Health acculturation and type 2 diabetes management among Vietnamese, Chinese, Korean, and Latino adult immigrants in the US

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HEALTH ACCULTURATION AND TYPE 2 DIABETES MANAGEMENT AMONG VIETNAMESE, CHINESE, KOREAN, AND LATINO ADULT IMMIGRANTS IN THE US

A dissertation

by

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Submitted in partial fulfillment
of the requirements for a degree of
Doctor of Philosophy

APRIL 2015

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Abstract

Diabetes management is a major part of treatment but many ethnic/racial minorities with type 2 diabetes do not make the needed adjustment. A key component of healthcare access is health acculturation, defined as a level of success in navigating the mainstream healthcare system. The overall goal of this study is to develop a measure of health acculturation and examine its relationship with diabetes management across several ethnic minority groups in the US. The first purpose is to investigate the relationship between health acculturation and type 2 diabetes management behaviors in a sample of foreign-born Vietnamese, Chinese, Korean and Latino adults. The second purpose is to assess ethnic differences by testing the interaction between health acculturation and ethnicity on diabetes management behaviors. Merged dataset from CHIS 2009 and 2011-2 were used for analysis. Multiple and logistic regression analysis revealed that those with high health acculturation skills performed more diabetes management than their counterparts. Latinos performed better than all Asian subgroups on most diabetes management behaviors regardless of the level of health acculturation. The study has implications for social workers and healthcare providers working with ethnic and minority populations. The results suggest that the health acculturation measure would be a good screening tool to identify immigrant populations who will most benefit from health intervention within the culture of western medicine. In addition, the results help to identify specific skills and tools needed by social workers and healthcare providers to better serve these populations.

TO MY PARENTS,

FOR YOUR SACRIFICES, LOVE, AND UNWAVERING SUPPORT.

In Vietnamese, a common metaphor for education is a ship going against the current. In order to increase or even maintain your knowledge of the world, you must doggedly study, because if you slack off you will be driven under by the surging waves. I've spent many sleepless nights, fighting my own way against those waves to truly learn and advance. Education means much more than money. It is an invisible asset. I am now writing the check against its value with gratitude and unspoken words. Here and forevermore to our future.

ACKNOWLEDGEMENTS

Completing this dissertation could not have been possible without the continued guidance and encouragement of many people. First and foremost, I want to thank my faculty advisors and committee members at Boston College including Dr. Thanh V. Tran, Dr. Thomas O'Hare, and Dr. Tam H. Nguyen. At different times, they have played a major role in my intellectual development and have been my constant, unwavering source of support, encouragement and enthusiasm.

I also want to thank the Boston College's Social Work doctoral program and the doctoral faculty members, including Dr. James Lubben and Dr. Marcie Pitt-Catsouphes, who have provided the financial support and encouragement needed to see me through this process. I am deeply grateful to my friends and colleagues at Research Services whose kindness and encouragement gave me the strength to reach the finishing line. The Director of Research Services, Barry Schaudt, and Manager, Rani Dalgin, have been wonderful.

Last but definitely not least, I want to thank my family and good friends who spent much time, love, and energy nudging me on. They gave me the strength and inspiration to stay on course even when I was in doubt. I am especially grateful to my wonderful friend, Ken Benesh, for his overwhelming support, patience, and kindness helping me through times of stress and despair.

I will always remember your generosity, support and patience.

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Chapter I. Introduction

Purpose

Access to healthcare in the United States continues to be a major problem in the twenty-first century for immigrants and refugees (Clough, Lee, & Chae, 2013; Mirza et al., 2014). Whether healthcare providers focus on the treatment of immediate medical needs or on preventive medicine and primary care, the importance of connecting patients with appropriate services is essential for improving outcomes and reducing healthcare cost, especially for immigrants and refugees. Issues of social, racial, and ethnic acculturation, particularly *health acculturation*, pose additional barriers to accessing an already complicated and confusing healthcare system. A key component of healthcare access is health acculturation, defined here as a level of success in navigating the mainstream healthcare system for one's own medical benefit. Because little research exists on the health aspects of the acculturation process among immigrant minority groups, this study is designed to define and conceptualize health acculturation. The overall goal is to develop a measure of health acculturation and examine its relationship with diabetes management across several ethnic minority groups in the US. To accomplish this, the primary purpose is to investigate the relationship between levels of health acculturation and type 2 diabetes management behaviors in a sample of foreign-born Vietnamese, Chinese, Korean and Latino adults. The secondary purpose is to identify ethnic differences as well as commonalities based on the demographic characteristics of these populations. This dissertation will compare the Asian sub-groups with the Latino population, which has been the focus of numerous diabetes studies.

Furthermore, these populations often share similar social, cultural, and language barriers (vonGoeler, Rosal, Ockene, Scavron, & De Torrijos, 2003; Hsu et al., 2006).

Significance

This study is significant because, to my knowledge, few studies uses "health acculturation" criteria to examine and compare type 2 diabetes management behaviors among ethnic minority sub-populations (Chinese, Korean, Vietnamese and Latino). The concept of health acculturation should be useful for a better understanding of barriers, making it easier for healthcare providers, facilitators and social workers to enable minorities to access healthcare resources. The potential influence on healthcare can be described using the framework of the already well-established Andersen's Behavioral Model, which will be discussed further in Chapter 2. Also, the relationship between acculturation and diabetes management has not been adequately explored; to date, existing research on acculturation and diabetes management has focused primarily on Chinese immigrant populations (Chun, Chesla, & Kwan, 2011; Fisher et al., 2004; Xu, Pan & Liu, 2011). Furthermore, health research in the US that focuses on Asians tends to aggregate all Asian subgroups even though these groups may be different linguistically and culturally from one another. Very few researchers have studied specific Asian ethnic groups.

Understanding healthcare on its own is complicated enough, but cultural and language barriers pose additional challenges for immigrants attempting to understand eligibility requirements and navigate existing resources in a fragmented healthcare system. Immigrants have to deal with a dual system of federal and state eligibility requirements (Perreira et al., 2012). There is a federal system, a state system, and then the

myriad of private-sector insurance programs such as HMOs and PPOs, which no two are alike. It is possible, depending on immigration status that members of the same family may have to meet different eligibility requirements or may not be eligible for the same benefits (Perreira et al., 2012). While the newly enacted Affordable Care Act (ACA) provides medical insurance coverage to more immigrants than ever, as many as 10 million documented immigrants are expected gain health insurance, the new system has added an additional layer of bureaucracy, regulations and a confusing set of healthcare cost standards, including varying out-of-pocket coinsurance fees, deductibles, provider networks, and coverage for drugs (Evans, 2014; Kenney & Huntress, 2012). It is still unclear how many immigrants have acquired coverage so far. The reason for the new policies is that patients, while having greater access, are expected to become more conscientious regarding healthcare spending and therefore, bear some of the costs (Rosenthal, 2015). According to some experts, these new regulations could leave people bewildered in their efforts to understand and take advantage of ACA provisions (Rosenthal, 2015).

Given the changing landscape in the US healthcare system with its new regulations, policies and guidelines, which are constantly being refined, the issue of health acculturation becomes even more critical when it comes to managing diabetes. According to the American Diabetes Association (ADA, 2014), the average diabetic incurs nearly $14,000 each year in medical expenses. It is a costly condition, more than two times what the patient would likely pay without diabetes. In addition to this expense, diabetics are more susceptible to additional chronic problems such as heart disease and strokes that also require ongoing treatment (ADA, 2014). While diabetes care is a

challenge in itself, it is even more challenging for immigrants. Their need for treatment requires an on-going care coordination and even daily management by patient and physician. To be effective for many immigrant populations, it often requires a third-party advocate who understands the patient's culture and language. It is extremely unlikely that immigrants, who do not have the necessary communication skills, or knowledge to access healthcare, would be able to strictly follow instructions for even routine things like checking blood glucose levels or knowing when to contact providers for retinal screening, foot examinations, and checks for early signs of renal, vascular, and neuropathic disease. Therefore, given the complexities of the US healthcare and the complexities of managing chronic diseases, the need to examine health acculturation is of utmost importance.

Researchers and policy experts have emphasized the depth of these challenges for immigrants and their families who are trying to access healthcare for the first time (Perreira et al., 2012; Mills, Compton, & Golden, 2011; Rosenbaum & Dean, 2011). Under the ACA, the rules and requirements related to eligibility have been changing rapidly, and immigrants, often having limited language and literacy skills, lack abilities to fill out a sometimes very complicated application or to obtain proper documentation for verification (Perreira et al., 2012). Once the immigrant finally has the insurance, a kind-of culture shock may set in when he or she learns that there are still expenses for a medical appointment, lab test or drug prescription (Chaves, 2014). The individual typically must pay a co-pay even for routine things which the immigrant assumes are covered by the monthly insurance premium. This is more than a mere issue of translation;

it extends to a lack of cultural understanding of the US healthcare system, which is a pervasive problem across immigrant communities including Latino and Asian.

Issues of healthcare access for immigrants are further complicated by their health culture, practices, norms and beliefs. These can range from a deep commitment to traditional medical practices to a genuine distrust of western healthcare practices (Chang-Muy & Congress, 2008). Western medicine has its roots in 16th century germ theory, an understanding that illnesses are caused by physical organisms such as bacteria and viruses. As western medical science developed, it became clear that illness could be related to behavior (e.g., poor diet) or natural processes (e.g., old age). These physical ailments can be treated by specific remedies such as medicine, diet, or changes in behavior (e.g., quit smoking cigarettes), or even surgical procedures. Immigrants, however, depending on where they come from, might link a particular illness to non-physical causes related to their personal relationship with the cosmos, spirituality, being out of harmony with nature, or even to the transgression of an ancestor sometime in the past (Congress & Lyons, 1992; Ma, 1999; Murguía, Peterson, & Zea, 2003; Chang-Muy & Congress, 2008). For both Latino and Asian immigrants, health is typically viewed as a state of equilibrium between one's physical condition, nature, spirit, and the cosmos. Many immigrants know very little about western medicine, and based on what they may have heard from others, might regard it as alien, something outside their comfort zone (Chang-Muy & Congress, 2008). They will most likely rely on their traditional remedies, or alternative medicines, that could be anything from medicinal plants to religious ceremonies. Immigrants may not disclose what they have been doing or using to a western healthcare provider, believing that the provider may not approve, and may also

be inclined to say what they believe the physician wants to hear. These culturally-based health attitudes pose problems for immigrants accessing care, because there could be complications or unexpected consequences if the physician does not get all of the information, or gets incomplete/ incorrect information (Murguía et al., 2003).

Diabetes Prevalence and Management Strategies

The high prevalence of diagnosed and undiagnosed type 2 diabetes within the immigrant population is a serious concern for both researchers and healthcare providers. In their 2007 California Health Interview Survey (CHIS) analysis, Choi and colleagues (2011) found that Vietnamese and Korean Americans had an age-adjusted prevalence higher than non-Latino Whites (7.03%, 6.3% vs. 5.94% respectively). Chinese Americans at 5.93% was the only Asian group studied whose prevalence was slightly lower than non-Latino Whites. A more recent 2014 report from the Center for Disease Control Prevention (CDC) also suggests that the age standardized prevalence for Asian (9.0%) and Latino (12.8%) is much higher compared to the non-Latino Whites (7.6%). These statistics indicate that while diabetes has often been associated with the non-Latino White population, it is now known to be widespread in Asian and Latino groups as well; and, body-mass index (BMI) may not be a reliable predictor of diabetes risks. When adjusting for age, sex, and BMI, the odds of becoming diabetic was 60% higher among Asian Americans (OR=1.6, 95% CI, 1.1-2.2) and 90% higher among Latinos (OR=1.9, 95% CI, 1.6-2.1) than non-Latino White (McNeely & Boyko, 2004). This means that despite having a lower average BMI, Asians still have a higher risk of developing type 2 diabetes compared to their non-Latino counterparts.

There are also possible risk factors for diabetes related to the process of acculturation the longer immigrants are influenced by western diet and lifestyles (Deng, Zhang, & Chan, 2013; Crockett et al., 2007; Finch, Kolody, & Vega, 2000; Frank, Cerda, & Rendon, 2007; Portes & Rumbault, 2006). The switch to an American diet and lifestyle often leads to higher caloric consumption, unhealthy food preferences, and less physical activity, leading to increased risks for obesity and type 2 diabetes (Abate & Chandalia, 2003; Candib, 2007; Deng et al., 2013; Gomez, Kelsey, Glaser, Lee, & Sidney, 2004; Lu & Cason, 2004; Unger et al., 2004; Hosler & Melnik, 2003; Huang et al., 1996). However, these findings are not always consistent. Within the Latino population, results have been mixed. Some studies found that Latinos with higher acculturation had diets that were lower in fruits and vegetables and higher in fat compared to those who were less acculturated (Neuhouser, Thompson, Coronado, & Solomon, 2004; Sharma et al., 2004; Unger et al., 2004). Others found a reverse association between acculturation and dietary intake (Lin, Bermudez, & Tucker, 2003; Satia-Abouta, Patterson, Neuhouser, & Elder, 2002). Likewise, research on Asian Americans, as well as Latino, found that a higher risk for overweight/obesity is associated with acculturation while others found no significant relationships (Franzen & Smith, 2009; Hubert, Snider, & Winkleby, 2005; Lee, Sobal, & Frongillo, 2000; Liou & Bauer, 2007; McDonald & Kennedy, 2005; Kandula et al., 2008). In addition, across all ethnic groups research has found a relationship between prevalence, education and income, in that diabetes prevalence was highest among people who had less education and lower income (Diamant et al., 2007). The inconsistent findings on acculturation and diabetes-related outcomes suggest a subtle

but significant relationship between diabetes and the acculturation process that requires further exploration.

While diabetes management, which generally includes checking blood glucose, insulin therapy, use of other medications, and lifestyle changes such as diet, exercise and foot care, is a major part of treatment, many minorities with diabetes do not make the needed adjustment (Heisler et al., 2007; Nelson, Reiber, & Boyko, 2002; Xu, Pan, & Liu, 2011). Frequently, social aspects (i.e., family harmony, family roles) mitigate against effective diabetes management. Instead of managing diabetes, patients may try concealing it to avoid bringing unnecessary attention to one's self, to avoid causing a disruption to social and cultural functions related to eating, and to maintain the appearance of family harmony (Chesla, Chun & Kwan, 2009; Chesla & Chun, 2005). As a result, in order to have a successful diabetes management plan, patients need to have knowledge of how their blood sugar changes due to diet or activities and learn how to manage these changes within their cultural framework. This process requires health acculturation.

Because of the high prevalence and risk for type 2 diabetes in the foreign-born populations, aspects of diabetes management in the context of health acculturation need to be explored. Even though most current research on diabetes does not consider foreign-born status, based on recent demographic characteristics of Vietnamese, Korean, Chinese, and Latinos in the US, in which anywhere between 50 and 80 percent might be foreign-born, it is reasonable to argue that foreign-born populations are particularly at risk for diabetes.

Demographic Profiles

Both the Asian and Latino populations grew rapidly between 2000 and 2010 at a comparable rate, around 43 percent (Census Bureau, 2011). Asian populations in the US are highly diverse, representing almost 50 nationalities, mostly from countries such as China, Vietnam, and Korea. Latino, for census purposes, includes persons of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race (Motel & Patten, 2012). However, demographic characteristics, like the cultural norms noted above can vary considerably and do not conform to any common pattern. Each group has its own unique culture, customs, values and beliefs, as well as its own unique immigration history and experience in adapting to the US culture. Consequently, when comparing snapshots of the Vietnamese, Korean, Chinese and Latino populations below, variables such as language proficiency, education and affluence do not necessarily follow a common pattern.

Vietnamese Demographics in the US

As of 2010 there were approximately 1.6 million Vietnamese in the US (US Census, 2010). They are the largest ethnic group to immigrate from Asia in the past forty years. In contrast to other Asian groups, the Vietnamese population in the US was very small until mass immigration began in 1975 with the Fall of Saigon. By the end of 1979, the economic and political repression of the new Communist regime lead to a second wave of asylees. An estimated 400,000 Vietnamese, known as *Boat People*, fled the country. A third wave of immigration from Vietnam occurred in the late 1980s consisting mostly of people who were sponsored by programs, such as the Amerasian Homecoming Act and the Orderly Departure Program (ODP) (Tran & Phan, 2012). Many of these

immigrants/refugees had spent more than three years, some more than a decade, as political detainees in forced-labor and re-education camps, while their families faced official, as well as, unofficial suspicion, prejudice, discrimination and ostracism, and at best, were treated as second-class citizens. Most former detainees were in their late forties and fifties and suffered, not only from many physical ailments, but also from serious mental health issues, such as depression and post-traumatic stress disorder (Tran & Phan, 2012).

According to data compiled by the Pew Research Center (2013) Vietnamese are now the fourth largest ethnic Asian group, behind the Chinese, Filipino and Indian. The majority of Vietnamese in the US are foreign born (84% of adults). These immigrants are more likely than the total foreign-born population to have limited English proficiency (LEP) and less likely to be college educated. On the other hand, they have higher income, a lower poverty rate, and more health insurance coverage than the overall foreign-born population. In 2012, their median annual household income ($55,736) was higher than total foreign-born population ($46,000) and the native-born population ($51,974) (Rkasnuam & Batalova, 2014). This may be because the Vietnamese immigrant families have more earners compared to the total foreign-born population and native-born population; on average, immigrant households have about 67 percent people working compared to 63 percent people in native households overall. This may also help explain why the 2012 poverty rate for Vietnamese immigrants (15%) was equivalent to the rate for the native-born population (15 percent) and lower than the rate for the overall foreign-born population (19 percent) (Rkasnuam & Batalova, 2014). Approximately 68 percent of Vietnamese immigrants were LEP, a percentage well above the 50 percent of the total

foreign-born population (Rkasnuam & Batalova, 2014). Only about a 23 percent of Vietnamese immigrants have earned a college degree (BA, BS or higher), which is lower than foreign-born population (27.1%) and the native-born population as a whole (28.5%).

Chinese Demographics in the US

The 2010 US Census reported over 3 million ethnic Chinese (US Census, 2010). Chinese have been immigrating to the United States since the 1830s (Hooper & Batalova, 2015). The 1848 California gold rush attracted mostly merchants and sailors with the railroad boom in 1852 attracting another 52,000. The Chinese Exclusion Act of 1882 banned their immigration and as a result there were only about 100,000 in the US in 1965. With immigration reform again allowing Chinese immigration they have become the largest community of foreign-born residents in the country and continue to immigrate in significant numbers. In 2010, 76 percent of Chinese adults in the US were foreign born, accounting for 4.5 percent of the country's 40 million total foreign-born residents (Hooper & Batalova, 2015). Chinese immigrants have taken education very seriously: 45.4 percent of Chinese immigrants age 25 and older have attained at least a bachelor's degree compared to 27.1 percent of the foreign born and 28.5 percent of the total native born (Hooper & Batalova, 2015). They also have obtained graduate degrees at a higher rate than the total foreign-born population (11.1%) and the native born Americans (26.1 percent vs 10.3 percent). Yet, more Chinese immigrants are LEP (62.8%) than the total foreign-born population (51.6%) (Hooper & Batalova, 2015). Also, while the share of foreign-born adult Chinese living in poverty (16.1%) is slightly lower than the foreign born population overall (18.7%), the percentage is higher than that of native born Americans (14.7%).

Korean Demographics in the US

There are approximately 1.4 million ethnic Koreans in the US making it the fifth largest Asian group (US Census, 2010). Korean immigration began in the early 19th century. The first wave was primarily voluntary male migrants coming to work on agricultural farms and to build railroads (Min & Kim, 2012). They had to be physically fit and healthy in order to be recruited and admitted into the US. Following the 1965 Immigration and Naturalization Act, Korean immigration has consisted mostly of family units and well-educated adults, and their demographics are quite different from those of the Vietnamese and Chinese populations. Seventy eight percent (78%) of Koreans in this country are foreign born. According to a recent research report, Korean families were significantly more affluent than US families, and significantly better educated than other immigrant populations and the US population as a whole. Data from 2013 American Community Survey (ACS) found that the median income for the average Korean immigrants' household was $55,800 whereas the median for the immigrant and native-born population was $48,100 and $53,000, respectively (Zong & Batalova, 2014). They were also more likely to have some kind of health insurance, with only 25 percent being uninsured compared to 32 percent for the overall immigrant population. Regarding education, 2013 ACS data revealed that about 52 percent of Korean immigrants age 25 and older had at least a bachelor's degree compared to 28 percent of all foreign-born adults and 30 percent of native-born Americans (Zong & Batalova, 2014). However, although educational attainment was very high, their English fluency was found to be lower; over 53 percent of Korean immigrants were LEP compared to 50 percent of all foreign-born residents (Zong & Batalova, 2014).

Latino Demographics in the US

According to the 2010 Census, Latino Origin refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race (Motel & Patten, 2012**)**. Up until the 1960s the Latino population in the US had been small and regional. Then, political instability along with continual economic instability has resulted in major immigration flows. Today, there are about 50.5 million Latinos, approximately 16 percent of the US population (Passel & Cohn, 2012). By 2050, the Census Bureau projects that the Latino population will reach 30 percent of the nation's population (Passel & Cohn, 2012). Additionally, although education among Latinos has significantly improved over the years and the education gap, particularly secondary education, has narrowed, Latinos continue to lag behind other racial and ethnic groups (Motel & Patten, 2012). Those who earned college degrees increased only from 10 percent in 2000 to 13 percent in 2010, while the national average is at 28 percent. It also remains troubling that more than 35% of all US Latinos (ages 5 and older) are still not proficient in English (Passel & Cohn, 2012). The median annual household income for Latinos is $40,000, which is substantially lower than that for the US population ($49,800). Also, with 31 percent of Latinos not having health insurance compared to 12 percent for the non-Latino white population, Latinos have the highest uninsured rates in the United States compared to all other racial and ethnic groups.

Table 1. *Demographics Overview of Ethnic Minority Groups in the US*

Ethnicities	US Population (millions)	Foreign Born	Poverty	No Health Insurance	Education (BA +)	LEP	Diabetes Prevalence
Vietnamese	1.6	84%	15%	20%	23%	75%	9.0%*
Chinese	1.8	75%	16.1%	15%	45%	63%	9.0%*
Korean	1.4	73.6%	11%	25%	51%	57%	9.0%*
Latino	50.5	38%	24%	31%	13%	35%	12.8%*

*CDC (2014): age-adjusted diabetes prevalence; CDC reported only aggregated statistics for the Asian populations

Research Questions and Hypothesis

The purpose of this dissertation is two-fold. The first is to examine the relationship between health acculturation and type 2 diabetes management among foreign-born Vietnamese, Chinese, Korean, and Latino adults in the US. The second is to assess ethnic differences by testing the interaction between Health Acculturation and ethnicity with respect to diabetes management behaviors. Because previous studies have stressed ethnicity as an important factor in health utilization, evidence of ethnic disparities in various elements of healthcare utilization strongly suggest that diabetes management would be significantly affected as well**.** There is a need for a better understanding of how ethnicity interacts with health acculturation to influence health services use in diabetes management.

Does health acculturation have an association on type 2 diabetes management behaviors? The following hypothesis postulates that high level of health acculturation has a direct association with the following dependent variables:

H1a: healthcare utilization (e.g. the number of physician visits in the past year)

H2a: physician contact with medical questions in the past year.

H3a: blood glucose testing per month.

H4a: foot exams in the past year.

H5a: hbA1c testing in the past year.

H6a: dilated eye exams in the past year.

H7a: diabetes medication adherence (pills/insulin).

H8a: provider-developed diabetes management plan.

Does ethnicity moderates the relationship of health acculturation and type 2 diabetes management behaviors? The following hypothesis postulates that ethnicity moderates the relationship between health acculturation and the following dependent variables:

H1b: healthcare utilization (e.g. the number of physician visits in the past year)

H2b: physician contact with medical questions in the past year.

H3b: blood glucose testing per month.

H4b: foot exams in the past year.

H5b: hbA1c testing in the past year.

H6b: dilated eye exams in the past year.

H7b: diabetes medication adherence (pills/insulin)

H8b: provider-developed diabetes management plan.

Chapter II. Literature Review

Health Acculturation

The concept of acculturation was first applied by J.W. Powell in the late 1800s to describe Native American experiences with cultural changes. It has since been employed in a number of fields including psychology, linguistics, and health studies (Baker, 2011). In the 1970s the study of acculturation focused primarily on the process of adjusting to the dominant culture (Teske & Nelson, 1974). Over time, the focus has shifted to studying the changes in values and behaviors that result in adjusting from one culture to another. As the immigration rates have increased throughout the world, interest in acculturation studies has increased also (Schwartz, Unger, Zamboanga, & Szapocznik, 2010).

There are now dozens of scales, measures and tests focusing on acculturation. Some aim for broad applications (e.g., American-International Relations Scale: Roysircar-Sodowsky & Plake, 1991; Multigroup Ethnic Identity Measure: Phinney, 1992) whereas most others focus on a particular group or groups (e.g., Acculturating Rating Scale for Mexican Americans: Cuellar, Arnold, & Maldonado, 1995; Suinn-Lew Asian Self-Identity Acculturation Scale: Suinn, Ahuna, & Khoo, 1992). Typical of these scales are language proficiency, length of time in the new country, age, ethnic ties, interaction with people within and outside the ethnic community, and education. Some, like the Suinn-Lew Asian Self-Identity Scale have been adapted to other purposes. For example, researchers used Suinn-Lew Asian Self-Identity Scale to show that the relationship between acculturation and diabetes management is significant; highly acculturated Chinese immigrants were less negatively impacted by diabetes and had a

better quality of life than their less-acculturated counterparts (Fisher et al., 2004; Xu, Pan & Liu, 2011).

Of the models applied to acculturation studies, the model developed by Berry has been the most widely used. Berry (2003) defined acculturation as the process of adopting into the mainstream culture, which is a process of first-hand interaction within and among distinct cultural groups. He described four possible modes of acculturation: *assimilation* (rejects heritage culture, adopt dominant culture), *integration* (maintains heritage culture, adopt dominant culture), *separation* (maintains heritage culture, reject dominant culture), and *marginalization* (rejects both heritage and dominant culture). In recent years, the theory of acculturation has moved beyond the assumption that immigrant acculturation is a straight-line process of exchanging one culture for another. Keeping traditional values and characteristics is now known to be essential to a healthy adaptation and assimilation experience (Berry, 2003; Triandis, 2000).

Acculturation in healthcare research has been difficult to measure (Zambrana & Carter-Pokras, 2010). Researchers have used immigration status, English proficiency, length of residence, and nativity as proxy indicators of acculturation in their studies of health behaviors (Berry, 2003; Gordon, 1964; Jang, Kim, Chiriboga & King-Kallimanis, 2007; Myers & Rodriguez, 2002; Triandis, 2000; Zane & Mak, 2003). In this paper, health acculturation is adapted from the larger, multidimensional concept of acculturation, which involves a range of values, beliefs, and behaviors (Berry, 2003; Celano & Tyler, 1990; Mavreas, Bebbington, & Der, 1989). Like acculturation, health acculturation focuses on immigrants adapting and adjusting to the mainstream culture, but is specifically focused on healthcare. Key attributes of this concept include more than

just survival skills; they also include adaptation to the healthcare system, involving learning the basics to communicate with health professionals and knowledge that would enable them to access and navigate the mainstream healthcare system. Gaining greater clarity of this concept and its relationship to healthcare access among immigrant populations is important. Immigrant populations are now a part of the American landscape, and as healthcare changes over the coming decades what we learn will become increasingly relevant on a broader scale.

Health acculturation is defined as a level of success in navigating the American healthcare system for one's own medical benefit. Health acculturation requires two related skill sets. The first is the ability to communicate with and understand healthcare providers. The second is the knowledge of how to independently access healthcare services from various providers such as primary-care doctors, specialists, clinics, hospitals and community health centers. This involves access to health services and a financial component of being able to afford the services, or taking advantage of state and local, public or private, medical assistance for people with limited or no financial resources. In other words, the financial component is embedded in the construct of "access to services." A person with financial resources will most likely be dealing directly with a medical provider or with an insurer, while a person with adequate knowledge of public medical assistance options but poor financial circumstances will deal with one or more local, state, or private agencies to establish eligibility for public medical assistance. This person is then directed to the healthcare provider. Thus, the ability to communicate with healthcare providers along with having actual access,

including the financial-support component, can be valid indicators of health acculturation and may be predictive of health behaviors.

While the concept of health acculturation may, at first glance, appear similar to health literacy, it actually differs in significant ways. Health literacy is broad and inclusive, and its definition is continually evolving. Its orientation is top down, focusing on delivering targeted services to the people. On the other hand, health acculturation is bottom up, focusing on the individual; bringing people to the resources.

Health Communication with Providers

Gaining proficiency in English is an enabling characteristic for health access and care among immigrants. This has been shown among older immigrant adults who speak English well (Andersen et al. 1995; Ponce et al., 2006). Language barriers can obstruct access to healthcare and lower the quality of care for immigrants who must function in a predominantly English speaking healthcare environment (Lee, 2003; Ponce et al., 2006). Regardless of how much knowledge about the healthcare system a person may have, linguistic disparity is among the top challenges that prevent immigrants in the US from receiving proper care. These barriers can affect a diabetic patient's understanding of even primary information about diabetes such as diet, blood glucose monitoring, scheduling medical appointments and purchasing needed diabetes medicine; hence, language barriers can inhibit the patient's ability to manage diabetes effectively.

While immigrants may have access to providers who are fluent in their native language, the need to gain necessary English proficiency remains important because they cannot always rely on the availability of native-language speakers. Furthermore, health research over the past two decades has documented adverse impacts of language barriers

on patients' abilities to make appointments, explain symptoms, understand medical terminology and follow treatment instructions (Lee, 2003; U.S. Conference of Local Health Officers, 1993). When socioeconomic characteristics remained constant, patients who had a low level of English proficiency reported fewer numbers of doctor visits and used fewer preventive-care resources (Derose & Baker, 2000; Hu & Covell, 1998; Woloshin, Schwartz, Katz, & Welch, 1997; Stein, Fox, & Murata, 1991; Marks, Garcia, & Solis, 1990). For example, among non-English speaking women, healthcare access was significantly affected in that they were less likely to receive routine breast examinations and have a regular source of primary care (Weinick & Krauss 2001; Woloshin et al., 1997).

Successful health acculturation, however, involves more than just having a good command of English. The verbal communication between patients and providers who are culturally and linguistically different requires that all participants in the communication comprehend and understand the content of the communication (Lee, 2003). Immigrants who lack the ability to communicate with providers would be able to benefit from the healthcare system only with the assistance from an interpreter or translator. Even with professional assistance, though, patients may not fully understand the complexity of health issues and not get the proper treatment. In the absence of a medical interpreter, patients with limited English proficiency have sometimes relied on relatives or friends to act as an interpreter (Perreira et al., 2012). These people typically do not have the medical expertise or knowledge to accurately translate questions and answers between patient and physician, resulting in misinterpretations and potential misdiagnoses.

Knowledge to Access Healthcare Systems

The ability to communicate and understand providers in English is in most circumstances necessary but is not in itself sufficient for health acculturation. For example, many inner cities residents who are native English speakers still use emergency care as their primary care resource (Newport & Mendes, 2009). In 2009, the Boston Globe reported that even though 92 percent of Bay State residents have health insurance and a primary-care physician compared to a national average of 84 percent, according to a Gallup Poll many are still relying on hospital emergency rooms for care that could have been handled less expensively by their primary care providers.

Health acculturation also includes the necessary knowledge to access healthcare services from various providers such as primary-care doctors, specialists, clinics, hospitals and community health centers. Even though patients may not be fluent in English, having a "usual source of care" from a medical provider or community health clinic is an indicator of access and an indicator of their knowledge of available resources (Hoffman & Paradise, 2008). People who have a usual source for care are not experiencing barriers related to uncertainties and inconveniences of searching for a provider. They are more likely to seek care, ask health questions, and make appointments with providers (Hoffman & Paradise, 2008). While this does not automatically translate into better health it improves the potential for better health.

Implicit in the "knowledge to access healthcare systems" is the perception of one's financial or socioeconomic status. The perception of a financial burden related to diabetes leads to a lack of medicine adherence and has been shown to be associated with poorly controlled diabetes, as indicated by a higher HbA1c (Ngo-Metzger, Sorkin,

Billimek, Greenfield, & Kaplan, 2012). For this reason, having health insurance is a significant enabling factor for accessing care because it protects people from the high and unexpected cost of medical care and also connects them to a network of health providers (Hoffman & Paradise, 2008; Ngo-Metzger et al., 2012). Having health insurance has been shown to increase healthcare use among the different population groups that have been studied, whereas a lack of health insurance coverage is significantly related to poor health seeking behaviors and restricted access to services (Mirza et al., 2014; Stockdale, Tang, Zhang, Belin, & Wells, 2007; Broyles et al., 1999). This disparity in health access was even more pronounced in a population study of low-income adults, especially low-income women. An analysis of a national survey showed that uninsured women were less likely than the insured to receive cancer screening, Pap tests, a lower rate for mammography (Adams, Breen, & Joski, 2007). Further, in a study of breast cancer, Ayanian and colleagues (1993) found that those without health insurance were less likely to receive basic preventative services, such as breast cancer screening. Other research showed that low-income and uninsured adults are less likely to be up-to-date with preventive care (Collins, Doty, Robertson, & Garber, 2011). They are less likely to use private physicians or health maintenance organizations (HMOs) and generally receive poorer healthcare services (Ku & Matani, 2001). Therefore, the perception of socioeconomic or financial status, including income and health insurance, could account for some of the differences in health studies of racial/ethnic minority populations

Many native Americans do not know how to access all available services due to the complexity of the American healthcare system. For immigrant populations their experiences can be further aggravated by attitudes towards the healthcare system based

on cultural beliefs. In the 1980s a large number of Vietnamese refugees who arrived in the U.S. reported understanding the American health system as a "crisis-oriented system of care" (Hoang & Erickson, 1982; Lee, 2003) because they were not familiar with the concept of having regularly-scheduled medical appointments and preventive care. Lee (2003) has recently found that among foreign-born Asian women, and especially among foreign-born Vietnamese women, such cultural misunderstandings about the American health system were apparent. The women believed that health problems are by nature an urgent matter and as such the emergency facility (ER) would be the logical place to go for their immediate medical needs. Therefore, not only the complexity of the system itself but also the cultural belief system regarding health, illness, and treatments acts as barriers to seeking medical care and the type of medical care receive.

Asians who typically hold culturally-rooted health beliefs and practices may not seek out westernized health screening and medicine and will likely use it only as the last resort if traditional practices fail (Houston, Harada, & Makinodan, 2002; Houston & Venkatesth, 1996; Jin, Slomka, & Blixen, 2002). Their traditional belief is that diseases is caused by an imbalance of the humoral forces of yin and yang, and they prefer to visit Chinese herbalists, acupuncturists, sorcerers, fortune-tellers and use herbal medicines and indigenous practices (McPhee, 2002; Houston et al., 2002). Previous research has shown that a lower level of acculturation is related to the use of complementary and alternative medicine (CAM) in minority populations (Buchwald, Beal, & Manson, 2000; Pachter, 1994; Schoenberg, Stoller, Kart, Perzynski, & Chapleski, 2004). Less acculturated Chinese and Vietnamese Americans are more likely to use CAM than those who are more acculturated (Ahn et al. 2006). On the other hand, people who hold positive attitudes

towards western healthcare systems and believe that it can respond to their needs use more western medical care services (Boon et al., 2000).

Two studies, Jayne & Ranklin (2001) and Renfrew and colleagues (2013) that examined diabetes knowledge and diabetes management within specific sub-groups revealed that minority ethnic immigrant groups typically relied on a situational understanding of the medical problem. The seriousness of the problem and ways to deal with it were determined by such things as its impact on familial and social relationships. Other groups, in spite of knowledge, were very skeptical of interacting with western medical practices. For example, among a Cambodian American population, few adhered to a diabetes management plan in spite of having access to resources (Renfrew et al., 2013). Being unfamiliar with western medicine, the majority reported distrusting the healthcare system, medical/health procedures, and testing such as mammograms and x-rays. They would rather use traditional herbal remedies. Even when dealing with a serious medical condition like diabetes as many as one-third of Vietnamese Americans relied on herbal remedies and traditional healers to control their glucose levels ((Hughes, 2002)Chang, Wallis, & Tiralongo, 2007; Hoa, Phan, Thuan, & Ostenson, 2009; Mull, Nguyen, & Mull, 2001). Other studies revealed that there was also a heavy reliance of CAM among elderly Latino and other immigrant populations as well (Najm, Reinsh, Hoehler, & Tobis, 2002). Often, these patients would not tell their physicians. This would sometimes result in adverse interactions with prescribed medications and could actually make chronic conditions such as unstable blood glucose levels much worse (Mull et al., 2001; Office of Minority Health & Health Disparities, 2006; Yang, Chu, Lin, Chen, & Lin, 2001).

Theoretical Framework

Since first conceptualized in the 1960s, Andersen's Behavioral Model has been the most widely cited model in health services studies, and has evolved as evidence emerges regarding the interactions between the social environment, healthcare systems, user characteristics/behaviors, and health outcomes (Thind & Andersen, 2003; Weller et al., 2003; Coughlin, Long, & Kendall, 2002; Gelberg, et al., 2000; Andersen et al., 1995; Coulton & Frost, 1982). According to the latest revision of Andersen's Behavioral Model (Figure 1), health services utilization can be determined by three major components: predisposing, enabling, and need (Andersen, Davidson & Baumeister, 2007). An individual's decision to seek care can be affected by his or her predisposing characteristics, characteristics that are internal, essentially stable or unchanging (e.g. age, sex, education, and ethnicity); enabling conditions that support or inhibit his or her health access (e.g. income, insurance coverage, usual source of care); and, perceived or evaluated need provides immediate reason for a person to seek healthcare services (e.g. self-reported health status) (Andersen, 1995; Andersen et al., 2007; Babitsch, Gohl, & von Lengerke, 2012). These three components directly affect health behaviors (e.g. health practices, use of health services), and health behaviors affect population characteristics. The model includes contextual components as well as individual components. The characteristics of the contextual components are divided in much the same way that individual characteristics have usually been divided; characteristics made up of predisposing, enabling, and need factors for seeking health services. Recent revisions of the model have shifted from a focus on the individual component to a broader focus on

the combination of the individual, the healthcare system, and their relationships, which can be understood as a series of feedback loops (Andersen et al., 2007).

Among the most frequently examined need factors were self-reported chronic conditions such as diabetes (Babitsch et al., 2012). In the current study, the target population is a sample of foreign-born Vietnamese, Korean, Chinese and Latino adults who self-reported having type 2 diabetes. Using Andersen's Behavioral Model as a theoretical guide, this dissertation focuses specifically on the relationship between an individual's predisposing, enabling, and need factors on management of type 2 diabetes behaviors (Figure 2).

Predisposing factors. Literature on predisposing characteristics has consistently shown a relationship between age, education, marital status, gender, and health services use among ethnic minorities (Hochhausen, Le & Perry, 2011; Andersen et al., 2002; Nabalamba, 2007; Blackwell, Martinez, Gentleman, Sanmartin, & Berthelot, 2009; Jorm, Parslow, Christensen, & Jacomb, 2002; Babitsch et al., 2012). A study of a population of African Americans and Latinos in the US found that older participants (60 years and older) were much more likely than the younger participants (30 years and younger) to report visiting a physician for their medical condition (70% vs 58%) (Ani et al., 2008). Education was generally found to be significantly associated with health utilization with more education corresponding with more physician visits (Andersen et al., 2002; Hammond, Matthews, & Corbie-Smith, 2010; Jorm et al., 2002). Overall, women were found to use healthcare services at a considerably higher rate than men (Jorm et al., 2002; Dhingra, Zack, Strine, Pearson, & Balluz, 2010).

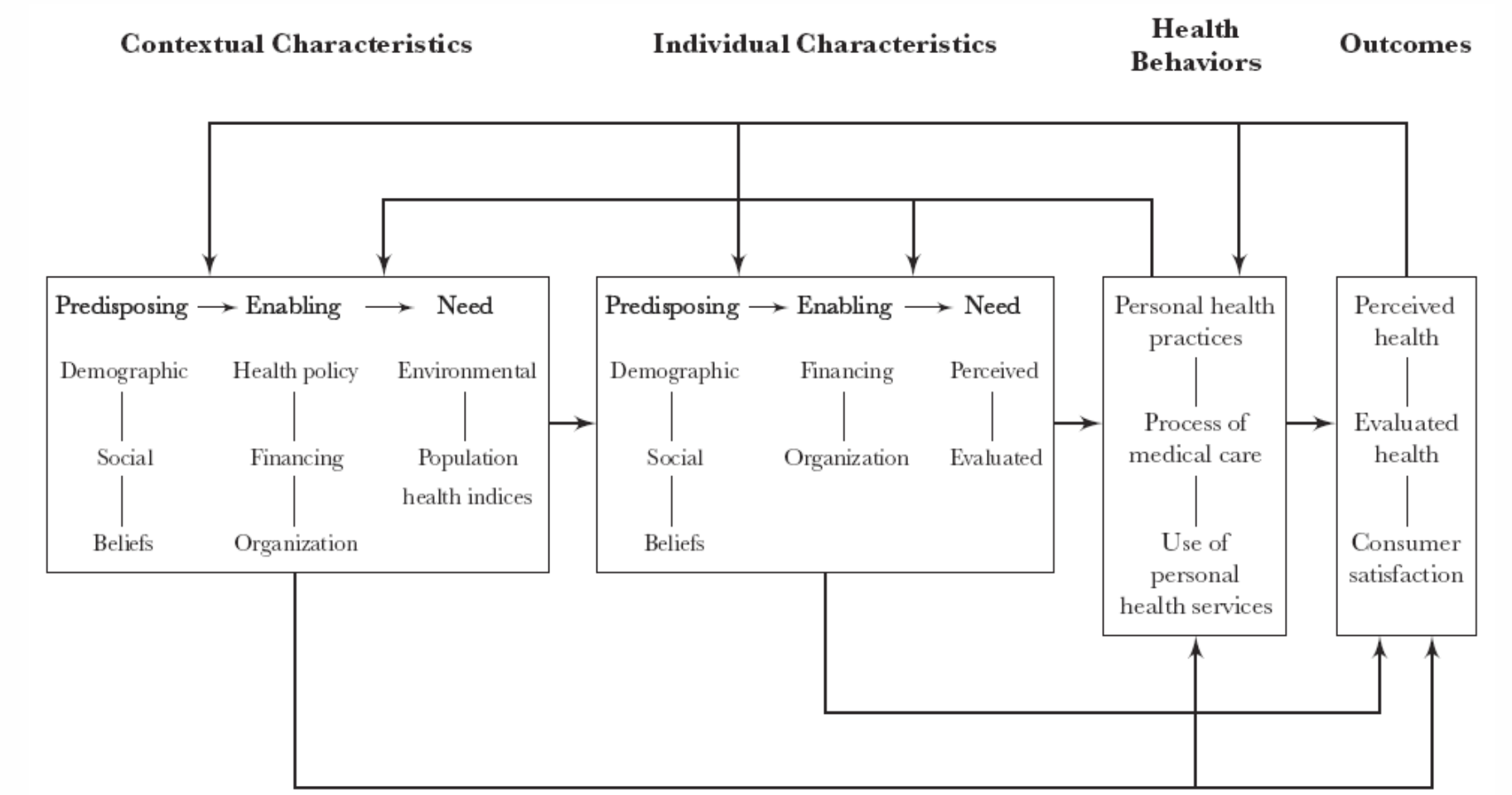

Figure 1. Andersen's Behavioral Model of Health Utilization (Andersen et al., 2007)

Marital status was also associated with health utilization although the direction of association differed among studies (Jorm et al., 2002; Insaf, Jurkowski, & Alomar, 2010). One study found that when compared to married couples, people who were widowed, divorced, or never married used mental health services more often while those who were currently married used them less often (Dhingra et al., 2010). A study involving recent Chinese immigrants in Canada found that unmarried women made fewer doctor visits for mental health problems than married women, whereas unmarried men made more visits than married men (Chen, Kazanjian, & Wong, 2008). Similarly, in the US, unmarried Latino women were more likely to delay routine healthcare than married women (Insaf et al., 2010).

Very few studies actually focused on specific Asian ethnic groups with the exception of Chinese immigrants, but even so health services component differed within this ethnic group. Literature on Chinese immigrants in Canada showed that their mental health use differed based on their geopolitical origins (Chen et al., 2008). Immigrants from Macau and Taiwan had the lowest rates of mental health visits to physician whereas those from mainland China and Hong Kong had a higher rate. These differences may stem from unidentified elements within Chinese sub-cultures. In addition, their length of time living in Canada was also associated with the increase rate of mental health visits across all gender and age groups. In this study ethnicity, age, sex, education, and marital status are used as predisposing factors.

Enabling factors. Enabling conditions are factors that support or enable individuals to obtain available health services; granted these services are located within geographic reach of the community in which an individual lives (Babitsch et al., 2012).

Thus, enabling factors extend far beyond the family resources (e.g. household income, health insurance, regular source of care). They include community-level health resources as well (e.g. health provider per capita, physician-patient ratio).

Enabling factors are consistently cited as predictors of health services use. According to Andersen's Behavioral Model, enabling factors involve primarily finance components that make it possible for individuals to obtain available healthcare services. The enabling factors most often studied are income, health insurance, and having a usual source of care or provider (Babitsch et al., 2012). Factors such as lower household income and lack of health insurance have been associated with under-utilization of healthcare resources as well as a lack of access (National Center for Health Statistics, 2012; Shi & Stevens, 2005). Those who are economically and socially disadvantaged, having no health insurance and a low income are significantly more likely to have medical problems that are not treated timely and effectively (Hanson, Neuman, & Voris, 2003; Coyle, Santiago, Shank, Ma, & Boyd, 2000; DeJong et al. 2002). Further, chronically ill patients, including diabetics, are often very sensitive to treatment costs associated with their conditions (Goldman et al., 2004; Solomon, 2005). These patients often cannot get prescriptions filled or other services necessary to comply with a physician's treatment regimen whereas those with better financial resources are more likely to seek treatment and comply with a physician's recommendation to treat even common health problems (Stuart & Grana, 1998). Along with financial resources and health insurance, having a usual source of care/provider is a key predictor of services use (Blackwell et al., 2009; Shi & Stevens, 2005; Smedley, Stith, & Nelson, 2002). Studies have shown that compared to those who have a regular doctor, those without were

significantly less likely to have contacted a physician during the previous year (Blackwell et al., 2009). A recent study revealed significant associations between having a usual health services place/provider and increased use of preventive and medical screening services (Blewett, Johnson, Lee, & Scal, 2008). Women with a usual place/provider were about four times more likely to receive clinical breast exam, Pap testing, and mammogram than those having neither. Similarly, men who had a usual source of care/provider were about ten times more likely to receive a Prostate-Specific Antigen (PSA) test than men who did not. Other studies showed that having medical insurance and a usual provider had additive effects for health utilization and may even contributed to better health outcomes (Phillips et al., 2004). In this study, insurance status, usual source of care, and income will be used as enabling variables to predict use of health services. In addition, citizenship and length of stay in the US will be considered as enabling factors and the argument will be set out in the following paragraphs.

Need Factors. Need factors include both perceived need and evaluated need for treatment; in other words, they are self-reported health and objective medical evaluations (Andersen et al., 2007). They provide "reasons" a person seeks healthcare, and in at least one study were among the determinants of emergency room use, and the main determinant for older patients (McCusker, Karp, Cardin, Durand, & Morin, 2003; Ponce, Hays, & Cunningham, 2006). Serious chronic health conditions such as heart disease, diabetes, and limitation in daily activities are among the most frequently seen need factors that have been linked with health use (Babitsch et al., 2012; Afilalo et al., 2004; Dhingra et al., 2010; Broyles, McAuley, & Baird-Holmes, 1999). In a later refinement of his model, Andersen discussed the nature of "need," stating that need factors are both a

social construction and a biological construction (Andersen et al., 2007). The social construction influences interpretation of symptoms. The biological construction is the reality. Andersen noted also that the biological construction cannot be totally separated from the social construction; the reality of the symptoms cannot be totally separated from the interpretation of that reality either. This study uses only the perceived health need to predict diabetes management behaviors.

The fact that Andersen's Behavioral Model has been around for so long attributes to its strengths. The model has answered questions and provided greater understanding of a broad spectrum of health behaviors in relation to specific health services and medical problems (e.g., long-term care, nursing homes, HIV, and dental care). For example, a systematic review conducted by Babitsch and colleagues (2012) found sixteen studies in which Andersen's Behavioral Model had been used extensively to explain healthcare access and health utilization. The model's strengths have been demonstrated also in its reliability in the study of health utilization, so researchers continue to use the same variables and rely on the same proxies in various studies. The usual predisposing variables examined have been age, gender/sex, education, and ethnicity; main enabling factors were income/financial situation, health insurance, and having a usual source of care/family doctor**;** and, finally, main need factors were perceived health or health status determined by medical exams.

However, researchers have sometimes classified predisposing and enabling variables differently and these differences demonstrate that certain variables can play more than one role in predicting health services use. For example, socioeconomic status has been used as both a predisposing characteristic and an enabling variable due to it

being associated with individual income and, at the same time, leverages access to healthcare. Age and sex have frequently been used as predisposing characteristics but, in different studies, have also been used as a need proxy for having a close ties with poor health (Chen et al., 2008; Babitsch et al., 2012). For these reasons, findings using age and sex as indicators of health use have shown inconsistencies.

Therefore, a key limitation of Andersen's Behavioral Model that is being addressed in this dissertation is its lack of critical attention to significant cultural factors: language proficiency, length of stay in the US, and citizenship are either ignored in the model or are combined with other predisposing factors (Portes, Kyles, & Eaton, 1992; Ponce et al., 2006; Chen et al., 2008). The concept of health acculturation considers having language proficiency, citizenship, and length of stay in the US as enabling factors to health services use. As stated earlier, health acculturation involves two related skill sets that serve as enabling factors to health utilization: (1) the ability to communicate with and understand healthcare providers, and (2) the knowledge of how to independently access healthcare services. Effective communication requires that all participants comprehend and understand the content of the communication with healthcare providers, not just the words and medical terms. This means cultural and linguistic comprehension as well as an understanding of Western medicine (Lee, 2003). For example, English is the primary language in the US, Great Britain and Singapore, but the healthcare systems are different and measures of English fluency do not necessarily translate to knowledge of the American healthcare system. An ethnic Chinese immigrant from Singapore, whose first language is English, may be just as mystified by the American healthcare system as an ethnic Chinese immigrant from China, who recently acquired English as a Second

Language (ESL). In addition, while self-reported English proficiency is commonly used to assess respondents' English ability, the item is likely influenced by reporting subjectivity and may present measurement issues if used as the only indicator (Lee, Nguyen, & Tsui, 2011). Other language variables such as language of interview and needing help to understand the physician will be taken into consideration in order to better understand a respondent's English and communication ability. The current study aims to illustrate a more comprehensive health acculturation scale than a mere assessment of English proficiency in understanding healthcare access among specific immigrant populations.

In addition, because an immigrant's ability to navigate the healthcare system is related to his/her ability to adapt well into the mainstream culture, variables such as length of stay in the US and citizenship are necessary indicators of knowledge to access care. This is embedded in the second major component argued in health acculturation. Successful navigation of the healthcare system assumes that one has been acculturated into the mainstream health culture, values, and norms. These provide knowledge needed to access healthcare. Studies have shown that the longer immigrants have been in the US, a proxy to adapting to its culture, the more they are able to access healthcare systems and use health services (Lebrun, 2012; Chen et al., 2008). For example, in a study of a diverse racial and ethnic population of immigrant women using "length of stay in the country and citizenship," and "English language proficiency" as variables, it was found that even without health insurance those who had a longer stay in the US (i.e. more than 10 years) were more likely to use health services than those who had been in the country for less than 10 years, and results were consistent for both Latino and Asian populations (Clough

et al., 2013). Keeping in mind that acquiring culture is implicit the following sections will discuss components of health acculturation using Andersen's Behavioral Model as a guide to understanding health services use among foreign-born populations.

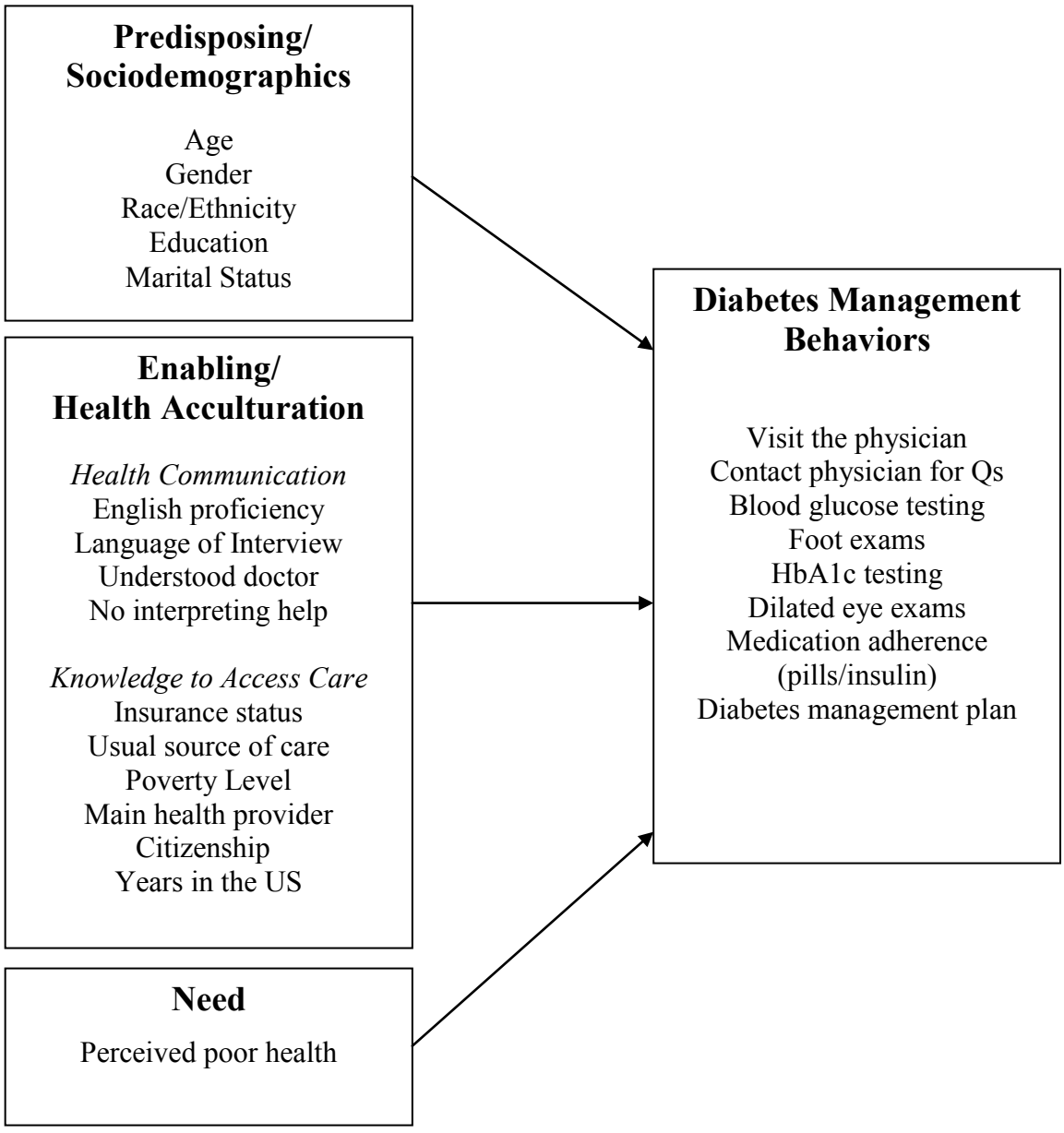

Figure 2. Adapted Andersen's Behavioral Model to Diabetes Management Behaviors

Research Rationale and Hypotheses

Although Andersen's Behavioral Model had been used to predict health utilization within immigrant populations such as Latino and Chinese, it had rarely been used in the U.S. to examine diabetes management in specific Asian populations. Despite different immigration patterns, demography, language and culture Asians tend to be aggregated. Health research on Asians in the U.S. needs to specifically study Chinese, Korean, and Vietnamese populations in order to better understand health acculturation as it relates to care utilization in the specific groups. This dissertation will compare diabetes management among Vietnamese, Korean and Chinese adult immigrants in the US. To gain perspective, this dissertation will also compare these populations with the Latino population, which has been the focus of numerous studies using Andersen's Behavioral Model.

Chapter III. Methods

Dataset

The 2009 and 2011-2012 California Health Interview Survey (CHIS) data were used in this study (CHIS, 2011, 2013). The CHIS data collection cycle has been conducted every other year since 2001 and is one of the largest population-based telephone health surveys in the nation. Beginning in 2012, CHIS transitioned to a continuous survey model and an annual release of data.

CHIS employs a Random Digit Dialing (RDD) method to select and interview adults aged 18 years or older in each randomly sampled household. CHIS used both cell phone and landline lists to select sampled households. In order to increase representatives of race and ethnic subgroups, CHIS employed both disproportional stratified sampling and multiple frame sampling methods. The CHIS adult data is unique among health surveys in that it includes a rich and diverse sample of individuals from different racial, ethnic and linguistic backgrounds. Interviews were conducted in five languages: English, Spanish, Chinese (Mandarin and Cantonese dialects), Vietnamese, and Korean. Interviews in all languages were administered using Westat's computer-assisted telephone interviewing (CATI) system. A detailed description and discussion of CHIS sampling methods can be found on the CHIS website.

Sample

The selected sample included 1,576 foreign-born adults aged 18 to 85 with type 2 diabetes (108 Chinese, 192 Korean, 149 Vietnamese, and 1,127 Latino). In multiple regression listwise deletion was used to handle missing data. The Korean and Latinos had more female respondents (Korean: 59.90%, Latino: 57.94%) and the Vietnamese and

Chinese had more male respondents (Vietnamese: 63.09%, Chinese: 56.48%). The majority of Chinese and Korean respondents had a college education or higher (Chinese: 62.96%, Korean: 55.21%) whereas most Vietnamese and Latino respondents had only a high school education or less (Vietnamese: 55.70 %, Latino: 79.77%). Most Chinese, Korean, and Vietnamese were aged 65 years or older (Chinese: 59.26 %, Korean: 71.35 %, Vietnamese: 48.99%) while most Latinos were aged from 44 to 64 years old (Latino= 54.92%). Finally, the majority of respondents from all four ethnic groups were married or living with a partner (Chinese: 65.22%, Korean: 53.13%, Vietnamese: 76.47%, Latino: 64.67%).

Measures

Predisposing/Socio-demographics. Age was coded 2 for respondents who were aged 65 and older, 1 for 44 to 64, and 0 for those who aged 18 to 44. Sex was coded 1 for male and 2 for female. Race/ethnicity was coded 1 for Latino, 2 for Chinese, 3 for Korean, and 4 for Vietnamese respondents. Education was coded 1 for college and higher and 0 for high school or less. Marital status was coded 1 for currently married or living with a partner and 0 for other groups.

Enabling/Health Acculturation. The measure of Health Acculturation was created by summing ten items measuring respondents' ability to communicate with and understand healthcare providers and their knowledge to access healthcare (see Table 1). The total score for the items ranged from 0 to 10 with a higher score indicating a higher level of health acculturation skills. In order to provide a more meaningful interpretation of the interaction effect, this variable is again recoded into binary categories with 0 for low level of health acculturation skills and 1 for high level of health acculturation skills.

Reliability analysis revealed that items in Health Acculturation have good reliability (*kr20* = 0.71) (Kuder & Richardson, 1937).

The following four items in the measure Health Acculturation tapped into an important dimension of health communication, specifically the ability to communicate with health providers to access care and utilization. These items were language proficiency, language of interview, the ability to understand the physician at the last visit, and whether or not respondents needed help to understand the physician at the last visit. Self-reported English proficiency was originally a 4-point Likert scale but, for this study, was coded 1 for speaking English only or very well and 0 for speaking English poorly or not at all. Self-reported language of interview was coded as 1 for English and 0 for other language(s). Ability to understand the physician was coded 1 for Yes and 0 for No. Finally, the ability to independently understand the physician without needing someone's help was coded 1 for No (they did not need help) and 0 for Yes (they needed help).

In addition, the following six items in the Health Acculturation Scale tapped into respondents' knowledge to access healthcare. These items include having health insurance coverage, a usual source of care (USC), income status, a main medical-care provider, years in the US, and citizenship. Health insurance coverage was coded 1 for respondents who are currently insured and 0 for those who are not insured. Respondents whose USC was at a doctor's office/HMO/ Kaiser, community/government clinic, or community hospital were coded 1 for having a USC. Those whose USC was at the emergency room, no particular place, or some other place were coded 0. Poverty level was coded 1 for above the 200% federal poverty line and 0 for below the 200% federal poverty line. Having a main medical-care provider was coded 1 for Yes and 0 for No.

Years in the US was coded 1 for 15 or more years and 0 for less than 15 years. Citizenship was coded 1 for Yes and 0 for No.

Need factor. Perceived poor health was coded as 1 for poor health and 0 for excellent, very good, good or fair health condition.

Dependent variables. The number of physician visits was measured by the number of times respondents reported having visited their physician during the past year. Contacting the physician with medical questions in the past year was coded 1 for Yes and 0 for No. Blood glucose testing was measured by the number of times respondents reported checking glucose/sugar per month. Foot exam was also measured by the number of times the physician checked respondents' feet for sores in the past year. Hemoglobin A1c (hbA1c) testing in the past year was coded 1 for at least twice and 0 for not checked or checked only once. Dilated eye exams were coded 1 for within the past year and 0 for more than a year ago. Taking pills to manage diabetes was coded 1 for Yes and 0 for No. Taking insulin to manage diabetes was coded 1 for Yes and 0 for No. Finally, having a medical provider-developed diabetes management plan was coded 1 for Yes and 0 for No.

Statistical Analyses

A series of multiple and logistic regression analysis of diabetes management behaviors were performed to determine the utility of the Health Acculturation Scale. To adjust for complex survey designs, the following syntax was used for weighted data: *svyset [pw=rakedw0], jkrw(rakedw1-rakedw80, multiplier(1) vce(jack)mse* (CHIS, 2009; 2011-2). The *testparm* procedure was used to confirm the overall interaction effect of health acculturation and ethnicity on diabetes management behaviors. The predictive

margins, margin r and *marginsplot* procedures were used to provide a more meaningful interpretation of the interaction effect than results from OLS regression.

Chapter IV: Findings

Relationship between health acculturation and healthcare utilization

Results from multiple regressions show that health acculturation (HA) significantly predicts the number of physician visits in the past year, controlling for all other sociodemographic and perceived poor health variables. The results in Table 2 (Model 1) support H1a in that HA significantly predicts the number of physician visits (b = 1.04, 95% CI: 0.52, 1.56, p< 0.001).

Results from Table 2 (Model 2) show both the main and adjusted interaction effect of HA and ethnicity significantly predict the number of physician visits in the past year (F (13, 67) = 5.59, p<0.001). The test for the interaction effect of HA and ethnicity, is statistically significant, controlling for covariates. It supports H1b in that levels of HA in the number of physician visits are dependent on ethnic differences. The Adjusted Wald test also confirms that the overall interaction of HA and ethnicity is statistically significant (F (7, 73) = 4.24, p<.001). To further explain the interaction effect of HA and ethnicity, a series of pair-group comparisons was performed for the mean number of physician visits for each group of HA and ethnicity. While HA significantly predicts the number of physician visits in the past year, the result is significantly on for Latinos and Koreans—not Chinese and Vietnamese. Table 3 shows that among Latinos and Koreans, respondents with high HA had a significantly greater predictive mean margin of physician visits than those with low HA (Latino: Predictive mean = 1.05, 95%CI: 0.48, 1.62, p < 0.001; Korean: Predictive mean = 2.28, 95%CI: 0.86, 3.69, p < 0.01).

Relationship between health acculturation and physician contact for medical Qs

Table 4 (Model 1) shows HA is significantly associated with physician contact for medical questions in the past year, controlling for sociodemographics and perceived poor health (OR = 5.13, 95% CI: 3.02, 8.69, $p< 0.001$). Results provide support for H2a, such that those with high HA are more likely to contact their physician for questions in the past year than those with low HA.

Table 4 (Model 2) shows the adjusted main and interaction effects of HA and ethnicity with the number of times one contacted their physician in the past year are statistically significant (F (13, 67) = 8.70, $p<0.001$). The test for the interaction effect of HA and ethnicity is statistically significant, thus providing support for H2b. The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant (F (7, 73) = 5.39, $p<.001$). To tease out the interaction effects, Table 5 shows that among Latinos, those with high HA had a significantly greater predictive probability of contacting their physician for medical questions than those with low HA (Latino: Predictive probability = 0.22, 95%CI: 0.15, 0.29, $p < 0.001$). Results are similar for the Korean and Vietnamese respondents with high HA (Korean: Predictive probability = 0.30, 95%CI: 0.06, 0.55, $p < 0.05$; Vietnamese: Predictive probability = 0.26, 95%CI: 0.01, 0.51, $p < 0.05$).

Relationship between health acculturation and blood glucose testing

Table 6 (Model 1) shows 6 indicators in the multiple regression model that significantly predict the number of blood glucose testing per month (F (10, 70) = 11.03, $p<0.001$). Health acculturation was found to have a significant effect on the number of

blood glucose testing per month, controlling for sociodemographic and perceived health variables (b = 7.55, 95% CI: 2.64, 12.47, p< 0.01). Results provide support for H3a.

Table 6 (Model 2) shows that the main and adjusted interaction effects of HA and ethnicity with the number of blood glucose testing per month are statistically significant (F (13, 67) = 8.87, p<0.001). The test of the interaction effects of HA and ethnicity, controlling for covariates, are statistically significant, thus providing support for H3b. The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant *(F* (7, 73) = 16.06, p<.001). Table 7 shows that within the Latino group, those with high HA had a greater predictive mean margin of blood glucose testing per month than those with low HA (b = 8.27, 95% CI: 3.37, 13.17, p< 0.01). Between group comparisons found significant ethnic differences in the level of HA. For high HA, Koreans had a significantly lower predictive mean margin of about 22 times per month than Latinos (Predictive mean = -22.11, 95%CI: -29.46, -14.76, p< 0.001). Findings were similar for those with low HA. Compared to Latinos, Koreans had a significantly lower predictive mean margin of 19 times testing for blood glucose per month (Predictive mean = -19.19, 95%CI: -26.32, -12.05, p<0.001). Figure 3 illustrates that Latinos with high HA had significantly greater predictive mean margin of blood glucose testing per month than their counterparts, regardless of the levels of HA, although Latinos with low HA performed more blood glucose testing. Koreans had a slightly more blood glucose testing at high HA but they had the overall lowest number of all ethnic groups.

Relationship between health acculturation and foot exams

Table 8 (Model 1) shows 6 indicators in the multiple regression model that significantly predict the number of foot exams (for sores) in the past year (F (10, 70) =

5.56, p<0.001). Controlling for covariates, age, sex and perceived poor health significantly predict the number of foot exams in the past year (age 44-64: b = 0.70, 95% CI: 0.14, 1.25, p< 0.05; age 65>: b = 1.01, 95% CI: 0.39, 1.63, p< 0.01; sex: b = -0.49, 95% CI: -0.92, -0.06, p< 0.05; perceived poor health: b = 0.73, 95% CI: 0.10, 1.36, p< 0.05). Ethnic differences also exist in predicting the number of foot exams in the past year: Compared to Latinos, both the Chinese and Koreans had less number of foot exams in the past year (Chinese: b = -1.03, 95% CI: -1.85, -0.22, p< 0.05; Korean: b = -2.00, 95% CI: -2.58, -1.41, p< 0.001). However, HA did not significantly predict the number of foot exams in the past year, controlling for covariates (b = 0.03, 95% CI: -0.42, 0.49, p> 0.05).

Table 8 (Model 2) shows that the main and adjusted interaction effects of HA and ethnicity with the number of foot exams in the past year are statistically significant (F (13, 67) = 7.20, p<0.001). Results support H4b in that the test of the interaction effects for HA and ethnicity, controlling for covariates, is significant. The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant *(F (7, 73)* = 10.56, p<.001). Table 9 shows that within the Chinese group, those with high HA had a greater predictive mean margin of foot exams in past year than those with low HA (b = 1.59, 95% CI: 0.49, 2.69, p< 0.01). Figure 4 illustrates the between groups differences, showing among those with low HA Chinese had a lower predictive mean margin of foot exams than Latinos in the past year (b = -2.40, 95% CI: -3.35, -1.44, p< 0.001). Similarly, Koreans with low HA had a lower predictive mean margin of foot exams than Latinos with low HA (b = -1.77, 95% CI: -3.00, -0.54, p< 0.01). Koreans

with high HA had also a lower predictive mean margin of foot exams than their Latino counterparts (*b* = -2.12, 95% CI: -2.66, -1.59, *p*< 0.001).

Relationship between health acculturation and hbA1c testing

Table 10 (Model 1) shows 5 indicators in the logistic model had significant associations with hbA1c testing (at least twice) in the past year (*F* (10, 70) = 5.80, *p*<0.01). Results support H5a. Those with high HA had a significantly higher likelihood of testing for hbA1c at least twice in the past year than those with low HA (*OR* = 2.40, 95% CI: 1.67, 3.44, *p*< 0.001).

Table 10 (Model 2) shows the main and adjusted interaction effects of HA and ethnicity with hbA1c testing in the past year are statistically significant (*F* (13, 67) = 6.01, *p*<0.001). Results support H5b, such that the test for the interaction of HA and ethnic is significant, controlling for covariates. The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant (*F* (7, 73) = 8.70, *p*<.001). Table 11 shows that within the Latino and Korean groups, those with high HA had a significantly greater predictive probability of hbA1c testing (at least twice) in the past year than their counterparts with low HA (Latino: Predictive probability = 0.20, 95%CI: 0.11, 0.29, *p*<0.001; Korean: Predictive probability = 0.32, 95%CI: 0.13, 0.50, *p*<0.001). Figure 5 illustrates between group differences. Among those with high HA, Koreans had a significantly lower predictive probability of hbA1c testing in past year than Latinos (Predictive probability = -0.18, 95%CI: -0.32, -0.03, *p*<0.05). Similarly, Koreans with low HA had a significantly lower predictive probability of hbA1c testing in the past year than Latinos (Predictive probability = -0.24, 95%CI: -0.34, -0.14, *p*<0.001).

In contrast, Vietnamese with low HA had a significantly greater predictive probability of hbA1c testing than Latinos (Predictive mean = 0.55, 95%CI: 0.33, 0.78, p<0.001).

Relationship between health acculturation and dilated eye exams

Table 12 (Model 1) shows that those with high HA had a significantly higher likelihood of having dilated eye exams in the past year, controlling for sociodemographics and perceived poor health (OR = 1.66, 95% CI: 1.10, 2.49, p< 0.05). Results provided support for H6a.

Table 12 (Model 2) provides support for H6b in that the test for the interaction effect of HA and ethnicity is significant, controlling for covariates. Both the main and adjusted interaction effects of HA and ethnicity with having dilated eye exams in the past year are statistically significant (F (13, 67) = 2.33, p<0.001). The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant (F (7, 73) = 3.19, p<.01). Table 13 shows that within the Latino group, those with high HA had a significantly greater predictive probability of having dilated eye exams in the past year than those with low HA (Predictive probability = 0.10, 95%CI: 0.00, 0.20, p<0.05). Figure 7 shows among those with low HA, Koreans had a significantly greater predictive probability of having dilated eye exam in the past year than Latinos (Predictive probability = 0.42, 95%CI: -0.66, -0.19, p<0.001). Koreans with high HA, however, had a significantly lower predictive probability of having dilated eye exams in the past year than Latinos (Predictive probability = -0.28, 95%CI: -0.43, -0.13, p<0.001).

Relationship between health acculturation and diabetes medication adherence

Diabetes pills. Table 14 (Model 1) shows that those with high HA had a significantly higher likelihood of taking diabetes pills, controlling for sociodemographics

and perceived poor health (*OR* = 1.81, 95% CI: 1.12, 2.93, $p < 0.05$). Results provide support for H7.1a.

Table 14 (Model 2) shows that the main and adjusted interaction effects of HA and ethnicity with taking diabetes pills in the past year were statistically significant (F (13, 67) = 4.03, $p<0.001$). Results support H7.1b. The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant (F (7, 73) = 4.45, $p<.001$). Table 15 shows that within the Latino group, those with high HA had a significantly greater predictive probability of taking diabetes pills than those with low HA (Latino: Predictive probability = 0.11, 95%CI: 0.01, 0.20, $p<0.05$). Also, within the Korean group, those with high HA had a significantly greater predictive probability of taking diabetes pills than those with low HA (Predictive probability = 0.41, 95%CI: 0.15, 0.67, $p<0.01$). Figure 8 illustrates the between group differences. Among those with low HA, Koreans had a significantly lower predictive probability of taking diabetes pills than Latinos (Predictive probability = -0.43, 95%CI: -0.70, -0.16, $p<0.01$). In contrast, Vietnamese with low HA had a significantly greater predictive probability of taking diabetes pills than Latinos (Predictive probability = 0.26, 95%CI: 0.09, 0.43, $p<0.01$).

Insulin. Table 16 (Model 1) shows that HA does not have a significant association with taking insulin, controlling for all other sociodemographics and perceived poor health (*OR* = 1.30, 95% CI: 0.84, 2.00, $p>0.05$).

Table 16 (Model 2) shows significant main and adjusted interaction effects in taking insulins to manage diabetes (F (13, 67) = 3.34, $p<0.001$), providing support for H7.2b. The Adjusted Wald test confirms that the overall interaction of HA and ethnicity is statistically significant (F (7, 73) = 3.26, $p<.001$). Table 17 shows that within the

Chinese group, those with high HA had a significantly greater predictive probability of taking insulin than those with low HA (Predictive probability = 0.09, 95%CI: 0.01, 0.17, $p<0.05$). Figure 8 shows that among those with high HA, Koreans had a significantly lower predictive probability of taking insulin compared with Latinos (Predictive probability = -0.13, 95%CI: -0.19, -0.07, $p<0.001$). Among those with low HA, Chinese with low HA also had significant lower predictive probability of taking insulin than Latinos (Predictive probability = -0.11, 95%CI: -0.18, -0.04, $p<0.01$).

Relationship between health acculturation and diabetes management plan

Table 18 (Model 1) shows that those with high HA have a significantly higher likelihood of a provider-developed diabetes management plan, controlling for sociodemographics and perceived poor health (OR = 2.12, 95% CI: 1.45, 3.09, $p< 0.001$). Results provide support for H8a.

Table 18 (Model 2) shows that the main and adjusted interaction effects of the HAS and ethnicity with having a diabetes management plan developed by a medical provider are statistically significant (F (13, 67) = 6.43, $p<0.001$); support H8b. Adjusted Wald test also confirm that the overall interaction of HA and ethnicity is statistically significant *(*F (7, 73) = 9.94, $p<.001$). Table 19 shows that within the Latino group, those with high HA had a significantly greater predictive probability of having a provider-developed diabetes plan than those with low HA (Predictive probability = 0.16, 95%CI: 0.06, 0.25, $p<0.001$). Similar results were found within the Korean group (Predictive probability = 0.20, 95%CI: 0.03, 0.38, $p<0.05$). Figure 9 shows that Koreans with low HA had a significantly greater predictive probability of having a provider-developed diabetes plan than Latinos with low HA (Predictive probability = 0.01, 95%CI: -0.09,

1.00, $p<0.001$). Among those with high HA, Koreans also had a greater significantly predictive probability of having a provider-developed diabetes plan than Latinos (Predictive probability = 0.03, 95%CI: -0.15, 0.20, $p<0.001$).Vietnamese respondents with low HA had a significantly lower predictive probability of having a provider-developed diabetes management plan than Latinos (Predictive probability = -0.00, 95%CI: -0.13, 0.12, $p<0.01$).

Table 2. *Multiple regression models of the number of physician visits (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	b Coef. (S.E)	95% C.I.	Predictors	b Coef. (S.E)	95% C.I.
Health Acculturation (HA)	1.04 (0.26)***	0.52, 1.56	HA # Ethnicity		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	-0.37 (0.96)	-2.29, 1.54
Chinese	-0.60 (0.46)	-1.51, 0.31	Low HA # Korean	-1.34 (0.73)	-2.80, 0.12
Korean	-0.49 (0.35)	-1.19, 0.21	Low HA # Vietnamese	2.22 (1.65)	-1.07, 5.51
Vietnamese	0.25 (0.60)	-0.94, 1.43	High HA # Latino	1.05 (0.28)***	0.48, 1.62
			High HA # Chinese	0.43 (0.54)	-0.64, 1.50
			High HA # Korean	0.94 (0.33)**	0.28, 1.60
			High HA # Vietnamese	0.81 (0.46)	-0.10, 1.73
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	0.12 (0.31	-0.50, 0.75	44 to 64 years	0.14 (0.31)	-0.48, 0.77
65 and older	0.90 (0.33)**	0.23, 1.56	65 and older	0.85 (0.33)*	0.20, 1.50
Sex	0.13 (0.22)	-0.30, 0.56	Sex	0.10 (0.21)	-0.33, 0.52
Education	0.18 (0.23)	-0.28, 0.63	Education	0.17 (0.23)	-0.28, 0.63
Marital Status	-0.15 (0.22)	-0.60, 0.31	Marital Status	-0.20 (0.22)	-0.65, 0.24
Perceived Poor Health	0.93 (0.30)**	0.33, 1.54	Perceived Poor Health	0.93 (0.30)*	0.34, 1.52
Constant	3.15 (0.47)***	2.20, 4.09	Constant	3.23 (0.47)***	2.30, 4.17

a. $F\ (10, 70) = 6.56$, $p < 0.001$

b. $F\ (13, 67) = 5.59$, $p < 0.001$

c. Adjusted Wald test for Interaction: $F\ (7, 73) = 4.24$, $p < .001$

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

Table 3. *Predictive margins of health acculturation and ethnicity on the number of physician visits (n= 1574)*

	Margins (Predictive mean)	95% C.I
Interaction Effects		
Latino # Low HA	3.49 (0.25)***	2.99, 3.98
Latino # High HA	4.54 (0.20)***	4.14, 4.94
Chinese # Low HA	3.11 (0.90)**	1.32, 4.90
Chinese # High HA	3.92 (0.50)***	2.92, 4.92
Korean # Low HA	2.15 (0.73)**	0.70, 3.60
Korean # High HA	4.42 (0.34)***	3.74, 5.10
Vietnamese # Low HA	5.70 (1.65)**	2.42, 9.00
Vietnamese # High HA	4.30 (0.40) ***	3.50, 5.10
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	1.05 (0.28)***	0.48, 1.62
Chinese (High HA vs. Low HA)	0.81 (0.93)	-1.05, 2.67
Korean (High HA vs. Low HA)	2.28 (0.71)**	0.86, 3.69
Vietnamese (High HA vs. Low HA)	-1.40 (1.62)	-4.63, 1.82
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	-0.37 (0.96)	-2.29, 1.54
(Chinese vs. Latino) High HA	-0.62 (0.49)	-1.59, 0.35
(Korean vs. Latino) Low HA	-1.34 (0.73)	-2.80, 0.12
(Korean vs. Latino) High HA	-0.11 (3.28)	-0.77, 0.54
(Vietnamese vs. Latino) Low HA	2.22 (1.65)	-1.07, 5.51
(Vietnamese vs. Latino) High HA	-0.24 (0.41)	-1.05, 0.58

[a.] Contrast of predictive margins, *F*-test of significance

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

Table 4. *Logistic regression models of physician contact for medical questions (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	OR (S.E)	95% C.I.	Predictors	OR (S.E)	95% C.I.
Health Acculturation (HA)	5.13 (1.36)***	3.02, 8.69	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	1.80 (1.53)	0.33, 9.80
Chinese	0.55 (0.20)	0.27, 1.15	Low HA # Korean	1.15 (0.83)	0.27, 4.88
Korean	1.12 (0.43)	0.52, 2.42	Low HA # Vietnamese	0.94 (1.03)	0.10, 8.37
Vietnamese	1.02 (0.49)	0.39, 2.64	High HA # Latino	5.40 (1.60)***	2.99, 9.74
			High HA # Chinese	2.69 (1.07)	1.22, 5.95
			High HA # Korean	6.12 (2.92)***	2.37, 15.81
			High HA # Vietnamese	5.55 (3.07)**	1.85, 16.69
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	1.00 (0.30)	0.55, 1.80	44 to 64 years	0.99 (0.29)	0.55, 1.79
65 and older	0.70 (0.25)	0.35, 1.42	65 and older	0.69 (0.24)	0.34, 1.40
Sex	1.52 (0.40)	0.91, 2.56	Sex	1.52 (0.39)	0.91, 2.55
Education	4.06 (0.97)***	2.52, 6.52	Education	4.00 (0.95)***	0.55, 1.79
Marital Status	0.97 (0.23)	0.60, 1.57	Marital Status	0.98 (0.24)	0.60, 1.58
Perceived Poor Health	0.88 (0.27)	0.47, 1.63	Perceived Poor Health	0.85 (0.27)	0.45, 1.61
Constant	0.03 (0.02)***	0.01, 0.09	Constant	0.03 (0.02)***	0.01, 0.09

a. $F\ (10, 70) = 11.61$, $p < 0.001$

b. $F\ (13, 67) = 8.70$, $p < 0.001$

c. Adjusted Wald test for Interaction: $F\ (7, 73) = 5.39$, $p < .001$

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

Table 5. *Predictive margins of health acculturation and ethnicity on physician contact for medical questions (n= 1574)*

	Margins (Predictive probability)	95% C.I
Interaction Effects		
Latino # Low HA	0.09 (0.03)***	0.04, 0.14
Latino # High HA	0.32 (0.04)***	0.25, 0.39
Chinese # Low HA	0.15 (0.10)	-0.05, 0.35
Chinese # High HA	0.20 (0.06)***	0.09, 0.32
Korean # Low HA	0.10 (0.06)	-0.01, 0.22
Korean # High HA	0.35 (0.09)***	0.17, 0.52
Vietnamese # Low HA	0.09 (0.08)	-0.07, 2.24
Vietnamese # High HA	0.33 (0.10)**	0.14, 0.52
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.22 (0.03)***	0.15, 0.29
Chinese (High HA vs. Low HA)	0.07 (0.16)	-0.25, 0.38
Korean (High HA vs. Low HA)	0.30 (0.13)*	0.06, 0.55
Vietnamese (High HA vs. Low HA)	0.26 (0.13)*	0.01, 0.51
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	0.04 (0.08)	-0.11, 0.20
(Chinese vs. Latino) High HA	-0.13 (0.07)	-0.27, 0.01
(Korean vs. Latino) Low HA	0.01 (0.05)	-0.09, 0.10
(Korean vs. Latino) High HA	0.03 (0.09)	-0.15, 0.20
(Vietnamese vs. Latino) Low HA	-0.00 (0.06)	-0.13, 0.12
(Vietnamese vs. Latino) High HA	0.00 (0.10)	-0.19, 0.21

[a.] Contrast of predictive margins, Chi-test of significance

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

Table 6. *Multiple regression models of blood glucose testing (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	b Coef. (S.E)	95% C.I.	Predictors	b Coef. (S.E)	95% C.I.
Health Acculturation (HA)	7.55 (2.47)**	2.64, 12.47	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	-10.48 (7.09)	-24.59, 3.62
Chinese	-11.01 (5.48)*	-21.91, -0.11	Low HA # Korean	-19.19 (3.59)***	-26.32, -12.05
Korean	-21.16 (2.86)***	-26.85, -15.47	Low HA # Vietnamese	31.52 (33.84)	-35.84, 98.89
Vietnamese	10.41 (7.27)	-4.05, 24.88	High HA # Latino	8.27 (2.46)**	3.37, 13.17
			High HA # Chinese	-3.00 (6.60)	-16.14, 10.13
			High HA # Korean	-13.84 (4.48)**	-22.76, -4.92
			High HA # Vietnamese	13.10 (6.03)*	1.09, 25.11
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	2.56 (3.26)	-3.93, 9.05	44 to 64 years	2.48 (3.26)	-4.00, 8.97
65 and older	4.39 (3.53)	-2.63, 11.42	65 and older	3.99 (3.44)	-2.85, 10.84
Sex	5.62 (2.70)*	0.25, 10.98	Sex	5.33 (2.64)*	0.07, 10.58
Education	6.43 (3.14)*	0.17, 12.69	Education	6.61 (3.12)*	0.40, 12.82
Marital Status	0.02 (2.52)	-4.99, 5.03	Marital Status	-0.13 (2.55)	-5.21, 4.95
Perceived Poor Health	12.25 (3.27)***	5.73, 18.77	Perceived Poor Health	12.49 (3.26)***	6.00, 18.98
Constant	9.64 (5.30)	-0.91, 20.20	Constant	9.86 (5.30)	-0.70, 20.41

a. F (10, 70) = 11.03, p<0.001
b. F (13, 67) = 8.87, p<0.001
c. Adjusted Wald test for Interaction: F (7, 73) = 16.06, p<.001
*p< 0.05, **p<0.01, *** p < 0.001

Table 7. *Predictive margins of health acculturation and ethnicity on blood glucose testing (n= 1574)*

	Margins (Predictive mean)	95% C.I
Interaction Effects		
Latino # Low HA	22.11 (2.39)***	17.35, 26.88
Latino # High HA	30.38 (2.22)***	25.97, 34.79
Chinese # Low HA	11.63 (7.09)	-2.49, 25.74
Chinese # High HA	19.11 (6.03)**	7.10, 31.12
Korean # Low HA	2.93 (3.62)	-4.28, 10.13
Korean # High HA	8.27 (4.07)*	0.16, 16.38
Vietnamese # Low HA	53.64 (34.12)	-14.28, 121.55
Vietnamese # High HA	35.21 (6.10)***	23.07, 47.36
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	8.27 (2.46)**	3.37, 13.17
Chinese (High HA vs. Low HA)	7.48 (8.16)	-8.75, 23.72
Korean (High HA vs. Low HA)	5.34 (4.78)	-4.17, 14.86
Vietnamese (High HA vs. Low HA)	-18.42 (35.27)	-88.62, 51.78
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	-10.48 (7.09)	-24.59, 3.62
(Chinese vs. Latino) High HA	-11.27 (6.05)	-23.31, 0.77
(Korean vs. Latino) Low HA	-19.19 (3.58)***	-26.32, -12.05
(Korean vs. Latino) High HA	-22.11 (3.69)***	-29.46, -14.76
(Vietnamese vs. Latino) Low HA	31.52 (33.84)	-35.84, 98.88
(Vietnamese vs. Latino) High HA	4.83 (5.93)	-6.97, 16.63

[a.] Contrast of predictive margins, *F*-test of significance

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

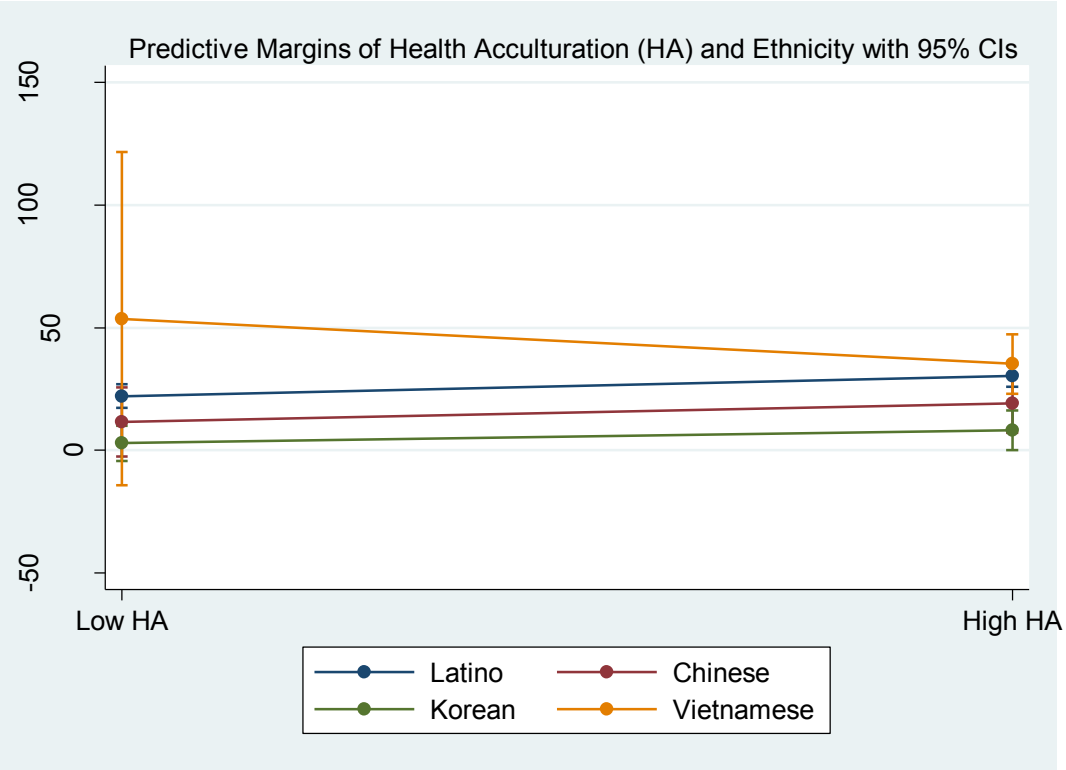

Figure 3. Predictive Margins of Health Acculturation and Blood Glucose Testing with 95% CIs

Table 8. *Multiple regression models of foot exams (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	b Coef. (S.E)	95% C.I.	Predictors	b Coef. (S.E)	95% C.I.
Health Acculturation (HA)	0.03 (0.23)	-0.42, 0.49	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	-2.40 (0.48)***	-3.35, -1.44
Chinese	-1.03 (0.41)*	-1.85, -0.22	Low HA # Korean	-1.77 (0.62)**	-3.00, -0.54
Korean	-2.00 (0.29)***	-2.58, -1.41	Low HA # Vietnamese	0.89 (1.09)	-1.27, 3.05
Vietnamese	-0.26 (0.45)	-1.15, 0.63	High HA # Latino	0.02 (0.25)	-0.48, 0.53
			High HA # Chinese	-0.80 (0.50)	-1.80, 0.19
			High HA # Korean	-2.10 (0.37)***	-2.84, -1.37
			High HA # Vietnamese	-0.55 (0.56)	-1.67, 0.56
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	0.70 (0.28)*	0.14, 1.25	44 to 64 years	0.70 (0.28)*	0.13, 1.26
65 and older	1.01 (0.31)**	0.39, 1.63	65 and older	1.01 (0.31)**	0.39, 1.64
Sex	-0.49 (0.22)*	-0.92, -0.06	Sex	-0.50 (0.22)*	-0.93, -0.07
Education	0.20 (0.27)	-0.35, 0.74	Education	0.24 (0.27)	-0.31, 0.78
Marital Status	-0.18 (0.27)	-0.72, 0.36	Marital Status	-0.20 (0.27)	-0.74, 0.35
Perceived Poor Health	0.73 (0.32)*	0.10, 1.36	Perceived Poor Health	0.78 (0.32)*	0.15, 1.42
Constant	2.40 (0.44)***	1.51, 3.28	Constant	2.42 (0.46)***	1.50, 3.33

a. F (10, 70) = 5.56, p<0.001

b. F (13, 67) = 7.20, p<0.001

c. Adjusted Wald test for Interaction: F (7, 73) = 10.56, p<.001

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

Table 9. *Predictive margins of health acculturation and ethnicity on foot exams (n= 1574)*

	Margins (Predictive mean)	95% C.I
Interaction Effects		
Latino # Low HA	1.96 (0.22)***	1.53, 2.40
Latino # High HA	1.98 (0.18)***	1.63, 2.34
Chinese # Low HA	-0.43 (0.41)	-1.25, 0.38
Chinese # High HA	1.16 (0.45)*	0.26, 2.06
Korean # Low HA	0.19 (0.58)	-0.97, 1.36
Korean # High HA	-0.14 (0.28)	-0.69, 0.41
Vietnamese # Low HA	2.85 (1.07)**	0.73, 4.97
Vietnamese # High HA	1.41 (0.50)**	0.40, 2.41
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.02 (0.25)	-0.48, 0.53
Chinese (High HA vs. Low HA)	1.59 (0.55)**	0.49, 2.69
Korean (High HA vs. Low HA)	-0.33 (0.55)	-1.42, 0.75
Vietnamese (High HA vs. Low HA)	-1.44 (1.22)	-3.87, 0.98
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	-2.40 (0.48)***	-3.35, -1.44
(Chinese vs. Latino) High HA	-0.82 (0.45)	-1.72, 0.07
(Korean vs. Latino) Low HA	-1.77 (0.62)**	-3.00, -0.54
(Korean vs. Latino) High HA	-2.12 (0.27)***	-2.66, -1.59
(Vietnamese vs. Latino) Low HA	0.89 (1.09)	-1.27, 3.05
(Vietnamese vs. Latino) High HA	-0.58 (0.48)	-1.52, 0.37

[a.] Contrast of predictive margins, *F*-test of significance

*$p < 0.05$, **$p<0.01$, *** $p < 0.0$

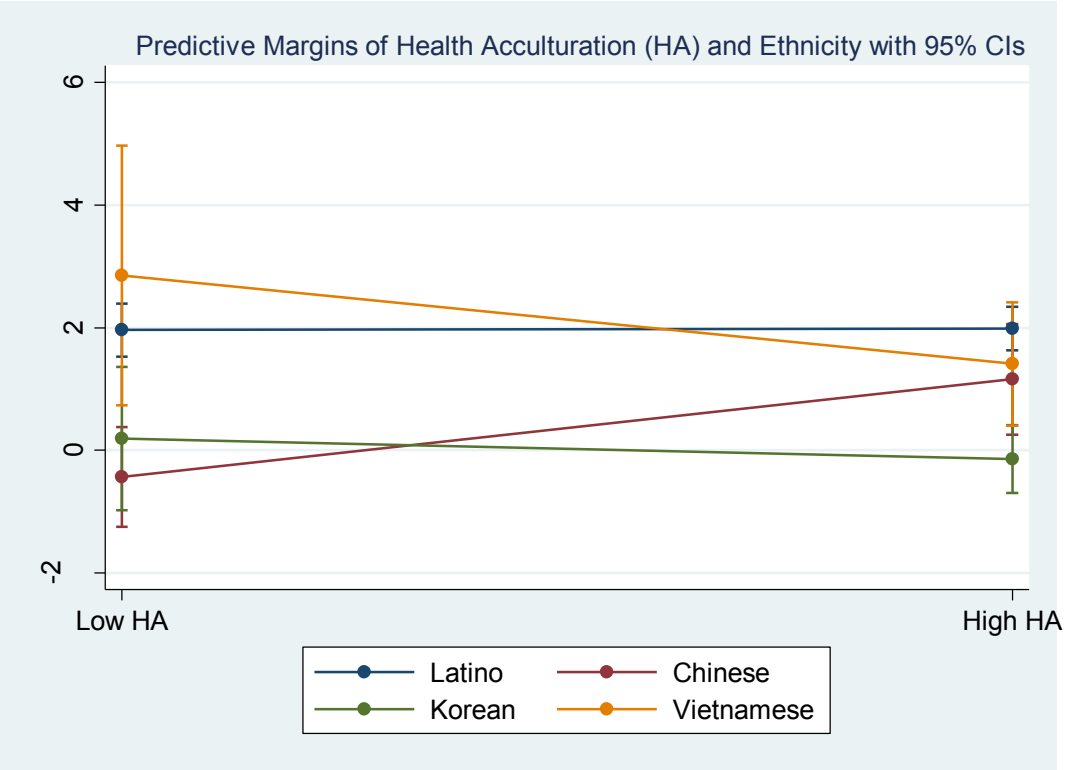

Figure 4. Predictive Margins of Health Acculturation and Foot Exams with 95% CIs

Table 10. *Logistic regression models of HbA1c testing (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	OR (S.E)	95% C.I.	Predictors	OR (S.E)	95% C.I.
Health Acculturation (HA)	2.40 (0.44)***	1.67, 3.44	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	0.58 (0.39)	0.15, 2.23
Chinese	0.91 (0.27)	0.50, 1.64	Low HA # Korean	0.18 (0.09)**	0.06, 0.49
Korean	0.40 (0.10)**	0.24, 0.67	Low HA # Vietnamese	15.34 (15.30)**	2.11, 111.75
Vietnamese	2.78 (1.34)*	1.06, 7.28	High HA # Latino	2.36 (0.46)***	1.60, 3.49
			High HA # Chinese	2.33 (0.91)*	1.08, 5.05
			High HA # Korean	1.13 (0.39)	0.57, 2.27
			High HA # Vietnamese	4.17 (1.91)**	1.68, 10.37
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	1.80 (0.50)*	1.04, 3.11	44 to 64 years	1.82 (0.51)*	1.05, 3.16
65 and older	1.74 (0.55)	0.93, 3.26	65 and older	1.71 (0.54)	0.91, 3.20
Sex	1.03 (0.21)	0.69, 1.56	Sex	1.02 (0.21)	0.67, 1.53
Education	1.71 (0.36)*	1.13, 2.60	Education	1.74 (0.36)**	1.15, 2.64
Marital Status	1.04 (0.20)	0.71, 1.52	Marital Status	1.00 (0.21)	0.67, 1.53
Perceived Poor Health	1.31 (0.30)	0.83, 2.06	Perceived Poor Health	1.33 (0.29)	0.86, 2.07
Constant	0.31 (0.15)*	0.12, 0.79	Constant	0.07 (0.04)*	0.02, 0.24

a. F (10, 70) = 5.80, $p < 0.01$

b. F (13, 67) = 6.01, $p < 0.001$

c. Adjusted Wald test for Interaction: F (7, 73) = 8.70, p<.001

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

Table 11. *Predictive margins of health acculturation and ethnicity on HbA1c testing (n= 1574)*

	Margins (Predictive probability)	95% C.I
Interaction Effects		
Latino # Low HA	0.35 (0.05)***	0.26, 0.45
Latino # High HA	0.55 (0.04)***	0.47, 0.64
Chinese # Low HA	0.24 (0.12)*	0.01, 0.48
Chinese # High HA	0.55 (0.09)***	0.38, 0.72
Korean # Low HA	0.09 (0.04)*	0.01, 0.17
Korean # High HA	0.38 (0.08)***	0.22, 0.53
Vietnamese # Low HA	0.88 (0.10)***	0.69, 1.08
Vietnamese # High HA	0.68 (0.09)***	0.50, 0.86
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.20 (0.04)***	0.11, 0.29
Chinese (High HA vs. Low HA)	0.32 (0.16)	0.00, 0.64
Korean (High HA vs. Low HA)	0.32 (0.09)***	0.13, 0.50
Vietnamese (High HA vs. Low HA)	-0.19 (0.12)	-0.42, 0.04
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	-0.10 (0.11)	-0.32, 0.12
(Chinese vs. Latino) High HA	0.00 (0.09)	-0.17, 0.16
(Korean vs. Latino) Low HA	-0.24 (0.05)***	-0.34, -0.14
(Korean vs. Latino) High HA	-0.18 (0.07)*	-0.32, -0.03
(Vietnamese vs. Latino) Low HA	0.55 (0.11)***	0.33, 0.78
(Vietnamese vs. Latino) High HA	0.13 (0.09)	-0.05, 0.31

[a.] Contrast of predictive margins, *Chi*-test of significance

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

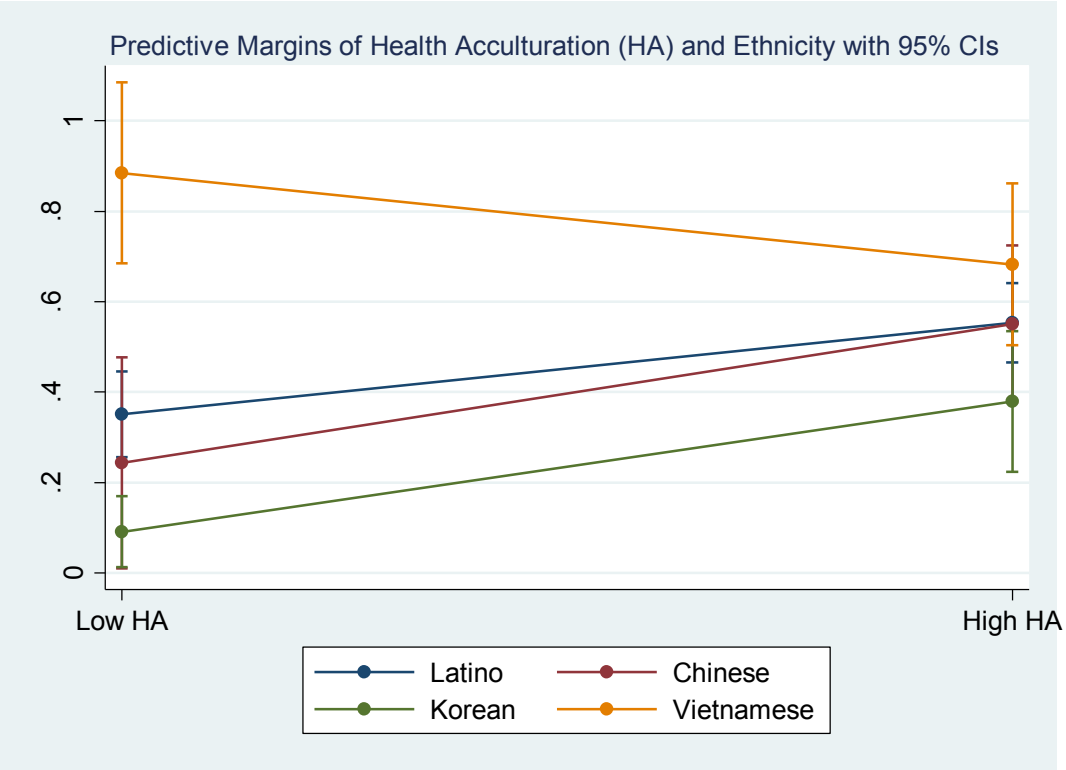

Figure 5. Predictive Margins of Health Acculturation and HbA1c Testing with 95% CIs

Table 12. *Logistic regression models of dilated eye exams (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	OR (S.E)	95% C.I.	Predictors	OR (S.E)	95% C.I.
Health Acculturation (HA)	1.66 (0.34)*	1.10, 2.49	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	0.46 (0.29)	0.13, 1.62
Chinese	0.50 (0.23)	0.20, 1.23	Low HA # Korean	0.14 (0.10)*	0.03, 0.63
Korean	0.23 (0.07)***	0.13, 0.42	Low HA # Vietnamese	1.38 (1.32)	0.21, 9.19
Vietnamese	1.06 (0.40)	0.51, 2.23	High HA # Latino	1.61 (0.36)	1.03 2.05
			High HA # Chinese	0.83 (0.45)	0.28, 2.43
			High HA # Korean	0.46 (0.16)*	0.23, 0.92
			High HA # Vietnamese	1.60 (0.67)	0.70, 3.67
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	1.27 (0.41)	0.66, 2.41	44 to 64 years	1.28 (0.41)	0.67, 2.43
65 and older	2.53 (0.98)*	1.17, 5.45	65 and older	2.51 (0.97)*	1.17, 5.41
Sex	0.84 (0.21)	0.51, 1.36	Sex	0.83 (0.20)	0.51, 1.36
Education	1.69 (0.40)*	1.05, 2.71	Education	1.68 (0.41)*	1.04, 2.72
Marital Status	1.52 (0.29)*	1.04, 2.23	Marital Status	1.49 (0.28)*	1.01, 2.17
Perceived Poor Health	1.18 (0.36)	0.64, 2.17	Perceived Poor Health	1.17 (0.36)	0.63, 2.17
Constant	1.24 (0.68)	0.41, 3.70	Constant	1.28 (0.71)	0.43, 3.83

a. F (10, 70) = 3.45, p<0.001

b. F (13, 67) = 2.33, p<0.001

c. Adjusted Wald test for Interaction: F (7, 73) = 3.19, p<.01

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

Table 13. *Predictive margins of health acculturation and ethnicity of dilated eye exams (n= 1574)*

	Margins (Predictive probability)	95% C.I
Interaction Effects		
Latino # Low HA	0.63 (0.06)***	0.53, 0.74
Latino # High HA	0.73 (0.04)***	0.65, 0.81
Chinese # Low HA	0.45 (0.15)**	0.15, 0.75
Chinese # High HA	0.59 (0.13)***	0.34, 0.84
Korean # Low HA	0.20 (0.12)	-0.03, 0.44
Korean # High HA	0.45 (0.09)***	0.27, 0.62
Vietnamese # Low HA	0.70 (0.19)***	0.32, 1.08
Vietnamese # High HA	0.73 (0.08)***	0.57, 0.89
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.10 (0.05)*	0.00, 0.20
Chinese (High HA vs. Low HA)	0.14 (0.16)	-0.18, 0.45
Korean (High HA vs. Low HA)	0.26 (0.15)	-0.04, 0.55
Vietnamese (High HA vs. Low HA)	0.03 (0.19)	-0.35, 0.40
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	-0.19 (0.15)	-0.48, 0.11
(Chinese vs. Latino) High HA	-0.14 (0.12)	-0.37, 0.09
(Korean vs. Latino) Low HA	0.42 (0.12)***	-0.66, -0.19
(Korean vs. Latino) High HA	-0.28 (0.08)***	-0.43, -0.13
(Vietnamese vs. Latino) Low HA	0.07 (0.20)	-0.33, 0.47
(Vietnamese vs. Latino) High HA	0.00 (0.07)	-0.14, 0.14

[a.] Contrast of predictive margins, *Chi*-test of significance

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

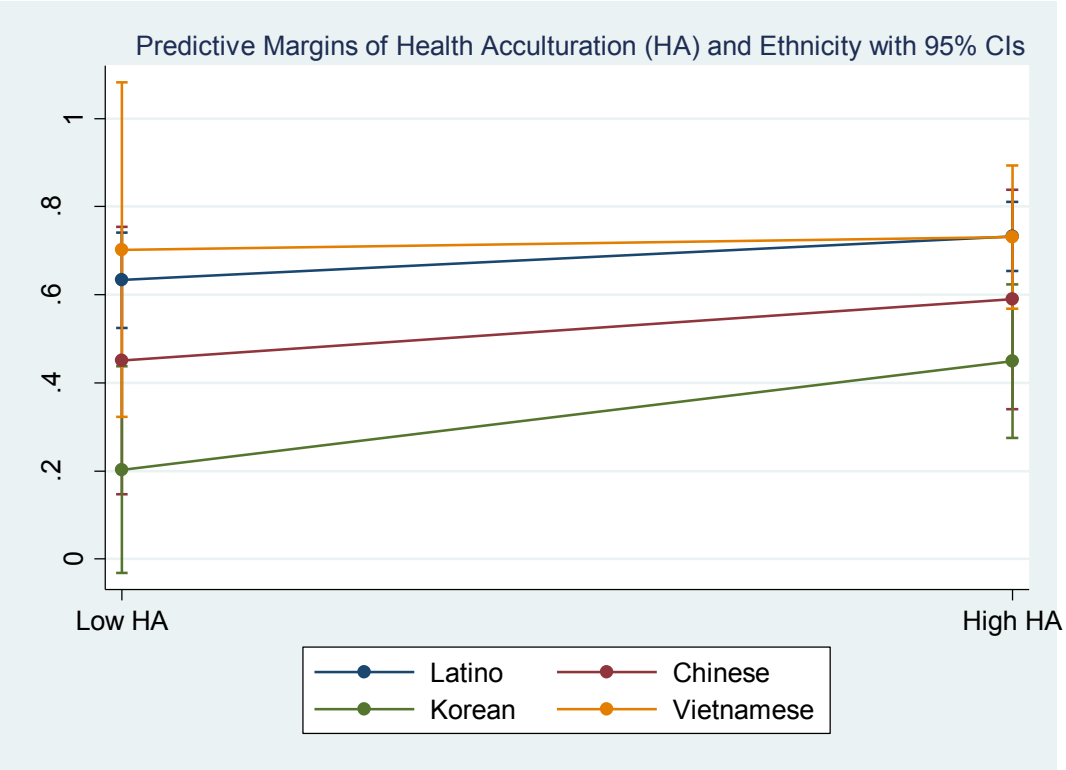

Figure 6. Predictive Margins of Health Acculturation and Dilated Eye Exams with 95% CIs

Table 14. *Logistic regression models of taking diabetes pills (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	*OR* (S.E)	95% C.I.	Predictors	*OR* (S.E)	95% C.I.
Health Acculturation (HA)	1.81 (0.44)*	1.12, 2.93	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	1.57 (1.57)	0.21, 11.52
Chinese	0.60 (0.26)	0.25, 1.44	Low HA # Korean	0.15 (0.12)*	0.03, 0.70
Korean	0.34 (0.12)**	0.17, 0.68	Low HA # Vietnamese	6.64 (7.70)*	0.66, 66.81
Vietnamese	1.11 (0.51)	0.45, 2.76	High HA # Latino	1.81 (0.49)	1.06, 3.11
			High HA # Chinese	0.97 (0.51)	0.34, 2.77
			High HA # Korean	0.97 (0.48)	0.36, 2.61
			High HA # Vietnamese	1.36 (0.60)	0.57, 3.29
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	1.91 (0.64)	0.98, 3.73	44 to 64 years	1.96 (0.67)	1.00, 3.85
65 and older	1.59 (0.57)	0.78, 3.24	65 and older	1.51 (0.55)	0.73, 3.11
Sex	0.66 (0.16)	0.42, 1.06	Sex	0.65 (0.15)	0.41, 1.03
Education	0.90 (0.23)	0.53, 1.51	Education	0.87 (0.22)	0.52, 1.46
Marital Status	1.43 (0.34)	0.90, 2.29	Marital Status	1.36 (0.33)	0.85, 2.20
Perceived Poor Health	1.90 (0.49)*	1.14, 3.18	Perceived Poor Health	1.82 (0.49)*	1.08, 3.10
Constant	2.49 (1.33)	0.86, 7.23	Constant	2.71 (1.42)	0.95, 7.71

a. F (10, 70) = 4.61, p<0.001

b. F (13, 67) = 4.03, p<0.001

c. Adjusted Wald test for Interaction: F (7, 73) = 4.45, p<.001

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

Table 15. *Predictive margins of health acculturation and ethnicity on taking diabetes pills (n= 1574)*

	Margins (Predictive probability)	95% C.I
Interaction Effects		
Latino # Low HA	0.66 (0.05)***	0.57, 0.76
Latino # High HA	0.78 (0.04)***	0.70, 0.86
Chinese # Low HA	0.75 (0.18)***	0.40, 1.11
Chinese # High HA	0.66 (0.10)***	0.45, 0.86
Korean # Low HA	0.24 (0.14)	-0.03, 0.51
Korean # High HA	0.66 (0.10)***	0.46, 0.85
Vietnamese # Low HA	0.93 (0.08)***	0.77, 1.08
Vietnamese # High HA	0.73 (0.09)***	0.56, 0.90
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.11 (0.05)*	0.01, 0.22
Chinese (High HA vs. Low HA)	-0.10 (0.20)	-0.49, 0.30
Korean (High HA vs. Low HA)	0.41 (0.13)**	0.15, 0.67
Vietnamese (High HA vs. Low HA)	-0.19 (0.11)	-0.40, 0.03
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	0.09 (0.18)	-0.26, 0.44
(Chinese vs. Latino) High HA	-0.12 (0.10)	-0.33, 0.08
(Korean vs. Latino) Low HA	-0.43 (0.14)**	-0.70, -0.16
(Korean vs. Latino) High HA	-0.12 (0.08)	-0.28, 0.04
(Vietnamese vs. Latino) Low HA	0.26 (0.09)**	0.09, 0.43
(Vietnamese vs. Latino) High HA	-0.05 (0.08)	-0.21, 0.11

[a.] Contrast of predictive margins, *Chi*-test of significance

*p< 0.05, **p<0.01, *** p < 0.00

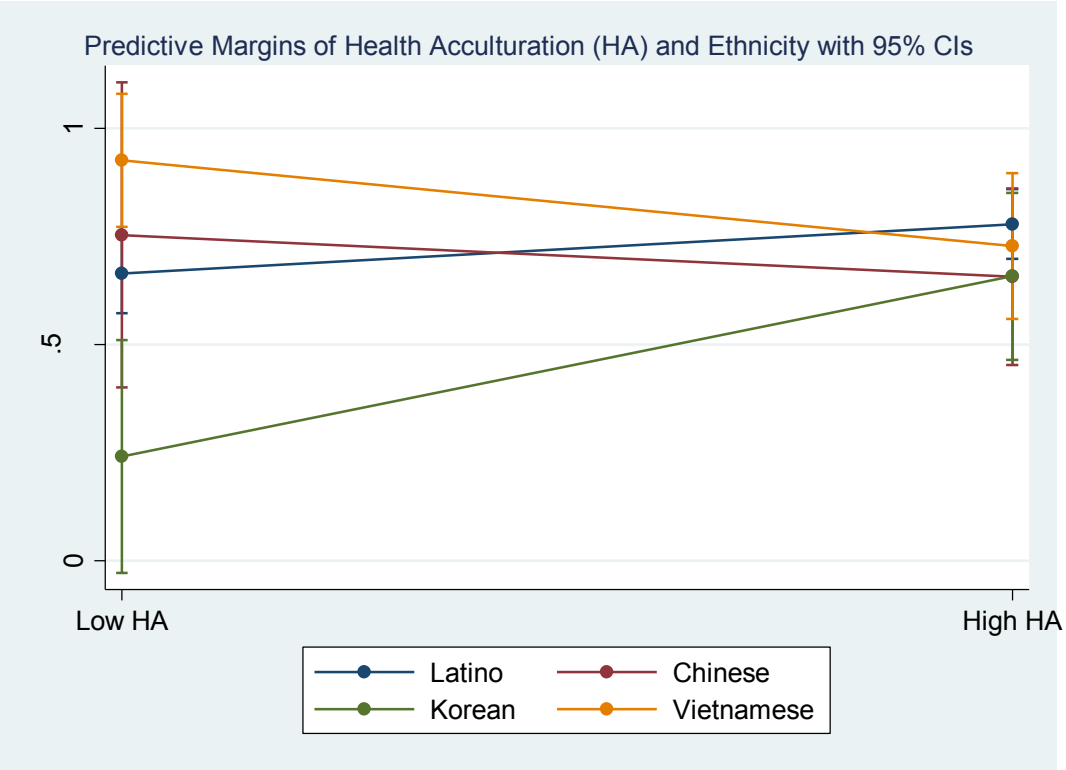

Figure 7. Predictive Margins of Health Acculturation and Diabetes Pills with 95% CIs

Table 16. *Logistic regression models of taking insulin (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	*OR* (S.E)	95% C.I.	Predictors	*OR* (S.E)	95% C.I.
Health Acculturation (HA)	1.30 (0.28)	0.84, 2.00	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	0.15 (0.18)	0.01, 1.63
Chinese	0.55 (0.18)	0.28, 1.06	Low HA # Korean	0.55 (0.81)	0.03, 10.21
Korean	0.28 (0.14)*	0.11, 0.77	Low HA # Vietnamese	7.99 (11.44)	0.46, 138.22
Vietnamese	1.76 (0.89)	0.64, 4.84	High HA # Latino	1.36 (0.31)	0.87, 2.14
			High HA # Chinese	0.86 (0.33)	0.40, 1.83
			High HA # Korean	0.28 (0.11)**	0.12, 0.63
			High HA # Vietnamese	1.54 (0.70)	0.63, 3.79
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	1.93 (0.73)	0.91, 4.08	44 to 64 years	1.92 (0.73)	0.91, 4.07
65 and older	2.21 (0.80)*	1.07, 4.57	65 and older	2.17 (0.79)*	1.06, 4.47
Sex	1.43 (0.31)	0.92, 2.21	Sex	1.40 (0.31)	0.89, 2.18
Education	0.79 (0.21)	0.46, 1.34	Education	0.83 (0.22)	0.48, 1.41
Marital Status	0.94 (0.22)	0.59, 1.51	Marital Status	0.93 (0.23)	0.57, 1.52
Perceived Poor Health	2.33 (0.51)***	1.51, 3.59	Perceived Poor Health	2.46 (0.53)***	1.59, 3.79
Constant	0.07 (0.04)***	0.02, 0.24	Constant	0.07 (0.04)***	0.02, 0.24

a. F (10, 70) = 3.37, $p < 0.01$

b. F (13, 67) = 3.34, $p < 0.001$

c. Adjusted Wald test for Interaction: F (7, 73) = 3.26, p<.01

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

Table 17. *Predictive margins of health acculturation and ethnicity on taking insulin (n= 1574)*

	Margins (Predictive probability)	95% C.I
Interaction Effects		
Latino # Low HA	0.13 (0.03)***	0.08, 0.18
Latino # High HA	0.17 (0.03)***	0.11, 0.23
Chinese # Low HA	0.02 (0.03)	-0.03, 0.08
Chinese # High HA	0.12 (0.04)**	0.04, 0.19
Korean # Low HA	0.08 (0.11)	-0.13, 0.29
Korean # High HA	0.04 (0.02)*	0.01, 0.07
Vietnamese # Low HA	0.53 (0.34)	-0.15, 1.20
Vietnamese # High HA	0.19 (0.07)**	0.06, 0.32
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.04 (0.03)	-0.02, 0.09
Chinese (High HA vs. Low HA)	0.09 (0.04)*	0.01, 0.17
Korean (High HA vs. Low HA)	-0.04 (0.11)	-0.26, 0.18
Vietnamese (High HA vs. Low HA)	-0.34 (0.33)	-0.99, 0.31
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	-0.11 (0.04)**	-0.18, -0.04
(Chinese vs. Latino) High HA	-0.06 (0.04)	-0.13, 0.02
(Korean vs. Latino) Low HA	-0.05 (0.10)	-0.26, 0.15
(Korean vs. Latino) High HA	-0.13 (0.03)***	-0.19, -0.07
(Vietnamese vs. Latino) Low HA	0.40 (0.34)	-0.28, 1.07
(Vietnamese vs. Latino) High HA	0.02 (0.06)	-0.11, 0.14

[a.] Contrast of predictive margins, *Chi*-test of significance

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

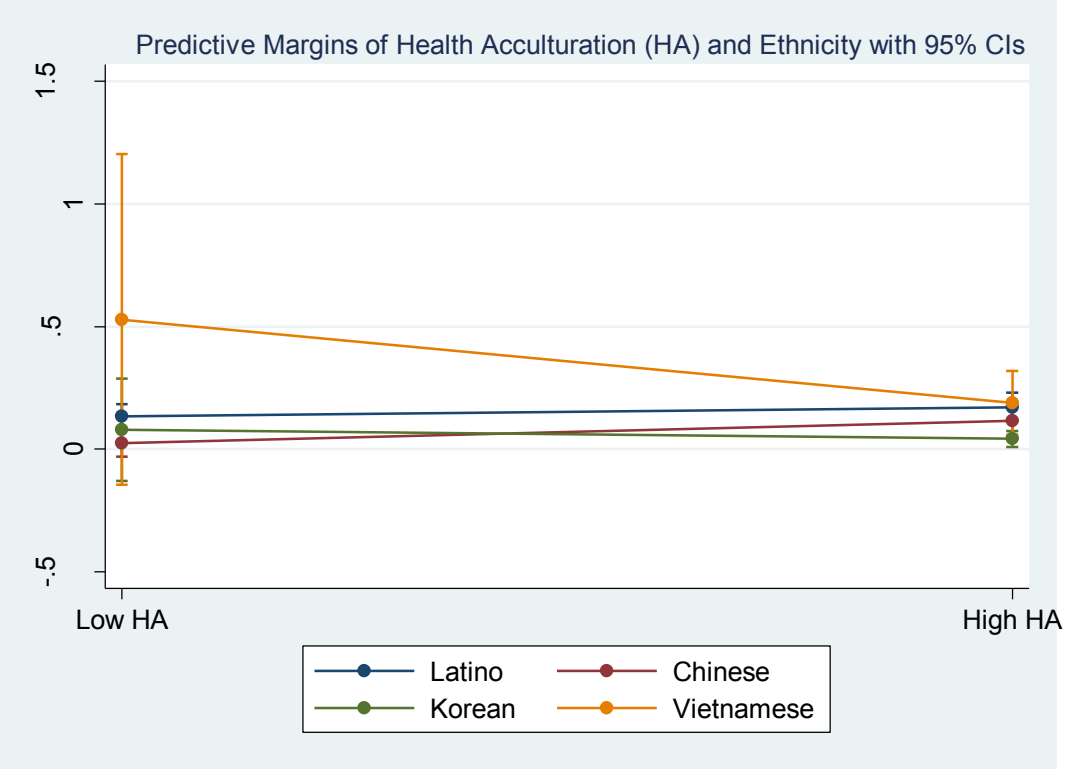

Figure 8. Predictive Margins of Health Acculturation and Insulin with 95% CIs

Table 18. *Logistic regression models of having a provider-developed diabetes plan (n= 1574)*

	Model 1: Direct associations[a]			Model 2: Interaction effects[b]	
Predictors	*OR* (S.E)	95% C.I.	Predictors	*OR* (S.E)	95% C.I.
Health Acculturation (HA)	2.12 (0.40)***	1.45, 3.09	HA # Ethnicity[c]		
Ethnicity			Low HA # Latino (Ref.)		
Latino (Ref.)			Low HA # Chinese	0.42 (0.26)	0.12, 1.42
Chinese	0.56 (0.21)	0.27, 1.17	Low HA # Korean	0.06 (0.04)***	0.02, 0.20
Korean	0.11 (0.04)***	0.05, 0.21	Low HA # Vietnamese	6.58 (6.99)	0.80, 54.50
Vietnamese	2.16 (0.86)	0.98, 4.76	High HA # Latino	2.12 (0.43)	1,41 3.18
			High HA # Chinese	1.25 (0.55)	0.52, 3.00
			High HA # Korean	0.25 (0.10)**	0.11, 0.56
			High HA # Vietnamese	3.21 (1.27)**	1.46, 7.04
Age Groups			Age Groups		
18 to 43 years (Ref.)			18 to 43 years (Ref.)		
44 to 64 years	0.57 (0.19)	0.29, 1.11	44 to 64 years	0.57 (0.19)	0.29, 1.12
65 and older	0.57 (0.21)	0.28, 1.17	65 and older	0.57 (0.20)	0.28, 1.16
Sex	0.74 (0.16)	0.48, 1.14	Sex	0.73 (0.16)	0.48, 1.13
Education	1.71 (0.40)*	1.07, 2.72	Education	1.73 (0.40)	1.09, 2.75
Marital Status	1.26 (0.25)	0.86, 1.86	Marital Status	1.24 (0.24)	0.84, 1.83
Perceived Poor Health	1.06 (0.27)	0.63, 1.77	Perceived Poor Health	1.07 (0.28)	0.64, 1.80
Constant	2.12 (1.17)	0.71, 6.37	Constant	2.18 (1.21)	0.72, 6.59

a. F (10, 70) = 7.33, $p < 0.001$

b. F (13, 67) = 6.43, $p < 0.001$

c. Adjusted Wald test for Interaction: F (7, 73) = 9.94, $p < 0.001$

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

Table 19. *Predictive margins of health acculturation and ethnicity on having a provider-developed diabetes management plan (n= 1574)*

	Margins (Predictive probability)	95% C.I
Interaction Effects		
Latino # Low HA	0.61 (0.05)***	0.50, 0.71
Latino # High HA	0.76 (0.03)***	0.71, 0.82
Chinese # Low HA	0.40 (0.14)**	0.13, 0.68
Chinese # High HA	0.66 (0.09)***	0.48, 0.84
Korean # Low HA	0.10 (0.05)	-0.00, 0.19
Korean # High HA	0.29 (0.09)**	0.12, 0.46
Vietnamese # Low HA	0.91 (0.09)***	0.73, 1.08
Vietnamese # High HA	0.83 (0.05)***	0.73, 0.93
Within Groups Comparisons[a]		
Latino (High HA vs. Low HA)	0.16 (0.05)***	0.06, 0.25
Chinese (High HA vs. Low HA)	0.25 (0.15)	-0.04, 0.55
Korean (High HA vs. Low HA)	0.20 (0.09)*	0.03, 0.38
Vietnamese (High HA vs. Low HA)	-0.08 (0.10)	-0.28, 0.12
Between Groups Comparisons[a]		
(Chinese vs. Latino) Low HA	0.04 (0.08)	-0.11, 0.20
(Chinese vs. Latino) High HA	-0.13 (0.07)	-0.27, 0.01
(Korean vs. Latino) Low HA	0.01 (0.05)***	-0.09, 0.10
(Korean vs. Latino) High HA	0.03 (0.09)***	-0.15, 0.20
(Vietnamese vs. Latino) Low HA	-0.00 (0.06)**	-0.13, 0.12
(Vietnamese vs. Latino) High HA	0.00 (0.10)	-0.19, 0.21

[a.] Contrast of predictive margins, *Chi*-test of significance

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

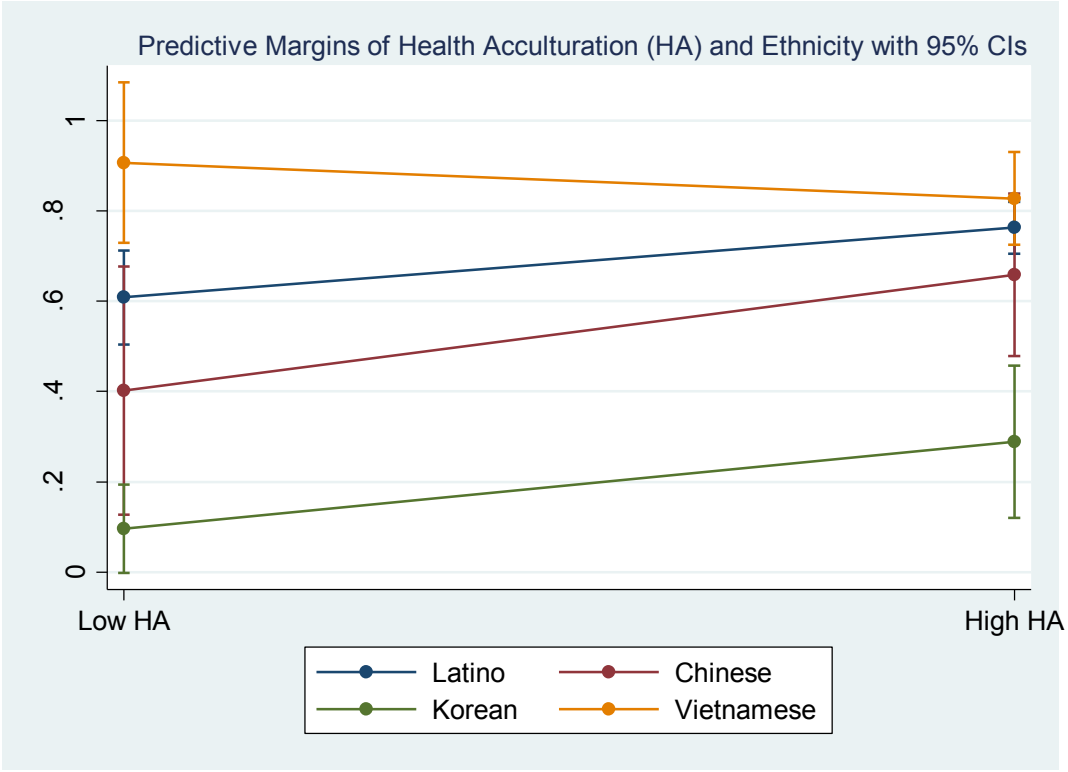

Figure 9. Predictive Margins of Health Acculturation and Provider-developed Diabetes Plan with 95% CIs

Chapter V: Discussion

Health acculturation is the ability to successfully navigate the mainstream healthcare system. It includes the ability to communicate with and understand healthcare providers in English and necessary knowledge to access healthcare. The primary purpose of the study was to assess the relationship between levels of health acculturation and type 2 diabetes management behaviors in a sample of foreign-born Vietnamese, Chinese, Korean, and Latino adults. The secondary purpose was to assess ethnic differences by testing the interaction between health acculturation and ethnicity with respect to diabetes management behaviors. The CHIS 2009 and 2011-2012 was merged to examine relationships for four different groups of foreign-born immigrants (Vietnamese, Chinese, Korean, and Latino adults) who shared common social, demographic, and economic characteristics. Findings suggest that health acculturation is statistically significant in predicting most diabetes management behaviors and those relationships are moderated by ethnic differences.

We see that immigrants with a high level of health acculturation were more likely to maintain a stable diabetes regimen, including blood glucose monitoring, hbA1c testing, and physician visits. They were more likely to have had dilated eye exams, adhered to diabetes medication use by taking their pills, and have a provider-developed diabetes management plan. Highly acculturated immigrants also visited their physician more frequently in the past year and contacted their physician office with medical questions. These results show that the measure of health acculturation can be used to identify and predict aspects of healthcare access as reflected in a sample of foreign-born immigrants.

The findings from this study also suggest that health acculturation in diabetes management behaviors are moderated by racial/ethnic differences. This means that health acculturation and health access should be understood in the context of ethnic/racial differences. For example, Latino immigrants had a lower socioeconomic status, a high school education or less, and limited English proficiency. However, compared to the Asian sub-groups they had a higher likelihood in using health services to manage diabetes. This occurred regardless of their level of health acculturation. At first glance this may be a bit unusual, but Latinos have been a part of the US fabric much longer, resulting in more developed social, community and media networks that enable access to healthcare. This would account for the higher than expected health services use. Also, while Latinos were the least likely of the racial/ethnic groups to use private physicians, they used community health centers more often. This accords with having more developed social and community networks—having health centers in the immediate vicinity can provide healthcare and language interpretation services regardless of a patient's inability to pay (Rosenbaum & Shin, 2006). Interestingly, Korean immigrants were less likely than Latinos to manage diabetes even though they were more likely to have a provider-developed diabetes management plan. These findings demonstrate that health acculturation does not depend solely on language skills, socioeconomic status, education, and affluence. To the extent that education reflects the ability to gain knowledge about the healthcare system, along with the financial component, it is possible that a range of available health options also increases to managing chronic illnesses. However, these factors do not explain why an ethnic group, like the Koreans, that is well-educated and affluent, will cooperate with a physician to develop a diabetes management

plan and yet score poorly on related health behaviors. Future research is needed to develop the concept beyond basic cultural factors, language proficiency and financial components. Also, there is a need to understand ethnic/cultural and other elements of health acculturation of other ethnic/racial groups.

Future Studies

This study defines a concept of health acculturation and may be considered the first step in developing a comprehensive measure for capturing all significant elements of health access. Future research is needed to develop the concept beyond traditional factors, such as, race/ethnicity, social economic status, language proficiency, and financial circumstances. There is also a need to identify and understand other factors that impact influence the predisposing and enabling components of health acculturation. Further research may determine such things as age at migration are related to diabetes management and health seeking behaviors in later life. Likewise, other migration factors and patterns themselves affect health utilization. Even within the same ethnic group, different waves of migration or migration circumstances may have elements that impact health behaviors. For example, for the Vietnamese there were three waves of immigration. The first wave resulted from the fall of Saigon (April 1975) and was an evacuation consisting mainly of South Vietnamese military, government officials, and employees of the US government, and their families. The second wave, following a few years later, involved a broad cross-section of individuals and families fleeing the socio-economic aftermath of life in Vietnam under the Communist regime. The third wave in the ‘90s was far more organized, involving private agencies as well as US and Vietnamese government agencies. Thus, their demographics, socioeconomic status and

the circumstances under which they left were significantly different for each wave. Also, unlike the majority of other immigrant groups, the Vietnamese immigrants were not subject to the same level of health screening and entry standards required by the US immigration and resettlement offices. Even within the same ethnic group, the different immigration histories may have significantly influenced the process of adapting into the mainstream American healthcare system and consequently affect health utilization behaviors.

The health-acculturated person understands that a chest pain is a symptom not only of a heart attack, but also symptomatic of heartburn which can be treated with available over-the-counter antacid medication or acid-reflux, which often responds to a change in dietary habits. Because they can access health information from a wide variety of sources, the health-acculturated person is less likely to immediately head for the emergency room when other heart-attack symptoms are absent. They understand, also, the value of preventative care and would be more likely to adopt lifestyles and behaviors that minimize health risks and thereby lower overall medical costs.

Computer literacy and its relationship to health acculturation is another element that should be addressed in future research as well. The Internet has become a factor in delivering medical information. The medical culture now includes more than just face-to-face appointments with providers. Providers are likely to use computers and internet resources to communicate with patients, offering a 24-hour online chat services. Some providers even have open sessions at set dates and times where patients can gather for a less formal group session. To become health acculturated, individuals must have the requisite knowledge and skills to seek medical advice and information from many

sources. They must be able to use computers and internet resources. Using the Internet to complete online forms and communicate with provider, and find reliable medical information, demonstrates not only knowledge about the healthcare system but confidence in one's own ability to navigate the healthcare system.

Future research should also consider social networks as a part of health acculturation. Service providers at the state, county and local level have commented that in their experience "word of mouth" from friends and cultural networks is the usual way most immigrants learn about health services (Perreira et al., 2012). In urban areas of densely immigrant-populated states like Texas, Massachusetts, and North Carolina, immigrant populations have better access to healthcare with the wide-array of available community organizations, networks, and service centers. Those living in smaller towns or cities or in places where the immigrant population is low have less health access because the community networks are scarce or non-existing. This impact of limited access has been recognized by both public agencies and community organizations as evidence that such networks lend support and orientates health delivery programs and services to meet changes in the demographic areas they serve. However, relying on word of mouth and other informal channels to inform public assistance benefits can often result in misinformation and mistrust that prevent immigrants from seeking needed services (Pereira et al., 2012). Developing a multilingual social network or internet based outreach platform will instead contribute to a long term solution of delivering correct information to immigrant populations that leads to effective and better healthcare access for all populations. This calls for a multidisciplinary team approach with the collaboration of doctors, nurses, pharmacists, dieticians, family members, physical therapists, social

workers and other social service personnel as well. Information initiatives utilizing print and digital media, both local and ethnic, should take advantage of community groups and/or religious centers to effectively reach out to many others through the influence of their networks (Deri, 2005). Therefore, effective diabetes treatment requires changes, not only in the patients' behaviors, but also their network of families, friends, and community.

Effective health-acculturation crosses broader socioeconomic boundaries. It is also affected by less measurable factors that influence a person's inclination to seek medical help. For example, a person's sense of control in managing his or her chronic condition or emotional well-being should be explored critically in the study of health acculturation. In addition, having a social network and social support system can help to reduce uncertainty and, therefore, enhances a person's sense of control over a chronic health condition, and their day-to-day situations as well **(**Glanz, Rimer, & Viswanath, 2008). The connections that people make in their social networks and support groups may help them to better understand their problems and re-evaluate events in a more positive and constructive way (Thoits, 1995). These connections will help immigrants to become more informed and more confident, enabling them to seek healthcare as needed, and not wait for a crisis.

Implications

Health disparities among ethnic/racial minority have often been recognized as an important policy issue for social work research and practice. With a growing immigrant population and increasing ethnic diversity and culture, the need for affordable healthcare becomes more urgent, and the healthcare system must adjust to an increasingly

multicultural patient base including a large number who are foreign-born. The Affordable Care Act in 2012 expanded health access, allowing more people than ever to afford health insurance coverage through subsidized government programs. However, having health insurance does not mean a diabetic person no longer faces financial pressures and it does not explain away the ethnic/racial disparities in healthcare access. The costs of diabetes treatment, even with insurance, remain a significant hurdle for many patients, especially for recently arrived immigrants who usually fall in the lower income brackets. Therefore, healthcare providers should address patients' financial circumstances early and often, even though the discussions might be uncomfortable (Ngo-Metzger et al., 2012). Due to a general distrust of governments among some immigrant populations, health providers and social workers must play a key role as navigators, because gaining their trust is a major step in the process. Hence, healthcare providers should be sensitive to cultural diversity among patients and recognize the cultural, informational, and linguistic needs of their patients. Both health acculturation and health literacy among racial and ethnic minorities must be strengthened in a culturally and linguistically sensitive manner. Initiatives such as cultural competency training should be incorporated to improve providers' cultural awareness and sensitivity.

Although cultural-competency training is necessary, effective health acculturation demands the need for a bilingual/bicultural staff. Communication between the patient and healthcare provider is among the most intriguing elements in healthcare. It is often overlooked or not well understood. Good patient-provider communication has been found to relate with health improvement and effective management of chronic diseases. It has also been noticed that its positive effect on the quality of life for the patient remains long

after the patient-provider encounter (Ong, de Haes, Hoos, and Lammes, 1995; Arora, 2003). Some efforts to assist in the communication process, however, don't always work well. Relying on a family member for interpretation in the absence of a trained professional is not usually a good idea and can even be dangerous because of unreliability and inaccuracy in the communication process (Perreira et al., 2012). This could have adverse medical consequences. The growing practice of relying on phone-based interpretation services, such as phone-based language lines, also has its limits. It eliminates the observation of body language, a very important aspect of the communication process in many cultures, and significantly reduces the reliability and accuracy of the interpretation; thus, lowering the effectiveness of the treatment in the short run and increasing the long term costs (Perreira et al., 2012). Having bilingual and bicultural in-house staff members is an investment that will in the long run pay off in cost reduction and treatment efficacy increase.

For social-workers as well as healthcare providers, research on health acculturation presents additional benefits apart from the results for the specific groups studied. The results suggest that the health acculturation measure would be a good screening tool to identify immigrant populations who will most benefit from health intervention within the culture of western medicine. In addition, the results help to identify specific skills and tools needed by social workers and healthcare providers to better serve these populations. In the physician-patient relationship, often just being aware of these potential issues can make communication with a patient or client more effective, leading to greater trust and confidence. And as we become more knowledgeable regarding the dynamics of health acculturation, this measure may be used

as another stepping-stone in the effort to capture significant elements of health access, leading to more appropriate treatments and education, which can lead to improved well-being of the population and reduce the overall cost of often scarce medical-care resources. Furthermore, these matters often fall under the domain of welfare agencies and social workers as much as medical services and health-care providers. Because patients are dealing with a complex set of issues as well as any number of public and private medical and welfare agencies, research into health-acculturation will find it worthwhile to focus on a broad, common theme such as managing chronic illness and preventative healthcare habits. As an overall health strategy and considering medical costs and constraints, health-acculturation in an effective, broad-based preventative-medicine environment might prove most beneficial.

Limitations

There are some limitations inherent in the study. First, the study relied exclusively on the use of secondary data, and the findings are limited to what could be readily captured from the dataset. Second, although CHIS is a large and widely used survey for studying health, specifically among Asian American subgroups, it is a study only of the California populations. However, California does have very large and diverse ethnic populations in the US, and findings of the current study can assume a certain degree of representativeness of immigrants who live in other parts of the country. Future studies using primary sources are needed to further validate and improve this concept of health acculturation, and these studies should include other ethnic groups from across the US. Third, there was a discrepancy in sample sizes among the selected groups of foreign born Latino and Asian populations, which could have skewed the results. Merged data from

CHIS 2009 and CHIS 2011-12 was used to mitigate the issue of sample size differences. Finally, the survey data provided only self-reported responses and therefore, the results may be affected by poor reliability in capturing the concept of health acculturation within the populations used.

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