI 1.97-12.30), rather than males (Table 5).

Table 4 Multivariate Regression-Adjusted Association between Acculturation and E-cigarette Use among Adult Immigrants, NHIS 2014

	Ever used E-Cigarette	Current using E-Cigarette
Length of Stay in US (yrs)		
0-4	Ref	Ref
5-9	2.08* [1.13, 3.85]	1.52 [0.46, 5.04]
10 and Above	2.04** [1.20, 3.48]	1.28 [0.38, 4.27]
English Spoken		
Low English Proficiency	Ref	Ref
High English Proficiency	1.75 [0.94, 3.25]	1.70 [0.64, 4.52]
Immigration Status		
Noncitizen	Ref	Ref
Naturalized citizen	0.97 [0.70, 1.35]	1.26 [0.58, 2.75]
Age (yrs)		
18-39	Ref	Ref
40-59	0.38*** [0.24, 0.60]	0.45* [0.22, 0.93]
60 and Above	0.14*** [0.07, 0.27]	0.14** [0.04, 0.53]
Gender		
Male	Ref	Ref
Female	0.87 [0.59, 1.28]	1.09 [0.61, 1.93]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.25*** [0.11, 0.54]	0.29 [0.08, 1.08]
Hispanic	0.55** [0.37, 0.83]	0.40* [0.18, 0.89]
Non-Hispanic Others	0.50** [0.30, 0.84]	0.44* [0.19, 0.99]
Education Attainment		
Less than high school	Ref	Ref
High school	4.00*** [1.96, 8.14]	2.28 [0.79, 6.55]
Some college and above	5.02*** [2.61, 9.65]	2.44 [0.79, 7.54]
Marital Status		
Non-Married	Ref	Ref
Married	0.48*** [0.35, 0.66]	0.66 [0.36, 1.19]
Poverty		
100% FPL and Above	Ref	Ref
Less than 100% FPL	1.19 [0.80, 1.78]	0.71 [0.34, 1.51]
Smoking Status		

Non-Smoker	Ref	Ref
Current smoker	24.40*** [14.30, 41.70]	55.60*** [18.00, 172.00]
Former smoker	6.49*** [3.99, 10.6]	28.4*** [9.89, 81.5]

* P<.05, ** P<.01, *** P<.001

Table 5 Sex-Stratified Multivariate Regression-Adjusted Association between Acculturation and Ever E-cigarette Use among Adult Immigrants, NHIS 2014

	Male	Female
Length of Stay in US (yrs)		
0-4	Ref	Ref
5-9	1.47 [0.75, 2.91]	4.42** [1.67, 11.70]
10 and Above	1.44 [0.82, 2.53]	4.92*** [1.97, 12.30]
English Spoken		
Low English Proficiency	Ref	Ref
High English Proficiency	1.80 [0.81, 4.02]	1.62 [0.70, 3.76]
Immigration Status		
Noncitizen	Ref	Ref
Naturalized citizen	1.12 [0.69, 1.83]	0.69 [0.38, 1.24]
Age (yrs)		
18-39	Ref	Ref
40-59	0.41** [0.24, 0.71]	0.28*** [0.15, 0.54]
60 and Above	0.14*** [0.06, 0.32]	0.12*** [0.05, 0.29]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.20** [0.08, 0.55]	0.31* [0.11, 0.82]
Hispanic	0.69 [0.43, 1.13]	0.36** [0.19, 0.71]
Non-Hispanic Others	0.65 [0.35, 1.20]	0.31** [0.15, 0.63]
Education Attainment		
Less than high school	Ref	Ref
High school	6.91*** [3.00, 15.90]	1.62 [0.68, 3.85]
Some college and above	6.75*** [3.03, 15.10]	3.77** [1.51, 9.40]
Marital Status		
Non-Married	Ref	Ref
Married	0.52** [0.34, 0.80]	0.38*** [0.22, 0.65]
Poverty		
100% FPL and Above	Ref	Ref
Less than 100% FPL	1.03 [0.61, 1.77]	1.41 [0.79, 2.54]
Smoking Status		
Non-Smoker	Ref	Ref
Current smoker	13.50*** [7.14, 25.40]	79.80*** [45.60, 139.70]
Former smoker	4.80*** [2.48, 9.30]	10.00*** [5.35, 18.80]

* P<.05, ** P<.01, *** P<.001

DISCUSSION

Prior literature has suggested that immigrants are less likely to use tobacco as compared to US natives. (Acevedo-Garcia et al., 2005; Almeida et al., 2012; Bosdriesz et al., 2013; Kaplan et al., 2014; Maher et al., 2005; Salas-Wright et al., 2014; Tong et al., 2012; Wilkinson et al., 2005) However, to our knowledge, there has been no research on whether these findings extend to use of e-cigarettes. Our study is also the first to examine the impact of acculturation on e-cigarette use among immigrant adults. Our univariate results suggest that naturalized citizens and noncitizens were more than 60% less likely to ever use e-cigarettes. Also, one percent of noncitizens report currently using e-cigarettes. However, noncitizens had about 55% lower odds of ever or current use of e-cigarettes after adjusting for demographic characteristics, marital status, poverty, and cigarette smoking status. We further examined e-cigarette use among current, former and non-cigarette smokers. For example, among current or former cigarette smokers, noncitizens were significantly less likely to try e-cigarettes. We also found highly acculturated immigrants were more likely to try e-cigarette products.

Given our findings, the reasons for the lower rate of e-cigarette use among immigrants versus natives are unclear. Previous research suggest that immigrant families tend to stigmatize substance use, such as smoking and alcohol use. (Qureshi et al., 2014; Schwartz et al., 2011) This was reflected in a study by Osypuk and Acevedo-Garcia that examined attitudes toward tobacco control policies by immigrant communities in the US. (Osypuk & Acevedo-Garcia, 2010) They found that immigrants were twice as likely

to support smoke-free policies implemented in public environments as US natives. (Osypuk & Acevedo-Garcia, 2010) This attitude toward smoking among immigrants may extend to e-cigarette products. For example, Mexico and 25 other countries have banned the sale of e-cigarettes, and 21 countries have various restrictions on their sale or marketing. (Institute for Global Tobacco Control, 2015) Immigrants originating from these countries may be less likely to begin e-cigarette use in the US, which is supported by our findings.

Geographic location in the US may also partly explain our findings. For example, one study found that e-cigarette retailers were less likely to locate near residential areas with high proportions of racial/ethnic minorities, including Hispanic communities. (Rose et al., 2014) This may limit access to e-cigarettes among immigrant populations. It is also unclear whether or not e-cigarette prices are significantly higher in immigrant communities if there are fewer retailers. Unlike tobacco smokers, consumers of e-cigarettes tend to be sensitive to their pricing. (Huang et al., 2014)

Few prior studies have reported national estimates of e-cigarette use among adults, but there is evidence that use of e-cigarette is on the rise. (King et al., 2015; Pearson et al., 2012) For example, 3.4% of adults within the United States had used it in 2010, (Pearson et al., 2012) and this number increased to 8.5% in 2013. (King et al., 2015) Using 2014 data, we found that one in eight adults in the US have now tried an e-cigarette at least once. Furthermore, nearly 4% are current users of e-cigarettes. An advantage of our estimates of e-cigarette use over prior studies is that the NHIS is an in-

person survey, whereas prior studies used interest-based survey designs. However, e-cigarettes have substantial increase in its popularity, though there are concerns over their safety and whether they serve as a gateway to tobacco use. (Bhatnagar, Whitsel, & Ribisl, 2014; Biener & Hargraves, 2015; Gualano et al., 2014; Lippert, 2015; Odum et al., 2012; Pisinger & Døssing, 2014) In January 2014, there were over 450 brands, providing nearly 8,000 unique flavors. (Zhu et al., 2014) Further research is needed to explore whether immigrants are more aware of the health concerns over e-cigarette use or less receptive to the marketing used by e-cigarette producers compared to US natives.

One reason for the popularity of e-cigarettes is the perception that they can increase the quit rates of tobacco users. (Choi & Forster, 2013; Schmidt et al., 2014) A study by Schmidt and colleagues documented that the two dominant reasons for initiating e-cigarette use among adults were "trying something new" and "trying to quit or reduce cigarette use". (Schmidt et al., 2014) In fact, our data show that current smokers are much more likely to ever use (AOR 30.8, 95% CI 25.7-37) and currently use (AOR 40.6, 95% CI 27.2-60.6) e-cigarettes than non-smokers. In addition, US natives have higher rates of tobacco use than immigrants, and natives are more likely to be currently using e-cigarettes. However, our results also suggest that, among current tobacco smokers, noncitizens were significantly less likely to use e-cigarettes. This implies that they may not share the same perceptions of e-cigarettes as an aid to quitting smoking as US natives.

There is concern that e-cigarettes may serve as a gateway to future tobacco use. (Zhu et al., 2014) For example, a study of high school students found that willingness to smoke tobacco was higher among the 18% of students using e-cigarettes compared to non-users. (Wills, Sargent, Knight, Pagano, & Gibbons, 2015) A recent longitudinal study showed that e-cigarette users were about eight times more likely to start smoking cigarettes within 1 year than e-cigarette non-users. (Primack et al., 2015) Results from a study of e-cigarette advertising found 6% of non-smokers were receptive to trying e-cigarettes after viewing the advertisement. (Smith, Bansal-Travers, O'Connor, Goniewicz, & Hyland, 2015) Our data show that 3.3% of NHIS respondents had tried e-cigarettes even though they were never users of tobacco. However, we also found that noncitizens were unlikely to initiate use of e-cigarettes compared to US natives among nonsmokers. These findings suggest that non-smoking US natives who are using e-cigarettes are at greater risk for tobacco use in the future. Furthermore, exposure to e-cigarette cues may also increase the probability of relapse into smoking among those who have succeeded in quitting smoking. (King, Smith, McNamara, Matthews, & Fridberg, 2015)

Numerous studies have suggested that acculturation is an important factor that may lead to poor health outcomes over time among immigrants. (Kaplan et al., 2014; Koya & Egede, 2007; Li & Wen, 2013; Rodriquez et al., 2015) Our results show noncitizens have lower odds of ever using or currently using e-cigarettes than natives after adjusting for confounding factors. However, it seems likely that acculturation will decrease these differences over time. In fact, our multivariate regression analyses in Table 2 show the differences in the likelihood of using e-cigarettes between naturalized citizens and

natives are smaller or not statistically significant compared to the differences between noncitizens and natives. We also examined length of US residency among immigrants, finding that those living in the US longer than 5 years were twice as likely to try e-cigarettes compared to those with less than 5 years of residency. Thus, we expect that e-cigarette use to rise among immigrants residing for a longer time in the US, and the use of e-cigarettes is likely to be significantly higher for the 2nd generation immigrants compared to the 1st generation immigrants.

Thus, our study suggests that previous findings on tobacco use among immigrants may apply to e-cigarette use. (Bennett et al., 2008; Bosdriesz et al., 2013; Kaplan et al., 2014; Koya & Egede, 2007) However, we did not find the positive association between e-cigarette use and higher language proficiency, suggested by Bennett and colleagues. (Bennett et al., 2008) This could be due to the correlation between length of stay in US and language proficiency, given the fact that they did not control for length of stay in the US. (Bennett et al., 2008) Our results without adjusting for length of stay in US were comparable to Bennett's findings. We did not find significant results in current e-cigarette use probably due to the fact that e-cigarette products are relatively new and the prevalence of current use is very low.

Key mechanisms through which acculturation impacts e-cigarette use still remain unclear. High English proficiency of immigrants may facilitate their interaction with US natives, thus increasing the probability of health behavior change resulting

from peer influence. One study reported that peer use might increase odds of adolescents' using e-cigarettes by 1.6 times. (Pentz et al., 2015) Longer length of stay is probably associated with higher acceptance of American mainstream culture and social norms. (Bennett et al., 2008) This may possibly lead immigrants to try e-cigarettes, which may have been stigmatized or even banned in their countries of origin. (Institute for Global Tobacco Control, 2015; Qureshi et al., 2014) Interestingly, the association between ever trying e-cigarettes and acculturation is stronger among females than males in our study, which is consistent with prior findings on substance use. (Bethel & Schenker, 2005; Kaplan et al., 2014) This is possibly due to the fact that the culture against substance use in immigrants' countries of origin may be more tolerant toward men than women compared to the US. (Bethel & Schenker, 2005)

There are some limitations to this study. First, NHIS does not provide detailed information related to e-cigarette use, such as number of cartridge refills per day and reason for initiating use. Thus, we were not able to examine differences of these characteristics across immigration status. Second, we could not determine temporality of tobacco smoking and e-cigarette use because NHIS is a cross-sectional dataset. Without this information, we were not able to measure the effect of e-cigarette use on subsequently quitting smoking or reducing use of tobacco cigarettes. In addition, data on e-cigarette use are self-reported and, thus, there may be recall bias. Finally, due to lack of data, we could not relate differences in immigrant use of e-cigarettes to geographical location or pricing. We also did not control for family and neighborhood-level factors that are potentially associated with both e-cigarette and acculturation.

CONCLUSION

Our study findings suggest there are differences in the use of e-cigarettes between immigrants and US natives even after controlling for demographics, socioeconomic status and history of tobacco use. This is consistent with other studies in the literature showing that immigrants tend to have lower rates of tobacco use compared to US natives. However, there is a concern that e-cigarette use by immigrants may increase with length of residency in the US. Future research is warranted to investigate how family and neighborhood-level factors modify the effect of acculturation on e-cigarette use among immigrants.

CHAPTER 3: EXAMINING CANCER-RELATED OFFICE-BASED MEDICAL PROVIDER VISITS BY IMMIGRATION STATUS

INTRODUCTION

Cancer is ranked as the second leading cause of death in the United States, just behind cardiovascular disease. (Siegel, Miller, & Jemal, 2015) Every four in ten Americans will be diagnosed with cancer at some point in their life, and there are more than 13 million cancer survivors in the United States. (SEER Program, 2015) Each year, cancer costs for one patient are approximately $16,000 more than an average US individual, including annual health care expenditure and indirect costs due to loss of productivity. (Guy et al., 2013)

Immigrants have been documented to experience higher incidence rates and worse survival outcomes for many types of cancer compared to US-born patients. (Agaku & Adisa, 2014; Gomez et al., 2010; Khan, Ruterbusch, Gomez, & Schwartz, 2013) This could be partially explained by their underutilization of health care due to substantial socioeconomic and legal barriers they are confronted with. (Derose et al., 2007; Stimpson, Wilson, & Eschbach, 2010) Early detection through screenings can considerably increase the probability of successful treatment in the early stages of cancer, thus improve patient outcomes. However, previous studies have shown that recent US immigrants are significantly less likely to receive preventive cancer screening, including mammography, Pap smear, and colonoscopy. (Echeverria & Carrasquillo, 2006; Ivanov

et al., 2010; Jandorf et al., 2010) Echeverria et al. found the only 58% of noncitizen women aged 50-70 years old received a mammogram within the past 2 years, much lower than 79% among US-born women. (Echeverria & Carrasquillo, 2006) Lack of knowledge about the screenings among immigrants also significantly contributes to this disparity. (Jandorf et al., 2010; Johnson, Mues, Mayne, & Kiblawi, 2008; Lin, Finlay, Tu, & Gany, 2005) For instance, one study suggested that many Asians believe that only women with noticeable symptoms should seek Pap smear tests, which prevents them from being compliant with recommended routine screenings. (Johnson et al., 2008)

Being regularly monitored and effectively treated is the other key to increase likelihood of remission among cancer survivors. Several studies have investigated health care seeking experience and associated needs among immigrants with cancer, such as the role of interpreters in physician-patient communications, barriers to health care, and social and emotional support. (P. N. Butow et al., 2011; P. Butow et al., 2011; Changrani, Lieberman, Golant, & Rios, 2010; Gany, Ramirez, Chen, & Leng, 2011; Gonzalez & Davis, 2012; Leng & Gany, 2014; Leng et al., 2012; Lim, Yi, & Zebrack, 2008; Lopez-Class et al., 2011) A survey of 82 Chinese immigrants diagnosed with cancer in New York City found that one in five had missed medical appointments, but the research did not include US-born cancer patients as a comparison and the generalizability of this finding was unclear. (Gany et al., 2011)

To our knowledge, no prior study has examined disparities in healthcare utilization between immigrants and native cancer patients nationwide. To address this gap, we

used national representative data to examine the differences in cancer-related office-based medical provider visits between noncitizens, naturalized citizens and natives in the United States. We compared healthcare utilization, expenditures and types of providers seen among cancer patients stratified by immigration status. Multivariate regression analyses were performed to analyze factors associated with the differences in utilization and treatment costs for immigrants and native cancer patients.

LITERATURE REVIEW

Much prior literature has documented differences in utilization of preventive cancer screening between US natives and immigrants and acculturation-related effects. (Brown, Consedine, & Magai, 2006; De Alba et al., 2005; Echeverria & Carrasquillo, 2006; Ivanov et al., 2010; Jandorf et al., 2010; Shahidi, Homayoon, & Cheung, 2013) For example, Shahidi and colleagues examined colorectal cancer screening utilization and associated factors by immigration status. The 2007 California Health Interview Survey data was used, including 30,434 eligible individuals. Being compliant in clinical recommendation was defined as fecal occult blood test within past year, a sigmoidoscopy within past 5 years, or colonoscopy within past 10 years. Respondents were categorized into three immigration groups: US-born citizen, naturalized citizen, and noncitizen. Even among US-born citizens, only 67% received the recommended screening, while the percentage for noncitizens was 46%. Multivariate results showed noncitizens were 32% less

likely than US-born citizens to have the screening; however, the difference between naturalized and US-born citizens was not significant. Evidences suggested living in rural areas, lacking insurance, and low English proficiency were associated with poor access to colorectal cancer screening among immigrants. However, the results derived from the state-level data may not be generalizable to the whole country. (Shahidi et al., 2013)

Ivanov et al. framed a study using Andersen's Behavioral Model to investigate factors associated with cancer screening among women who immigrated from the former Soviet Union to the United States. Three types of cancer screenings in the study included mammography, Pap smear, and breast self-exam. Data was collected from 99 women aged 18 and older at a center for immigrants and refugees in Greensboro. Respondents were required to complete two questionnaires: Demographic Information designed for immigrants from the Former Soviet Union Survey, and Language, Identity, and Behavior (LIB) Acculturation Measure tool. The results showed high English proficiency increased self-exam, and longer length of stay in US was associated with mammogram. However, there were limitations. First, this study did not include US natives as a reference group to describe differences in use. Second, it used a local convenience sample at one community center, which lacked generalizability. Third, the researchers could not perform multivariate regression models due to limited sample size, instead they only used Pearson's correlation to measure the relationships. (Ivanov et al., 2010)

Echeverria et al. used the 2000 National Health Interview Survey to examine Pap smear and mammography screening across women with different immigration status.

The recommended practice of two screenings were defined as Pap smear within the past 3 years (18-65 years old) and mammogram within the past 2 years (50-70 years). Acculturation level was measured based on language preference. Noncitizens were significantly less likely than US natives to receive mammogram and Pap smear after adjusting for age, education, family, income and marital status. However, after adjusting for health insurance status and usual source of care, the disparity in mammogram was not significant any more. Among Latinas, further controlling for acculturation attenuated the difference in Pap smear use between noncitizens and US natives. There were some limitations in this study, including no information on country of origin and noncitizens' legal status. (Echeverria & Carrasquillo, 2006)

Other studies have investigated treatment experiences, social & economic barriers to care, and quality of care among immigrants with cancer. For instance, Gonzalez et al. conducted a qualitative study to investigate experiences during seeking health care among poor Hispanic immigrant women with breast cancer in a mid-sized city located in southeastern United States. Four respondents were between 31 and 45 years old with length of stay in US less than 5 years. Bilingual interpreters assisted during in-depth interviews to ensure quality of information collected. They reported their limited language ability leading to linguistic unavailability to health education and information materials, and difficulties in communicating with healthcare providers. They also worried about high health care expenditures, lack of health insurance and supports, and psychological distress. In addition to medical services, a few of them relied on spiritual or religious means to reduce their discomforts and distress. Two concerns about this study included

that a very small sample of 4 women might not achieve information saturation for generalizable results, and poverty status was self-identified by respondents, thus might not be accurate. (Gonzalez & Davis, 2012)

Gany and colleagues examined social and economic barriers to treatment appointments by collecting data from 82 Chinese immigrants diagnosed with cancer in the New York. The respondents were from 11 cancer clinics with low compliance in keeping medical appointments among patients. Questions asked varied from poor housing, employment status, to lack of health insurance and transportation. Of all participants, more than one fifth reported they had missed physician appointments for oncology follow-up, chemotherapy, and/or radiation therapy. About 94% of them missed the appointments due to lack of financial resources. Among those who did not miss any appointment for cancer care, approximately 80% also need financial support. Other reasons included ineffective communication between health professionals and patients, appointment confliction, and transportation etc. Researchers believed financial issue and language barrier were the most important factors leading to incompliance of medical appointment among immigrant patients with cancer. However, this study had a relatively small sample of only one ethnic group, and moreover, it did not have US natives as the reference group. (Gany et al., 2011)

Lim et al. examined how acculturation and social support influenced quality of life among Korean immigrant survivors with breast or gynecological cancer. The study

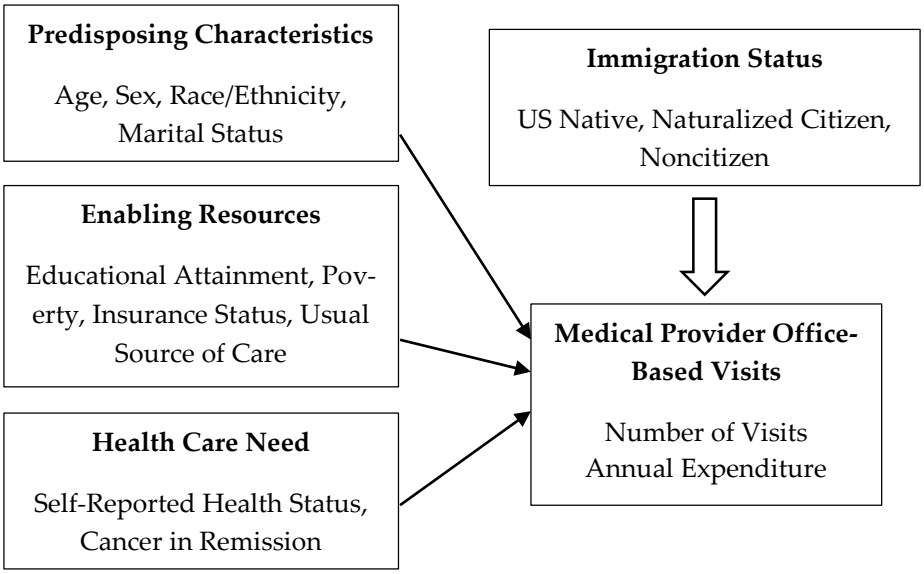
collected data from 51 Korean immigrants residing in Southern California through multiple questionnaire instruments, including Quality of Life – Cancer Survivor (QOL-CS), Brief Symptom Inventory – 18 (BSI-18), Medical Outcomes Study (MOS) Social Support Survey, Social Network Index (SNI), and Asian American Multidimensional Acculturation Scale (AAMAS). Multiple imputation was used for missing values. The researchers performed the Structural Equation Modeling to investigate pathways through which acculturation, social support, and quality of life for cancer survivors were interrelated to each other. They found acculturation was positively associated with social network size and ties, and negatively with depressive symptom, resulting in better quality of life among those survivors. This study highlighted importance of social and emotional interventions for increasing cancer patients' quality of life. However, the response rate of this study was only 40%, and all the data was self-reported, so the results might be subject to selection and recall bias. (Lim et al., 2008)

THEORY

The Andersen's Behavioral Model of Health Services Use was initially proposed by Dr. Ronald M. Andersen in 1960s. (Andersen, 1995) The model suggests that three sets of health care utilization predictors, including predisposing characteristics, enabling resources, and health care need. Predisposing factors often refer to biological and demographic determinants that are difficult to change or even cannot be changed, including age, sex, and race/ethnicity, gene etc. Enabling factors increased or decreased likelihood

of seeking health care when individuals need health services, including educational attainment, family income, health insurance status, and regular source of care etc. For example, patients with a generous health insurance plan are more likely to use more services than those without. Health care need indicators typically included number of chronic medical conditions, self-reported health status, and comorbidities index etc. Sicker patients tend to utilize more health services holding all other factors constant. We used Andersen's Behavioral Model of Health Services Use to frame this study in terms of variable selection to investigate impacts of immigration status on office-based medical provider visits among cancer patients in the United States. Variables included age, sex, race/ethnicity, marital status, educational attainment, poverty, insurance status, usual source of care, self-reported health status, and cancer in remission. All of the factors were categorized into three categories as the model suggests.

Figure 4 Conceptual Framework of Office-Based Visits among Immigrants with Cancer



METHODS

Data and Sample

Data from the 2007-2012 Medical Expenditure Panel Survey (MEPS) were used as the main source to measure the disparities in office-based medical provider visits among cancer patients across immigration status. Three MEPS components were linked for this study, including full-year consolidated data files, medical condition files, and office-based medical provider visit files. MEPS is an ongoing, nationally representative household survey annually administered by the Agency for Healthcare Research and Quality (AHRQ). (Agency for Healthcare Research and Quality, 2009) Respondents to MEPS are selected from respondents to the National Health Interview Survey (NHIS), thus permitting linkages between these databases. The data are publicly available, and it covers respondents' demographic characteristics, socioeconomic status, health conditions, and health utilization and expenditures etc. MEPS aggregates ICD-9-CM (International Classification of Diseases, Ninth Revision, Clinical Modification) diagnosis codes for similar medical conditions into groups, and each of them is given a unique Clinical Classification Code (CCC code). Based on this, we restricted our sample to adults aged 18 and older, who had been diagnosed with any kind of cancer ever in the past. Patients with non-melanoma skin cancer were then excluded following prior literature, because the cancer has different prognosis and treatment due to its low metastatic potential and mortality rates. (Lee & Khan, 2015; Madan, Lear, & Szeimies, 2010) After further deleting

observations with missing values, the final analytical sample size was 2,521, including 2,176 US-born and 345 foreign-born cancer patients.

Measures

Our primary outcome variables were cancer-related office-based medical provider visits and associated expenditures within the past 12 months for each patients. We identified the cancer-related visits using four CCC codes for each record from office-based medical provider visit files. Utilization was defined as both dichotomized (having at least one visit vs. no visits) and count (number of visits) variables, while total annual expenditures for the visits were measured in dollars. For our visit-level analysis, three other outcome variables included the type of health care professional seen (medical doctor vs. other), services provided (general checkup, diagnosis or treatment, follow-up or post-operative visit, and other), and doctor specialty (primary care physician, oncologist, and other). Primary care physicians were defined as having specialty of family practice, general practice, gynecology/obstetrics, or internal medicine.

We categorized all patients into 3 immigration groups based on their current citizenship status and place of birth, provided by the linkage of MEPS to NHIS data. Patients born in the United States were defined as US natives. For those born outside of the United States, we defined them as naturalized citizens if they already gained US citizenship. The rest of them were defined as noncitizens.

Other demographic, socioeconomic and health covariates in the study included age (18-29, 30-44, 45-64 and 65 years and older), sex, race/ethnicity (Hispanic, Non-Hispanic White, Non-Hispanic Black, and Non-Hispanic Others), marital status (married vs. non-married), educational attainment (less than high school, high school, and some college and above), poverty (annual family income below 125% of Federal Poverty Line vs. 125% and above), insurance status (insured vs. uninsured), usual source of care (yes vs. no), self-reported health status (excellent, very good, and good, vs. fair and poor), and cancer remission status (yes vs. no). We defined usual source of care based on each respondent's answer to the question: "Is there a particular doctor's office, clinic, health center, or other place that you usually go if sick or in need of advice about health?". MEPS respondents are also asked "Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?". If the answer is yes, they are further required to specify the type of cancer and whether it is in remission or not.

Analytical Plan

We conducted univariate analyses to describe distributions of cancer-related office-based medical provider visits received, total expenditures, type of health care professional seen, service, doctor specialty, as well as demographic, socioeconomic and health covariates, across immigration groups. The Pearson χ^2 test was used to identify statistically significant disparities in office-based visits between US natives, naturalized citizens, and noncitizens. Multivariate negative binomial and generalized linear model

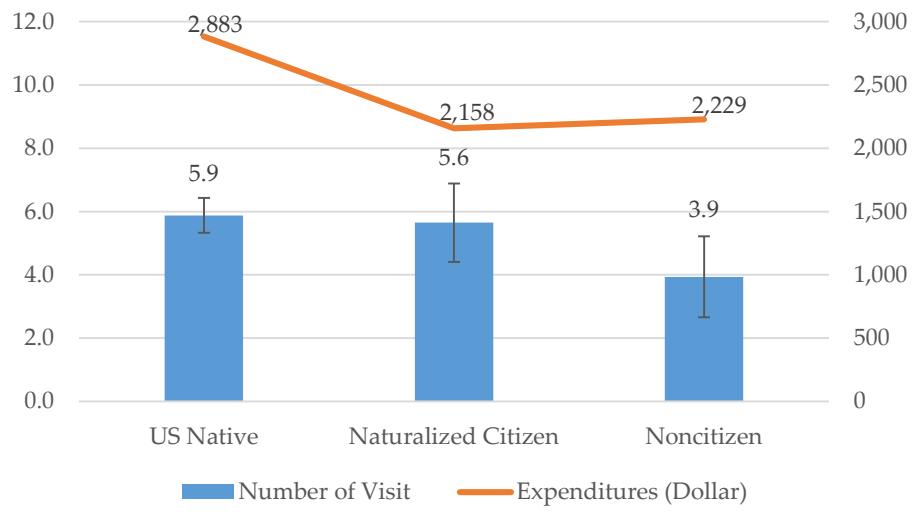
with log link and gamma distribution were used to measure the association between immigration status and number of office-based visits, and associated expenditures among cancer patients, respectively. The models adjusted for age, sex, race/ethnicity, marital status, educational attainment, poverty status, insurance status, usual source of care, self-reported health status, cancer remission status, and survey year. Complex survey design and population weight were adjusted in all analyses using STATA 14 (StataCorp, College Station, TX). A p-value less than 0.05 was considered statistically significant.

Finally, we also performed sensitivity analyses for regression results by using propensity score matching (PSM) method in order to adjust for potential selection bias, considering the limited sample size of immigrants in our data. The PSM method was first proposed by Paul Rosenbaum and Donald Rubin in 1983, and has been often applied in observational studies measuring intervention effects. (Rosenbaum & Rubin, 1983) Those studies, unlike randomized trials, typically cannot randomly assign participants into treatment or control groups to reach unbiased estimation, because a set of covariates could both influence outcomes and predict participants' receiving the intervention. In our study, we consider immigration status as the intervention. Noncitizens are more likely than natives to have lower socioeconomic status, which might result in underutilization of office-based visits among them. In this case, simply comparing outcomes from noncitizen and native groups with different characteristics may lead to selection bias. The PSM method attempts to create a new subsample of natives with demographic, socioeconomic, and health factors comparable to noncitizens to address this issue, and thus strengthen our ability to draw causal inference from this study.

RESULTS

Of 2,521 cancer patients in our sample, 86.3% (2,176) were US natives, 9.8% (248) were naturalized citizens, and the rest 3.8% (97) were noncitizens. All the patients had at least one cancer-related office-based medical provider visit within the past 12 months. Average number of office-based visits and associated annual expenditures by immigration status are presented in Figure 5. Noncitizens had two fewer visits in a 12 month period in comparison to natives – 3.9 (95% CI 2.6-5.2) for noncitizens vs. 5.9 (95% CI 5.3-6.4), and the difference was statistically significant. Naturalized citizens on average had 5.6 (95% CI 4.4-6.9) times of office-based visits within the past year, which was not significantly different from US natives and noncitizens. For expenditures, total annual cancer care expenses per patient were higher for US natives than immigrants ($2,883 vs. $2,158 for naturalized citizens and $2,229 for noncitizens); however, the differences were not statistically significant.

Figure 5 Average Number of Cancer-Related Office-Based Visits and Associated Annual Expenditures by Immigration Status, MEPS 2007-2012



Demographically, most noncitizen cancer patients were aged less than 65 years old while most native and naturalized citizen patients were 65 year old or older. About 42% of noncitizen patients were Hispanic versus 28.6% of naturalized citizens and 2.2% of natives. Educational attainment tended to be lower for noncitizens than naturalized citizens and natives. Noncitizens were significantly more likely to be low income than natives; 12.4% of natives had annual family income below 125% of the federal poverty line, while percentages for naturalized citizens and noncitizens were 20.3% and 27.1%, respectively. Noncitizens were 3 times more likely than US natives to be uninsured (7.1% vs. 2.3%), and naturalized citizens had an even lower rate 1.5%. Furthermore, 16.1% (95% CI 8.3-28.9) of noncitizens reported not having a usual source of care compared to just 6.7% of natives (95% CI 5.3-8.4). We did not find significant differences in sex, marital status, educational attainment, self-reported health status, and cancer remission status across immigration status among the patients (Table 6).

Table 6 Descriptive Statistics of Demographic, Socioeconomic, and Health Status among Cancer Patients across Immigration Status, MEPS 2007-2012

	US Native	Naturalized Citizen	Noncitizen	P-Value
Age (yrs)				
18-29	1.5 [1.0, 2.2]	0.4 [0.1, 2.7]	6.6 [1.8, 21.3]	0.003
30-44	6.2 [4.9, 7.8]	10.6 [5.6, 19.1]	18.1 [9.5, 31.6]	
45-64	39.8 [36.2, 43.5]	32.2 [24.2, 41.5]	43.4 [29.1, 59.0]	
65-	52.5 [48.7, 56.3]	56.8 [46.1, 66.9]	32.0 [18.0, 50.1]	
Sex				
Male	46.8 [44.1, 49.5]	38.5 [30.7, 46.9]	42.6 [29.7, 56.6]	0.145
Female	53.2 [50.5, 55.9]	61.5 [53.1, 69.3]	57.4 [43.4, 70.3]	
Race/Ethnicity				
Non-Hispanic White	88.4 [86.3, 90.2]	51.3 [40.9, 61.6]	39.6 [23.8, 57.9]	<0.001
Non-Hispanic Black	7.5 [6.3, 9.0]	3.6 [1.6, 8.0]	5.3 [1.9, 13.8]	
Hispanic	2.2 [1.5, 3.2]	28.6 [21.4, 37.0]	42.0 [28.1, 57.2]	
Non-Hispanic Others	1.9 [1.2, 3.2]	16.6 [9.8, 26.6]	13.1 [6.1, 26.1]	

Marital Status				
Married	63.1 [59.4, 66.7]	60.7 [50.2, 70.2]	71.8 [58.4, 82.2]	0.448
Non-Married	36.9 [33.3, 40.6]	39.3 [29.8, 49.8]	28.2 [17.8, 41.6]	
Educational Attainment				
Less than High School	13.9 [12.1, 16.0]	15.5 [10.2, 22.9]	24.8 [15.7, 36.9]	0.076
High School	33.2 [30.1, 36.5]	25.6 [17.9, 35.1]	19.7 [11.4, 31.8]	
Some College and Above	52.9 [49.5, 56.2]	58.9 [49.8, 67.4]	55.5 [39.7, 70.3]	
Poverty				
Less than 125% FPL	12.4 [10.7, 14.2]	20.3 [15.0, 27.0]	27.1 [14.4, 45.2]	0.001
125% FPL and Above	87.7 [85.8, 89.3]	79.7 [73.0, 85.0]	72.9 [54.8, 85.6]	
Insurance Status				
Insured	97.7 [96.8, 98.4]	98.6 [96.5, 99.5]	92.9 [85.9, 96.6]	0.008
Uninsured	2.3 [1.6, 3.3]	1.4 [0.5, 3.5]	7.1 [3.4, 14.1]	
Usual Source of Care				
Yes	93.3 [91.6, 94.7]	91.8 [86.0, 95.4]	84.0 [71.1, 91.8]	0.044
No	6.7 [5.3, 8.4]	8.2 [4.6, 14.0]	16.1 [8.3, 28.9]	
Self-Report Health Status				
Good and Above	54.0 [51.3, 56.7]	46.7 [37.5, 56.1]	48.1 [34.3, 62.2]	0.230
Fair and Poor	46.0 [43.3, 48.7]	53.3 [43.9, 62.5]	51.9 [37.8, 65.7]	
Cancer in Remission				
Yes	88.9 [86.9, 90.7]	93.1 [87.5, 96.3]	91.5 [82.1, 96.2]	0.207
No	11.1 [9.3, 13.1]	6.9 [3.7, 12.5]	8.5 [3.8, 17.9]	

The distribution of provider types, services, and doctor specialties during visits across immigration groups is given in Figure 6-8. A total number of 14,687 visits occurred among all cancer patients from the years 2007-2012 (natives 12,848, naturalized citizens 1,416, and 423 noncitizens). Noncitizen (88.3%, 95% CI 83.1-92.1) were more likely than US natives (76.7%, 95% CI 72.6-80.4) to be seen by a medical doctor during a visit. For noncitizens seen by medical doctors, 9.1% and 41.9% of their visits involved primary care physicians and oncologists, both of which were lower than natives and naturalized citizens; however, the disparities were not statistically significant. The distribution of received services did not significantly differ by immigration status either. We found that 57 visits among natives were associated with psychotherapy or mental health

counseling, but no such visits occurred among naturalized citizens and noncitizens in our data.

Figure 6 Distribution of Types of Providers Seen among Cancer Patients across Immigration Status, MEPS 2007-2012

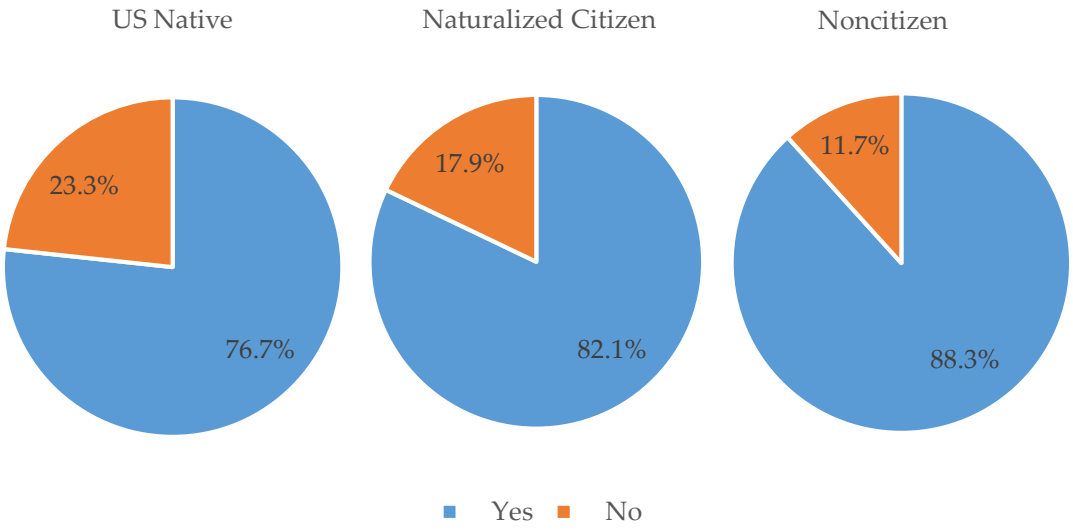


Figure 7 Distribution of Doctor Specialties among Cancer Patients across Immigration Status, MEPS 2007-2012

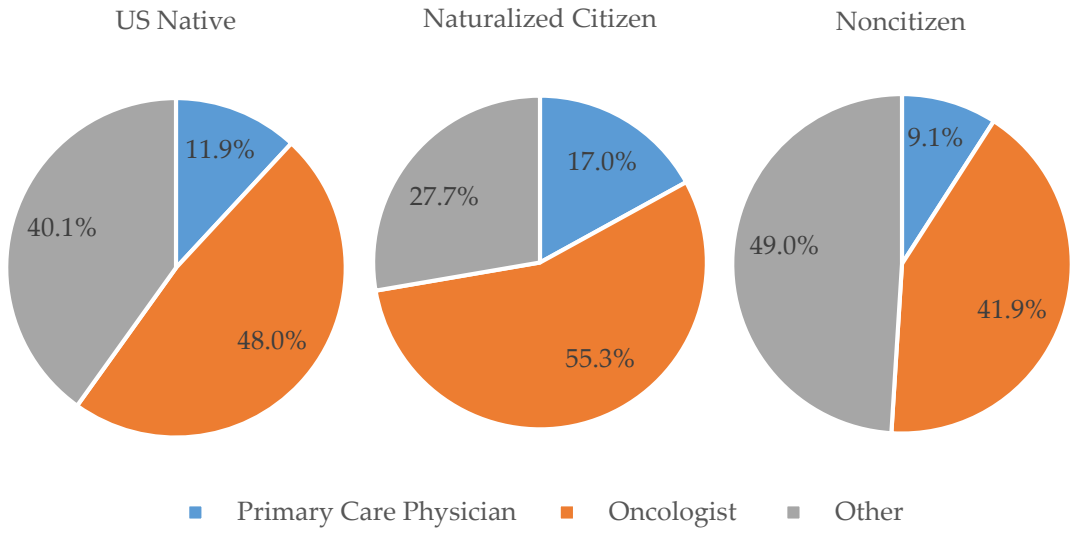


Figure 8 Distribution of Services among Cancer Patients across Immigration Status, MEPS 2007-2012

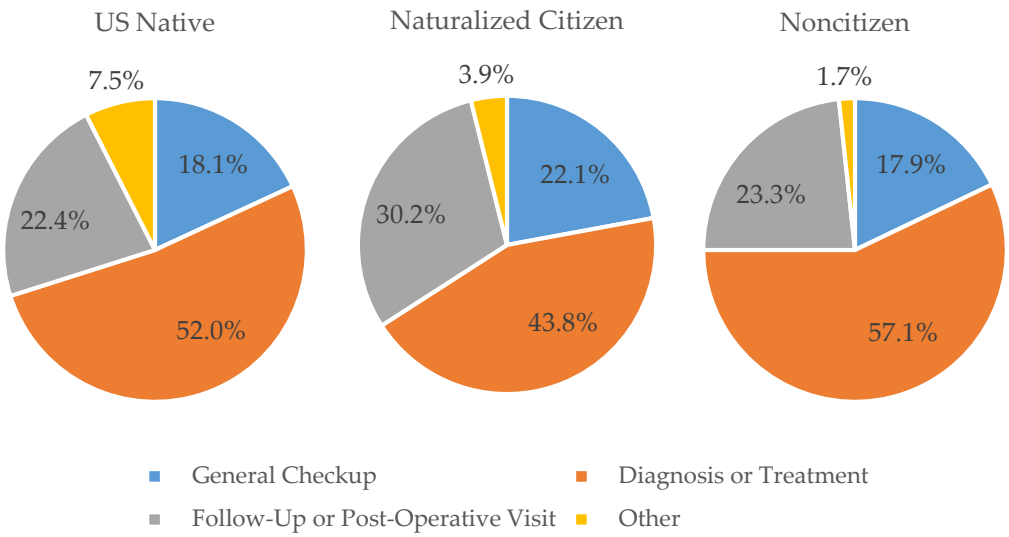


Table 7 presents the association of immigration status to the number and expenditures of cancer-related office-based medical provider visits, adjusting for demographic, socioeconomic, and health covariates. The negative binomial regression model suggested that noncitizens had a 38% lower number of visits to medical providers at office-based settings for cancer care than US natives (Adjusted Incidence Rate Ratio 0.62, 95% CI 0.45-0.84). However, this significant disparity was not found between naturalized citizens and natives. There were no significant differences in expenditures across immigration status based on the coefficients of the generalized linear model. Besides, socioeconomic and health (including cancer remission status) factors were overall strong predictors of cancer-related office-based visits and associated annual expenditures, although the effects varied across different outcome variables. For example, better self-reported health status and cancer in remission status were significantly associated with the lower number of visits and expenditures. Higher educational attainment predicted greater

number of visits, rather than expenditures. The results largely remained the same when we performed stepwise regression models for the number and expenditures (Table A4 and A5). We also examined if there was interaction between immigration status and health insurance status on both outcomes; however, we did not find significant results (Table A6). Additional results stratified by poverty status show that being covered by health insurance increased number of visits and expenditures on cancer care only among patients with annual family income equal or above 125% federal poverty line (Table A7). For example, insured patients spent approximately $1,700 more than uninsured ones on cancer-related office-based visits each year.

Table 7 Multivariate-Adjusted Relationship of Immigration Status to Number and Expenditures of Cancer-Related Office-Based Medical Provider Visits, MEPS 2007-2012

	Number of Visits	Expenditures
Immigration Status		
US Native	Ref	Ref
Naturalized Citizen	0.93 [0.75, 1.15]	-0.21 [-0.58, 0.15]
Noncitizen	0.62** [0.45, 0.84]	-0.32 [-1.03, 0.39]
Age (yrs)		
18-29	Ref	Ref
30-44	1.84** [1.20, 2.82]	0.70* [0.02, 1.37]
45-64	1.49* [1.05, 2.11]	0.70* [0.15, 1.25]
65-	1.26 [0.92, 1.73]	0.26 [-0.25, 0.77]
Sex		
Male	Ref	Ref
Female	0.92 [0.79, 1.09]	-0.14 [-0.44, 0.15]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.22 [0.92, 1.60]	0.51* [0.07, 0.95]
Hispanic	1.39* [1.01, 1.91]	0.52* [0.004, 1.04]
Non-Hispanic Others	1.06 [0.76, 1.48]	0.12 [-0.43, 0.67]
Marital Status		
Non-Married	Ref	Ref
Married	1.07 [0.92, 1.26]	0.21 [-0.09, 0.51]
Educational Attainment		

Less than High School	Ref	Ref
High School	1.38** [1.12, 1.70]	0.30 [-0.06, 0.65]
Some College and Above	1.22* [1.01, 1.48]	0.24 [-0.11, 0.59]
Poverty		
125% FPL and Above	Ref	Ref
Less than 125% FPL	0.94 [0.80, 1.10]	0.20 [-0.11, 0.52]
Insurance Status		
Uninsured	Ref	Ref
Insured	2.19*** [1.66, 2.87]	0.98** [0.28, 1.68]
Usual Source of Care		
No	Ref	Ref
Yes	1.07 [0.83, 1.37]	0.23 [-0.12, 0.57]
Self-Report Health Status		
Fair and Poor	Ref	Ref
Good and Above	0.50*** [0.43, 0.57]	-0.93*** [-1.19, -0.67]
Cancer in Remission		
Yes	Ref	Ref
No	1.88*** [1.53, 2.32]	0.93*** [0.52, 1.34]

* p<0.05, ** p<0.01, *** p<0.001
Number of visit modeled by negative binomial regression; Expenditure modeled by generalized linear model.

We conducted propensity score matching method (PSM) as a sensitivity analysis to check if the regression results were robust. After ordering patients by the score predicted by a logistic regression model, we matched the five closest neighbors of US natives to naturalized citizens and noncitizens, respectively. This method generated comparable immigration groups with balanced demographic, socioeconomic, and health covariates (Table A8). Table 4 presents differences in office-based utilization across immigration status using the PSM method. The results were largely consistent with those in the multivariate-adjusted regressions. On average, noncitizens had 1.67 fewer visits within the past 12 months than natives (P-Value<0.05), while the difference between naturalized citizens and natives was not statistically significant. Both naturalized citizens

and noncitizens had about $300 less in expenditures than US natives within the past 12 months, but these differences were not statistically significant.

Table 8 Disparities in Number and Expenditures of Cancer-Related Office-Based Visits across Immigration Status Using Propensity Score Matching Method, MEPS 2007-2012

	Difference	95% CI	P-Value
Naturalized Citizen - US Natives			
Number of Visits	0.69	[-0.74, 2.12]	0.339
Expenditures	-305.5	[-1,598.02, 987.01]	0.640
Noncitizen - US Natives			
Number of Visits	-1.67	[-3.14, -0.19]	0.028
Expenditures	-304.57	[-1,475.41, 866.26]	0.604

DISCUSSION

In this study, we addressed a research gap by using a nationally representative sample of patients to measure disparities in cancer-related office-based medical provider visits between immigrants and US natives. Our univariate analyses show that although all the patients visited medical providers in office-based settings at least once within 12 months, noncitizens had significantly fewer visits than US natives. The disparity remained significant between natives and noncitizens after adjusting for confounding factors. However, we did not find significant differences in expenditures across immigration. Propensity score matching results were largely consistent with those from the multivariate regression analyses. Interestingly, we also found noncitizens were more likely to report seeing a medical doctor during a visit than US natives.

Our findings on office-based visits by immigrants with cancer are consistent with previous research on cancer treatment and health care in general. For example, Fancesca

et al. reported that 18 out of 82 immigrants had missed at least one physician appointment for cancer follow-up and treatments in New York Chinese Communities. (Gany et al., 2011) Research by Wilson and colleagues found immigrants were significantly less likely to utilize eye care or dental services relative to US natives. (Wilson, Wang, Stimpson, McFarland, & Singh, 2015; Wilson, Wang, & Stimpson, 2015) The lower number of office-based visits among immigrants as compared to natives may result in poorer clinical outcomes that have been demonstrated in prior studies on cancer. (Agaku & Adisa, 2014; Gomez et al., 2010; Khan et al., 2013) Cancer treatment is very costly. Total US expenditures on cancer care has been increasing at an annual rate of 2.9%, and is projected to reach $173 billion by 2020. (Lee, Roehrig, & Butto, 2016; Mariotto, Robin Yabroff, Shao, Feuer, & Brown, 2011) Barriers to access to healthcare leading to less timely or effective cancer treatment among immigrant populations may further increase these costs to the health care system. In fact, a substantial proportion of noncitizen cancer patients reported lacking a usual source of care according to our data.

Interestingly, a larger percentage of office-based visits among noncitizens involved medical doctors than that among natives (88.3% vs. 76.7%). One possible reason is that unlike US natives, noncitizens may face language barriers when communicating with health care providers during visits, and undocumented immigrants are even concerned about risks of deportation. Due to these, a strong and trustful relationship between physicians and patients is critical when they decide places for care. Literature suggests smaller physician practices are associated with such relationship resulting in high-quality patient-centered care. (Liaw, Jetty, Petterson, Peterson, & Bazemore, 2016)

Thus, noncitizens may tend to seek health care in solo or small practices, rather than large physician group practices where nurse practitioners and physician assistants work. There is another possibility. Research shows that an increasing number of Mexican-origin Latinos start to move to rural areas where solo or small practice are more common than large group practices. (Berdahl, Kirby, & Stone, 2007; McKernan, Kuthy, & Kavand, 2013; Schulte et al., 2014) In both cases, noncitizens are more likely to be seen by physicians than US natives.

We also found that having health insurance, worse self-reported health status, and cancer not in remission were positively associated with higher expenditures and a larger number of cancer-related office-based visits. Although noncitizen patients were less likely to have insurance, they had no differences in self-reported health and cancer remission status. Thus, it appears that their lower socioeconomic status might substantially contribute to the disparities in cancer care between immigration groups. In our study, the average number of office-based visits for insured patients was more than 2 times as that for uninsured ones. Given the potentially large out-of-pocket (OOP) expenses associated with cancer treatment, lack of health insurance is a crucial barrier to care faced by many immigrants. Interestingly, our finding on insurance was stronger than that of poverty status which was not statistically significant in predicting utilization and expenses. This contrasts to a prior study showing 87% of immigrants with cancer reported need of financial assistance. (Gany et al., 2011) Our stratified results by annual family income suggest that insurance cannot significantly increase their utilization of

cancer care among patients in poverty even if they have health insurance, possibly because they are incapable to pay OOP part for treatments.

In addition to socioeconomic factors, noncitizens are confronted with substantial legal barriers to access to health care as compared to US citizens. For instance, undocumented immigrants and legal residents with length of residency less than 5 years are not eligible for federally funded health benefit programs based on the 1996 Personal Responsibility of Work Opportunity Reconciliation Act (PRWORA). (Derose et al., 2007) Furthermore, although the Affordable Care Act (ACA) forbids insurers to deny health coverage based on pre-existing conditions, including cancer, undocumented immigrants are not entitled to insurance premium subsidies in the health insurance exchange marketplaces established by the ACA. (Wallace, Torres, Nobari, & Pourat, 2013) Given this, we expect disparities in cancer care between US citizens and noncitizens may parallel their gap in health insurance coverage. However, depending on where immigrants reside, they might be eligible for some state health care benefits. For example, California currently provides several state programs to improve access to care among vulnerable populations. The programs provide insurance subsidies and health care services based on individuals' health needs, rather than their immigration status, e.g., the IMPACT program offering screening services and treatment for prostate cancer. (Gelatt, Koball, & Pedroza, 2014)

This study is not without limitations. First, undocumented noncitizens may face greater legal barriers to care than legal foreign residents. Because NHIS data does not

contain noncitizens' legal status, we were unable to differentiate them. Second, every type of cancer has its own progression and prognosis, and they may require different follow-up plans. However, we could not perform stratified analyses based on cancer sites due to our limited sample size. Third, we use number of office-based visits within the past 12 months as our outcome variable, but increased visits may not necessarily be associated with high quality care or improved clinical outcomes. We could not establish an empirical relationship between health utilization and costs with treatment outcomes for patients in our data. This needs further investigations in future studies.

CONCLUSION

We used nationally representative data to characterize disparities in cancer-related office-based visits and expenditures between US natives, naturalized citizens, and noncitizens. Our findings support use of policy and clinical-based interventions tailored to high-risk immigrant communities in order to reduce the economic and legal barriers to care may immigrant cancer patients are facing. Future research is warranted to investigate the role of countries of origin, geographic access to oncologists, and family support on cancer care utilization among immigration populations.

CHAPTER 4: EXAMINING POTENTIALLY PREVENTABLE EMERGENCY DEPARTMENT VISITS ACROSS IMMIGRATION STATUS IN THE U.S.

INTRODUCTION

Reducing potentially preventable medical events is a critical approach to contain ever-increasing health care expenditure and improve quality of care in the United States. Those events have been often identified by using ambulatory care sensitive conditions (ACSCs) in research since they were first introduced by Billings and colleagues in 1993. (Billings et al., 1993; Dresden, Feinglass, Kang, & Adams, 2016; Johnson et al., 2012) ACSCs are defined as conditions that can be well kept under control by providing adequate and continuous primary care, which could otherwise result in admissions to hospitals or emergency departments (ED). Primary care functions to "prevent the onset of an illness or conditions, control an acute episodic illness or conditions, or managing a chronic disease or condition", (Billings et al., 1993) thus ACSC-related admission has been widely used as an indicator for poor access to primary care. (Bermudez & Baker, 2005; Laditka, Laditka, & Probst, 2009) A recent report by the Agency for Healthcare Research and Quality showed that age-sex adjusted rate of preventable ED visits among adults aged 18 years and older increased by 11.4% during 2008 and 2012, from 2,350 to 2,618 per 100,000 population. (Fingar, Barrett, Elixhauser, Stocks, & Steiner, 2015)

Prior studies have shown that immigrants have poorer access to primary care of high quality than US citizens in a recommended manner. A national study estimated

that foreign-born Asians were 48% less likely to access routine care than US-born ones. (Ye, Mack, Fry-Johnson, & Parker, 2012) Wilson and colleagues also found immigrants had significantly lower odds of receiving optometric and dental services within the past year. (Wilson, Wang, Stimpson, et al., 2015; Wilson, Wang, & Stimpson, 2015) Another study in California revealed that among children with special health care needs, those born in immigrant families were more likely to report a lack of a usual source of care and delays in medical care compared to their counterparts in non-immigrant families. (Javier, Huffman, Mendoza, & Wise, 2010) Thus, immigrants tend to use emergency department as their primary source of care, new immigrants with less acculturation in particular. (Chan, Krishel, Bramwell, & Clark, 1996; Coffman, Shobe, Dmochowski, & Fox, 2007) For example, a survey conducted in a university hospital emergency department near United States-Mexico border reported nearly half of undocumented immigrants considered ED as the only acceptable source for their health needs. (Chan et al., 1996) All of this evidence supporting immigrants' limited utilization of primary care suggests that they may be at a greater risk of experiencing potentially preventable ED visits.

Emergency room overcrowding by undocumented immigrants has been a long-debated political issue. Their overutilization is claimed to be one of major drivers that has caused substantial increases in US ED health care expenditures. Recent research found that a 40% decrease in the number of illegal immigrants was associated with 37% decrease in annual emergency-room spending on noncitizens during the period 2007 to 2012 in Arizona. (Davis, 2016) However, in fact, there is overwhelming evidence showing that immigrants generally were significantly less likely to use ED services than US

natives, although this may not be true for children. (Cunningham, 2006; Ku & Matani, 2001; Mohanty et al., 2005; Ortega et al., 2007; Pourat, Wallace, Hadler, & Ponce, 2014; Tarraf, Vega, & González, 2014) Multivariate analyses of a nationally representative sample by Tarraf et al. showed adult noncitizens and naturalized citizens had 23% and 18% lower odds of having any ED visits than the US-born. (Tarraf et al., 2014) Two other studies found similar results that undocumented immigrants even utilized less ED services than US natives did in California. (Ortega et al., 2007; Pourat et al., 2014) The underlying reasons for such disparities vary across health system and individual levels, including anti-immigrant health care policies, fear of deportation, and low socioeconomic status etc. (Derose et al., 2007; Hacker, Anies, Folb, & Zallman, 2015) These factors interact with each other and jointly contribute to underutilization of ED services among immigrants. (Heyman, Núñez, & Talavera, 2009)

To our best knowledge, no prior research has examined disparities in utilizing emergency department services due to ACSCs across immigration status. To address this gap, we used national representative data to measure differences in having ACSC-related ED visits between noncitizen, naturalized citizens and natives in the United States. We compared probabilities of having ACSC-related ED visits stratified by immigration. Multivariate regression analyses were also performed to examine relationships of immigration status and other covariates to ACSC-related ED visits among whole population and ED services utilizers, respectively. Non-linear Fairlie's decomposition method is finally applied to investigate contributions of each demographic, socioeco-

nomic, and need factors to the immigration-related disparities. We hypothesize that immigrants, especially noncitizens, are more likely to experience preventable ED visits, because ACSC-related medical events are associated with their lower socioeconomic status and lack of access to primary care.

LITERATURE REVIEW

Previous studies have compared differences in use of emergency room services between immigrants and natives using national and regional data in US. (Cunningham, 2006; Ku & Matani, 2001; Mohanty et al., 2005; Ortega et al., 2007; Pourat et al., 2014; Tarraf et al., 2014) For example, Pourat and colleagues used data from the 2009 California Health Interview Survey (CHIS) to examine differences in emergency service use across immigrant status. This study included 47,614 adults (18 years and older) and 12,324 children aged 0-17. The CHIS data provided information on respondents' immigration status, including US-born, naturalized citizens, or permanent residents and other documented noncitizens. Based on demographic characteristics and socioeconomic status, the authors further predicted if an immigrant was documented or not. The outcome of interest was whether an individual had any ED visits within the past year. Univariate results showed that among adults, undocumented immigrants (11%) were significantly less likely to have ED visits within the past 12 months than the US-born (20%), naturalized citizens (16%), and other documented immigrants (17%). No significant differences were found among children and adolescents. However, the disparities among either

adults or children were not significant any more, after adjusting for demographic characteristics, socioeconomic status, health condition, and geographic location. The study did not find evidence that supported undocumented immigrants are responsible for ED overcrowding. However, there were a few limitations. For example, due to state-level data, results might not be generalizable to the whole country. Undocumented status was predicted, thus may not be accurate. (Pourat et al., 2014)

Tarraf et al. also investigated emergency department visits among immigrants and US natives using data from the 2000-2008 Medical Expenditure Panel Survey (MEPS) linked to National Health Interview Survey (NHIS). Based on birth of place and current citizenship at the interview, all the respondents were categorized into three groups, including US-born native, foreign-born citizen, and noncitizen. Self-reported ED service use was dichotomized into no ED visit vs. one or more ED visits within the past year, and ED expenditure was also examined. The author employed multivariate logistic regression models to measure the relationship between ED visits and immigrant status controlling for demographics, socioeconomic status, medical condition, and geographic region. They further used Fairlie's nonlinear decomposition to identify what factors contributed most to disparities in ED service use across immigration status. Although annual per-capita expenditure did not vary significantly across immigration status, out-of-pocket proportion was the highest among noncitizens. Both univariate and multivariate results revealed that immigrants were significantly less likely to use ED services than those born in the United States. The covariates only explained less than 50% of the disparities. Some limitations in this study included: no characteristics on ED visits (urgent

vs. non-urgent), lack of information on individual preferences in health care seeking behavior, and legal status of staying in US. (Tarraf et al., 2014)

A similar national study was done by Cunningham and colleagues to compare use of hospital emergency department between US citizens and noncitizens. The data source was the 2003 Community Tracking Study Household Survey with a sample size of 46,600. The authors was not able to distinguish US- and foreign-born citizens due to limited data in this study. Two-part linear model was used to measure if noncitizens underutilized ED services compared to US citizens. They found that noncitizens on average had approximately 17 fewer ED visits than US citizens per 100 population within the past. The disparity among those in poverty was even greater. (Cunningham, 2006)

Other researchers have investigated factors associated with use of emergency room services, experiences, and attitudes towards the services among immigrants. (Akincigil, Mayers, & Fulghum, 2011; Chan et al., 1996; Coffman et al., 2007; DuBard & Massing, 2007; Keller et al., 2010; Maldonado, Rodriguez, Torres, Flores, & Lovato, 2013; Nandi et al., 2008; Shibusawa & Mui, 2010; Vaughn & Jacquez, 2012) For instance, Maldonado et al. investigated barriers to access emergency department services among Latino immigrants by surveying patients in two hospitals affiliated to University of California San Francisco. Of total 1,224 patients, 217 refused to participate this study, and the rest of them were asked about demographics, language proficiency, primary source of care, insurance status, fear, perception, and experiences associated with seeking emer-

gency care. Of undocumented Latino immigrants, 12% expressed their fear of being discovered, reported to authorities and then deported from the US when they came to a hospital emergency department; 16% believed health professionals did not treat them as well as US natives. The researchers further found these fears and concerns mainly came from immigrants' social network, such as their families and friends, and media. However, the data came from only two hospitals in San Francisco Area, with about 20% non-response rate, which could potentially bias the results. (Maldonado et al., 2013)

Akincigil and colleagues examined use of emergency room services among undocumented Mexican immigrants and how acculturation influenced the pattern. The data came from Mexican Migrant Worker Survey conducted by the Pew Hispanic Center, consisting 4,836 respondents in 7 large cities across the US. Each of them was asked "which of these would you be most likely to use if you were seeking medical care?", with possible answers "hospital emergency room", "clinic", "private doctor", and "consult with a friend". The authors measured acculturation level based on three factors, including English proficiency, length of stay in US, and educational attainment. They found 38% of respondents considered emergency department as their primary source of care. Acculturation was negatively associated with utilization of emergency department services among Mexican immigrants. However, multivariate regression models did not adjust for insurance types and health status due to data limitation. Also, it was a cross-sectional study, which could not draw casual inferences. (Akincigil et al., 2011)

Shibusawa et al. drew a sample of 100 Indian immigrants aged 65 years and older from the Asian American Elders in New York City (AAENYC). The survey was conducted in 2000 using a regional probability sampling, and the final data consisted of 100-150 household from 60 blocks. Most of respondents in the study had a green card (female 74.1% and male 59.6%). Multivariate results showed that Medicare Plan B was significantly associated with using emergency department services (OR 6.09, 95% confidence CI: 1.25-29.72), controlling for age, sex, living alone, English proficiency, and medical condition. Those who could not speak English well tended to use more traditional, instead of western medicine, probably because of inefficient communication between them and US health care professionals. Due to self-reported and city-level data, the study may be subject to recall bias and lack of generalizability. (Shibusawa & Mui, 2010)

METHODS

Data and Sample

We used data from the 2003-2012 Medical Expenditure Panel Survey (MEPS) linked to corresponding National Health Interview Survey (NHIS) Panels to examine disparities in preventable ED visits between immigration groups. Four MEPS data components were merged for this purpose, including full-year consolidated data files, emergency room visits files, office-based medical provider visits files, and hospital inpatient stays files. Conducted by the Agency for Healthcare Research and Quality (AHRQ), MEPS is an ongoing survey that annually collects high quality micro-level data through

household and medical provider interviews, including demographic characteristics, socioeconomic status, health status, health services utilization and expenditures etc. The survey data are publicly available and nationally representative of noninstitutionalized US population. Our original sample contained 218,071 adults aged 18 and older. After deleting respondents with any missing values in covariates, the final analytical sample size was 199,233, including 151,760 US natives, 20,302 naturalized citizens, and 27,171 noncitizens.

Measures

Our primary outcome variable was dichotomized, indicating if a respondent had any potentially preventable ED visits within the past year. We identified those visits using the Prevention Quality Indicators (PQIs) Version 4.5 provided by the AHRQ. Each PQI is a set of ICD-9-CM (International Classification of Disease, 9th Revision, Clinical Modification) diagnosis codes, medical conditions associated to which can be managed well by ambulatory care in outpatient settings. Out of 14 AHRQ PQIs, 11 were used in this study, including 3 acute ACSCs (bacterial pneumonia, dehydration, urinary tract infection) and 8 chronic ACSCs (heart failure, hypertension, angina, asthma between 18 and 39 years old, chronic obstructive pulmonary disease or asthma older than 40 years old, short-term diabetes complications, long-term diabetes complications, and uncontrollable diabetes). The other three PQIs, including low birthweight, perforated appendix, and lower-extremity amputation, were excluded because they were based on pregnant women or patients, rather than the adult population. Different from five-digit ICD-

9-CM diagnosis codes specified in the AHRQ PQI tool, the publicly available MEPS data only provides the first three digits of each diagnosis. Although it may not be precise, the first three digits can be used to sufficiently identify the included PQIs in this study. (Galarraga, Mutter, & Pines, 2015)

The linked MEPS-NHIS data contains respondents' current citizenship and place of birth, which allowed us to classify them into three different immigration groups, including US native, naturalized citizen, and noncitizen. Respondents born within the United States were defined as US natives. Those who were foreign-born but had already gained US citizenship by interviews were defined as naturalized citizens. The rest of respondents without US citizenship were defined as noncitizens.

Other demographic characteristics and socioeconomic status in this study included age (18-29, 30-44, 45-64, and 65 years and older), sex, race/ethnicity (Hispanic, Non-Hispanic White, Non-Hispanic Black, and Non-Hispanic Others), marital status (married vs. non-married), education level (less than high school, high school, and some college and above), poverty (self-reported annual family income less than 125% of Federal Poverty Line vs. 125% and above), insurance status (with vs. without health insurance coverage), and usual source of care (yes vs. no). MEPS respondents were asked whether there is a particular doctor's office, clinic, health center, or other place that they usually go if sick or in need of advice about health. Based on answers to this question, we defined usual source of care as a dichotomized variable. We also used diagnosis codes from MEPS emergency room visits files, office-based medical provider visits files,

and hospital inpatient stays files to construct Charlson index score (0, 1, 2, vs 3 and above) to represent respondents' health needs, with higher values indicating a larger number of more severe medical conditions. This index is a common measure for comorbidities, and it has 17 groups of medical conditions defined by ICD-9-CM diagnosis codes. (Manitoba Centre for Health Policy, 2016; Southern, Quan, & Ghali, 2004) Each condition is given a different weight score varying from 1 to 6 based on its severity.

Analytical Plan

We performed univariate analyses to measure likelihoods of being admitted to an emergency room due to acute and chronic ACSCs across three immigration status among all the adult respondents and ED services users, respectively. We also described the distributions of demographic characteristics, socioeconomic status, comorbidities across the groups. The Pearson χ^2 test was employed to examine if differences in ACSC-related ED visits and other covariates were statistically significant between US natives, naturalized citizens, and noncitizens. Multivariate logistic regression models were used to measure the relationship of immigration status and probability of ACSC-related ED visits, controlling for demographic characteristics, socioeconomic status, and comorbidities. Stratified models were additionally performed to check heterogeneous effects of covariates on utilizing ED services for ACSCs across immigration groups.

We finally applied a decomposition method to measure the contribution of each covariates to disparities in ACSC-related ED utilization between US natives, naturalized

citizens, and noncitizens. The Oaxaca-Blinder decomposition method examines the extent to which different distributions of explanatory variables between two defined groups can account for their disparities in health outcomes. Researchers have widely used this approach to understand relative importance of each explanatory variable in increasing or decreasing in health and health care inequalities. (Emamian et al., 2014; Yoo, Hasebe, & Szilagyi, 2014) However, the method was originally proposed for decomposing linear outcomes, while our outcome variable – whether a respondent had ACSC-related ED visits within the past year – was binary. We instead adopted Fairlie's decomposition method, which is an extension of Oaxaca-Blinder method with an application of logistic model. (Fairlie, 2005) The method first selects a random subsample using bootstrapping from the larger group to create two groups of the same sample size. It then replaces the distribution of one variable from one group with the others while keeping all other variables constant and estimates the difference in conditional probabilities of any ACSC-related ED visits between the two groups using marginal effects derived from the logistic regression model. Such step is repeated for every variable, and each difference is the variable's contribution to the disparities between two groups. All the analyses were performed using Statistical Software Package Stata 14 SE (StataCorp, College Station, TX), with MEPS survey year and complex design being adjusted. A p-value less than 0.05 was considered statistical significance in this study.

RESULTS

Table 9 presents distribution of ACSC-related ED visits, demographic characteristics, socioeconomic status, and comorbidities stratified by immigration status. Of 199,233 respondents, 76.2% (151,760) were US natives, 10.2% (20,302) were naturalized citizens, and 13.6% (27,171) were noncitizens. Among all adult respondents, both noncitizens and naturalized citizens were significantly less likely to have had any preventable ED visits than US natives across all types of ACSCs, except for chronic ACSCs for naturalized citizens. For example, 2.0% (95% CI 1.9%-2.1%) of US natives had visited emergency department due to any ACSCs within the past year as compared to 0.9% (95% CI 0.8%-1.1%) of noncitizens and 1.5% (95% CI 1.3%-1.7%) of naturalized citizens. Among total 27,026 ED services users, the differences in probabilities of having ACSC-related ED visits between noncitizens and natives remained significant but much smaller only for overall and acute ACSCs, while there was no statistically significant difference between naturalized citizens and natives any more. We also estimated annual total number of adults admitted to emergency departments related to overall, acute and chronic ACSCs by immigration status in the United States (Figure 9). For example, 3.27 million natives used ED services due to ACSCs each year versus 0.22 million naturalized citizens and 0.14 million noncitizens.

In our sample, US natives and naturalized citizens shared a similar age distribution, with most being 45 years and older, while more than 70% of noncitizens were younger than this age. Naturalized citizens (63.5%) and noncitizens (61.7%) were more

likely than natives (54.4%) to be married. Approximately 60% of noncitizens were Hispanic origin, compared to 6.4% of natives and 36.9% of naturalized citizens. Both naturalized citizens (20.5%) and noncitizens (40.4%) were more likely to only have less than a high school education level than natives (14.2%). More than quarter of noncitizens had annual family income less than 125% federal poverty income, but the percentages for naturalized citizen and natives were only 15.6% and 14.2%, respectively. About four in ten noncitizens reported lacking of health insurance coverage (41.9%) and usual source of care (47.3%), significantly higher than natives and naturalized citizens. However, noncitizens tended to be healthier, indicated by that 92.1% of them had Charlson index score 0 versus 83.0% of natives and 84.5% of naturalized citizens (Table 9).

Table 9 Descriptive Statistics of Preventable ED Visits, Demographic, Socioeconomic, and Comorbidity across Immigration Status, MEPS 2003-2012

	US Native	Naturalized Citizen	Noncitizen	P-Value
Among All Respondents				
Overall ACSCs	2.0 [1.9, 2.1]	1.5 [1.3, 1.7]	0.9 [0.8, 1.1]	<0.001
Acute ACSCs	0.9 [0.9, 1.0]	0.6 [0.5, 0.8]	0.4 [0.3, 0.5]	<0.001
Chronic ACSCs	1.1 [1.0, 1.1]	0.9 [0.7, 1.0]	0.5 [0.4, 0.7]	<0.001
ED Utilizers				
Overall ACSCs	14.0 [13.5, 14.6]	15.0 [13.2, 16.9]	11.2 [9.8, 12.9]	0.008
Acute ACSCs	6.7 [6.3, 7.1]	6.4 [5.2, 7.9]	4.8 [3.8, 6.0]	0.029
Chronic ACSCs	7.6 [7.2, 8.1]	8.7 [7.4, 10.2]	6.5 [5.4, 7.9]	0.097
Age (yrs)				
18-29	21.5 [21.0, 22.1]	12.3 [11.5, 13.2]	27.8 [26.7, 29.1]	<0.001
30-44	26.3 [25.8, 26.8]	29.7 [28.5, 30.9]	44.1 [42.9, 45.3]	
45-64	35.0 [34.5, 35.5]	39.8 [38.5, 41.2]	22.6 [21.6, 23.7]	
65-	17.2 [16.6, 17.7]	18.2 [17.1, 19.3]	5.4 [4.8, 6.1]	
Sex				
Male	47.8 [47.5, 48.2]	46.7 [45.7, 47.7]	51.7 [50.8, 52.6]	<0.001
Female	52.2 [51.9, 52.5]	53.3 [52.3, 54.3]	48.3 [47.4, 49.2]	
Race/Ethnicity				
Non-Hispanic White	78.7 [77.7, 79.7]	27.6 [25.9, 29.4]	13.5 [12.1, 14.9]	<0.001
Non-Hispanic Black	11.8 [11.0, 12.7]	7.2 [6.3, 8.3]	6.2 [5.2, 7.3]	

Hispanic	6.4 [5.8, 7.0]	36.9 [35.0, 38.9]	60.7 [58.3, 63.1]	
Non-Hispanic Others	3.1 [2.7, 3.6]	28.3 [26.1, 30.6]	19.7 [18.1, 21.4]	
Marital Status				
Married	54.4 [53.6, 55.2]	63.5 [62.0, 64.8]	61.7 [60.2, 63.1]	<0.001
Non-Married	45.6 [44.8, 46.4]	36.6 [35.2, 38.0]	38.3 [36.9, 39.8]	
Educational Attainment				
Less than High School	14.0 [13.6, 14.4]	20.5 [19.4, 21.7]	40.4 [38.6, 42.3]	<0.001
High School	32.4 [31.7, 33.0]	24.6 [23.4, 25.9]	23.1 [22.1, 24.1]	
Some College and Above	53.6 [52.7, 54.5]	54.9 [53.4, 56.4]	36.5 [34.7, 38.3]	
Poverty				
Less than 125% FPL	14.2 [13.8, 14.7]	15.6 [14.7, 16.5]	26.7 [24.9, 28.5]	<0.001
125% FPL and Above	85.8 [85.3, 86.2]	84.4 [83.5, 85.3]	73.3 [71.5, 75.1]	
Insurance Status				
Insured	88.5 [88.1, 88.8]	85.5 [84.5, 86.5]	58.1 [55.9, 60.2]	<0.001
Uninsured	11.6 [11.2, 11.9]	14.5 [13.5, 15.5]	41.9 [39.8, 44.1]	
Usual Source of Care				
Yes	79.7 [79.2, 80.2]	76.0 [74.8, 77.1]	52.7 [51.1, 54.3]	<0.001
No	20.3 [19.8, 20.9]	24.0 [22.9, 25.2]	47.3 [45.7, 48.9]	
Charlson Index				
0	83.0 [82.7, 83.4]	84.5 [83.7, 85.3]	92.1 [91.5, 92.7]	<0.001
1	11.5 [11.3, 11.8]	10.9 [10.2, 11.5]	6.1 [5.6, 6.6]	
2	3.8 [3.6, 3.9]	3.3 [2.9, 3.7]	1.3 [1.1, 1.5]	
>3	1.7 [1.5, 1.8]	1.3 [1.1, 1.6]	0.5 [0.4, 0.7]	

Figure 9 Estimated annual total number of adults admitted to emergency departments related to overall, acute and chronic ACSCs by immigration status (in million), MEPS 2003-2012

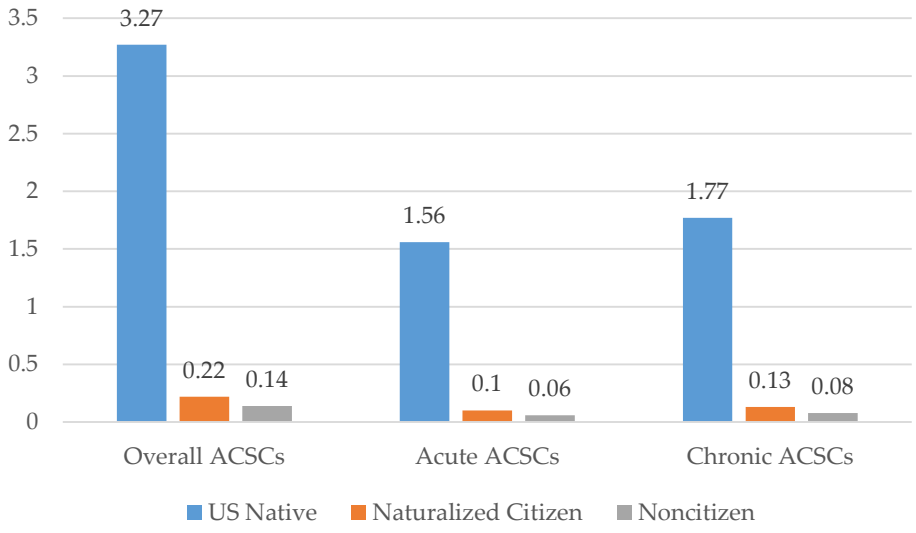


Table 10 shows the multivariate-adjusted associations between immigration status and preventable ED visits among all adult respondents and ED services users, respectively. The logistic regression model showed that both naturalized citizens (Adjusted Odds Ratio (AOR): 0.76, 95% Confidence Interval (CI) 0.64-0.90) and noncitizens (AOR: 0.58, 95% CI 0.47-0.71) had lower odds of having any preventable ED visits within the past year than US natives, after adjusting for demographic characteristics, socioeconomic status, and comorbidities. However, among ED service users, immigration-related differences in probability of having visited emergency department for ACSCs became statistically insignificant. We also found similar patterns in the disparities stratified by acute and chronic ACSCs (Table A9 and A10).

Table 10 Multivariate-Adjusted Association between Preventable ED Visits and Immigration Status, MEPS 2003-2012

	ACSC ED Visits (Population)	ACSC ED Visits (Utilizers)
Immigration		
US Native	Ref	Ref
Naturalized Citizen	0.76** [0.64, 0.90]	0.98 [0.82, 1.18]
Noncitizen	0.58*** [0.47, 0.71]	0.92 [0.75, 1.12]
Age (yrs)		
18-29	Ref	Ref
30-44	0.95 [0.82, 1.09]	1.07 [0.93, 1.24]
45-64	1.01 [0.88, 1.16]	1.34*** [1.16, 1.55]
65-	1.26** [1.08, 1.47]	1.59*** [1.36, 1.86]
Sex		
Male	Ref	Ref
Female	1.52*** [1.40, 1.65]	1.42*** [1.29, 1.55]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.58*** [1.43, 1.74]	1.46*** [1.32, 1.62]
Hispanic	1.01 [0.86, 1.19]	1.05 [0.90, 1.23]
Non-Hispanic Others	1.10 [0.89, 1.37]	1.27* [1.03, 1.56]
Marital Status		
Non-Married	Ref	Ref
Married	0.81*** [0.74, 0.89]	0.96 [0.87, 1.05]

Educational Attainment		
Less than High School	Ref	Ref
High School	0.74*** [0.67, 0.82]	0.86** [0.77, 0.95]
Some College and Above	0.51*** [0.46, 0.57]	0.70*** [0.62, 0.78]
Poverty		
125% FPL and Above	Ref	Ref
Less than 125% FPL	1.49*** [1.34, 1.66]	1.09 [0.98, 1.22]
Insurance Status		
Insured	Ref	Ref
Uninsured	1.04 [0.92, 1.19]	1.11 [0.98, 1.26]
Usual Source of Care		
No	Ref	Ref
Yes	1.20** [1.05, 1.38]	1.09 [0.96, 1.25]
Charlson Index		
0	Ref	Ref
1	5.88*** [5.25, 6.59]	3.35*** [3.00, 3.75]
2	6.51*** [5.76, 7.34]	3.19*** [2.80, 3.63]
>3	10.50*** [8.94,12.40]	4.32*** [3.63, 5.13]

* p<0.05, ** p<0.01, *** p<0.001

Results of the relationships of demographics, socioeconomic status, and comorbidities to having preventable ED visits stratified by immigration status are given in Table 11. Across immigration status, females were constantly more likely than males to have preventable ED visits within the past year. Married status (AOR 0.82, 95% CI 0.74-0.91) significantly decreased the odds of having preventable ED visits among US natives, while having annual family income less than 125% federal poverty line (AOR 1.51, 95% CI 1.36-1.69) and usual source of care (AOR 1.20, 95% CI 1.04-1.40) increased the odds. However, these associations were not found to be significant among naturalized citizens and noncitizens. Among noncitizens, lack of health insurance was associated with 50% decrease in the odds of having preventable ED visits (AOR 0.51, 95% 0.34-0.75). We further found significant dose response relationships showing severe comorbidities increased likelihood of having preventable ED visits among naturalized citizens and US

natives; however the odds ratio of Charlson index score 3 and greater was lower than those of 1 and 2. A similar pattern was also observed for age, although not significant.

Table 11 Relationships of Preventable ED Visits to Demographic Characteristics, Socioeconomic Status, and Comorbidity Stratified by Immigration Status, MEPS 2003-2012

	US Native	Naturalized Citizen	Noncitizen
Age (yrs)			
18-29	Ref	Ref	Ref
30-44	0.95 [0.82, 1.10]	1.02 [0.53, 1.95]	0.96 [0.55, 1.66]
45-64	1.00 [0.86, 1.16]	1.08 [0.56, 2.10]	1.34 [0.81, 2.21]
65-	1.28** [1.08, 1.51]	1.51 [0.78, 2.91]	0.57 [0.27, 1.22]
Sex			
Male	Ref	Ref	Ref
Female	1.50*** [1.37, 1.64]	1.81*** [1.35, 2.43]	1.52** [1.11, 2.07]
Race/Ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	1.59*** [1.44, 1.76]	1.16 [0.71, 1.90]	1.15 [0.47, 2.79]
Hispanic	1.00 [0.82, 1.21]	0.99 [0.68, 1.43]	0.70 [0.40, 1.22]
Non-Hispanic Others	1.36* [1.07, 1.74]	0.66 [0.43, 1.01]	0.45* [0.24, 0.87]
Marital Status			
Non-Married	Ref	Ref	Ref
Married	0.82*** [0.74, 0.91]	0.78 [0.57, 1.07]	0.85 [0.62, 1.17]
Educational Attainment			
Less than High School	Ref	Ref	Ref
High School	0.74*** [0.67, 0.83]	0.86 [0.58, 1.27]	0.60* [0.39, 0.93]
Some College and Above	0.51*** [0.45, 0.57]	0.71 [0.49, 1.01]	0.51** [0.32, 0.82]
Poverty			
125% FPL and Above	Ref	Ref	Ref
Less than 125% FPL	1.51*** [1.36, 1.69]	1.38 [0.95, 2.01]	1.21 [0.86, 1.71]
Insurance Status			
Insured	Ref	Ref	Ref
Uninsured	1.14 [0.99, 1.30]	0.88 [0.52, 1.49]	0.51*** [0.34, 0.75]
Usual Source of Care			
No	Ref	Ref	Ref
Yes	1.20* [1.04, 1.40]	1.12 [0.73, 1.73]	1.15 [0.75, 1.76]
Charlson Index			
0	Ref	Ref	Ref
1	5.72*** [5.07, 6.44]	5.94*** [4.11, 8.59]	10.40*** [6.63, 16.40]
2	6.53*** [5.74, 7.42]	4.58*** [2.68, 7.80]	10.40*** [5.62, 19.30]
>3	10.60*** [8.95,12.60]	8.01*** [4.09, 15.70]	5.94** [2.05,17.30]

* p<0.05, ** p<0.01, *** p<0.001

Table 4 presents contributions of each of demographic, socioeconomic and comorbidity variable to the disparities in having preventable ED visits between immigration groups by using the Oaxaca-Blinder-Fairlie decomposition method. Only 33.4% of the disparity between natives and naturalized citizens can be explained by all variables listed above. Among those, sex, marital status and race/ethnicity accounted for 15.1%, 8.6% and 26.2%, respectively. However, all the variables explained almost 80% of the disparity between noncitizens and natives. The largest two contributions were made by race/ethnicity (35.4%) and comorbidities (36.8%). Enabling factors, including health insurance and usual source of care, explained 15% of the disparity, whereas educational attainment reduced the disparity (-19.6%).

Table 12 Oaxaca-Blinder-Fairlie Decomposition Results of Differences in Preventable ED Visits between Immigration Groups, MEPS 2003-2012

	Native vs. Naturalized Citizen	Native vs. Noncitizen
Sex	15.1%	4.9%
Age	-1.0%	7.6%
Race/Ethnicity	26.2%	35.4%
Marital Status	8.6%	2.4%
Education	-2.2%	-19.6%
Poverty	1.5%	-1.4%
Health Insurance	0.4%	12.4%
Usual Source of Care	0.6%	2.6%
Comorbidities	-1.0%	36.8%
Year	-14.5%	-3.6%
Unexplained	66.6%	22.5%

DISCUSSION

Our results using a nationally representative sample suggest that noncitizens are significantly less likely than US natives to have preventable ED visits within the past

year. More than 50% of the difference is attributable to race/ethnicity, lack of insurance, and usual source of care. However, noncitizens still have 42% lower odds of having visited emergency departments for ambulatory care-sensitive conditions compared to natives among all adult respondents, even after adjusting for demographic, socioeconomic and comorbidity covariates. Naturalized citizens also have lower odds of having preventable ED visit, but the difference is smaller than that between US natives and noncitizens. Stratified logistic regression models suggest the impacts of demographic, socioeconomic and comorbidity factors on having those visits are heterogeneous across immigration status, for example, noncitizens are more sensitive to lack of insurance than naturalized citizens and natives.

Our study does not support the political stereotype that noncitizens are overcrowding hospital emergency rooms and are mainly responsible for the substantial increase in ED expenditures. The results of preventable ED visits by immigrants are consistent with previous regional and national studies on general ED visits. (Cunningham, 2006; Ku & Matani, 2001; Mohanty et al., 2005; Ortega et al., 2007; Pourat et al., 2014; Tarraf et al., 2014) Cunningham found noncitizens on average had approximately 17 fewer ED visits per 100 population than citizens using data collected from 60 randomly selected communities across the United States. (Cunningham, 2006) Another study showed 11% of undocumented adults had ED visits within the past year as compared to 20% of US-born ones in California. (Pourat et al., 2014) Similar findings have also been observed from studies on other types of health services, such as preventive cancer screening, eye, and dental care. (De Alba et al., 2005; Wilson, Wang, Stimpson, et al.,

2015; Wilson, Wang, & Stimpson, 2015) There are two possible explanations for their lower utilization. One explanation is "healthy migrant effect" – healthier individuals tend to migrate from home country to the United States, (Fennelly, 2007) which is corroborated by higher percentage of younger population with lower Charlson comorbidity score among noncitizens as compared to natives in our sample. They may be less likely to suffer from the ambulatory care-sensitive conditions, thus have fewer related ED visits. The other possible reason is that noncitizen are inclined to postpone health services due to existing barriers to care. (Coffman et al., 2007; Heyman et al., 2009; Javier et al., 2010)

The Emergency Medical Treatment and Labor Act (EMTALA) highlighting equal right of health was enacted in 1986 in the US, and it requires physicians to treat whoever presents to hospital emergency departments for care, regardless patients' immigration status. (Taylor, 2008) Since then, immigrants have increased their utilization of ED services. In a survey, four in five illegal immigrants reported seeking care in emergency departments because of economic reasons. (Chan et al., 1996) Due to lack of a usual source of care, undocumented immigrants with lower socioeconomic status even use the emergency room for primary care. However, immigrants may still be much less likely to use ED services as compared to US natives considering potential barriers they are confronted with, such as fear and language. For example, Maldonado and colleagues conducted a survey among Latino immigrants in emergency departments, and found 13% of the undocumented immigrants expressed the fear of being reported to immigration authorities thus leading to deportation. (Maldonado et al., 2013) Another study reported

11% of patients in Boston emergency department needed an interpreter to facilitate their communication with physicians, (Ginde, Clark, & Camargo, 2009) and most of immigrants preferred family members or friends to serve this role. (Ginde, Sullivan, Corel, Caceres, & Camargo, 2010) Without such support, communication difficulty may embarrass them and decrease their odds of going to an emergency room.

We also observed variations in impacts of demographic, socioeconomic, and comorbidity variables across immigration status. Interestingly, being 65 years and older among natives was associated with a higher likelihood of having preventable ED visits as compared to 18-29, while the opposite association was found among noncitizens although it was insignificant. This suggests that instead of staying in US, old noncitizens with severe medical conditions may return to their home country where constant health care is more affordable. Our findings that higher education reduced ED service use among noncitizens contradicted the results of a similar study conducted by Nandi et al. (Nandi et al., 2008) The authors argued that immigrants with higher educational attainment were knowledgeable about US health care system, such as EMTALA, so that they were more likely to use the emergency department as usual source of care than those who did not know the act. However, we believed that better-educated immigrants may have a higher socioeconomic status and better access to primary care, thus lower odds of preventable ED visits.

The Oaxaca-Blinder-Fairlie composition shows that race/ethnicity and health insurance coverage substantially contributes to the differences in having preventable ED

visits between noncitizens and natives. This may result from discrimination against immigrants by health care organizations. Keller et al. surveyed Latino immigrants in North Carolina to examine perceived discrimination on health care utilization. (Keller et al., 2010) They found discrimination based on race/ethnicity and insurance status were associated with under-utilization of needed health care and lower likelihood of having any ED visits within the past year. With the application of this decomposition method, our explanatory variables explained nearly 80% of the difference between noncitizens and natives, as compared to only 33% between naturalized citizens and natives. Future research is warranted to further investigate what other factors contribute to the unexplained differences in our study, especially between two types of US citizens.

Our findings of lower likelihood of preventable ED visits and less severe comorbidity seem to support "Immigrant Paradox" – Immigrant population with lower socioeconomic status surprisingly tends to be healthier than US natives. The probability of preventable ED visits among noncitizens is actually determined by both their health status and quality of primary care they are receiving. Compared to natives, significantly higher percentages of noncitizens having no insurance and usual source of care made it difficult to believe that they were receiving higher quality of primary care. It is more plausible that they are less likely to experience preventable ED visits because of lower probability of having ACSCs. Given this, some legal barriers immigrants are facing actually further limits their access to health are. For example, the Affordable Care Act (ACA) excluded undocumented immigrants from purchasing health coverage from exchange markets. The 1996 Personal Responsibility and Work Opportunity Reconciliation Act

(PRWORA) restricts undocumented immigrants and legal residents with length of residency less than 5 years from benefiting from federally funded health programs. Fortunately, San Francisco and Massachusetts have set examples to reduce those barriers by providing state- or city-level health benefits to unauthorized immigrants. (Marrow & Joseph, 2015)

This study has some limitations. First, due to lack of noncitizens' legal status, we were unable to distinguish undocumented noncitizens from legal foreign residents. However, undocumented noncitizens are afraid of being deported from the US and may perceive more discriminations. Second, MEPS Medical Provider Visit files only provide the first three digit of ICD-9-CM diagnosis codes, so identifying ACSC-related preventable ED visits and calculating Charlson comorbidity score may not be accurate. Future research may consider using restricted MEPS data with fully-specified diagnosis codes to replicate this research. Third, each ED visit record has 3 diagnosis codes, and the first one listed may not be primary diagnosis in MEPS. Results using AHRQ ACSCs defined based on the primary diagnosis could be biased. However, we did sensitivity analyses using records with only one diagnosis, and our main results largely remain the same.

CONCLUSION

We used nationally representative data to measure differences in ED service use related to ambulatory care sensitive conditions between US natives, naturalized citizen, and noncitizens. Our finding of immigrants' lower likelihood of having preventable ED

visits contradicts the misconception of their overutilization of ED services. Legal barriers should be gradually removed to reduce undocumented migrants' fear of seeking health care. Future research is needed to further investigate geographic variations in immigration-related differences in preventable ED visits, as well as how organization- and system-level factors influence the differences.

CHAPTER 5: POLICY IMPLICATIONS

Results from this dissertation suggest that immigrants are more likely to adopt unhealthy behaviors (e.g. e-cigarette use) as they go through acculturation process; however, as their length of stay in US increases, they continue to face major barriers in accessing health care services. Medical conditions associated with unhealthy behaviors and healthcare underutilization may jointly have a stronger negative impacts on their health. This is especially true for undocumented immigrants, which accounts for over 25% of total immigrant population. (Costa et al., 2014) Our findings are largely consistent with prior studies among immigration populations. (Brown et al., 2006; Echeverria & Carrasquillo, 2006; Koya & Egede, 2007; Ortega et al., 2007; Pourat et al., 2014; Rodriquez et al., 2015; Tarraf et al., 2014; Wahl & Eitle, 2010; Wilkinson et al., 2005; Wilson, Wang, Stimpson, et al., 2015; Wilson, Wang, & Stimpson, 2015). We target modifiable factors and propose the following policy recommendations.

Culturally-sensitive health education intervention programs are needed to facilitate selective acculturation among immigrant communities. Selective acculturation is defined as a process where immigrants are losing their own cultural heritage and practices to only certain normative components in dominant culture, and Yeh et al. explained its critical role in preventing obesity among Latinos. (Yeh, Viladrich, Bruning, & Roye, 2009) In fact, immigrants tend to stigmatize substance use. (Qureshi et al., 2014; Schwartz et al., 2011) This may be one underlying reason that we found such significant

differences in tobacco and E-cigarettes use between immigrants and US natives. However, the lack of health knowledge due to lower educational attainment could possibly influence their decisions about what behaviors they should intentionally maintain. Thus, implementing community- or school-based health education programs tailored to immigrant cultures may effectively prevent them from adopting unhealthy practices after they settle down in the United States.

Community health workers can help immigrants find needed services and establish a linkage between patients and medical providers, in order to reduce disparities in health care utilization between immigrants and US natives. If these workers are well trained, they can be sensitive to immigrant cultures and speak different languages. A recent systematic review reported that community health workers significantly improve health outcomes among immigrants, especially chronic conditions and the use of preventive services. (Enard & Ganelin, 2013; Shommu et al., 2016) They can also work as interpreters in clinical settings. In addition, training more medical providers with various ethnic and immigrant backgrounds can address the language barriers, increase bonding between immigrants and physicians, and reduce discrimination, thus leading to improved satisfaction of immigrants during their visits to medical providers. Evidence showed that race and language concordance between patients and providers were associated with better treatment adherence among patients with cardiovascular diseases. (Traylor, Schmittdiel, Uratsu, Mangione, & Subramanian, 2010)

Future research in immigration-related disparities is warranted and should include investigations of the impact of the Affordable Care Act, as well as state-level policy variations, on immigrant health and care utilization. Community-based participatory research should be encouraged to mutually benefit researchers and immigrant populations, including assess health needs, and barriers to care etc.

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APPENDICES

Table A1 Multivariate-Adjusted Association between E-Cigarette Use and Country of Origin, NHIS 2014

	Ever used E-Cigarette	Current using E-Cigarette
Country of Origin		
United States	Ref	Ref
Mexico, Central American, Caribbean Islands	0.54** [0.37, 0.78]	0.37** [0.19, 0.75]
Other	0.65** [0.50, 0.85]	0.82 [0.54, 1.24]
English Spoken		
Low English Proficiency	Ref	Ref
High English Proficiency	2.62** [1.45, 4.74]	3.00* [1.17, 7.68]
Age (yrs)		
18-39	Ref	Ref
40-59	0.38*** [0.33, 0.44]	0.71*** [0.58, 0.86]
60 and Above	0.16*** [0.14, 0.19]	0.38*** [0.28, 0.50]
Gender		
Male	Ref	Ref
Female	0.89 [0.78, 1.01]	0.91 [0.74, 1.13]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.34*** [0.28, 0.41]	0.42*** [0.31, 0.57]
Hispanic	0.85 [0.69, 1.06]	0.95 [0.66, 1.37]
Non-Hispanic Others	0.84 [0.65, 1.08]	0.74 [0.49, 1.11]
Education Attainment		
Less than high school	Ref	Ref
High school	1.57** [1.19, 2.06]	1.29 [0.86, 1.94]
Some college and above	1.75*** [1.34, 2.27]	1.43 [0.95, 2.15]
Marital Status		
Non-Married	Ref	Ref
Married	0.63*** [0.56, 0.72]	0.72*** [0.59, 0.87]
Poverty		
100% FPL and Above	Ref	Ref
Less than 100% FPL	0.88 [0.75, 1.05]	0.98 [0.77, 1.25]
Smoking Status		
Non-Smoker	Ref	Ref
Current smoker	30.60*** [25.50, 36.60]	40.20*** [26.90, 60.00]
Former smoker	6.11*** [5.13, 7.29]	11.2*** [7.74, 16.10]

* P<.05, ** P<.01, *** P<.001

Table A2 Multivariate Regression-Adjusted Odds Ratios of E-cigarette Use by Immigration Status among Adult Respondents with Different Smoking Status, NHIS 2014

	Ever used E-Cigarette			Current using E-Cigarette		
	Current Smoker	Former Smoker	Non-Smoker	Current Smoker	Former Smoker	Non-Smoker
Immigration Status						
US natives	Ref	Ref	Ref	Ref	Ref	Ref
Naturalized citizen	0.68 [0.45, 1.02]	0.85 [0.51, 1.41]	0.47** [0.28, 0.79]	0.65 [0.36, 1.15]	1.35 [0.69, 2.63]	0.42 [0.10, 1.82]
Noncitizen	0.35*** [0.24, 0.51]	0.56* [0.32, 0.97]	0.61 [0.35, 1.04]	0.40* [0.20, 0.82]	1.26 [0.43, 3.69]	0.09** [0.02, 0.54]
Age (yrs)						
18-39 (Ref)	Ref	Ref	Ref	Ref	Ref	Ref
40-59	0.59*** [0.48, 0.73]	0.22*** [0.17, 0.28]	0.25*** [0.16, 0.38]	0.95 [0.72, 1.26]	0.37*** [0.25, 0.56]	0.17*** [0.06, 0.47]
60 and Above	0.39*** [0.31, 0.50]	0.05*** [0.04, 0.07]	0.05*** [0.03, 0.10]	0.76 [0.54, 1.06]	0.11*** [0.07, 0.20]	N/A
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	1.05 [0.89, 1.24]	0.94 [0.75, 1.16]	0.57*** [0.44, 0.75]	1.03 [0.81, 1.30]	0.83 [0.55, 1.25]	0.35*** [0.19, 0.63]
Race/Ethnicity						
Non-Hispanic White	Ref	Ref	Ref	Ref	Ref	Ref
Non-Hispanic Black	0.34*** [0.27, 0.42]	0.45** [0.28, 0.72]	0.36*** [0.25, 0.53]	0.34*** [0.24, 0.50]	0.65 [0.33, 1.27]	0.77 [0.32, 1.89]
Hispanic	0.69** [0.53, 0.90]	0.60** [0.42, 0.87]	1.10 [0.80, 1.51]	0.81 [0.57, 1.15]	0.27*** [0.13, 0.59]	2.69* [1.13, 6.38]
Non-Hispanic Others	0.80 [0.56, 1.16]	0.92 [0.60, 1.41]	0.94 [0.61, 1.45]	0.73 [0.44, 1.20]	0.66 [0.31, 1.38]	1.84 [0.71, 4.80]
Education Attainment						
Less than high school	Ref	Ref	Ref	Ref	Ref	Ref
High school	1.57** [1.16, 2.13]	1.62 [0.89, 2.95]	2.59 [0.98, 6.86]	1.44 [0.88, 2.33]	1.17 [0.45, 3.07]	1.65 [0.28, 9.91]
Some college and above	1.98*** [1.46, 2.69]	1.53 [0.85, 2.76]	2.88* [1.09, 7.58]	1.84* [1.13, 3.00]	1.10 [0.42, 2.90]	1.01 [0.18, 5.83]
Marital Status						
Non-Married	Ref	Ref	Ref	Ref	Ref	Ref
Married	0.88 [0.73, 1.05]	0.50*** [0.41, 0.62]	0.41*** [0.30, 0.56]	0.87 [0.66, 1.15]	0.52** [0.36, 0.77]	0.41* [0.20, 0.86]
Poverty						
100% FPL and Above	Ref	Ref	Ref	Ref	Ref	Ref
Less than 100% FPL	0.89 [0.72, 1.10]	0.74 [0.52, 1.05]	0.98 [0.72, 1.33]	0.99 [0.76, 1.30]	0.99 [0.58, 1.70]	0.90 [0.43, 1.90]

* P<.05, ** P<.01, *** P<.001

Table A3 Multivariate-Adjusted Association between E-cigarette Use and English Proficiency among Adult Respondents, NHIS 2014

	Ever used E-Cigarette	Current using E-Cigarette
English Spoken		
Low English Proficiency	Ref	Ref
High English Proficiency	1.88* [1.01, 3.49]	1.73 [0.64, 4.71]
Immigration Status		
Noncitizen	Ref	Ref
Naturalized citizen	1.10 [0.80, 1.51]	1.30 [0.66, 2.57]
Age (yrs)		
18-39	Ref	Ref
40-59	0.39*** [0.25, 0.62]	0.45* [0.22, 0.90]
60 and Above	0.15*** [0.08, 0.28]	0.14** [0.04, 0.52]
Gender		
Male	Ref	Ref
Female	0.89 [0.60, 1.31]	1.11 [0.61, 2.00]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.26*** [0.12, 0.57]	0.31 [0.08, 1.16]
Hispanic	0.59** [0.40, 0.87]	0.41* [0.19, 0.88]
Non-Hispanic Others	0.52* [0.31, 0.86]	0.44 [0.20, 1.00]
Education Attainment		
Less than high school	Ref	Ref
High school	3.81*** [1.87, 7.79]	2.22 [0.77, 6.43]
Some college and above	4.50*** [2.35, 8.62]	2.37 [0.78, 7.19]
Marital Status		
Non-Married	Ref	Ref
Married	0.49*** [0.36, 0.67]	0.67 [0.36, 1.22]
Poverty		
100% FPL and Above	Ref	Ref
Less than 100% FPL	1.14 [0.76, 1.70]	0.71 [0.34, 1.48]
Smoking Status		
Non-Smoker	Ref	Ref
Current smoker	24.10*** [14.2, 40.8]	55.30*** [17.9, 171.10]
Former smoker	6.64*** [4.07, 10.80]	28.80*** [9.83, 84.20]

* P<.05, ** P<.01, *** P<.001

Table A4 Stepwise Multivariate-Adjusted Association between Immigration Status to Number of Cancer-Related Office-Based Medical Provider Visits, MEPS 2007-2012

	Model 1	Model 2	Model 3	Model 4
Immigration Status				
US Native	Ref	Ref	Ref	Ref
Naturalized Citizen	0.98 [0.77, 1.23]	0.89 [0.71, 1.11]	0.89 [0.71, 1.11]	0.93 [0.75, 1.15]
Noncitizen	0.67** [0.51,0.89]	0.56*** [0.41, 0.77]	0.58** [0.42, 0.81]	0.62** [0.45, 0.84]
Age (yrs)				
18-29		Ref	Ref	Ref
30-44		1.85** [1.16,2.94]	1.91** [1.22, 3.00]	1.84** [1.20, 2.82]
45-64		1.57* [1.05, 2.35]	1.52* [1.03, 2.26]	1.49* [1.05, 2.11]
65-		1.38 [0.95, 2.02]	1.31 [0.91, 1.89]	1.26 [0.92, 1.73]
Sex				
Male		Ref	Ref	Ref
Female		0.93 [0.78, 1.11]	0.92 [0.77, 1.09]	0.92 [0.79, 1.09]
Race/Ethnicity				
Non-Hispanic White		Ref	Ref	Ref
Non-Hispanic Black		1.34 [0.99, 1.82]	1.35 [0.99, 1.84]	1.22 [0.92, 1.60]
Hispanic		1.42* [1.04, 1.93]	1.43* [1.05, 1.93]	1.39* [1.01, 1.91]
Non-Hispanic Others		1.10 [0.75, 1.62]	1.09 [0.75, 1.60]	1.06 [0.76, 1.48]
Marital Status				
Non-Married		Ref	Ref	Ref
Married		1.08 [0.90, 1.29]	1.04 [0.88, 1.24]	1.07 [0.92, 1.26]
Educational Attainment				
Less than High School			Ref	Ref
High School			1.24 [0.97, 1.58]	1.38** [1.12, 1.70]
Some College and Above			1.00 [0.81, 1.24]	1.22* [1.01, 1.48]
Poverty				
125% FPL and Above			Ref	Ref

Less than 125% FPL	0.99 [0.83, 1.17]	0.94 [0.80, 1.10]
Insurance Status		
Uninsured	Ref	Ref
Insured	1.72** [1.18, 2.50]	2.19*** [1.66, 2.87]
Usual Source of Care		
No	Ref	Ref
Yes	0.97 [0.73 ,1.28]	1.07 [0.83, 1.37]
Self-Report Health Status		
Fair and Poor		Ref
Good and Above		0.50*** [0.43, 0.57]
Cancer in Remission		
Yes		Ref
No		1.88*** [1.53, 2.32]

* p<0.05, ** p<0.01, *** p<0.001

Table A5 Stepwise Multivariate-Adjusted Association between Immigration Status to Expenditures of Cancer-Related Office-Based Medical Provider Visits, MEPS 2007-2012

	Model 1	Model 2	Model 3	Model 4
Immigration Status				
US Native	Ref	Ref	Ref	Ref
Naturalized Citizen	-0.22 [-0.60, 0.17]	-0.37* [-0.71,-0.03]	-0.36* [-0.70, -0.02]	-0.21 [-0.58, 0.15]
Noncitizen	-0.27 [-0.71, 0.18]	-0.43 [-1.04, 0.18]	-0.44 [-1.06, 0.18]	-0.32 [-1.03, 0.39]
Age (yrs)				
18-29		Ref	Ref	Ref
30-44		0.76* [0.01, 1.50]	0.74 [-0.003, 1.48]	0.70* [0.02, 1.37]
45-64		0.74* [0.15, 1.33]	0.68* [0.09, 1.26]	0.70* [0.15, 1.25]
65-		0.48 [-0.08, 1.04]	0.34 [-0.23, 0.91]	0.26 [-0.25, 0.77]
Sex				
Male		Ref	Ref	Ref
Female		-0.12 [-0.44, 0.20]	-0.12 [-0.44, 0.19]	-0.14 [-0.44, 0.15]
Race/Ethnicity				
Non-Hispanic White		Ref	Ref	Ref
Non-Hispanic Black		0.58** [0.17, 0.99]	0.53* [0.09, 0.97]	0.51* [0.07, 0.95]
Hispanic		0.54* [0.12, 0.97]	0.49* [0.05, 0.92]	0.52* [0.004, 1.04]
Non-Hispanic Others		0.21 [-0.45, 0.86]	0.16 [-0.49, 0.81]	0.12 [-0.43, 0.67]
Marital Status				
Non-Married		Ref	Ref	Ref
Married		0.26 [-0.06, 0.57]	0.22 [-0.09, 0.53]	0.21 [-0.09, 0.51]
Educational Attainment				
Less than High School			Ref	Ref
High School			0.08 [-0.49, 0.64]	0.30 [-0.06, 0.65]
Some College and Above			-0.14 [-0.68, 0.40]	0.24 [-0.11, 0.59]
Poverty				
125% FPL and Above			Ref	Ref

Less than 125% FPL	0.13 [-0.13, 0.39]	0.20 [-0.11, 0.52]
Insurance Status		
Uninsured	Ref	Ref
Insured	1.11*** [0.64, 1.59]	0.98** [0.28, 1.68]
Usual Source of Care		
No	Ref	Ref
Yes	0.08 [-0.33, 0.49]	0.23 [-0.12, 0.57]
Self-Report Health Status		
Fair and Poor		Ref
Good and Above		-0.93*** [-1.19, -0.67]
Cancer in Remission		
Yes		Ref
No		0.93*** [0.52, 1.34]

* p<0.05, ** p<0.01, *** p<0.001

Table A6 Multivariate-Adjusted Regression Model Examining Interaction of immigration and Insurance Status on Number and Expenditures of Cancer-Related Office-Based Medical Provider Visits, MEPS 2007-2012

	Number of Visits	Expenditures
Immigration Status		
US Native	Ref	Ref
Naturalized Citizen	0.89 [0.49, 1.59]	-0.76 [-1.78, 0.27]
Noncitizen	0.63 [0.39, 1.02]	-1.08 [-2.24, 0.07]
Insurance Status		
Uninsured	Ref	Ref
Insured	2.18*** [1.61, 2.97]	0.92* [0.16, 1.67]
Interaction		
Insured Naturalized Citizen	1.05 [0.56, 1.95]	0.55 [-0.53, 1.63]
Insured Noncitizen	0.98 [0.61, 1.56]	0.80 [-0.52, 2.12]
Age (yrs)		
18-29	Ref	Ref
30-44	1.84** [1.20, 2.82]	0.71* [0.03, 1.39]
45-64	1.49* [1.05, 2.11]	0.71* [0.16, 1.26]
65-	1.26 [0.91, 1.73]	0.28 [-0.23, 0.79]
Sex		
Male	Ref	Ref
Female	0.92 [0.79, 1.09]	-0.14 [-0.44, 0.15]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.22 [0.92, 1.60]	0.51* [0.07, 0.95]
Hispanic	1.39* [1.01, 1.92]	0.54* [0.02, 1.07]
Non-Hispanic Others	1.06 [0.75, 1.48]	0.12 [-0.43, 0.67]
Marital Status		
Non-Married	Ref	Ref
Married	1.07 [0.75, 1.48]	0.21 [-0.09, 0.51]
Educational Attainment		
Less than High School	Ref	Ref
High School	1.38** [1.12, 1.70]	0.30 [-0.06, 0.66]
Some College and Above	1.22* [1.01, 1.48]	0.25 [-0.10, 0.59]
Poverty		
125% FPL and Above	Ref	Ref
Less than 125% FPL	0.94 [0.80, 1.10]	0.20 [-0.12, 0.51]
Usual Source of Care		
No	Ref	Ref
Yes	1.07 [0.83, 1.37]	0.22 [-0.12, 0.57]
Self-Report Health Status		
Fair and Poor	Ref	Ref
Good and Above	0.50*** [0.43, 0.57]	-0.93*** [-1.20, -0.67]
Cancer in Remission		
Yes	Ref	Ref
No	1.88*** [1.53, 2.32]	0.93*** [0.52, 1.34]

* p<0.05, ** p<0.01, *** p<0.001

Table A7 Multivariate-Adjusted Relationship of Insurance Status to Number and Expenditures of Cancer-Related Office-Based Medical Provider Visits Stratified by Annual Family Income, MEPS 2007-2012

	Number of Visits		Expenditures	
	≥ 125% FPL (N=2,030)	< 125% FPL (N=491)	≥ 125% FPL (N=2,030)	< 125% FPL (N=491)
Immigration Status				
US Native	Ref	Ref	Ref	Ref
Naturalized Citizen	1.05 [0.82, 1.35]	0.59** [0.42, 0.81]	-0.11 [-0.54, 0.32]	-0.34 [-0.94, 0.27]
Noncitizen	0.59** [0.41, 0.85]	0.77 [0.53, 1.11]	-0.84* [-1.51, -0.17]	1.01** [0.36, 1.66]
Age (yrs)				
18-29	Ref	Ref	Ref	Ref
30-44	2.12** [1.30, 3.46]	0.99 [0.45, 2.18]	0.66 [-0.10, 1.43]	-0.49 [-1.46, 0.49]
45-64	1.63* [1.12, 2.36]	1.11 [0.48, 2.58]	0.53 [-0.09, 1.16]	0.61 [-0.41, 1.64]
65-	1.33 [0.93, 1.91]	1.22 [0.55, 2.67]	0.07 [-0.53, 0.67]	0.40 [-0.64, 1.44]
Sex				
Male	Ref	Ref	Ref	Ref
Female	0.91 [0.76, 1.08]	0.94 [0.74, 1.18]	-0.16 [-0.47, 0.14]	0.07 [-0.35, 0.49]
Race/Ethnicity				
Non-Hispanic White	Ref	Ref	Ref	Ref
Non-Hispanic Black	1.29 [0.93, 1.78]	1.07 [0.84, 1.36]	0.62* [0.12, 1.12]	0.36 [-0.08, 0.79]
Hispanic	1.14 [0.88, 1.49]	2.18** [1.31, 3.62]	0.47 [-0.12, 1.06]	0.95* [0.15, 1.74]
Non-Hispanic Others	1.04 [0.72, 1.51]	1.10 [0.64, 1.88]	0.11 [-0.45, 0.67]	0.16 [-1.24, 1.55]
Marital Status				
Non-Married	Ref	Ref	Ref	Ref
Married	1.08 [0.90, 1.28]	0.94 [0.75, 1.18]	0.12 [-0.19, 0.42]	0.16 [-0.25, 0.57]
Educational Attainment				
Less than High School	Ref	Ref	Ref	Ref
High School	1.40** [1.10, 1.78]	1.17 [0.93, 1.46]	0.36 [-0.03, 0.75]	-0.11 [-0.51, 0.29]
Some College and Above	1.21 [1.00, 1.48]	1.16 [0.84, 1.59]	0.28 [-0.07, 0.63]	-0.10 [-0.67, 0.48]
Insurance Status				

Uninsured	Ref	Ref	Ref	Ref
Insured	2.19*** [1.58, 3.02]	1.50 [0.93, 2.43]	1.30*** [0.77, 1.83]	0.41 [-0.35, 1.18]
Usual Source of Care				
No	Ref	Ref	Ref	Ref
Yes	1.22 [0.97, 1.53]	0.59** [0.39, 0.88]	0.19 [-0.13, 0.52]	-0.42 [-1.05, 0.20]
Self-Report Health Status				
Fair and Poor	Ref	Ref	Ref	Ref
Good and Above	0.48*** [0.42, 0.55]	0.59*** [0.48, 0.71]	-1.06*** [-1.32, -0.79]	-0.07 [-0.45, 0.31]
Cancer in Remission				
Yes	Ref	Ref	Ref	Ref
No	1.93*** [1.55, 2.41]	1.77*** [1.30, 2.42]	0.93*** [0.53, 1.33]	1.36*** [0.87, 1.84]

* p<0.05, ** p<0.01, *** p<0.001; FPL: Federal Poverty Line.
Marginal Effect of Insurance on Expenditure by STATA: $1,696.

Table A8 Descriptive Statistics in Demographic, Socioeconomic, and Health Covariates between Matched Groups Using Propensity Score Matching Method, MEPS 2007-2012

	Naturalized Citizen vs. US Natives			Noncitizen vs. US Natives		
	Naturalized Citizen	US Natives	P-Value	Noncitizen	US Natives	P-Value
Female	61.7%	68.9%	0.094	59.8%	54.8%	0.489
Age 30-44	9.7%	11.7%	0.468	23.7%	20.4%	0.582
Age 45-64	37.1%	32.4%	0.275	43.3%	43.9%	0.931
Age 65-	52.8%	55.2%	0.590	27.8%	30.1%	0.729
Race Hispanic	39.5%	37.7%	0.672	60.8%	63.5%	0.702
Race Black	5.6%	4.7%	0.627	7.2%	3.9%	0.319
Race Others	21.8%	23.8%	0.593	10.3%	7.6%	0.516
Married	60.9%	60.1%	0.855	60.8%	65.8%	0.477
High School	23.8%	25.1%	0.739	21.6%	18.4%	0.568
Some College and Above	54.0%	55.2%	0.787	39.2%	42.5%	0.642
Poor	21.8%	19.1%	0.463	36.1%	36.5%	0.953
Insured	97.2%	97.3%	0.913	87.6%	90.3%	0.554
Usual Source of Care	94.0%	95.2%	0.526	83.5%	92.6%	0.052
Self-report Health	44.4%	49.4%	0.265	33.0%	38.1%	0.456
Cancer not in Remission	9.3%	7.4%	0.456	10.3%	7.4%	0.482
Sample N	248	518		97	234	

Table A9 Multivariate-Adjusted Association between Acute and Chronic ACSC-related ED Visits and Immigration Status among All Respondents, MEPS 2003-2012

	Acute ACSC	Chronic ACSC
Immigration		
US Native	Ref	Ref
Naturalized Citizen	0.70** [0.54, 0.91]	0.79* [0.64, 0.99]
Noncitizen	0.50*** [0.36, 0.68]	0.66** [0.50, 0.87]
Age (yrs)		
18-29	Ref	Ref
30-44	0.82* [0.68, 0.99]	1.13 [0.90, 1.41]
45-64	0.76** [0.64, 0.91]	1.31* [1.04, 1.65]
65-	1.45*** [1.20, 1.75]	1.18 [0.93, 1.51]
Sex		
Male	Ref	Ref
Female	1.86*** [1.63, 2.11]	1.25*** [1.11, 1.41]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.01 [0.87, 1.16]	2.12*** [1.87, 2.41]
Hispanic	0.90 [0.73, 1.11]	1.16 [0.93, 1.44]
Non-Hispanic Others	0.94 [0.71, 1.25]	1.26 [0.97, 1.62]
Marital Status		
Non-Married	Ref	Ref
Married	0.87* [0.76, 1.00]	0.76*** [0.67, 0.85]
Educational Attainment		
Less than High School	Ref	Ref
High School	0.76*** [0.66, 0.89]	0.75*** [0.65, 0.87]
Some College and Above	0.54*** [0.46, 0.63]	0.51*** [0.44, 0.59]
Poverty		
125% FPL and Above	Ref	Ref
Less than 125% FPL	1.51*** [1.32, 1.73]	1.44*** [1.26, 1.65]
Insurance Status		
Insured	Ref	Ref
Uninsured	0.89 [0.73, 1.08]	1.26** [1.06, 1.50]
Usual Source of Care		
No	Ref	Ref
Yes	1.17 [0.97, 1.42]	1.15 [0.96, 1.38]
Charlson Index		
0	Ref	Ref
1	1.97*** [1.70, 2.29]	16.00*** [13.30, 19.30]
2	3.05*** [2.51, 3.70]	15.40*** [12.80 ,18.70]
>3	3.71*** [2.90, 4.74]	29.20*** [23.30, 36.70]

* p<0.05, ** p<0.01, *** p<0.001

Table A10 Multivariate-Adjusted Association between Acute and Chronic ACSC-related ED Visits and Immigration Status among ED users, MEPS 2003-2012

	Acute ACSC	Chronic ACSC
Immigration		
US Native	Ref	Ref
Naturalized Citizen	0.93 [0.72, 1.20]	1.00 [0.79, 1.26]
Noncitizen	0.79 [0.59, 1.06]	1.04 [0.80, 1.36]
Age (yrs)		
18-29	Ref	Ref
30-44	0.92 [0.76, 1.11]	1.33* [1.07, 1.66]
45-64	0.96 [0.81, 1.14]	1.84*** [1.47, 2.30]
65-	1.70*** [1.41, 2.04]	1.53*** [1.20, 1.95]
Sex		
Male	Ref	Ref
Female	1.67*** [1.46, 1.90]	1.15* [1.01, 1.31]
Race/Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.89 [0.77, 1.02]	2.02*** [1.76, 2.31]
Hispanic	0.92 [0.75, 1.14]	1.23 [0.99, 1.52]
Non-Hispanic Others	1.06 [0.81, 1.38]	1.44** [1.12, 1.84]
Marital Status		
Non-Married	Ref	Ref
Married	1.04 [0.91, 1.18]	0.87* [0.77, 0.99]
Educational Attainment		
Less than High School	Ref	Ref
High School	0.90 [0.78, 1.05]	0.86 [0.74, 1.01]
Some College and Above	0.77** [0.66, 0.90]	0.68*** [0.59, 0.79]
Poverty		
125% FPL and Above	Ref	Ref
Less than 125% FPL	1.07 [0.93, 1.22]	1.09 [0.95, 1.26]
Insurance Status		
Insured	Ref	Ref
Uninsured	0.98 [0.81, 1.19]	1.27** [1.06, 1.52]
Usual Source of Care		
No	Ref	Ref
Yes	1.00 [0.83, 1.21]	1.16 [0.98, 1.38]
Charlson Index		
0	Ref	Ref
1	1.01 [0.88, 1.17]	8.67*** [7.32, 10.30]
2	1.40** [1.15, 1.71]	7.01*** [5.79, 8.48]
>3	1.36* [1.06, 1.73]	11.40*** [9.03, 14.30]

* p<0.05, ** p<0.01, *** p<0.001