Title

Acculturation and Religiosity as Moderators of Cardiovascular Disease Risk Factors among South Asians in the United States

Author

Bharmal, Nazleen

Publication Date

2012

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Acculturation and Religiosity as Moderators of Cardiovascular Disease Risk Factors among South Asians in the United States

A dissertation submitted in partial satisfaction of the

Requirements for the degree Doctor of Philosophy

in Health Services

by

Nazleen Hatim Bharmal

2012

The dissertation of Nazleen Hatim Bharmal is approved.

William McCarthy

Martin F. Shapiro

Carol Mangione

Mitchell D. Wong

Marjorie Kagawa-Singer

Robert M. Kaplan, Committee Chair

University of California, Los Angeles

2012

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

TABLES

FIGURES

APPENDIX: Chapter 2

APPENDIX: Chapter 3

APPENDIX: Chapter 4

ACKNOWLEDGEMENTS

Chapter 2 preliminary findings were presented as a poster at the Society of General Internal Medicine Annual Conference 2011 in Phoenix, Arizona.

Chapter 4 incorporates text from a previously prepared manuscript, Bharmal NH, Divan HA, McCarthy WJ, "Impact of Religiosity on BMI in Asian Indians in California, 2004"; Annals of Epidemiology, 2009 submission

Dr. Bharmal was supported by the Robert Wood Johnson Clinical Scholars Program (grant number 59981), the National Research Service Award (T32 PE19001), the American Heart Association-Pharmaceutical Roundtable Spina Outcomes Research Fellowship (0875133N), and the UCLA Specialty Training & Advanced Research (STAR) Fellowship. CAITS was funded by the California Department of Health Services Tobacco Control Section (contract 02-25446)

Special thanks to all the members of the dissertation committee for their support and guidance.

VITA

April 12, 1976	Born, Cherry Hill, New Jersey
1998	B.S., Neuroscience Brown University Providence, RI
2004	M.D. Harvard Medical School Boston, MA
2004	M.P.P. John F. Kennedy School of Government Cambridge, MA
2004-2005	Intern in medicine, primary care Brigham & Women's Hospital Boston, MA
2005-2007	Resident in medicine Brigham & Women's Hospital Boston, MA
2007-2009	Robert Wood Johnson Clinical Scholars Fellow University of California, Los Angeles
2009-2011	Research Fellow University of California, Los Angeles National Research Service Award Specialty Training and Advanced Research Fellow
2011-present	Research Fellow University of California, Los Angeles American Heart Association-Pharmaceutical Roundtable Spina Outcomes Research Center Specialty Training and Advanced Research Fellow

SELECTED PUBLICATIONS

1. Kaplan GB, Bharmal NH, Leite-Morris KA, Adams WR. Role of Adenosine A1 and A2a receptors in the Alcohol Withdrawal Syndrome. *Alcohol*. 1999 Oct;19(2):157-162. PMID: 10548160

2. Bharmal N, Kennedy D, Jones L, Lee-Johnson C, Morris D, Caldwell B, Brown A, Houston T, Meeks C, Vargas R, Franco I, Razzak AR, Brown AF. Through Our Eyes: Exploring African-American Men's Perspective on Factors Affecting Transition to Manhood.*J Gen Intern Med*. 2012 Feb;27(2):153-9. PMID: 21910088

3. Bharmal N, Tseng CH, Kaplan R, Wong MD. State-level variations in racial disparities in life expectancy. *Health Serv Res.* 2012 Feb;47(1 Pt 2):544-55. PMID: 22092060

4. Bharmal N, Chaudhry S. Preventive Health Services Delivery to South Asians in the United States. *Journal of Immigrant and Minority Health.*2012 Apr 1 [Epub ahead of print]. PMID: 22466312

ABSTRACT OF THE DISSERTATION

Acculturation and Religiosity as Moderators of

Cardiovascular Disease Risk Factors among South Asians in the United States

by

Nazleen Hatim Bharmal

Doctor of Philosophy in Health Services

University of California, Los Angeles, 2012

Professor Robert M. Kaplan, Chair

South Asians are people with origins in India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and the Maldives. In the United States (US), South Asians are among the fastest growing ethnic/immigrant groups with a growth rate of 70% from the 2000 to the 2010 Census, now consisting of 1-2% of the total population. California is the state with the largest population of South Asians in the US.

South Asians have a genetic tendency towards insulin resistance and central adiposity, increasing their risk for cardiovascular disease (CVD), coronary heart disease, and diabetes mellitus. Immigrants to Western countries may have an amplified risk of CVD due to the adoption of a Western diet and physical inactivity. Two potential social factors that may moderate CVD risk factors among South Asians in the US are acculturation and religiosity. Chapter 1 provides a literature review of acculturation and health, CVD risk factors among South Asians and how they may vary by duration of residence in the US, and religion and health. Conceptual models

for the relationships between acculturation and CVD risk factors and between religiosity and obesity are also presented in Chapter 1.

Acculturation to American cultural practices has generally been associated with unfavorable changes in CVD risk factors among foreign-born populations. There are few validated measures of acculturation for Asian Americans or South Asians, and acculturation is often operationalized as duration of residence in the US despite problems with this proxy measure. Chapter 2, the first manuscript, examines the validity of acculturation proxy measures, such as duration of residence in the US, with self-reported acculturation measures in validated acculturation scales using the California Asian Indian Tobacco Survey. We found that greater duration of residence in the US, greater percentage of lifetime in the US, and younger age at immigration were associated with more American acculturated responses to the items for South Asian immigrants. We also developed an 11-item acculturation scale for South Asians using existing survey items with an internal consistency reliability of 0.73 and examined the psychometric properties of the scale.

Chapter 3, the second manuscript, uses national and state-level cross-sectional data to examine the association of duration of residence in the US with self-reported CVD risk factors among South Asian adults using regression analysis. We found that South Asians immigrants who have resided in the US for greater than 15 years were more likely to be overweight or obese, drink alcohol, eat five or more servings of fruits and vegetables per day, and engage in physical activity compared with more recent immigrants in models adjusting for confounding socio-demographic characteristics, health status, health access, and health behaviors. Age at immigration modified the relationship between duration of residence in the US and body mass index, binge drinking, and alcohol use. Duration of residence was not associated with increased

risk for hypertension, high cholesterol, diabetes mellitus, cigarette smoking, fast food intake, or soda intake in adjusted models.

Religious involvement has been associated with improved health practices and outcomes. Longitudinal and cross-sectional studies have found lower morality rates, lower prevalence of smoking, and better self-reported health status among individuals who report high levels of religiosity or attend religious services frequently. However, religiosity has also been associated with greater risk of obesity. For South Asians, religiosity and religious participation may be an especially important concept to understand in health promotion because of the dietary restrictions associated with traditional Indian religions and community fellowship for immigrant populations. Chapter 4, the third manuscript, examines the association of religiosity with obesity among a multi-religious group of South Asians in California using regression analysis. We found that high self-identified religiosity was significantly associated with higher BMI after adjusting for socio-demographic and acculturation measures, including the acculturation scale developed in Chapter 2. Highly religious South Asians had 1.53 greater odds (95% CI: 1.18, 2.00) of being overweight or obese than low religiosity immigrants, though this varied by religious affiliation. Religiosity was associated with greater odds of being overweight/obese for Hindus (OR 1.54; 95% CI: 1.08, 2.22) and Sikhs (OR 1.88; 95% CI: 1.07, 3.30), but not for Muslims (OR 0.69; 95% CI: 0.28, 1.70).

The findings from this dissertation may provide information on relevant social and cultural norms that may be incorporated in the conceptual model and design of a cardiovascular disease prevention lifestyle change intervention culturally tailored for South Asians in the US.

Abbreviations

US – United States
ARSMA - Acculturation Rating Scale for Mexican American
SASH - The Short Acculturation Scale for Hispanics
SL-ASIA - Suinn-Lew Asian Self-Identity Acculturation Scale
BAS - Bidimensional Acculturation Scale
AAMSA-CO - The Asian American Multidimensional Acculturation Scale-Culture of Origin
CVD – cardiovascular disease
CHD – coronary heart disease
UK – United Kingdom
NHIS – National Health Interview Survey
CHIS – California Health Interview Survey
NIS – National Immigrant Survey
HDL – high density lipoprotein
LDL – low density lipoprotein
BMI – body mass index
SHARE - Study of Health Assessment and Risk in Ethnic Groups
SES – socioeconomic status
MESA – Multi-Ethnic Study of Atherosclerosis
CARDIA – Coronary Artery Development in Young Adults
CAITS – California Asian Indian Tobacco Study
IV – intervening variable
CFI – comparative fit index
RMSEA – root mean square error of approximation
PSU – primary sampling unit
RDD – random-digit dial
PA - physical activity
NHANES – National Health and Nutrition Examination Survey
MASALA - Metabolic Syndrome and Atherosclerosis in South Asians Living in America

Chapter 1: INTRODUCTION

Chapter 2 Background: Validity of Temporal Measures as Proxies for Measuring Acculturation in Asian Indian Survey Respondents

Foreign-born residents, or first-generation immigrants, make up a significant percentage of the population of the United States (US), rising from 5% in 1970 to a predicted 15% by 2050.[1] US immigrants have primarily resided in urban centers in California, Florida, Illinois, New York, and Texas, but more recently have settled throughout the country. Although definitions vary, acculturation is the process by which individuals exposed regularly to another culture adopt the attitudes, values, customs, beliefs, and behaviors of the foreign culture.[2]

Acculturation to western cultural practices influences health behaviors and health. Greater acculturation by US immigrants to western cultural practices is associated with a higher likelihood of having chronic health conditions, such as obesity and cardiovascular disease, at rates similar to native-born American counterparts.[3] Sociocultural influences, such as a sense of invulnerability to chronic disease or preference for traditional healers (i.e., Eastern medicine healers), may also influence health indirectly through information-seeking and more directly through the decision to participate in screening behaviors.[4-6] However, the mechanisms by which health outcomes and acculturation are linked are not fully understood. A better understanding of how acculturation impacts health may provide insights into public health strategies that could help to reduce health inequities among immigrants.

Definitions: Culture refers to shared meanings, understandings, or referents held by a group of people, and is sometimes synonymous with nations and national boundaries.[7] Culture is the

core, fundamental, dynamic, responsive, adaptive, and relatively coherent organizing system of patterns of living designed to optimize the survival and well-being of its members. Lifelong homage to one's culture tends to be associated with finding meaning and purpose throughout life.[8] Ethnicity is defined as one's sense of identity as a member of a cultural group within a power structure of a multicultural society and as identified by others as a member of that group on the basis of socio-historical context.[8] For a broader definition of ethnicity and culture, and how they may influence health, please refer to Kagawa-Singer et al. (2010).[8]

The Acculturation Construct

Acculturation was initially defined in 1936 as resulting when groups of individuals having different cultures come into ongoing first-hand contact, resulting in changes in the original cultural patterns of either or both groups.[9] However, the immigrating group frequently experiences the majority of changes, especially with immigration into Western societies where the native population has more economic and political power than that of the immigrating group.[10] In 1964, sociologist Milton Gordon developed a theory of assimilation that focused on immigrant integration into the host society. Gordon's linear view of cultural change conceptualized the acculturative process as one where immigrants acquired the values, practices, and beliefs of their new homelands while simultaneously discarding those from the cultural heritage.[11] In general, the assimilation model and its derivatives have been critiqued for ignoring the possibility of bicultural identity and for regarding acculturation as a unidirectional, linear outcome rather than as a complex, multidirectional process.[12,13]

Cultural psychologist John Berry noted that the acquisition of beliefs, values, and practices of the receiving country does not require an immigrant to relinquish the beliefs, values, and practices of

his/her country of origin (e.g., bicultural identity).[14] Berry developed a model of acculturation with receiving-culture acquisition and heritage-culture retention as independent dimensions. These two dimensions intersect to create four fluid acculturation strategies: 1) assimilation (adopts the receiving culture and discards the heritage culture), 2) separation (rejects the receiving culture and retains the heritage culture), 3) integration (adopts the receiving culture and retains the heritage culture), and 4) marginalization (rejects both the heritage and receiving cultures). Berry's work provides the underpinning for most modern acculturation analysis and measurement. The integration component of this two dimensional model acknowledges the fact that immigrants frequently maintain many features of their original culture in their personal lives (e.g., at home) even as they adapt to their host culture in their public lives (e.g., at work).[10]

Acculturation may also be described by several components, such as cultural practices, cultural values, and cultural identification.[15] Cultural practices include language use, media preferences, social affiliations, and cultural customs and traditions (e.g., behavioral acculturation). Cultural values refers to belief systems associated with a specific context or group, such as the value placed on the individual person versus the value placed on the family or other group (e.g., value acculturation). Cultural identification describes attachments to cultural groups, and the positive esteem drawn from these attachments (e.g., identity-based acculturation).

Acculturation is best understood in the interactional context in which it occurs, including the characteristics of the migrants (i.e., age at immigration, gender), the groups/countries from which they originate, their socioeconomic status and resources, the country and local community in which they settle, and the duration of residence and the fluency of language (e.g., English fluency) of the country of settlement.[10,15-17]

Measures of Acculturation

Proxy measures (e.g., years lived in the US) and multi-item acculturation scales are two common ways of assessing the degree of acculturation used in published studies examining associations of acculturation with health outcomes.

Proxy measures, such as language preferences, country of nativity, and length of residence in the host country, are widely used as indicators of acculturation in population studies. While proxy measures are quick and convenient, they do not measure the process of acculturative change (such as attitudes or behaviors) or quantify the level or context of acculturation of immigrants.[18] However, some proxy measures correlate significantly with direct measures of acculturation.[19]

Language preference and country of nativity (place of birth) are the most frequently used proxy measures of acculturation in Latino and Asian immigrant health studies.[19,20] Increased English language proficiency has been associated with increased access to health education materials, health services, and positive patient-provider communication.[19] However, it is unclear if and how language proficiency assesses the extent of cultural adaptation. Asian American and Hispanic adolescents who are not proficient in their families' native languages nonetheless tend to identify strongly with their countries of familial origin and retain many of their heritage values and Asian/Hispanic ethnic identity.[21-23] Furthermore, South Asians and Filipinos cannot rely on language use as a proxy for acculturation because English is often the working language of the professional classes in their countries of origin.[24,25] Additionally, many Asian Indian immigrants, regardless of socioeconomic status in the US, learned to speak, read, and write English in elementary school in India or elsewhere outside of the US and were therefore exposed

to English language media from an early age.[24] Asian Indians represent 90 percent of the South Asians in the US.[26]

Temporal indices include duration of residence in the host country or generational status. Generational status refers to the number of generations an individual's family has been in the US; 1) first-generation immigrant (born outside the US), 2) second-generation (US-born individual with one or both parents born outside the US), 3) third-generation or higher (both parents and the individual born in the US). A general assumption in the use of temporal indices is that duration of residence in a new country increases social contacts and interactions, which in turn lead to improved communication skills and ability to navigate the new society.[20,27,28] These measures are often described as either direct measures or proxies for acculturation, but their relationship with the acculturation process may not be straightforward. For instance, duration of residence relates differently to acculturation depending on whether the immigrant arrived as an adult or as a child, with the latter group resembling the native –born population.[29-31] Place of residence can also modify the relationship between duration of residence and acculturation. Living in an ethnic enclave may hinder social integration into the host country irrespective of years of residence, with subsequent effects on expected outcomes.[20]

Nevertheless, any discussion of the shortcomings of language use or temporal indices as proxies of acculturation should acknowledge the very real limitations of data that confront researchers in immigrant health, especially Asian immigrants. Nativity, language use, and duration of residence in the US are often the only available indicators of acculturation in many of the public-use data sets routinely used in studies of health.

Psychometric scales. Zane and Mak (2003) reported on 21 scales measuring acculturation, with even more scales being developed.[32] Acculturation scales can be unidimensional, bidimensional, or multidimensional. Unidimensional or unidirectional instruments describe changes in terms of losses occurring in one cultural orientation and the accompanied gains in another and thus present the acculturation process as a continuum ranging from unacculturated to acculturated. Examples of these instruments in the Hispanic and Asian populations are the Acculturation Rating Scale for Mexican Americans (ARSMA), the Short Acculturation Scale for Hispanics (SASH), and the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA).[33-35] Unidimensional instruments imply preferences for the majority culture, potentially obscuring the role of protective factors that limited acculturation may afford, such as maintenance of healthy traditional dietary practices or continuation of social support. Bidimensional instruments measure acculturative change in each culture individually. One scale measures the level of maintenance that occurs in the culture of origin and the other measures adoptive changes that occur in the new culture. These instruments include questions about a range of attitudes, beliefs and behaviors, but produce separate scores for the culture of origin and the new culture. Multidimensional instruments evaluate two or more elements of acculturation, such as attitudes, values and ethnic interaction. Examples of bidimensional and multidimensional scales are the revised SL-ASIA and ARSMA II (see review by Kang).[36]

Acculturation scales have been criticized for simplifying the acculturation process and its effect on health.[13] In particular, the summation of items into a composite score combines behaviors, values, and attitudes that may influence health outcomes in different ways than are measured by a unidimensional scale. Current instruments primarily capture changes in language use and proficiency, irrespective of the range of components included.[36,37] In a review by Thomson et al.

of ten acculturation scales for Latinos, the authors found that most acculturation instruments actually measure linguistic acculturation, and that the scales used to measure acculturation assess functional integration into the community through language use and proficiency rather than the extent of cultural adaption or change.[19] In addition, researchers have rarely specified the conceptual model of acculturation that they used or created clear theoretical links between their measure of acculturation and the outcomes of interest.[38] Acculturation scales are often developed for one cultural group, and often may need to be evaluated and modified before being used in another cultural group. In contrast, proxy measures (e.g., temporal measures) are not limited to a specific cultural group, although duration of life spent in the US may mask exposures to western cultural values for Asian immigrants who sojourned in the UK, Canada or Australia before coming to the US.

Associations of Temporal Measures with Acculturation Scales

Some studies that examined psychometric properties of acculturation scales for Hispanic and Asian populations reported validation testing with temporal measures. Both the ARSMA and ARSMA II scales were positively correlated with generational status (ARSMA II: $r = 0.61$, $p<0.001$).[33,39] There was a positive correlation between the SASH scale and generational status ($r = 0.65$, $p<0.001$), length of residence ($r = 0.70$, $p<0.0001$), and self-reported acculturation ($r = 0.76$, $p<0.001$); there was a significant negative correlation with age of arrival in the US ($r = -0.69$, $p<0.001$).[34] The Bidimensional Acculturation Scale (BAS) was positively correlated with generational status, length of residence in the US, age at arrival in the US, and ethnic self-identification.[40] The Caetaneo scale was significantly positively correlated with being foreign-born and the number of years lived in the US.[41] The SL-ASIA scale scores were significantly correlated with (a) total years attending school in the US, $r = 0.61$; (b) age upon attending school

in the US, r = -0.60; (c) years living in the US, r = 0.56; (d) age upon arriving in the US, r = -0.49; e) years lived in non-Asian neighborhood, r = 0.41; (f) self-rating of acculturation, r = 0.62.[42] The Asian American Multidimensional Acculturation Scale-Culture of Origin (AAMSA-CO) and generational status were inversely related (r = -0.36).[43]

Acculturation and Health

Salant et al. (2003) provide an extensive review of acculturation and health for Asian American/Pacific Islanders. Mental health studies have yielded conflicting results, such as acculturation being inversely related to depressive symptoms or psychological distress in some studies, but associated with increased psychiatric disorders in others.[20] Similar conflicting findings have been demonstrated by Rogler et al. (1991) in Hispanic populations.[13] Some studies demonstrate that acculturative change initially produces stress, followed by improvement in mental well-being as the individual moves towards integration.[20]

Acculturation on the Suinn-Lew Self-Identity Scale for Asians[1] is associated with greater healthcare utilization.[35,42] Health studies often use "Westernization", or the adaptation to a Western lifestyle (i.e., assimilationist and behavioral definition of acculturation), and/or emphasize environmental and behavioral factors that are also disease risk factors (e.g., having an "Oriental" diet, increased fat intake, reduced physical activity, red meat consumption, or obesity). Studies that have operationalized acculturation as a temporal lifestyle change find that it is associated with chronic diseases (e.g., coronary heart disease, diabetes, cancer).[20] But

[1] The Suinn-Lew Self-Identity Scale for Asians sums 21-26 items measuring acculturation and ethnic self-identification; low, medium, and high scores are termed Asian-identified, bicultural, and Western-identified, respectively. Domains of the scales include linguistic preference and use, social relationships (childhood and current friends), and cultural activities (music, movies, food). Additional items measure generation level and time of residence. It is modeled after the Acculturation Rating Scale for Mexican Americans.

chronic disease in immigrants might not always be the result of acculturation-related lifestyle change; rather, chronic disease may hasten the acculturative process by facilitating increased contact with the Western healthcare system.[12]

Chapter 3 Background: The Association of Duration of Residence with Cardiovascular Disease Risk Factors among South Asian Immigrants in the United States: findings from two population-based surveys

South Asians are people with origins in India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and the Maldives. In the United States (US), South Asians are among the fastest growing ethnic/immigrant groups with a growth rate of 70% from the 2000 to the 2010 Census, now consisting of 1-2% of the total population.[44] Most South Asians migrated to the US after the passage of the 1965 Immigration Act, and more recent immigrants came from the educated middle class, spoke English, and settled mostly in California, New York, and New Jersey.[45,46] This background section provides a brief review of cardiovascular disease and risk factors among South Asians.

CVD Prevalence and Mortality in South Asians

The INTERHEART study showed that people in South Asian countries have earlier onset and earlier mortality from cardiovascular disease (CVD; especially coronary heart disease, CHD) than people in Western countries.[47] This disparity appears to be explained by South Asians having more risk factors at younger ages than individuals from Western countries (age 40 years versus 60 years, respectively).[47] Specifically, the study showed that nine risk factors (apolipoprotein B100/apolipoprotein A1 ratio, current and former smoking, hypertension, diabetes, high waist-to-hip ratio, psychological factors of stress or depression, no moderate or

high intensity exercise, alcohol consumption greater than once per week, and less than two servings of consumption of fruits and vegetables daily) explained over 90% of the risk of developing myocardial infarction in different populations across the world including the South Asian population (represented 18% of study participants).[47]

These disparities persist for South Asians who immigrate to developed countries, such as the United Kingdom (UK), Canada, and the US. Population-based studies in the UK and Canada report higher prevalence and higher mortality rates of CHD and stroke (age-standardized mortality rate for CHD is 30-60% higher) for South Asian immigrants than the general population.[48-59] Less information is known about other CVD conditions among South Asian immigrants, such as peripheral vascular disease and congestive heart failure.[55,60]

Prevalence and mortality rates for South Asians in the US are limited because South Asians are either classified as "Asian" or "Other" race/ethnicity on death certificates and national datasets, or because national surveys are not conducted in South Asian languages.[46] In California, CVD is the leading cause of death in Asian Indians (largest subgroup of South Asians; 90%).[26] Asian Indians have 2-3 times the CHD mortality rate of the total population at all age groups, and young Asian Indian men ages 25-44 years are at particularly high relative risk of death from CHD (three times) compared to agemates in the general population.[61] In one study, Asians Indians had more than three times the rate of hospitalization for ischemic heart disease than non-Hispanic Whites in Northern California (relative risk 3.7).[62]

Unlike studies in the UK and Canada, two population-based studies in the US have not shown higher CHD prevalence in South Asians than in non-Hispanic White populations (studies used

NHIS 1997-2000 and CHIS 2001).[63,64] However, these surveys were not conducted in South Asian languages and may have missed low-income, less acculturated, and/or higher risk groups. Another study based in Northern California using electronic medical records found that Asian Indian men had increased odds of age-adjusted CHD compared with non-Hispanic Whites, but no difference in odds of stroke or peripheral vascular disease.[60] Asian Indian women were found to have decreased age-adjusted odds of peripheral vascular disease compared with non-Hispanic Whites, but no difference in odds of CHD or stroke.[60]

Other studies in the US have reported high CHD or stroke prevalence and described higher CHD rates at earlier ages among South Asian immigrants, but were limited to one-hospital setting[65-67], geographic community[63,68,69], or homogeneous community in terms of profession or region of origin[70,71]. These limitations in sampling design preclude generalizing the CHD prevalence estimates beyond their samples. However, the high rates reported in these studies are concerning given that less than 5% of Asian Indians in the US are over age 65 years, and the health of this relatively young and rapidly growing population has implications for future public health costs in the US. On a more global note, South Asians represent one-fifth of the world's population and the prevalence of CHD in South Asian immigrants is twice as high as other immigrant populations[72] and three times higher than in the Framingham Heart Study[73,74], even after adjustment for conventional risk factors.

Moderator of CVD & CVD Risk Factors

One possible moderator of CVD risk factors for South Asians is acculturation, or the adoption of behaviors and cultural values of an individual or group as a result of contact with another culture.[9] Please refer to the background section of Chapter 2 (above) for a discussion on

acculturation and health. Both duration of residence in the US and age at immigration are often used as proxy measures for acculturation.[75] These variables have not been extensively studied in the literature examining the health of South Asian immigrants.

Mooteri el al. found that duration of residence in the US was positively associated with self-reported CHD in a convenience sample of Asian Indians.[70] Other studies from Canada and the US have shown increased atherosclerosis among South Asian immigrants with greater duration of residence in the host country.[76,77]

Duration of residence in the US is positively associated with hypertension, obesity, diabetes, hyperlipidemia, and smoking in immigrants in cross-sectional studies using population-based datasets (i.e., NHIS, CHIS, NIS).[75,78-84] Later age at immigration has been shown to modify the association of duration of residence in the US with CVD risk factors, such as diabetes and obesity.[75,78] Most of these studies did not report on South Asian subgroups, likely due to sample size constraints resulting in unreliable estimates for South Asian subgroups.

The impact of duration of residence in the US or acculturation on the already high CVD risk among South Asians is unclear. South Asians have a baseline genetic risk for insulin resistance, partially explaining their high prevalence of diabetes and CHD. Several researchers have postulated that after immigration, South Asians who adopt the diet and physical activity behaviors (i.e., more sedentary than in home country) of a Western lifestyle may amplify their risk of diabetes and CVD (i.e., gene-environment interaction).[46,85-87] As seen in other immigrant groups, I hypothesize that acculturation to American culture will be an important moderator of

CVD risk factors among South Asian immigrants in the US, and greater duration in the US will be positively associated with CVD risk factors in population-based surveys.

CVD Risk Factors

Hypertension

Hypertension has not been found to be more prevalent in South Asian populations compared to white European[40,41], native-born Canadian[88], or Asian and non-Hispanic White US populations.[63,64,89] Singh et al. found that hypertension rates increased as a function of time since immigration to the US for a diverse group of immigrants, though subgroup information on Asians or South Asians was not reported (used National Longitudinal Mortality Study 1979-1989 and NHIS 1993-1994).[84] However, hypertension prevalence rates did not vary with length of residence in a Canadian study that included South Asian immigrants.[88]

Dyslipidemia

South Asians have lower levels of HDL cholesterol, higher triglycerides, and smaller/denser LDL (which is associated with the presence of insulin resistance and a more atherogenic profile) relative to European populations.[90-94] Two studies in the US reported rates of dyslipidemia among South Asians using laboratory evaluation, which is likely closer to the true prevalence of dyslipidemia than self-report data.[95] In a cross-sectional study of 1,038 Asian Indian immigrant adults selected randomly from Asian Indian surnamed lists in seven major US urban centers, Misra et al. found high prevalence rates for hypertriglyceridemia (42%), hypercholesterolemia (44%), high LDL-C (41%, >130 mg/dl), and low HDL-C (26%).[96] The rate of hypertriglyceridemia for Asian Indians was higher than for other racial/ethnic groups in the US according to prevalence statistics reported by the American Diabetes Association and Centers for

Disease Control in 2001.[96] In a cohort study of 1,445 South Asians in Northern California, Flowers et al. found rates of high triglycerides (>150 mg/dl) to be 19% and low HDL (<40 mg/dl) to be 47%.[97] Immigrants who had lived in the US for ≥15 were more likely to self-report hyperlipidemia than those who lived in the US for <10 years based on NHIS data, though results for South Asian immigrants were not provided.[82]

Diabetes Mellitus

India and other South Asian countries have been experiencing an epidemic of type 2 diabetes mellitus.[98-100] One study in six major urban centers in India reported an age standardized diabetes prevalence rate of 12.1 percent.[99] However, according to the Prevalence of Diabetes in India study (PODIS) that included both urban and rural centers, the prevalence of diabetes in India was 4.3 percent (5.9% in urban populations; 2.7% in rural populations).[101] Global estimates that took into account both of the above mentioned studies reported that India has the largest number of people aged 20-79 affected with diabetes mellitus at 50.8 million in 2010 (7.1% of the country's population), and that this number is projected to reach 87 million by 2030.[102] More recent studies and reviews have shown that prevalence rates of diabetes and glucose intolerance continue to rise in India, Pakistan, and Bangladesh, especially among the rural populations.[103-105]

In the US, epidemiologic studies using self-reported survey data or laboratory measures associated with diabetes have consistently shown that Asian Americans have an increased prevalence of type 2 diabetes mellitus when compared with non-Hispanic Whites, and South Asians or Asian Indians have the highest prevalence among Asian subgroups (range from 7-18%).[64,89,96,97,106-111] In a study by Oza-Frank et al., diabetes prevalence increased with length of

residence among US immigrants, independent of age and BMI, with the greatest effect on immigrants who arrived at 25-44 years of age and plateauing after 10 years of residence using data from NHIS 1997-2005.[78] Oza-Frank et al. did not report results for Asian Americans or Asian subgroups; however, Mooteri et al. found that diabetes prevalence was significantly related to length of residence in a specific Asian Indian sample.[70] Other studies have not found an association between length of residence and diabetes prevalence among US immigrants, though fewer categories of residence were used (possibly decreasing the ability of statistical tests to detect differences between them) and/or studies were done in non-Asian Indian subgroups (Koreans, Filipinos).[82,112,113]

Obesity/Metabolic Syndrome

South Asians appear to have a greater genetic tendency for abdominal obesity (or central adiposity) than other populations, which may partially explain the disparities in CHD morbidity and mortality.[114,115] However, body mass index guidelines for obesity (BMI $\geq$ 30 kg/m^2) do not appear to capture the central adiposity CVD risk in South Asians, and may explain why studies have not reported high rates of obesity for South Asians compared to other groups.[46,116] Some groups have advocated lower BMI cut-off levels for diagnosis and treatment of obesity for South Asians (Normal BMI 18.5-22.9 kg/m^2; Overweight BMI 23-24.9 kg/m^2; Obesity BMI $\geq$ 25 kg/m^2)[114,117-119], but BMI may still be a less valid measure than waist-to-hip ratio or waist circumference in predicting CVD risk.[46,120,121] Nonetheless, most population-based datasets calculate BMI from measured or self-reported height and weight, and do not include data on waist or hip circumferences.

The characteristic profile of central obesity and the associated features of insulin resistance (high fasting glucose levels, hyperinsulinemia, hypertriglyceridemia, low HDL, hypertension) is also described as metabolic syndrome and is more commonly observed among South Asians in their birth countries and in South Asian patients at risk of CHD or type 2 diabetes mellitus.[53,87,122,123] Several studies have reported high prevalence rates of metabolic syndrome among South Asians in the US based on laboratory measures (prevalence ranged from 26-38% depending on criteria for metabolic syndrome).[96,97,124] In terms of obesity, length of residence in the US is associated with higher risk of overweight and obesity among US immigrants.[82-84,125] After 15 years of residence, the prevalence of obesity among US immigrants approached that of US-born adults.[83,126] Immigrants who arrive in the US before the age of 20 years are more likely to be overweight or obese with increasing duration of residence than immigrants who arrive at later ages.[75] Results for Asian subgroups or South Asians were not reported in these studies.

Smoking

South Asians self-report lower rates of current smoking or tobacco use than non-Hispanic Whites and other Asian American subgroups in studies from convenience samples and population-based surveys, though rates varied from 5-21 percent.[63,64,89,127,128] Smokeless tobacco, which is also considered a risk factor for CVD, may have high prevalence rates among South Asians (e.g., pan, pan masala, zarda, gutka).[129] In convenience samples of South Asians from New York City and Southern California, rates of smokeless tobacco were 24-28 percent.[130,131] In another study, McCarthy et al. found that 60% of Asian Indians reported smokeless tobacco use in their lifetime, and 20% were current users in a population-based tobacco survey in California.[128] Smoking rates increased as a function of duration of residence for US immigrants in studies using NHIS data, though results for Asian subgroups or South Asians were not reported.[82,84] In

contrast, current smokeless tobacco use was inversely related to longer duration of residence among South Asians in a community survey conducted in several South Asian languages.[131] A meta-analysis of the effects of acculturation on smoking behavior in Asian Americans found that more acculturated men were less likely to smoke than less acculturated men, but the reverse was true for women.[132]

Alcohol

A systematic review and meta-analysis of 84 studies reported that light to moderate alcohol consumption (≤ 2 drinks/day for men; ≤ 1 drink/day for women) was associated with reduced risk of incident CHD and CVD/CHD mortality, but greater amounts of alcohol consumption was associated with increased risk for stroke mortality.[133] While moderate alcohol use may be cardio-protective, heavy drinking (i.e., defined as three or more alcoholic beverages per day) or binge drinking (i.e., defined as five or more alcoholic beverages in one occasion) have been shown to be independent risk factors for CVD.[133]

Alcohol intake, defined as alcohol consumption greater than once per week, was not found to be a risk or protective factor for CHD among South Asians in the INTERHEART study.[47] Nationally, Asian Indians reported low rates of binge drinking compared to other Asian subgroups or non-Hispanic Whites in the US.[89] However, one study using CHIS data reported alcohol use in the past month was associated with increased odds of CVD risk (odds ratio 1.2) among South Asians, though quantity and frequency of alcohol use were not reported.[63] No studies were identified that examined the association of alcohol use with acculturation or duration of residence in the US for Asian Americans or South Asians.

Physical Activity

The recommended guidelines for physical activity to reduce the risk of CVD, diabetes, and obesity are moderate physical activity for at least 150 minutes per week or vigorous physical activity for at least 75 minutes per week (or a combination of both), and includes leisure-time, household, and occupational physical activity.[134,135] A review of cross-sectional and qualitative studies conducted in the US and other Western countries indicated that 40% or more of South Asian immigrants failed to meet these guidelines.[136] Ye et al. found that physical inactivity prevalence was highest among Asian Indians compared to other Asian subgroups or non-Hispanic Whites in the US.[89]

Leisure-time physical activity has been shown to be lower among recent immigrants and those who do not speak English.[137,138] In community samples, leisure-time physical activity among South Asian immigrants increased with length of residence in their new country[69,139,140], English proficiency[141], and having a more American or bicultural identity[69,142]. In two US population-based surveys, length of residence was associated with decreased odds of sedentary lifestyle among immigrants, but both studies were not powered to possibly see differences among Asian subgroups.[82,143]

Diet

The INTERHEART study showed that daily intake of fruits and vegetables, which was protective of CVD, was surprisingly low among South Asians compared to ethnic groups from other countries despite vegetarianism being common among Asian Indians.[47] The high prevalence of CVD, type 2 diabetes mellitus, metabolic syndrome, and dyslipidemia in South Asians has been linked to possible changes in lifestyle and dietary patterns in both birth countries

and host countries for immigrants.[46,144] Dietary change in immigrant South Asians, or "dietary acculturation", may include the decreased vegetarian status and use of South Asian ethnic foods, inclusion of Westernized food items, and alteration in meal patterns.[145] Additionally, age may influence dietary choices, and younger immigrants may change their food habits more readily to more energy-dense foods.[145,146]

A high dietary intake of fat has been reported in South Asians or Asian Indians in several studies, mainly from clarified butter, hydrogenated oils, and coconut products.[46,145,147,148] Asian Indians in the UK had a lower intake of omega-3 fatty acids (*n*-3 polyunsaturated fat) and fiber, and a higher intake of carbohydrates, saturated fat, and trans-fatty acids compared with UK Whites.[144] The Canadian Study of Health Assessment and Risk in Ethnic Groups (SHARE) study, where 70% of the 620 participants were either Aboriginal, Chinese, or Asian Indian, showed that higher intake of saturated and trans fats were independently associated with subclinical atherosclerosis among all racial/ethnic groups.[149] Vegetarian South Asian immigrants in the US had higher BMI values than non-vegetarians due to an increased intake of high-fat dairy products (milk and milk products), which was also associated with high levels of serum triglycerides and low levels of HDL-C.[148] One study in the UK reported that South Asians found food with a high fat content as socially desirable, that they lacked control of portion sizes due to the existence of obligatory patterns of food intake in terms of hospitality, and that women's cooking habits were often influenced by other members of the family.[150]

South Asians may also consume relatively more carbohydrates than other populations in their host countries, especially at dinner time, which may be linked to postprandial hyperglycemia and hypertriglyceridemia late in the day.[116,144,148,151] Raj et al. found that traditional dishes based on

cereals, vegetables and legumes decreased with duration of residence in US (possibly due to lack of time and lengthy preparation), and that rice was the staple for most Asian Indians.[152] Indian snacks that were deep fried and sweets with concentrated sugar, salt, fat, dried fruit and nuts were reserved for special occasions, such as weekend socials, family gatherings, festivals, and religious ceremonies. However, these occasions occur quite frequently in the Indian calendar and these foods are inexpensive and ubiquitous in the US.[152]

Chapter 3 Conceptual Model

The relationship of interest in the study for Chapter 3 is the association of acculturation, measured by duration of residence in the US, with CVD risk factors. The CVD risk factors include health outcomes (i.e., hypertension, hyperlipidemia, diabetes mellitus, and obesity) and health behaviors (i.e., smoking, heavy alcohol use or binge drinking, physical activity, and diet). As previously stated, a discussion on the relationship between acculturation and health is discussed in the background section of Chapter 2 (above). We hypothesize that greater duration in the US will be positively associated with CVD risk factors among South Asian immigrants, specifically hypertension, hyperlipidemia, diabetes mellitus, obesity, current smoking, binge drinking or heavy alcohol use, sedentary lifestyle (no physical activity), and diets low in fruit and vegetable intake and high in sugar-sweetened beverages and fast food intake. We also hypothesize that the relationship between duration of residence and CVD risk factors will be moderated by age at immigration. Among immigrants with the same duration of residence in the US, immigrants who arrived at younger ages will have greater prevalence of CVD risk factors than those who arrived at older ages.

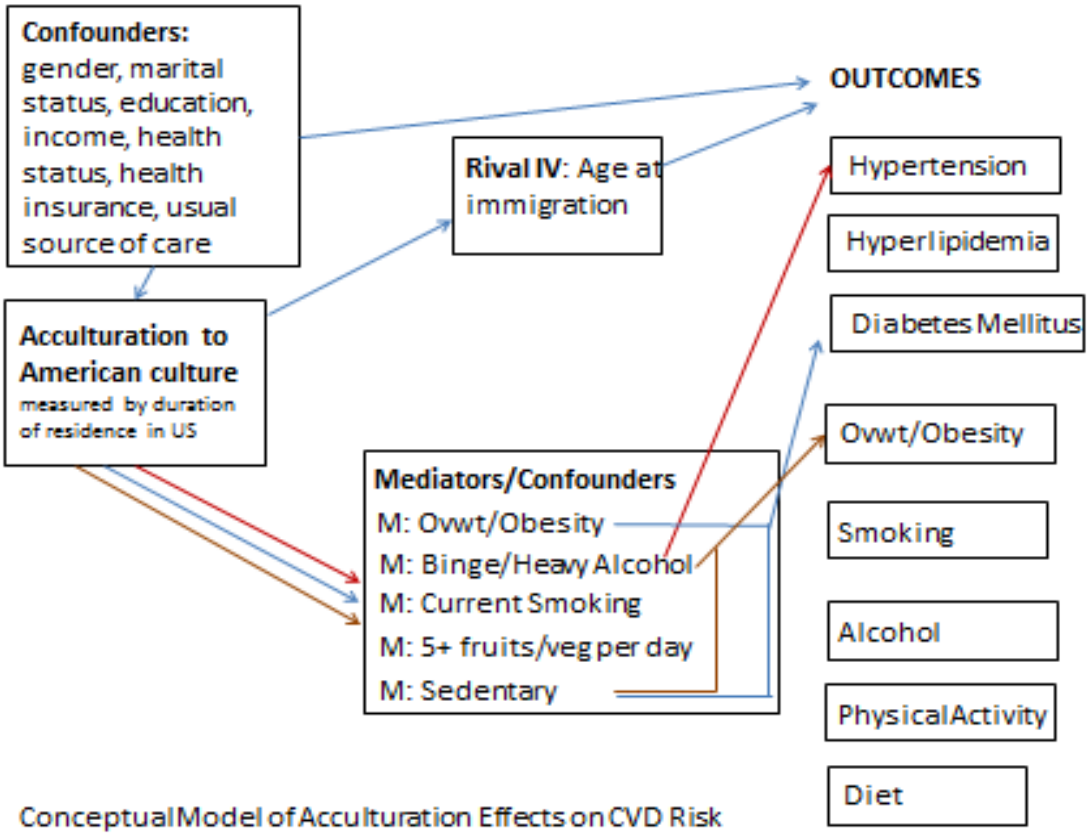
Potential confounders of the relationship between acculturation and CVD risk factors among South Asian immigrants include socio-demographic characteristics, health status/illness burden, and measures of access to health care. In addition, health behaviors (i.e., smoking, alcohol use, physical activity, diet) may confound the relationship between acculturation and hypertension, diabetes, and obesity. Obesity may also confound the relationship between acculturation and diabetes. A brief description of potential confounders is provided in the following table.

Confounding variable	**Association with acculturation**	**Association with CVD risk factors**
Gender (sex)	Studies have reported on the gendered process of acculturation and that health behaviors may differ by acculturation for Latino and Asian American men and women.[132,153-157]	CVD risk factors can vary between men and women.[96,158-160]
Marital status	More acculturated married couples may experience greater marital distress and/or more direct expressions of conflict than less acculturated married couples[161,162], and interracial marriage is more likely with greater acculturation[163].	Being "happily" married is associated with lower rates of hypertension and morbidity/mortality from CVD, possibly through reduced stress and stress-related illness (converse is true for "unhappy" marriages).[164-166] However, being married (versus never married) is associated with higher BMI levels[167,168], and divorce is associated with voluntary weight loss.[168]
Socioeconomic status (educational attainment and income)	There is a positive correlation with acculturation and SES.[169-171]	Educational attainment and income are associated with lower rates of smoking, obesity, and mortality in ethnic groups.[84,172]
Health status	Foreign-born residents and recent immigrants often have fewer chronic conditions and better self-reported health status than native-born residents and long-term resident immigrants, which may be due to aging in the latter group and the healthy immigrant effect in the former group.[173,174]	Self-reported health status is associated with health outcomes, including mortality.[175]
Health access and utilization (health insurance, usual source of care)	Acculturation and length of residence are associated with increased access to the healthcare system.[176]	A usual source of care (and health insurance to access that usual source of care) is important for preventive care services and health screening of CVD risk factors.[177,178]

Other potential confounders in the relationship between acculturation and CVD risk factors include patient-physician communication, medication use and adherence, social networks, built environment or ethnic enclaves, and religious affiliation.[20,46,179,180] Living in an ethnic enclave may hinder social integration into the host country irrespective of years of residence, with subsequent effects on expected outcomes.[20] Religious affiliation and/or participation may be an important moderator of the acculturation effects on CVD risk factors among South Asian immigrants since several traditional Indian religions (e.g., Hinduism, Jainism) practice vegetarianism, as opposed to more common Western dietary practices of meat-eating, and religious Muslims abstain from alcohol.[179,181-184] Measures for these constructs (i.e., ethnic enclaves, religious affiliation) were not available in the datasets used for Chapter 3 study.

Age at immigration may moderate the relationship between acculturation or duration of residence and CVD risk factors[75], and this interaction is examined in multivariate analysis in Chapter 3. Compared to immigrants who arrive in the US at later ages, immigrants who migrate during childhood and adolescence are more exposed to the lifestyles of their native-born counterparts because they are more likely to receive schooling in the US, and more likely to marry native-born Americans.[185] Older immigrants are less likely to acculturate or build new social networks because they usually migrate to rejoin family members already in the US, and the presence of a network of people of the same ethnicity is likely to delay or inhibit acculturation[186]; younger immigrants migrate either to accompany their families or for education and/or economic opportunities and, as a result, may be more willing to acculturate to American culture.[187]

Health behaviors (i.e., smoking, binge drinking or heavy alcohol use, physical activity, fruit and vegetable intake) may also confound and/or mediate the relationship between acculturation/duration of residence and hypertension, diabetes, and obesity. In addition, obesity may confound and/or mediate the relationship between acculturation/duration of residence and diabetes. The Chapter 3 background section describes how these health behaviors may vary with acculturation or duration of residence in the US. Binge drinking has been shown to increase CVD mortality both independently and through elevated blood pressure.[188] Obesity, sedentary lifestyle, unhealthy diet (high in fat and simple carbohydrates, low in fiber), smoking, and heavy alcohol consumption have been associated with increased diabetes risk.[189-192] Heavy alcohol use, sedentary lifestyle, and unhealthy diet have been associated with increased obesity risk, while current smoking has been associated with decreased BMI levels.[193,194]



ConceptualModel of Acculturation Effects on CVD Risk

Overwt = overweight body mass index; IV = intervening variable

Chapter 4 Background: The Association of Religiosity with BMI among Asian Indian immigrants in California

A substantial literature connects religiosity and spirituality to physical and mental health.[195-200] This background section focuses on both general health literature, as well as literature specific to cardiovascular disease risk factors, such as obesity.

Religiosity and spirituality represent related constructs. Spirituality refers to an individual's attempt to find meaning in life, which can include a sense of involvement with the transcendent outside institutional boundaries. Religion or religiosity includes aspects of spirituality, and refers to beliefs and behaviors that are linked to the sacred or supernatural and are grounded in a religious community or tradition.[198]

Levels of religious belief and behavior are remarkably high in the US, and most Americans believe that their spiritual beliefs and behaviors influence their health. According to Gallup survey polls, over 90% of American adults say that they pray and believe in God or a higher being, two-thirds are members of churches or synagogues, 40% attend religious services regularly, and a majority of patients would like medical providers to discuss the spiritual aspects of their illness.[201,202] Moreover, 79% of US adults believe that spiritual faith can help people recover from illness, injury, or disease.[198,202]

How religiosity affects health

There is not a consensus on a conceptual model that delineates how religion impacts health. Several mid-range theories[2], or conceptual schemes that are developed to explain a fairly circumscribed part of religiosity and health, include:

- Religious coping: use of positive religious coping responses to deal with adverse life events and health-related benefits from forgiveness of others.
- Sociality: church-based social relationships bolster and maintain physical and mental health; the Alameda County study found that religious attendance was linked to positive changes in both social ties and health behaviors.[203]
- Control: God-mediated control or belief that God helps people gain control over their lives by working together with Him.[195]
- Health behaviors encouraged or proscribed by particular religions.[198] For example, early studies of Seventh-day Adventists in the US documented lower risk of cancer and other diseases in this group than the general population, and Seventh-day Adventist teaching prohibits the use of tobacco and alcohol and encourages vegetarianism.[204]

Similarly, Hood et al. propose that religion satisfies the need to find meaning in life, the need to exercise control over the environment, and the need to form and maintain relationships with others (i.e., sociality).[205] In one attempt to unify these religion-health theories, Krause posits that these needs may be driven by a deeper and more fundamental need for self-transcendence, or to further a cause beyond the self and to experience communion beyond the boundaries of self.[195] Briefly, Krause discusses a hierarchical conceptual model connecting religion to health through

[2] Middle-range theory is an approach to theory construction that starts with an empirical phenomenon and abstracts from it to create general statements that can be verified by data. (Merton RK. *Social theory and social structure*: Free Press; 1968)

these needs: (1) efforts to satisfy the need for self-transcendence motivate people to participate in formal worship services that take place within religious institutions; (2) attending religious services provides the opportunity to satisfy the need for sociality; (3) in the process of satisfying their need for sociality, fellow members of religious communities help each other satisfy the need for control; (4) satisfying the need for sociality and the need for control makes it possible to satisfy the need for meaning in life; and (5) individuals who have derived a deeper sense of meaning in life will enjoy better health-related outcomes than people who have not been able to satisfy their meaning for life.[195] Several studies suggest a strong sense of meaning in life is associated with favorable self-rated health, greater odds of living longer, and fewer symptoms of depression.[195] Limitations of this conceptual model include how to empirically assess the satisfaction of needs, missing fundamental needs from the model, and whether needs can legitimately be ordered in a hierarchical manner.

A recent review discussed physiologic evidence for the health benefits of religiosity/spirituality, such as attenuation of the sympathetic nervous system activity and enhanced parasympathetic activation, leading to decreased blood pressure or reduced inflammatory cytokine levels.[197] Additionally, religiosity/spirituality has also been related to lower circulating cortisol levels or cortisol responsiveness, and may thereby contribute to reduced risks for a range of health outcomes.[197]

It is worth noting critiques on the connection between religiosity/spirituality and health, especially by Sloan and Bagiella.[206] In their 2002 article, they discuss several limitations with the literature that claims a health advantage with religiosity/spirituality, such as studies on denominational differences that convey no information on the health value of religious

involvement, studies that fail to control for multiple comparisons or lack controls for confounders (e.g., church attendance without control for functional status), and studies that examined the religious consequences of having medical problems. The authors also critiqued the methodology and results interpretation of studies in reviews of religion and health.[206]

Measure of religiosity/spirituality

Religiosity is a complex, multidimensional construct, and similar to the conceptual model, there is not a consensus about how religiosity should be measured. When religiosity/spirituality has been studied, it has often been included only as add-on variables in the context of other research agendas. Many of the religiosity/spirituality research findings, especially in relation to health, have emerged from either large epidemiological surveys of medical populations or large-scale sociological surveys of national populations. Thus, measures of religion and spirituality are often but one of many variables under investigation and, as a result, researchers have relied heavily on brief (frequently single-item) and imprecise global indices, such as frequency of church attendance, denominational affiliation, or self-rated religiousness and spirituality.[196,207] In fact, Hill and Hood identified more than 125 measurement instruments in their review, and suggested that at least ten major aspects of religiosity/spirituality could be considered, namely: denomination/affiliation, religious/spiritual belief, religious/spiritual attitudes, organizational or social religious activity, nonorganizational or private religious/spiritual activity, religious/spiritual salience or importance, religious/spiritual orientation or motivation, religious/spiritual coping, religious/spiritual history, religious/spiritual experience, and religious/spiritual development or maturity.[208]

The limited reliability of brief measures may weaken the association of the religiosity variable with the health variables of interest, resulting in smaller effect sizes than would be observed if the religiosity variable were assessed with more reliable measures. Also, such measures may not uncover harmful health effects of religion. Still, despite the use of global measures with limited reliability, religiosity has been a surprisingly robust variable in predicting health-related outcomes; simplistic measures, such as church attendance, have been significant predictors of health outcomes (e.g., mortality).[207]

Besides the scarcity of multidimensional, psychometrically tested measures of religiosity, other limitations of existing measures include the lack of objective (not self-report) measures, lack of measures of religious change/transformation, and lack of contextually sensitive measures. The need for tradition-specific measures may be especially important for implications of well-being in Eastern religions; for example, most measures have been geared towards Protestants and members of the Judeo-Christian traditions and the Hindu concept of karma have no direct equivalent in Western religions.[198,207,209]

Religion and health

There is a well-documented inverse association between religiosity and all-cause mortality.[197,210-214] A study of 21,000 adults using the data from the National Health Interview Survey reported a strong graded association between religious attendance and mortality, with people who had never attended services having a 19 times higher risk of death over an 8-year period than those who attended more than once a week, after controlling for demographic (age, sex, race, region), socioeconomic (education, family income), health (baseline health status, activity limitation status, bed-sick days), behavioral (smoking, alcohol use, weight-for-height measure), and social

support (marital status, social activity, friends to call on in times of need, relatives to call on in times of need) variables.[210] Life expectancy at age 20 for people who attended services more than once a week was, on average, seven and a half years longer than those who never attended. This association was even stronger in African Americans, with a 13.7-year difference in life expectancy (life expectancy at age 20 for Blacks who attended religious service more than once a week was 60.1 years compared to 46.4 years for Blacks who never attended religious service).[210]A meta-analysis of 42 studies, surveying nearly 126,000 people, and controlling for sociodemographic and physical health status factors, concluded that active religious involvement increased the odds of being alive at follow-up by 26% (length of follow-up ranged from 3-276 months).[212] These effects were stronger for women than men, possibly due to differences between men and women in the psychosocial support that they receive from religion.[212] A rigorous review concluded that religious service attendance was associated with a "strong, consistent, prospective and often graded reduction in risk of mortality," even after adjusting for confounding factors.[213]

A recent meta-analysis of 91 studies investigating the association between religiosity/spirituality and mortality in initially healthy populations (69) and diseased populations (22) showed that religiosity/spirituality was associated with reduced mortality in healthy population studies, but not in diseased population studies.[197] The authors gave higher ratings for studies that controlled for age, sex, smoking, alcohol, BMI or physical activity and socioeconomic status in healthy populations and age, sex, smoking, alcohol, BMI or physical status, basal disease status, medical therapy, and socioeconomic status in diseased populations.[197] More religiosity/spirituality is thought to be related to healthier behavior, including less smoking, more exercising, more moderate drinking, less dietary fat intake, and better sleep quality.[196,203] The authors found that

the protective effect of religiosity/spirituality on mortality was independent of these behavioral factors, negative affect (buffering of psychological distress), and (increased) social support.[197]

Not surprisingly, there is an extensive literature relating religiosity/spirituality with mental health. Two meta-analyses (one with 49 studies, the other with 147 studies) found that positive forms of religious coping (i.e., a secure relationship with God, spiritual connectedness, sense of meaning in life) were related to lower levels of depression, anxiety, and distress, while negative forms of religious coping (i.e., religious struggle, ominous view of world, less secure relationship with God) were associated with poorer psychological adjustment.[215,216] Religiosity variables have been shown to have protective associations with multiple mental health outcomes, including well-being, suicidal behavior and substance misuse.[199] A critical review of 17 studies found that intrinsic religion (i.e., internalized religion or genuine, devout faith) tends to be associated with reduced anxiety, while extrinsic religion (i.e., utilitarian use of religion as a means to an end, such as church attendance to gain social status) tends to be positively associated with anxiety, and similar findings have been reported from reviews of religious beliefs and coping among HIV-positive individuals.[217,218]

Both positive and negative findings have been reported from review studies of religiosity among patients with cancer and cardiovascular disease (CVD).[196,197,200,210,219,220] A systematic review of randomized controlled trials found that religious prayer improved health outcomes in coronary patients and survival among children with leukemia.[221] However, in the Women's Health Initiative Observational Study, Schnall et al. reported that while religious affiliation, frequent religious service attendance, and religious strength and comfort were associated with reduced risk of all-cause mortality, these variables were not associated with reduced risk of coronary heart disease

morbidity and mortality after 7 years of follow-up.[214] Prior studies have also suggested that religious attendance may be associated with lower risk of incident CVD [222,223], but a recent study (MESA) found no association between measures of religiosity and presence/extent of CVD or incident CVD after 4 years of follow-up in older adults[224].

In terms of cardiovascular disease risk factors, studies show both protective and harmful associations with religiosity. Lower rates of smoking have been found with frequent religious service attendance in longitudinal and cross-sectional studies.[224-227] A review of 35 studies on the relationship between religiosity and health-related physiological processes found that both Judeo-Christian and Eastern religious practices were associated with reduced blood pressure and improved immune function; moreover, Zen, yoga, and meditation practices correlated with lower levels of stress hormone (i.e., cortisol) and cholesterol and better overall health outcomes in clinical patient populations.[209] However, other work has found little to no significant cross-sectional[228,229] or longitudinal[230] associations between religious attendance, spirituality, and other dimensions of religiosity (e.g., religious coping) and blood pressure.

Religiosity and obesity

Religiosity has been associated with significantly greater body weight and/or obesity in numerous cross-sectional analyses[224,225,231-233], though some analyses have not found a significant association.[234-236] In the nationally representative, multi-ethnic sample of older adults (MESA study), Feinstein et al. found that religious involvement (i.e., self-reported prayer, religious participation, and spirituality) was associated with greater obesity in older adults.[224] In a recently published paper by Feinstein et al., religious involvement (i.e., frequency in participation of religious activities) was significantly associated with greater incidence of obesity

in young adults (CARDIA longitudinal study), but this did not remain significant after adjustment for baseline characteristics.[227]

Numerous theories have been proposed to explain the finding that greater religiosity is associated with a greater risk of obesity. In their 2006 analysis, Cline and Ferraro posit that two reasons for this association is the relative emphasis that religious organizations place on avoiding vices such as smoking, compared with the scant attention paid to avoiding the sin of gluttony, and the possibility that religiosity leads to obesity to a lesser extent than obesity leads to religiosity, as religious organizations may offer a welcoming environment for those who are obese and seek protection from social stigma.[231] One longitudinal analysis suggested that religious individuals are more likely to become obese because religious organizations rarely address dietary over-consumption and religious gatherings often center around food and drink.[230] Another possible reason for the relationship between religiosity and obesity is that the low prevalence of smoking among religious individuals actually causes increased levels of obesity due to the role of smoking as an appetite suppressant.[237] A 2003 study found that positive associations between religiosity and obesity were no longer significant when adjusted for smoking status[237]; however, it remains unclear if abstinence from smoking is a primary explanation for greater obesity among more religious individuals.

South Asians and religiosity

Associations between religiosity/spirituality and obesity are particularly important to understand among South Asians, for whom religion/spirituality and fellowship in religious communities have been viewed as particularly salient. Cultural patterns that include community fellowship surrounding eating and reported tendencies to eat foods high in fat may contribute to increased

rates of central adiposity and obesity in South Asians. Some religious social settings may encourage less healthy eating and lead to weight gain for South Asians, but these potential relationships are poorly understood.

Chapter 4 Conceptual Model

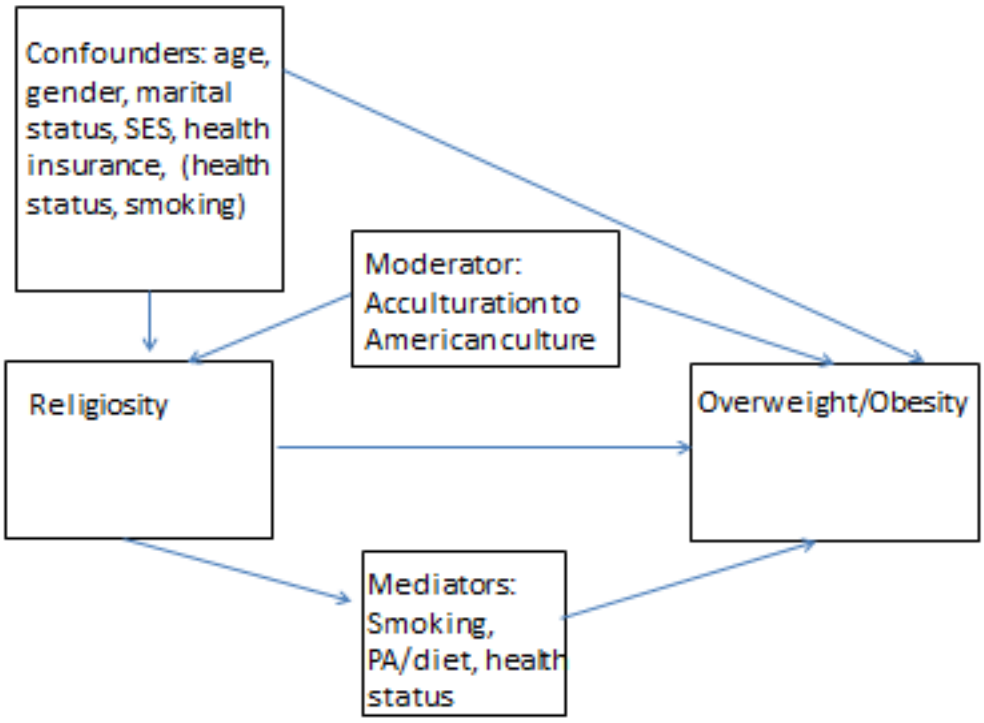
The focal relationship of interest in the Chapter 4 study is the association of religiosity with BMI in Asian Indian adults in the US, with the hypothesis that greater religiosity is associated with greater BMI (and risk for obesity and obesity-related diseases like coronary heart disease). Potential confounders of this focal relationship are presented in the following table.

Confounding variable	Association with religiosity	Association with obesity
Age	Religiosity may increase with age, as older cohorts may be more religious than younger adults.[238]	Greater weight, a component of body mass index, is associated with older age, presumably from a decrease in basal metabolic rate.[239,240]
Gender (sex)	Women have consistently reported greater religiosity than men in observational studies.[241]	Weight has also been shown to vary by sex, with men having more muscle mass, and potentially higher BMI.[239,240]
Marital status	A meta-analysis of 94 studies demonstrated a correlation between religiousness and marital satisfaction or decreased divorce rate, though the effects are small.[242]	Studies have shown an association between being married (versus never married) and higher BMI levels, with the idea that the marriage environment leads to inducements to eat (e.g., sharing meals) and may lead to higher caloric intake, which increases weight.[167,168] Inversely, divorce has been associated with voluntary weight loss.[168]
Socioeconomic status (educational attainment and income)	The association between socioeconomic status and religiosity is not clear. The frequency of religious participation is associated with more years of schooling completed among women raised conservative Protestant.[243]	There appears to be an inverse relationship between educational attainment, one component of socioeconomic status, and adult obesity (or higher BMI); this appears to be due to contextual factors (family, neighborhood environment) as opposed to innate childhood intelligence measured by IQ tests[244-247]. Lower income is also associated with obesity.[248]

Health access (health insurance)	The correlation between health insurance and religiosity is not clear. Religiosity is associated with greater healthcare utilization.[249,250]	Health insurance status is often a proxy for health care access and utilization, both of which may be necessary to get health information and counseling on healthy lifestyle and preventive health practices that may lower one's risk for obesity.

One moderating effect on the impact of religiosity on BMI may be acculturation to American culture. The hypothesis that greater acculturation may lead to less religiosity among Asian Indian immigrants will be examined in bivariate analysis and interactions in multivariate analysis in Chapter 4.

Mediating variables/constructs on the association of religiosity with obesity may include smoking, physical activity, diet, and health status. Several studies have found an inverse relationship between religiosity and smoking status.[224-227] Smoking has a known impact on body mass index. Obese body mass index, one risk factor for cardiovascular disease, is inversely related to smoking behavior because of the appetite suppressant effects of nicotine, and smokers typically weigh less than ex-smokers or never smokers .[193] Health status may also be another mediator of the focal relationship between religiosity and obesity, since health status has been positively associated with religiosity, but negatively associated with health outcomes (including higher BMI levels). [175] Other possible mediators are physical activity and diet, which may both be influenced by one's religious practices, and are known to directly affect an individual's weight status.



Conceptual Model of Religiosity Effects on Obesity Risk

SES = socioeconomic status, PA = physical activity

REFERENCES

1. Martin P, Midgley E. Immigration: shaping and reshaping America. *Population.* 2003;58(2):1-46.

2. Clark L, Hofsess L. Acculturation. In: Loue S, ed. *Handbook of Immigrant Health*. New York, NY: Plenum Press; 1998:37-59.

3. Argeseanu Cunningham S, Ruben JD, Venkat Narayan KM. Health of foreign-born people in the United States: A review. *Health & Place.* 2008;14(4):623-635.

4. Facione NC, Giancarlo C, Chan L. Perceived risk and help-seeking behavior for breast cancer. A Chinese-American perspective. *Cancer Nurs.* Aug 2000;23(4):258-267.

5. Wu TY, West B, Chen YW, Hergert C. Health beliefs and practices related to breast cancer screening in Filipino, Chinese and Asian-Indian women. *Cancer Detect Prev.* 2006;30(1):58-66.

6. Parsa P, Kandiah M, Abdul Rahman H, Zulkefli NM. Barriers for breast cancer screening among Asian women: a mini literature review. *Asian Pacific journal of cancer prevention.* 2006;7(4):509-514.

7. Shore B. Taking culture seriously. *Human Development.* 2000;45(4):226-228.

8. Kagawa-Singer M, Valdez Dadia A, Yu MC, Surbone A. Cancer, Culture, and Health Disparities: Time to Chart a New Course? *CA: A Cancer Journal for Clinicians.* 2010;60(1):12-39.

9. Redfield R, Linton R, Herskovits MJ. Memorandum for the study of acculturation. *Am. Anthropol.* 1936;38(1):149-152.

10. Berry J, Sam D. Acculturation and adaptation. In: Berry JW, Segal MH, Kagitcibasi C, eds. *Handbook of cross-cultural psychology: Social behavior and applications.* Vol 3. Boston, MA: Allyn and Bacon; 1997:291–326.

11. Gordon MM. *Assimilation in American life: The role of race, religion, and national origins*: Oxford University Press, USA; 1964.

12. Palinkas LA, Pickwell SM. Acculturation as a risk factor for chronic disease among Cambodian refugees in the United States. *Social Science & Medicine.* 1995;40(12):1643-1653.

13. Rogler LH, Cortes DE, Malgady RG. Acculturation and mental health status among Hispanics: Convergence and new directions for research. *American Psychologist.* 1991;46(6):585-597.

14. Berry JW. Acculturation as varieties of adaptation. *Acculturation: Theory, models and some new findings.* 1980:9-25.

15. Schwartz SJ, Unger JB, Zamboanga BL, Szapocznik J. Rethinking the concept of acculturation: implications for theory and research. *Am Psychol.* May-Jun 2010;65(4):237-251.

16. Berry JW. Conceptual approaches to acculturation. In: K Chun, P Balls Organista, Marin G, eds. *Acculturation: Advances in theory, measurement and applied research*. Washington, D: American Psychological Association; 2003:17–37.

17. McDermott-Levy R. Acculturation: a concept analysis for immigrant health. *Holist Nurs Pract.* Sep-Oct 2009;23(5):282-288.

18. Cabassa LJ. Measuring acculturation: Where we are and where we need to go. *Hispanic Journal of Behavioral Sciences.* 2003;25(2):127.

19. Thomson MD, Hoffman-Goetz L. Defining and measuring acculturation: A systematic review of public health studies with Hispanic populations in the United States. *Social Science & Medicine.* 2009;69(7):983-991.

20. Salant T, Lauderdale DS. Measuring culture: a critical review of acculturation and health in Asian immigrant populations. *Social Science & Medicine.* 2003;57(1):71-90.

21. Portes A, Rumbaut RG. *Legacies: The story of the immigrant second generation*: Univ of California Pr; 2001.

22. Schwartz SJ, Zamboanga BL, Jarvis LH. Ethnic identity and acculturation in Hispanic early adolescents: Mediated relationships to academic grades, prosocial behaviors, and externalizing symptoms. *Cultural Diversity and Ethnic Minority Psychology.* 2007;13(4):364.

23. Unger JB, Ritt-Olson A, Wagner K, Soto D, Baezconde-Garbanati L. A comparison of acculturation measures among Hispanic/Latino adolescents. *Journal of youth and adolescence.* 2007;36(4):555-565.

24. Mehta S. Relationship between acculturation and mental health for Asian Indian immigrants in the United States. *Genetic, Social, and General Psychology Monographs.* Feb 1998;124(1):61-78.

25. Mogelonsky M. Asian-Indian Americans. *American Demographics.* 1995;17(8):32-39.

26. Palaniappan L, Mukherjea A, Holland A, Ivey SL. Leading causes of mortality of Asian Indians in California. *Ethn Dis.* Winter 2010;20(1):53-57.

27. Dawson EJ, Crano WD, Burgoon M. Refining the meaning and measurement of acculturation: Revisiting a novel methodological approach. *International Journal of Intercultural Relations.* 1996;20(1):97-114.

28. Tran TV. Language acculturation among older Vietnamese refugee adults. *The Gerontologist.* 1990;30(1):94-99.

29. Chen X, Unger JB, Cruz TB, Johnson CA. Smoking patterns of Asian-American youth in California and their relationship with acculturation. *Journal of Adolescent Health.* 1999;24(5):321-328.

30. Roshania R, Narayan KM, Oza-Frank R. Age at arrival and risk of obesity among US immigrants. *Obesity (Silver Spring).* Dec 2008;16(12):2669-2675.

31. Tu SP, Yasui Y, Kuniyuki A, et al. Breast cancer screening among Cambodian American women. *Cancer detection and prevention.* 2000;24(6):549.

32. Zane N, Mak W. Major approaches to the measurement of acculturation among ethnic minority populations: A content analysis and an alternative empirical strategy. In: Chun KM, Organista PB, Marin G, eds. *Acculturation: Advances in theory, measurement, and applied research* Washington, DC: American Psychological Association; 2003:39–60.

33. Cuellar I, Harris LC, Jasso R. An acculturation scale for Mexican American normal and clinical populations. *Hispanic Journal of Behavioral Sciences.* Sep 1980;2(3):199-217.

34. Marin G, Sabogal F, Marin BV, Otero-Sabogal R, Perez-Stable EJ. Development of a Short Acculturation Scale for Hispanics. *Hispanic Journal of Behavioral Sciences.* June 1, 1987;9(2):183-205.

35. Suinn RM, Rickard-Figueroa K, Lew S, Vigil P. The Suinn-Lew Asian Self-Identity Acculturation Scale: An Initial Report. *Educational and Psychological Measurement.* Summer 1987;47(2):401-407.

36. Kang S-M. Measurement of Acculturation, Scale Formats, and Language Competence. *Journal of Cross-Cultural Psychology.* November 1, 2006;37(6):669-693.

37. Coronado GD, Thompson B, McLerran D, Schwartz SM, Koepsell TD. A short acculturation scale for Mexican-American populations. *Ethn Dis.* 2005;15(1):53-62.

38. Abraido-Lanza AF, Armbrister AN, Florez KR, Aguirre AN. Toward a Theory-Driven Model of Acculturation in Public Health Research. *Am J Public Health.* August 1, 2006;96(8):1342-1346.

39. Cuellar I, Arnold B, Maldonado R. Acculturation Rating Scale for Mexican Americans-II: A Revision of the Original ARSMA Scale. *Hispanic Journal of Behavioral Sciences.* August 1, 1995;17(3):275-304.

40. Marin G, Gamba RJ. A New Measurement of Acculturation for Hispanics: The Bidimensional Acculturation Scale for Hispanics (BAS). *Hispanic Journal of Behavioral Sciences.* August 1, 1996;18(3):297-316.

41. Caetano R. Acculturation and drinking patterns among US Hispanics. *British Journal of Addiction.* 1987;82(7):789-799.

42. Suinn RM, Ahuna C, Khoo G. The Suinn-Lew Asian Self-Identity Acculturation Scale: Concurrent and Factorial Validation. *Educational and Psychological Measurement.* Winter 1992;52(4):1041-1046.

43. Chung G, Ruth H, Kim B, Abreu J. Asian American Multidimensional Acculturation Scale: Development, Factor Analysis, Reliability, and Validity. *Cultural Diversity and Ethnic Minority Psychology.* 2004;10(1):66-80.

44. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the Asian adult population: United States, 2004–2006. Advance data from vital and health statistics; no 394. Hyattsville, MD: National Center for Health Statistics. 2008.

45. U.S. Census Bureau and India Abroad Center for Political Awareness. Indian-American Population by State. http://www.indianembassy.org/ind_us/census_2000/ia_population_map_2001.pdf. Accessed July 9, 2009.

46. Palaniappan LP, Araneta MRG, Assimes TL, et al. Call to Action: Cardiovascular Disease in Asian Americans. A Science Advisory From the American Heart Association. *Circulation.* August 23, 2010;122:1242–1252.

47. Joshi P, Islam S, Pais P, et al. Risk factors for early myocardial infarction in South Asians compared with individuals in other countries. *JAMA.* Jan 17 2007;297(3):286-294.

48. Chiu M, Austin PC, Manuel DG, Tu JV. Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007. *Canadian Medical Association Journal.* May 18, 2010;182(8):E301-E310.

49. Tillin T, Forouhi NG, Davey-Smith G, McKeigue PM, Chaturvedi N. Cardiovascular Disease Mortality in Relation to Childhood and Adulthood Socio-Economic Markers in British South Asian Men. *Heart.* 2008;94:476–481.

50. Forouhi NG, Sattar N, Tillin T, McKeigue PM, Chaturvedi N. Do known risk factors explain the higher coronary heart disease mortality in South Asian compared with European men? Prospective follow-up of the Southall and Brent studies, UK. *Diabetologia.* Nov 2006;49(11):2580-2588.

51. Barnett AH, Dixon AN, Bellary S, et al. Type 2 diabetes and cardiovascular risk in the UK south Asian community. *Diabetologia.* Oct 2006;49(10):2234-2246.

52. Sheth T, Nair C, Nargundkar M, Anand S, Yusuf S. Cardiovascular and cancer mortality among Canadians of European, south Asian and Chinese origin from 1979 to 1993: an analysis of 1.2 million deaths. *Canadian Medical Association Journal.* 1999;161(2):132-138.

53. Anand SS, Yusuf S, Vuksan V, et al. Differences in risk factors, atherosclerosis, and cardiovascular disease between ethnic groups in Canada: the Study of Health Assessment and Risk in Ethnic groups (SHARE). *Lancet.* Jul 22 2000;356(9226):279-284.

54. Harding S, Rosato M, Teyhan A. Trends for coronary heart disease and stroke mortality among migrants in England and Wales, 1979–2003: slow declines notable for some groups. *Heart.* April 1, 2008;94(4):463-470.

55. Gholap N, Davies M, Patel K, Sattar N, Khunti K. Type 2 diabetes and cardiovascular disease in South Asians. *Prim Care Diabetes.* Apr 2011;5(1):45-56.

56. Balarajan R. Ethnicity and variations in the nation's health. *Health trends.* 1995;27(4):114-119.

57. Gill P, Kai J, Bhopal R, Wild S. Health care needs assessment: black and minority ethnic groups. *Health Care Needs Assessment. The epidemiologically based needs assessment reviews. Third Series. Abingdon: Radcliffe Publishing Ltd.* 2007.

58. Gunarathne A, Patel JV, Gammon B, Gill PS, Hughes EA, Lip GYH. Ischemic Stroke in South Asians. *Stroke.* June 1, 2009;40(6):e415-e423.

59. Gunarathne A, Patel JV, Potluri R, et al. Increased 5-year mortality in the migrant South Asian stroke patients with diabetes mellitus in the United Kingdom: The West Birmingham Stroke Project. *International Journal of Clinical Practice.* 2008;62(2):197-201.

60. Holland AT, Wong EC, Lauderdale DS, Palaniappan LP. Spectrum of Cardiovascular Diseases in Asian-American Racial/Ethnic Subgroups. *Ann. Epidemiol.* 2011;21(8):608-614.

61. Palaniappan L, Wang Y, Fortmann SP. Coronary heart disease mortality for six ethnic groups in California, 1990-2000. *Ann Epidemiol.* Aug 2004;14(7):499-506.

62. Klatsky AL, Tekawa I, Armstrong M, Sidney S. The risk of hospitalization for ischemic heart disease among Asian Americans in northern California. *Am. J. Public Health.* 1994;84(10):1672-1675.

63. Ivey SL, Mehta KM, Fyr CL, Kanaya AM. Prevalence and correlates of cardiovascular risk factors in South Asians: population-based data from two California surveys. *Ethn Dis.* Autumn 2006;16(4):886-893.

64. Mohanty SA, Woolhandler S, Himmelstein DU, Bor DH. Diabetes and cardiovascular disease among Asian Indians in the United States. *J Gen Intern Med.* May 2005;20(5):474-478.

65. Bhalodkar NC, Blum S, Rana T, et al. Comparison of levels of large and small high-density lipoprotein cholesterol in Asian Indian men compared with Caucasian men in the Framingham Offspring Study. *Am J Cardiol.* Dec 15 2004;94(12):1561-1563.

66. Bhalodkar NC, Blum S, Rana T, Kitchappa R, Bhalodkar AN, Enas EA. Comparison of high-density and low-density lipoprotein cholesterol subclasses and sizes in Asian Indian women with Caucasian women from the Framingham Offspring Study. *Clin Cardiol.* May 2005;28(5):247-251.

67. Silbiger JJ, Ashtiani R, Attari M, et al. Atheroscerlotic heart disease in Bangladeshi immigrants: risk factors and angiographic findings. *Int J Cardiol.* 2011;146:38-40.

68. Baweja G, Nanda NC, Parikh N, Bhatia V, Venkataraman R. Prevalence of stroke and associated risk factors in Asian Indians living in the state of Georgia, United States of America. *Am J Cardiol.* Jan 15 2004;93(2):267-269.

69. Jonnalagadda SS, Diwan S. Health behaviors, chronic disease prevalence and self-rated health of older Asian Indian immigrants in the U.S. *J Immigr Health.* Apr 2005;7(2):75-83.

70. Mooteri SN, Petersen F, Dagubati R, Pai RG. Duration of residence in the United States as a new risk factor for coronary artery disease (The Konkani Heart Study). *Am J Cardiol.* Feb 1 2004;93(3):359-361.

71. Enas EA, Garg A, Davidson MA, Nair VM, Huet BA, Yusuf S. Coronary heart disease and its risk factors in first-generation immigrant Asian Indians to the United States of America. *Indian Heart J.* Jul-Aug 1996;48(4):343-353.

72. Bhopal R, Fischbacher C, Vartiainen E, Unwin N, White M, Alberti G. Predicted and observed cardiovascular disease in South Asians: application of FINRISK, Framingham and SCORE models to Newcastle Heart Project data. *Journal of Public Health.* 2005;27(1):93-100.

73. Dodani S. Coronary artery diseases in South Asian immigrants: an update on high density lipoprotein role in disease prevention. *J Immigr Minor Health.* Oct 2009;11(5):415-421.

74. Dodani S. Do We Need More Research on Platelet Function in South Asian Immigrants? *Inflamm Allergy Drug Targets.* 2010;9(5):382-386.

75. Roshania R, Venkat Narayan KM, Oza-Frank R. Age at Arrival and Risk of Obesity Among US Immigrants. *Obesity.* 2008;16(12):2669-2675.

76. Lear SA, Humphries KH, Hage-Moussa S, Chockalingam A, Mancini GBJ. Immigration presents a potential increased risk for atherosclerosis. *Atherosclerosis.* Aug 2009;205(2):584-589.

77. Dodani S, Dong L. Acculturation, coronary artery disease and carotid intima media thickness in South Asian immigrants--unique population with increased risk. *Ethn Dis.* Summer 2011;21(3):314-321.

78. Oza-Frank R, Stephenson R, Venkat Narayan K. Diabetes Prevalence by Length of Residence Among US Immigrants. *Journal of Immigrant and Minority Health.* 2009:1-8.

79. Kaushal N. Adversities of acculturation? Prevalence of obesity among immigrants. *Health Econ.* Mar 2009;18(3):291-303.

80. Lauderdale DS, Rathouz PJ. Body mass index in a US national sample of Asian Americans: effects of nativity, years since immigration and socioeconomic status. *Int J Obes Relat Metab Disord.* Sep 2000;24(9):1188-1194.

81. Sanchez-Vaznaugh EV, Kawachi I, Subramanian SV, Sanchez BN, Acevedo-Garcia D. Differential effect of birthplace and length of residence on body mass index (BMI) by education, gender and race/ethnicity. *Soc Sci Med.* Oct 2008;67(8):1300-1310.

82. Koya DL, Egede LE. Association between length of residence and cardiovascular disease risk factors among an ethnically diverse group of United States immigrants. *J Gen Intern Med.* Jun 2007;22(6):841-846.

83. Goel MS, McCarthy EP, Phillips RS, Wee CC. Obesity Among US Immigrant Subgroups by Duration of Residence. *JAMA: The Journal of the American Medical Association.* December 15, 2004;292(23):2860-2867.

84. Singh GK, Siahpush M. Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: an analysis of two national data bases. *Hum Biol.* Feb 2002;74(1):83-109.

85. Mukhopadhyay B, Sattar N, Fisher M. Diabetes and cardiac disease in South Asians. *The British Journal of Diabetes & Vascular Disease.* 2005;5(5):253-259.

86. Patel DJ, Winterbotham M, Britt RP, et al. Coronary risk factors in people from the Indian subcontinent living in West London and their siblings in India. *The Lancet.* 1995;345(8947):405-409.

87. Misra A, Khurana L. The metabolic syndrome in South Asians: epidemiology, determinants, and prevention. *Metab Syndr Relat Disord.* Dec 2009;7(6):497-514.

88. Chiu M, Austin PC, Manuel DG, Tu JV. Cardiovascular Risk Factor Profiles of Recent Immigrants vs Long-term Residents of Ontario: A Multi-ethnic Study. *Canadian Journal of Cardiology.* 2012;28(1):20-26.

89. Ye J, Rust G, Baltrus P, Daniels E. Cardiovascular Risk Factors among Asian Americans: Results from a National Health Survey. *Ann. Epidemiol.* 2009;19(10):718-723.

90. Cruickshank JK, MacDuff J, Drubra U, Cooper J, Burnett M. Ethnic differences in fasting plasma C-peptide and insulin in relation to glucose tolerance and blood pressure. *The Lancet.* 1991;338(8771):842-847.

91. Whitty CJM, Brunner EJ, Shipley MJ, Hemingway H, Marmot MG. Differences in biological risk factors for cardiovascular disease between three ethnic groups in the Whitehall II study. *Atherosclerosis.* 1999;142(2):279-286.

92. McKeigue PM, Ferrie JE, Pierpoint T, Marmot MG. Association of early-onset coronary heart disease in South Asian men with glucose intolerance and hyperinsulinemia. *Circulation.* Jan 1993;87(1):152-161.

93. Laws A, Jeppesen JL, Maheux PC, Schaaf P, Chen YD, Reaven GM. Resistance to insulin-stimulated glucose uptake and dyslipidemia in Asian Indians. *Arteriosclerosis, Thrombosis, and Vascular Biology.* 1994;14(6):917-922.

94. Palaniappan LP, Kwan AC, Abbasi F, Lamendola C, McLaughlin TL, Reaven GM. Lipoprotein abnormalities are associated with insulin resistance in South Asian Indian women. *Metabolism.* Jul 2007;56(7):899-904.

95. Bays H, Bazata D, Clark N, et al. Prevalence of self-reported diagnosis of diabetes mellitus and associated risk factors in a national survey in the US population: SHIELD (Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes). *BMC Public Health.* 2007;7(1):277.

96. Misra R, Patel T, Kotha P, et al. Prevalence of diabetes, metabolic syndrome, and cardiovascular risk factors in US Asian Indians: results from a national study. *Journal of Diabetes and its Complications.* 2010;24(3):145-153.

97. Flowers E, Molina C, Mathur A, et al. Prevalence of metabolic syndrome in South Asians residing in the United States. *Metabolic Syndrome and Related Disorders.* 2010;8(5):417-423.

98. International Diabetes Federation. Diabetes Atlas. Brussels: 2010.

99. Ramachandran A, Snehalatha C, Kapur A, et al. High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia.* 2001;44(9):1094-1101.

100. Yoon K-H, Lee J-H, Kim J-W, et al. Epidemic obesity and type 2 diabetes in Asia. *The Lancet.* November 2006;368(9548):1681-1688.

101. Sadikot SM, Nigam A, Das S, et al. The burden of diabetes and impaired glucose tolerance in India using the WHO 1999 criteria: prevalence of diabetes in India study (PODIS). *Diabetes research and clinical practice.* 2004;66(3):301-307.

102. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes research and clinical practice.* 2010;87(1):4-14.

103. Misra P, Upadhyay RP, Misra A, Anand K. A review of the epidemiology of diabetes in rural India. *Diabetes Res Clin Pract.* Jun 2011;92(3):303-311.

104. Shera AS, Jawad F, Maqsood A. Prevalence of diabetes in Pakistan. *Diabetes research and clinical practice.* 2007;76(2):219-222.

105. Rahim MA, Hussain A, Azad Khan AK, Sayeed MA, Keramat Ali SM, Vaaler S. Rising prevalence of type 2 diabetes in rural Bangladesh: A population based study. *Diabetes research and clinical practice.* 2007;77(2):300-305.

106. McNeely MJ, Boyko EJ. Type 2 Diabetes Prevalence in Asian Americans. *Diabetes Care.* January 1, 2004;27(1):66-69.

107. Venkataraman R, Nanda NC, Baweja G, Parikh N, Bhatia V. Prevalence of diabetes mellitus and related conditions in Asian Indians living in the United States. *Am J Cardiol.* Oct 1 2004;94(7):977-980.

108. Gupta LS, Wu CC, Young S, Perlman SE. Prevalence of Diabetes in New York City, 2002–2008. *Diabetes Care.* August 1, 2011;34(8):1791-1793.

109. Wang EJ, Wong EC, Dixit AA, Fortmann SP, Linde RB, Palaniappan LP. Type 2 diabetes: Identifying high risk Asian American subgroups in a clinical population. *Diabetes research and clinical practice.* 2011;93(2):248-254.

110. Kanaya A, Wassel C, Mathur D, et al. Prevalence and correlates of diabetes in South Asian Indians in the United States: findings from the metabolic syndrome and atherosclerosis in South Asians living in America study and the multi-ethnic study of atherosclerosis. *Metabolic Syndrome and Related Disorders.* 2010;8(2):157-164.

111. Rajpathak S, Gupta L, Waddell E, et al. Elevated risk of type 2 diabetes and metabolic syndrome among Asians and south Asians: results from the 2004 New York City HANES. *Ethn. Dis.* 2010;20(3):225-230.

112. Yang EJ, Chung HK, Kim WY, Bianchi L, Song WO. Chronic diseases and dietary changes in relation to Korean Americans' length of residence in the United States. *Journal Of The American Dietetic Association.* Jun 2007;107(6):942-950.

113. Araneta MRG, Wingard DL, Barrett-Connor E. Type 2 diabetes and metabolic syndrome in Filipina-American Women: a high-risk nonobese population. *Diabetes Care.* 2002;25(3):494-499.

114. Razak F, Anand SS, Shannon H, et al. Defining Obesity Cut Points in a Multiethnic Population. *Circulation.* April 24, 2007;115(16):2111-2118.

115. Fernandez R, Miranda C, Everett B. Prevalence of obesity among migrant Asian Indians: a systematic review and meta-analysis. *International Journal of Evidence Based Healthcare.* 2011;9(4):420-428.

116. Misra A, Vikram NK. Insulin resistance syndrome (metabolic syndrome) and obesity in Asian Indians: evidence and implications. *Nutrition.* 2004;20(5):482-491.

117. Misra A, Chowbey P, Makkar B, Vikram N, Wasir J, Chadha+ D. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. *JAPI.* 2009;57:163-170.

118. Shiwaku K, Anuurad E, Enkhmaa B, Kitajima K, Yamane Y. Appropriate BMI for Asian populations. *The Lancet.* 2004;363(9414):1077(letter).

119. World Health Organization expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet.* Jan 10 2004;363(9403):157-163.

120. Alberti K, Zimmet P, Shaw J. Metabolic syndrome—a new worldwide definition. A Consensus Statement from the International Diabetes Federation. *Diabetic Med.* 2006;23(5):469-480.

121. Zheng W, McLerran DF, Rolland B, et al. Association between Body-Mass Index and Risk of Death in More Than 1 Million Asians. *New England Journal of Medicine.* 2011;364(8):719-729.

122. Enas EA, Mohan V, Deepa M, Farooq S, Pazhoor S, Chennikkara H. The Metabolic Syndrome and Dyslipidemia Among Asian Indians: A Population With High Rates of

Diabetes and Premature Coronary Artery Disease. *Journal of the CardioMetabolic Syndrome.* 2007;2(4):267-275.

123. Ramachandran A, Snehalatha C, Satyavani K, Sivasankari S, Vijay V. Metabolic syndrome in urban Asian Indian adults a population study using modified ATP III criteria. *Diabetes research and clinical practice.* 2003;60(3):199-204.

124. Misra KB, Endemann SW, Ayer M. Measures of obesity and metabolic syndrome in Indian Americans in Northern California. *Ethn. Dis.* Spr 2006;16(2):331-337.

125. Oza-Frank R, Cunningham SA. The weight of US residence among immigrants: a systematic review. *Obesity Reviews.* 2010;11(4):271-280.

126. Antecol H, Bedard K. Unhealthy assimilation: Why do immigrants converge to American health status levels? *Demography.* 2006;43(2):337-360.

127. Enas EA, Yusuf S, Mehta J. Meeting of the International Working Group on Coronary Artery Disease in South Asians. 24 March 1996, Orlando, Florida, USA. *Indian Heart J.* Nov-Dec 1996;48(6):727-732.

128. McCarthy WJ, Divan H, Shah D, et al. *California Asian Indian Tobacco Survey – 2004.* Sacramento, CA: California Department of Health Services;2005.

129. Gupta PC, Ray CS. Smokeless tobacco and health in India and South Asia. *Respirology.* 2003;8(4):419-431.

130. Changrani J, Gany FM, Cruz G, Kerr R, Katz R. Paan and gutka use in the United States: a pilot study in Bangladeshi and Indian-Gujarati immigrants in New York City. *Journal of Immigrant and Refugee Studies.* 2006;4(1):99-111.

131. Glenn BA, Surani Z, Chawla N, Bastani R. Tobacco use among South Asians: results of a community–university collaborative study. *Ethnicity & Health.* 2009;14(2):131-145.

132. Choi S, Rankin S, Stewart A, Oka R. Effects of acculturation on smoking behavior in Asian Americans: a meta-analysis. *Journal of Cardiovascular Nursing.* 2008;23(1):67-73.

133. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA. Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. *BMJ: British Medical Journal.* 2011;342:d671.

134. Nelson ME, Rejeski WJ, Blair SN, et al. Physical Activity and Public Health in Older Adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise.* 2007;39(8):1435-1445

135. Pate RR, Yancey AK, Kraus WE. The 2008 Physical Activity Guidelines for Americans: Implications for Clinical and Public Health Practice. *American Journal of Lifestyle Medicine.* May/June 2010 2010;4(3):209-217.

136. Daniel M, Wilbur J. Physical Activity Among South Asian Indian Immigrants: An Integrative Review. *Public Health Nursing.* 2011;28(5):389-401.

137. Crespo CJ, Smit E, Carter-Pokras O, Andersen R. Acculturation and leisure-time physical inactivity in Mexican American adults: results from NHANES III, 1988-1994. *Am. J. Public Health.* 2001;91(8):1254-1257.

138. Im EO, Choe M. Korean women's attitudes toward physical activity. *Research in nursing & health.* 2004;27(1):4-18.

139. Jonnalagadda SS, Diwan S. Regional variations in dietary intake and body mass index of first-generation Asian-Indian immigrants in the United States. *J Am Diet Assoc.* Sep 2002;102(9):1286-1289.

140. Misra R, Patel T, Davies D, Russo T. Health promotion behaviors of Gujurati Asian Indian immigrants in the United States. *Journal of Immigrant Health.* 2000;2(4):223-230.

141. Hine C, Fenton S, Hughes AO, Velleman G. Coronary heart disease and physical activity in South Asian women: local context and challenges. *Health Education Journal.* 1995;54(4):431-443.

142. Jonnalagadda SS, Diwan S. Nutrient intake of first generation Gujarati Asian Indian immigrants in the U.S. *J Am Coll Nutr.* Oct 2002;21(5):372-380.

143. Kandula NR, Lauderdale DS. Leisure time, non-leisure time, and occupational physical activity in Asian Americans. *Ann Epidemiol.* Apr 2005;15(4):257-265.

144. Misra A, Khurana L, Isharwal S, Bhardwaj S. South Asian diets and insulin resistance. *Br J Nutr.* Feb 2009;101(4):465-473.

145. Misra A, Ganda OP. Migration and its impact on adiposity and type 2 diabetes. *Nutrition.* 2007;23(9):696-708.

146. Papadaki A, Scott JA. The impact on eating habits of temporary translocation from a Mediterranean to a Northern European environment. *European journal of clinical nutrition.* 2002;56(5):455-461.

147. Misra A, Sharma R, Pandey R, Khanna N. Adverse profile of dietary nutrients, anthropometry and lipids in urban slum dwellers of northern India. *European journal of clinical nutrition.* 2001;55(9):727-734.

148. Yagalla MV, Hoerr SL, Song WO, Enas E, Garg A. Relationship of diet, abdominal obesity, and physical activity to plasma lipoprotein levels in Asian Indian physicians residing in the United States. *Journal Of The American Dietetic Association.* 1996;96(3):257-261.

149. Merchant AT, Kelemen LE, de Koning L, et al. Interrelation of saturated fat, trans fat, alcohol intake, and subclinical atherosclerosis. *The American Journal of Clinical Nutrition.* January 1, 2008;87(1):168-174.

150. Netto G, McCloughan L, Bhatnagar A. Effective heart disease prevention: lessons from a qualitative study of user perspectives in Bangladeshi, Indian and Pakistani communities. *Public Health.* Mar 2007;121(3):177-186.

151. Kamath SK, Hussain EA, Amin D, et al. Cardiovascular disease risk factors in 2 distinct ethnic groups: Indian and Pakistani compared with American premenopausal women. *The American Journal of Clinical Nutrition.* April 1, 1999;69(4):621-631.

152. Raj S, Ganganna P, Bowering J. Dietary habits of Asian Indians in relation to length of residence in the United States. *J Am Diet Assoc.* Sep 1999;99(9):1106-1108.

153. Alaniz ML, Treno AJ, Saltz RF. Gender, acculturation, and alcohol consumption among Mexican Americans. *Substance use & misuse.* 1999;34(10):1407-1426.

154. Lopez-Gonzalez L, Aravena VC, Hummer RA. Immigrant Acculturation, Gender and Health Behavior: A Research Note. *Social Forces.* September 1, 2005;84(1):581-593.

155. Chen L, Juon H-S, Lee S. Acculturation and BMI Among Chinese, Korean and Vietnamese Adults. *J. Community Health.*1-8.

156. An N, Cochran SD, Mays VM, McCarthy WJ. Influence of American Acculturation on Cigarette Smoking Behaviors Among Asian American Subpopulations in California. *Nicotine & Tobacco Research.* April 1, 2008;10(4):579-587.

157. Kim SS, Ziedonis D, Chen KW. Tobacco Use and Dependence in Asian Americans: A Review of the Literature. *Nicotine & Tobacco Research.* February 1, 2007;9(2):169-184.

158. Taggu W, Lloyd G. Treating cardiovascular disease in women. *Menopause International.* December 1, 2007;13(4):159-164.

159. Resnick HE, Howard BV. Diabetes and Cardiovascular Disease. *Annual Review of Medicine.* 2002;53(1):245-267.

160. Berry JD, Dyer A, Carnethon M, Tian L, Greenland P, Lloyd-Jones DM. Association of Traditional Risk Factors With Cardiovascular Death Across 0 to 10, 10 to 20, and greater than 20 Years Follow-Up in Men and Women. *The American Journal of Cardiology.* 2008;101(1):89-94.

161. Flores E, Tschann JM, VanOss Marin B, Pantoja P. Marital conflict and acculturation among Mexican American husbands and wives. *Cultural Diversity and Ethnic Minority Psychology.* 2004;10(1):39-52.

162. Negy C, Snyder DK. Ethnicity and acculturation: Assessing Mexican American couples' relationships using the Marital Satisfaction Inventory—Revised. *Psychological Assessment.* 1997;9(4):414-421.

163. Kitano HHL, Fujino DC, Sato JT. Interracial marriages: Where are the Asian Americans and where are they going? In: Lee LC, Zane NWS, eds. *Handbook of Asian American psychology*. Thousand Oaks, CA, US: Sage Publications, Inc; 1998:233-260.

164. Robles TF, Kiecolt-Glaser JK. The physiology of marriage: pathways to health. *Physiology & Behavior.* 2003;79(3):409-416.

165. Kamiya Y, Whelan B, Timonen V, Kenny R. The differential impact of subjective and objective aspects of social engagement on cardiovascular risk factors. *BMC Geriatrics.* 2010;10(1):81-91.

166. Lillard LA, Waite LJ. 'Til death do us part: Marital disruption and mortality. *American Journal of Sociology.* 1995:1131-1156.

167. Sobal J, Rauschenbach BS, Frongillo Jr EA. Marital status, fatness and obesity. *Social Science & Medicine.* 1992;35(7):915-923.

168. Jeffery RW, Rick AM. Cross-Sectional and Longitudinal Associations between Body Mass Index and Marriage-Related Factors. *Obesity.* 2002;10(8):809-815.

169. Chiswick BR, DebBurman N. Educational attainment: analysis by immigrant generation. *Economics of Education Review.* 2004;23(4):361-379.

170. Sharpe DL, Abdel-Ghany M. Determinants of income differentials: Comparing Asians with Whites and Blacks. *Journal of family and economic issues.* 2006;27(4):588-600.

171. Negy C, Woods DJ. A note on the relationship between acculturation and socioeconomic status. *Hispanic Journal of Behavioral Sciences.* 1992;14(2):248-251.

172. Shea S, Stein AD, Basch CE, et al. Independent Associations of Educational Attainment and Ethnicity with Behavioral Risk Factors for Cardiovascular Disease. *American Journal of Epidemiology.* September 15, 1991;134(6):567-582.

173. Jasso G, Massey DS, Rosenzweig MR, Smith JP. Immigrant Health: Selectivity and Acculturation. In: Anderson NB, Bulatao RA, Cohen B, eds. *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*. Washington (DC): National Academies Press (US); 2004:227-266.

174. McDonald JT, Kennedy S. Insights into the 'healthy immigrant effect': health status and health service use of immigrants to Canada. *Social Science & Medicine.* October 2004;59(8):1613-1627.

175. McGee DL, Liao Y, Cao G, Cooper RS. Self-reported health status and mortality in a multiethnic US cohort. *American Journal of Epidemiology.* 1999;149(1):41-46.

176. Lebrun LA. Effects of length of stay and language proficiency on health care experiences among Immigrants in Canada and the United States. *Social Science & Medicine.* 2012;74(7):1062-1072.

177. Bindman AB, Grumbach K, Osmond D, Vranizan K, Stewart AL. Primary care and receipt of preventive services. *J Gen Intern Med.* May 1996;11(5):269-276.

178. Blewett L, Johnson P, Lee B, Scal P. When a Usual Source of Care and Usual Provider Matter: Adult Prevention and Screening Services. *J. Gen. Intern. Med.* 2008;23(9):1354-1360.

179. Pollard TM, Carlin LE, Bhopal R, Unwin N, White M, Fischbacher C. Social networks and coronary heart disease risk factors in South Asians and Europeans in the UK. *Ethn Health.* Aug 2003;8(3):263-275.

180. Pourat N, Kagawa-Singer M, Breen N, Sripipatana A. Access Versus Acculturation: Identifying Modifiable Factors to Promote Cancer Screening Among Asian American Women. *Medical Care.* 2010;48(12):1088-1096

181. Netto G, Bhopal R, Lederle N, Khatoon J, Jackson A. How can health promotion interventions be adapted for minority ethnic communities? Five principles for guiding the development of behavioural interventions. *Health Promotion International.* June 1, 2010;25(2):248-257.

182. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. *Int J Obes.* 2011;35(2):167-187.

183. Grace C, Begum R, Subhani S, Kopelman P, Greenhalgh T. Prevention of type 2 diabetes in British Bangladeshis: qualitative study of community, religious, and professional perspectives. *BMJ.* November 4, 2008;337(3):a1931-a1937.

184. Raymond C, Sukhwant BAL. The drinking habits of Sikh, Hindu, Muslim and white men in the West Midlands: a community survey. *Addiction.* 1990;85(6):759-769.

185. Stevens G. Age at immigration and second language proficiency among foreign-born adults. *Language in Society.* 1999;28(4):555-578.

186. Angel RJ, Angel JL, Lee GY, Markides KS. Age at migration and family dependency among older Mexican immigrants: Recent evidence from the Mexican American EPESE. *The Gerontologist.* 1999;39(1):59-65.

187. Gibson M. Immigrant Adaptation and Patterns of Acculturation. *Human Development.* 2001;44(1):19-23.

188. Sull JW, Yi SW, Nam CM, Choi K, Ohrr H. Binge Drinking and Hypertension on Cardiovascular Disease Mortality in Korean Men and Women. *Stroke.* October 1, 2010 2010;41(10):2157-2162.

189. Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active Smoking and the Risk of Type 2 Diabetes. *JAMA: the journal of the American Medical Association.* December 12, 2007;298(22):2654-2664.

190. Joosten MM, Grobbee DE, Verschuren WMM, Hendriks HFJ, Beulens JWJ. Combined effect of alcohol consumption and lifestyle behaviors on risk of type 2 diabetes. *The American Journal of Clinical Nutrition.* 2010;91(6):1777-1783.

191. Manson JE, Skerrett PJ, Greenland P, VanItallie TB. The Escalating Pandemics of Obesity and Sedentary Lifestyle: A Call to Action for Clinicians. *Arch Intern Med.* February 9, 2004;164(3):249-258.

192. Shai I, Jiang R, Manson JAE, et al. Ethnicity, obesity, and risk of type 2 diabetes in women. *Diabetes Care.* 2006;29(7):1585-1590.

193. Diverse PC. Smoking, body weight, and CHD mortality in diverse populations. *Preventive Medicine.* 2004;38(6):834-840.

194. Sayon-Orea C, Martinez-Gonzalez MA, Bes-Rastrollo M. Alcohol consumption and body weight: a systematic review. *Nutr. Rev.* 2011;69(8):419-431.

195. Krause N. Religion and Health: Making Sense of a Disheveled Literature. *Journal of Religion and Health.* 2011;50(1):20-35.

196. Koenig HG, McCullough ME, Larson DB. *Handbook of religion and health*: Oxford University Press, USA; 2001.

197. Chida Y, Steptoe A, Powell LH. Religiosity/Spirituality and Mortality. *Psychotherapy and Psychosomatics.* 2009;78(2):81-90.

198. Williams DR, Sternthal MJ. Spirituality, religion and health: evidence and research directions. *Medical journal of Australia.* May 21 2007;186(10 Suppl):S47-50.

199. Moreira-Almeida A, Lotufo Neto F, Koenig HG. Religiousness and mental health: a review. *Revista Brasileira de Psiquiatria.* 2006;28:242-250.

200. Aukst-Margetic B, Margetic B. Religiosity and health outcomes: review of literature. *Coll Antropol.* 2005;29(1):265-271.

201. Miller WR, Thoresen CE. Spirituality, religion, and health: An emerging research field. *American Psychologist.* Jan 2003;58(1):24-35.

202. Gallup G, Lindsay DM. *Surveying the religious landscape: Trends in US beliefs*. Harrisburg, PA: Morehouse Pub.; 1999.

203. Strawbridge W, Shema S, Cohen R, Kaplan G. Religious attendance increases survival by improving and maintaining good health behaviors, mental health, and social relationships. *Annals of Behavioral Medicine.* 2001;23(1):68-74.

204. Mills PK, Beeson WL, Phillips RL, Fraser GE. Cancer incidence among California Seventh-Day Adventists, 1976-1982. *The American Journal of Clinical Nutrition.* May 1, 1994;59(5):1136S-1142S.

205. Hood Jr RW, Hill PC, Spilka B. *The psychology of religion: An empirical approach*. New York, NY: The Guilford Press; 2009.

206. Sloan R, Bagiella E. Claims about religious involvement and health outcomes. *Annals of Behavioral Medicine.* 2002;24(1):14-21.

207. Hill P, Pargament K. Advances in the conceptualization and measurement of religion and spirituality. Implications for physical and mental health research. *The American psychologist.* 2003;58(1):64-74.

208. Hill PC, Hood RW. *Measures of religiosity*. Birmingham, AL: Religious Education Pr; 1999.

209. Seeman TE, Dubin LF, Seeman M. Religiosity/spirituality and health: A critical review of the evidence for biological pathways. *American Psychologist.* 2003;58(1):53-63.

210. Hummer R, Rogers R, Nam C, Ellison C. Religious involvement and U.S. adult mortality. *Demography.* 1999;36(2):273-285.

211. Koenig HG, Hays JC, Larson DB, et al. Does religious attendance prolong survival? A six-year follow-up study of 3,968 older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences.* 1999;54(7):M370-376.

212. McCullough ME, Hoyt WT, Larson DB, Koenig HG, Thoresen C. Religious involvement and mortality: A meta-analytic review. *Health Psychol.* 2000;19(3):211-222.

213. Powell LH, Shahabi L, Thoresen CE. Religion and spirituality: Linkages to physical health. *American Psychologist.* 2003;58(1):36-52.

214. Schnall E, Wassertheil-Smoller S, Swencionis C, et al. The relationship between religion and cardiovascular outcomes and all-cause mortality in the Women's Health Initiative Observational Study. *Psychol Health.* Feb 2010;25(2):249-263.

215. Smith TB, McCullough ME, Poll J. Religiousness and depression: Evidence for a main effect and the moderating influence of stressful life events. *Psychological bulletin.* 2003;129(4):614-636.

216. Ano GG, Vasconcelles EB. Religious coping and psychological adjustment to stress: A meta-analysis. *Journal of Clinical Psychology.* 2005;61(4):461-480.

217. Shreve-Neiger AK, Edelstein BA. Religion and anxiety: A critical review of the literature. *Clinical Psychology Review.* 2004;24(4):379-397.

218. Pargament KI, McCarthy S, Shah P, et al. Religion and HIV: A Review of the Literature and Clinical Implications. *Southern Medical Journal.* 2004;97(12):1201-1209.

219. Stefanek M, McDonald PG, Hess SA. Religion, spirituality and cancer: Current status and methodological challenges. *Psycho-Oncology.* 2005;14(6):450-463.

220. Thuné-Boyle IC, Stygall JA, Keshtgar MR, Newman SP. Do religious/spiritual coping strategies affect illness adjustment in patients with cancer? A systematic review of the literature. *Social Science & Medicine.* 2006;63(1):151-164.

221. Townsend M, Kladder V, Ayele H, Mulligan T. Systematic review of clinical trials examining the effects of religion on health. *Southern Medical Journal.* 2002;95(12):1429-1434.

222. Oman D, Kurata J, Strawbridge W, Cohen R. Religious attendance and causes of death over 31 years. *International journal of psychiatry in medicine.* 2002;32(1):69-89.

223. Colantonio A, Kasl SV, Ostfeld AM, Berkman LF. Psychosocial predictors of stroke outcomes in an elderly population. *Journal of Gerontology.* 1993;48(5):S261-268.

224. Feinstein M, Liu K, Ning H, Fitchett G, Lloyd-Jones DM. Burden of cardiovascular risk factors, subclinical atherosclerosis, and incident cardiovascular events across dimensions of religiosity: The multi-ethnic study of atherosclerosis. *Circulation.* Feb 9 2010;121(5):659-666.

225. Lapane KL, Lasater TM, Allan C, Carleton RA. Religion and cardiovascular disease risk. *Journal of Religion and Health.* 1997;36(2):155-164.

226. Strawbridge WJ, Cohen RD, Shema SJ, Kaplan GA. Frequent attendance at religious services and mortality over 28 years. *Am. J. Public Health.* 1997;87(6):957-961.

227. Feinstein M, Liu K, Ning H, Fitchett G, Lloyd-Jones DM. Incident obesity and cardiovascular risk factors between young adulthood and middle age by religious involvement: The Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Preventive Medicine.* Feb 1, 2012;54(2):117-121.

228. Buck AC, Williams DR, Musick MA, Sternthal MJ. An examination of the relationship between multiple dimensions of religiosity, blood pressure, and hypertension. *Social Science & Medicine.* 2009;68(2):314-322.

229. Fitchett G, Powell LH. Daily Spiritual Experiences, Systolic Blood Pressure, and Hypertension among Midlife Women in SWAN. *Annals of Behavioral Medicine.* 2009;37(3):257-267.

230. Krause N, Liang J, Shaw BA, Sugisawa H, Kim HK, Sugihara Y. Religion, death of a loved one, and hypertension among older adults in Japan. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences.* 2002;57(2):S96-S107.

231. Cline KMC, Ferraro KF. Does religion increase the prevalence and incidence of obesity in adulthood? *J. Sci. Stud. Relig.* Jun 2006;45(2):269-281.

232. Ferraro KF. Firm Believers? Religion, Body Weight, and Well-Being. *Review of Religious Research.* 1998;39(3):224-244.

233. Gillum RF. Frequency of attendance at religious services, overweight, and obesity in American women and men: the Third National Health and Nutrition Examination Survey. *Ann Epidemiol.* Sep 2006;16(9):655-660.

234. Ellis L, Biglione D. Religiosity and obesity: are overweight people more religious? *Personality and Individual Differences.* 2000;28(6):1119-1123.

235. Roff LL, Klemmack DL, Parker M, Koenig HG, Sawyer-Baker P, Allman RM. Religiosity, smoking, exercise, and obesity among southern, community-dwelling older adults. *J. Appl. Gerontol.* Aug 2005;24(4):337-354.

236. Reeves RR, Adams CE, Dubbert PM, Hickson DMA, Wyatt SB. Are Religiosity and Spirituality Associated with Obesity Among African Americans in the Southeastern United States (the Jackson Heart Study)? *Journal of Religion and Health.* 2011:1-17.

237. Kim KH, Sobal J, Wethington E. Religion and body weight. *Int J Obes Relat Metab Disord.* Apr 2003;27(4):469-477.

238. Argue A, Johnson DR, White LK. Age and Religiosity: Evidence from a Three-Wave Panel Analysis. *J. Sci. Stud. Relig.* 1999;38(3):423-435.

239. Ervin RB. Prevalence of metabolic syndrome among adults 20 years of age and over, by sex, age, race and ethnicity, and body mass index: United States. *National health statistics reports.* 2009;13:1-8.

240. Gallagher D, Visser M, Sepulveda D, Pierson RN, Harris T, Heymsfield SB. How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? *American Journal of Epidemiology.* 1996;143(3):228-239.

241. Miller AS, Hoffmann JP. Risk and Religion: An Explanation of Gender Differences in Religiosity. *J. Sci. Stud. Relig.* 1995;34(1):63-75.

242. Mahoney A, Pargament KI, Tarakeshwar N, Swank AB. Religion in the home in the 1980s and 1990s: A meta-analytic review and conceptual analysis of links between religion, marriage, and parenting. *Journal of Family Psychology.* 2001;15(4):559-596.

243. Lehrer E. Religiosity as a Determinant of Educational Attainment: The Case of Conservative Protestant Women in the United States. *Review of Economics of the Household.* 2004;2(2):203-219.

244. Yu ZB, Han SP, Cao XG, Guo XR. Intelligence in relation to obesity: a systematic review and meta-analysis. *Obesity Reviews.* 2010;11(9):656-670.

245. Eriksson J, Forsen T, Osmond C, Barker D. Obesity from cradle to grave. *Int. J. Obes.* 2003;27(6):722-727.

246. Halkjaer J, Holst C, Sorensen TIA. Intelligence Test Score and Educational Level in Relation to BMI Changes and Obesity. *Obesity.* 2003;11(10):1238-1245.

247. Lawlor DA, Clark H, Davey Smith G, Leon DA. Childhood intelligence, educational attainment and adult body mass index: findings from a prospective cohort and within sibling-pairs analysis. *Int J Obes.* 2006;30(12):1758-1765.

248. Wardle J, Waller J, Jarvis MJ. Sex differences in the association of socioeconomic status with obesity. *Am J Public Health.* Aug 2002;92(8):1299-1304.

249. Reindl Benjamins M, Brown C. Religion and preventative health care utilization among the elderly. *Social Science & Medicine.* 2004;58(1):109-118.

250. Schiller PL, Levin JS. Is there a religious factor in health care utilization?: A review. *Social Science & Medicine.* 1988;27(12):1369-1379.

Chapter 2: Validity of Temporal Measures as Proxies for Measuring Acculturation in Asian Indian Survey Respondents

ABSTRACT

Objective: To examine the associations of temporal measures with self-reported measures of acculturation among Asian Indians in the US

Methods: We used the 2004 California Asian Indian Tobacco Survey to examine the number of years in the US, percentage of lifetime in the US, and age at immigration by 11 acculturation items. These items were combined to form an acculturation scale for Asian Indians.

Results: Greater duration of residence in the US, greater percentage of lifetime in the US, and younger age at immigration were associated with more acculturated responses to the items for Asian Indian immigrants. Item-scale correlations for the 11-item acculturation scale ranged from 0.28-0.55 and internal consistency reliability was 0.73. Product-moment correlations of the scale were statistically significant ($p<0.001$) with duration of residence in the U.S. ($r = 0.37$), percentage of lifetime in the U.S. ($r = 0.45$), and age of the Asian Indian immigrant on arrival to the U.S ($r = -0.34$). Some support was found for a two-factor solution; the comparative fit index=0.89 and root means squared error of approximately = 0.07. The internal consistency reliability was 0.70 for one dimension corresponding to private life and 0.59 for the other dimension corresponding to public life.

Conclusion: Temporal measures only partially capture the full dimensions of acculturation. Our 11-item acculturation scale captured several domains and possibly two dimensions of acculturation, and future studies should compare the association of temporal measures and acculturation scale with health outcomes for Asian Indians.

Keywords: Asian Indian, temporal measures, acculturation

INTRODUCTION:

Foreign-born residents, or immigrants, make up a significant percentage of the population of the United States (US), rising from 5% in 1970 to a predicted 15% by 2025.[1] US immigrants have primarily resided in urban centers in California, Florida, Illinois, New York, and Texas, but more recently have settled throughout the country. Although definitions vary, acculturation is broadly described as the process by which individuals exposed regularly to another culture adopt the attitudes, values, customs, beliefs, and behaviors of that foreign culture.[2]

Greater acculturation to US cultural practices is associated with a higher likelihood of having chronic health conditions, such as obesity and cardiovascular disease, at rates similar to native-born American counterparts.[3] Sociocultural influences, such as a sense of invulnerability to chronic disease or preference for traditional healers (e.g., Eastern medicine healers), may also influence health indirectly through information-seeking and more directly through the decision to undergo screening behaviors.[4-6] However, the estimated impact of acculturation depends on how it is measured.[7,8]

Acculturation was initially conceptualized as a linear, unidirectional process where immigrants acquired the values, practices, and beliefs of their new homelands while simultaneously discarding those from the cultural heritage.[9] More recent views of acculturation acknowledge that immigrants frequently maintain many features of their original culture in their personal lives (e.g., at home) and adapt to their host culture in their public lives (e.g., at work).[10] Nonetheless, unidirectional measures of acculturation are prominent because of limitations in acculturation scales or available measures in large datasets.[8,11,12]

Language preference, country of nativity (place of birth), and duration of residence in the US are the most frequently used proxy measures of acculturation in Latino and Asian immigrant health studies.[8,12] However, for some Asian American populations, language use or preference may not serve as an adequate proxy for acculturation. For example, studies of South Asians, or people with countries of origin from India, Pakistan, Bangladesh, Nepal, Sri Lanka, and Bhutan, cannot rely on language use as a proxy for acculturation because English is often the working language of the professional classes in their countries of origin.[13,14] Furthermore, duration of residence in the host country has been criticized as a proxy measure because immigrant groups with a history of diaspora (e.g., South Asians, Chinese) may have immigrated to the US after having spent a generation exposed to western cultural values in Hong Kong or the United Kingdom.[15] We were not able to identify studies that quantified the proportion of South Asians who immigrated to the US from a developed country versus a developing country. Measures that assess several domains of acculturation, such as social relationships, cultural activities, and linguistic preference, for Asian populations are thought to be more valid.[16-19] However, many scales lack a conceptual framework of acculturation and these scales are rarely used in studies evaluating health behaviors or health outcomes because of respondent burden and costs.[8] Given that proxy measures are often the only available indicators of acculturation in many of the data sets routinely used to study Asian American immigrant health, it is important to know how valid they are as measures of acculturation among Asian American immigrants.

The California Asian Indian Tobacco Survey (CAITS) provides a unique opportunity to evaluate temporal measures of acculturation, such as duration of residence in the US. CAITS was a multilingual, population-based assessment of Asian Indians that contains several measures of acculturation among Asian Indians. Asian Indians are among the fastest growing ethnic groups

in the US, with a growth rate of 70% from the 2000 to the 2010 Census.[20] Our objective was to examine the associations of temporal measures with self-reported measures of acculturation among Asian Indians. In addition, given the heterogeneity of the Asian American immigrant population and that no commonly accepted acculturation scale exists for Asian Indians, we created an acculturation scale using existing survey items and report the properties of the scale.

METHODS:

Data Source:

CAITS was a 27-minute multilingual (English, Gujarati, Hindi, or Punjabi) telephone survey administered in 2004 to 3,228 adults randomly selected from Asian Indian surnamed telephone lists, aged 18 years old or above, of Asian Indian background and resident in California.[21] Respondents provided information about health status, utilization of health services, tobacco use, acculturation, and socio-demographic information. Surnames for the CAITS were compiled from Social Security and the Vital Statistics Office of the California Department of Health Services from the years 1998-2002. The household response rate was 67%, and the response rate for the randomly selected interviewees within households was 81%. The final adult response rate was 54% (household response rate of 67% x random adult response rate of 81%). For more information about how the sample was selected and survey design, please see McCarthy et al. (2005).[21] We received institutional review board exemption from the University of California, Los Angeles for secondary data analysis as it did not contain identifiable private information (IRB#12-000582).

Measures:

Three temporal measures of acculturation were examined as dependent variables in the analysis: duration of residence in the US, percentage of lifetime in the US, or age at immigration. Duration of residence in years was calculated by subtracting the survey year from the year the respondent entered the US. Percentage of lifetime was calculated from years lived in the US divided by the current age of the respondent multiplied by 100. Age entered the US in years was calculated from year entered the US minus the year of birth for the respondent. These measures were only answered by foreign-born respondents (90% of the sample; not demographically different from full sample).

Acculturation measures were 11 questions that represented six aspects of acculturation: language use (3 questions), media behavior (1 question), social customs (3 questions), social contacts (1 question), cultural identity (1 question), and generational status (2 questions). These items have been included in existing scales of acculturation in the Asian American population.[11,17,22] "Language of the interview" was dichotomized into English or Asian Indian language. "How open would you be to your son marrying outside of cultural group" and "How open would you be to your daughter marrying outside of cultural group?" correlated at r=0.95. To deal with local dependency, we generated a new variable "How open would you be to your child marrying outside of cultural group" using the average of the two responses. Of note, respondents were not given a definition or characteristics of a cultural group prior to their response; the survey administrators defined culture as shared meanings, understandings, or referents held by a group of people, and is sometimes synonymous with nations and national boundaries.[23] "Nativity" (i.e., born in a developed versus non-developed country) and "Generational status" correlated at

r=0.75, and responses from both questions were averaged to form one item. Table 2-1 provides a description of the core items and possible responses.

Analysis Plan:

We hypothesized that duration of residence in the US and percentage of lifetime in the US would be greater for respondents who were more acculturated than those who were less acculturated to American culture. First, we examined the mean number of years in the US, mean percentage of lifetime in the US, and mean age at immigration by responses to the acculturation domain questions Responses to the acculturation items were analyzed both in their original categories and as dichotomized categories (described below). We also conducted standard contingency table analysis to identify temporal measure cut-off points that differed between more American acculturated responses and less acculturated responses.[24] The reference category was a dichotomized acculturation item and the classification category was the temporal measure.[24] Acculturation items were dichotomized as 0 for less acculturated or 1 for more acculturated to US culture. For example, response for "how often do you keep in contact with friends and family in India?" was dichotomized into those who responded "very often," "somewhat often," or "neither often or rarely" vs. those who responded "somewhat rarely" or "very rarely". We used a specificity cut point of greater than or equal to 0.70.

Second, we conducted exploratory factor analyses to evaluate the dimensionality of the items in the overall acculturation scale.[25] Several factor criteria (Guttman's weakest lower bound, scree plot, eigenvalue >1, and parallel analysis) were examined to determine the number of factors. An oblique (PROMAX) factor rotation was used to examine the simple structure for the plausible number of underlying factors. Then, confirmatory factor analysis was conducted to

evaluate the fit of possible models for the data. The goodness-of-fit of the confirmatory factor analysis models was evaluated using the chi-square statistic, the comparative fit index (CFI), and the root mean squared error of approximation (RMSEA). Models with a CFI of 0.90 may be considered acceptable.[25]

Third, we standardized and summed 11 questions to form an overall acculturation scale with a higher score signifying a greater level of American acculturation. Individual items were standardized on a 0-100 scale. For example, the item "how often do you speak your native language at home" had five response categories labeled 1 through 5 that were standardized to 0, 25, 50, 75, 100 (Table 2-1). Item descriptives (mean, range, skewness, kurtosis), item-scale correlations (corrected for item overlap), Cronbach's alpha internal consistency reliability, and Pearson product-moment correlations of the scale with the temporal measures were computed.

Post-stratification weights were used in the analyses to correct for non-coverage (i.e., surname omitted from sampling frame) and non-response. The post-stratification adjustments were stratified by gender and age grouping, and counties were grouped by 12 California regions used in previous tobacco control research to generate more stable weights.[21] The analyses were conducted using STATA 11.2 software.

RESULTS:

Sample Demographics

The average age of the sample was 37 years and 52% was male (Table 2-2). The majority of the sample was well-educated – only 12% had a high school degree or less compared to 43% of the US as a whole.[26] Foreign-born respondents had a mean duration of residence of 13 years,

accounting for one-third of their percentage of lifetime in the US. The median age at immigration to the US was 25 years old.

Construct Validity of Temporal Measures

In general, greater duration of residence in the US, greater percentage of lifetime in the US, and younger age at immigration were associated with more acculturated responses to the items for Asian Indian immigrants (Table 2-3 for duration of residence; Appendix Tables 2-1 and 2-2 for percentage of lifetime and age at immigration, respectively). Specifically, with increasing duration of residence in the US, Asian Indian immigrants were more likely to prefer English as their primary language (mean duration 10.7 years for non-English as primary language versus mean duration 14.4 years for English as primary language, $p<0.001$) and language of the interview (mean duration 9.9 years for non-English interview versus mean duration 12.8 years for English interview, $p<0.001$). Asian Indian immigrants with greater duration in the US were less likely to speak their native language at home (11 years for very often vs. 18 years for very rarely, $p<0.001$), read Indian newspapers, magazines, or books (10 years for very often vs. 15 years for very rarely, $p<0.001$), observe the traditional holidays important in their culture or religion (12 years for almost always vs. 14 for rarely or never, $p<0.001$), and stay in contact with family and friends in India (10 years for very often vs. 18 years for very rarely, $p<0.001$). More years in the US were also associated with second or greater generational status and respondent birth in a developed country. Responses to the acculturation items were analyzed both in their original categories and as dichotomized categories; however, we only report the former because the results were similar.

There was a non-linear relationship with frequency of Indian food consumption or openness to respondent's child marrying outside the cultural group and duration of residence in the US. Small sample sizes in some response categories may explain the lack of a linear relationship; inappropriate measures of acculturation for Asian Indians may be another explanation. For example, marriage outside of a cultural group may have been interpreted as marriage to someone of Indian descent but of a different Indian language/culture/religion (as opposed to marriage to someone of a different race/ethnicity).

Contingency table analysis suggested a meaningful cut-off at around 12-16 years duration of residence in the US and 34-40% for percentage of lifetime in the US between respondents who were more versus less acculturated to American culture (Appendix Table 2-3). Product-moment correlations between self-reported acculturation items and duration of residence in the US ranged from 0.05 for generational status to 0.32 for ethnic identity. Correlations of percentage of lifetime in the US with acculturation items ranged from 0.10 for marriage of child outside cultural group to 0.54 for generational status. Age at immigration into the US had a negative linear relationship with most acculturation items except native language spoken at home, frequency of Indian food consumption, and contacts with family and friends in India. Correlations between acculturation items and age at immigration ranged from -0.04 for contact with family and friends in India to -0.42 for generational status with a meaningful cut-off at 29-31 years of age. We would expect measures that assess acculturation domains to be negatively correlated with age at immigration because acculturation varies depending on whether the immigrant arrived as an adult or as a child, with the latter group more closely resembling the native –born population; that is, they typically report having had less exposure and ties to their country of origin.[27] We also examined the data stratified by age at immigration and duration of

residence in the US (less than or equal to/greater than 15 years), and found similar associations and linear trends among the different age at immigration categories with the same duration of residence in the US (Appendix Table 2-4).

Acculturation Scale

The number of factor criteria suggested between 2-4 factors. Promax obliquely rotated factor solutions supported a two-factor solution based on simple structure (see Table 2-4). The estimated correlation between the two factors was 0.23: though not perfect, Factor 1 appears to correspond to frequency or "how often" items (home language preference, preference for Indian/non-Indian media, social custom of traditional foods, Indian versus non-Indian social contacts, ethnic identity, and generational status) and Factor 2 corresponds to social behaviors (English fluency, respondent choice of language in the interview, and two social customs of observance of traditional holidays and openness to one's child marrying outside one's cultural group). We found five correlated errors suggested by Lagrange multiple indices and added these to improve the model fit. The factor loadings were statistically significant and moderate to large in size (see Table 2-5). The CFI for the final model was 0.89 and the RMSEA was 0.07 (90% CI: 0.062, 0.074).

Eleven items measuring different domains of acculturation were combined to form an acculturation scale. Scale scores were transformed linearly to a 0-100 possible range. The mean scale score was 39 with a standard deviation of 17, skewness of 0.45 and kurtosis of 3.04. Item-scale correlations (corrected for overlap) for the acculturation scale items ranged from 0.28-0.55 and internal consistency reliability for the scale was 0.73 (see Table 2-6a). Product-moment correlation of the scale with duration of residence in the U.S. was 0.37, with percentage of

lifetime in the U.S. was 0.45, and with age of the Asian Indian immigrant on arrival to the U.S was -0.34.; $p<0.001$ for correlations. The linear relationship between the mean acculturation scale score and duration of residence in the US among Asian Indian immigrants is shown in Appendix, Figure 2-1.

For the frequency subscale, item-scale correlations ranged from 0.36-0.50 and internal consistency reliability for the scale was 0.70 (see Table 2-6b). Product-moment correlation of the frequency subscale with duration of residence in the U.S. was 0.40, with percentage of lifetime in the U.S. was 0.48, and with age of the Asian Indian immigrant on arrival to the U.S was -0.23.; $p<0.001$ for correlations. For the social behaviors subscale, item-scale correlations ranged from 0.29-0.41 and internal consistency reliability for the scale was 0.59 (see Table 2-6b). Product-moment correlation of the social behaviors subscale with duration of residence in the U.S. was 0.21, with percentage of lifetime in the U.S. was 0.26, and with age of the Asian Indian immigrant on arrival to the U.S was -0.32.; $p<0.001$ for correlations.

DISCUSSION:

This study examined the associations of temporal measures (such as duration of residence, percentage of lifetime, and age at immigration in the US) with direct measures of acculturation among Asian Indians. While temporal measures may only partially capture acculturation, duration of residence or percentage of lifetime in the US may be better proxies for acculturation than English proficiency, interview language, or country of nativity for this population. Studies of Asians Indians cannot rely on language use as a proxy for acculturation because large majorities of Asian Indian immigrants are proficient English speakers and English is often the working language of the professional classes in their countries of origin.[13,14] Furthermore, many

Asian Indian immigrants, regardless of socioeconomic status in the US, had learned to speak, read, and write English in elementary school in India or elsewhere outside of the US and were therefore exposed to English language media from an early age.[13] Additionally, Asian Indians who immigrate to the US may have spent significant time in a Westernized country (e.g., UK for collegiate studies) prior to immigration to the US, although we were not able to quantify that percentage in our sample except for nativity in a developed country.[15]

Our study had several limitations. We developed a shorter acculturation scale than those used in the literature for Asians with acceptable reliability for group measurements, but its reliability is too low to justify its use for individual level measurement.[28] Our scale is based on a unidirectional process of acculturation, or a linear relationship between moving from one cultural identity (e.g., ethnic identity) to the other (e.g., mainstream cultural identity) over time.[9] While the strength of this assimilation model of acculturation is its simplicity, this model has been criticized for not allowing ethnic minorities to have bicultural identities, despite the fact that many ethnic minorities describe themselves as such (e.g., Indian-American).[29] As previously mentioned, temporal measures of acculturation have also been criticized. However, proxy measurement and unidirectional scales continue to be widely used in Asian immigrant health research because of the practical and financial challenges of using more in-depth psychometric scales and lack of a sound theoretical approach to acculturation-related health research.[30,31] Some have criticized the use of acculturation (and/or acculturation measures) in health research given the conceptual and methodological difficulties in the construct of acculturation, as well as its limitation as a modifiable factor in health promotion.[32,33] Given these concerns, studies examining acculturation and healthcare should also account for modifiable access and utilization indicators, such as health insurance coverage, usual source of care, patient-provider

communication, and socioeconomic status.[33] Specifically for Asian Indians who may be insular in their social activities, food, cultural and religious practices, a greater understanding of these variables may be useful in determining health outcomes.

Despite these limitations, the 11-item acculturation scale captured the breadth of acculturation. There is some support for two dimensions in the acculturation scale, one corresponding to frequency items and the other to social behaviors. The correlations of our 11-item scale scores for Asian Indians were comparable to the 21-item SL-ASIA scale scores correlations for duration of residence in the US ($r = 0.45$ vs. SL-ASIA, $r = 0.56$) and age of arrival in the US ($r = - 0.34$ vs. SL-ASIA, $r = -0.49$).[34] To provide clarity about the relationship between acculturation and health, an important next step is to estimate associations of temporal measures on health outcomes, such as obesity, self-reported health status, and smoking, with the acculturation scale items. Additional work needs to be done on understanding how acculturation and health interrelate, especially in populations with different historical perspectives, and if and how the expression of illness and objective health may change with acculturation in ethnic minorities.

Table 2-1. Acculturation Scale core items, lower-level domains, and responses

Items	Responses
LANGUAGE USE	
1. English as primary language	0=No 1=Yes
2. How often native language spoken at home?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
3. Language of interview	0=Hindi, Punjabi, Gujarati 1=English
MEDIA BEHAVIOR	
4. How often do you read Indian newspapers, magazines, books?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
SOCIAL CUSTOMS	
5. How often do you eat Indian food?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
6. How open are you to your child marrying outside of cultural group?	1=Strongly against 2=Moderately against 3=Neither open or against 4=Moderately open 5=Very open
7. Do you observe the traditional holidays in your culture/religion?	1=Yes, almost always 2=Yes, much of the time 3=Yes, some of the time 4=No, rarely or never
SOCIAL CONTACTS	
8. How often do you keep in contact with family/friends in India?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
ETHNIC IDENTITY	
9. What is your cultural identity?	1=Full-Indian 2=Indian first-American second 3=Equal blend of Indian-American 4=American first-Indian second 5=Full American
GENERATIONAL STATUS	
10. What is your generational status?	1=1st generation 2=2nd+generation
11. Were you born in a developed country?	0=No 1=Yes

Table 2-2. Characteristics of Asian Indian adults in the CAITS dataset*

	N	**%**	
Total	3228	100	
Demographics			
Sex			
Male	1782	52	
Female	1446	48	
Age, median, mean +/- SD (range)	3199	35, 37 +/- 13	(18-88)
Marital status			
Married	2502	73	
Not married	711	27	
Education level			
≤ High school graduate	350	12	
> High school graduate	2872	88	
*Temporal Measures***			
Duration of residence in US, median, mean +/- SD (range)	2951	9, 13 +/- 10	(0-56)
Percentage of lifetime in US, median, mean +/- SD (range)	2951	26, 32 +/- 22	(0-100)
Age at immigration, median, mean +/- SD (range)	2951	25, 26 +/- 11	(0-75)

*Categories may not sum to total N or 100% due to missing observations or rounding
*Survey weights applied to percentage of sample
**Temporal measures only answered by foreign-born respondents or 90% parent sample.

Table 2-3. Relationship of duration of residence in US with acculturation domains for Asian Indians*

	N	%	Mean duration (years)	95% CI	Correlation with duration in US
LANGUAGE USE					
English as primary language	2934				
Yes	1408	48	14.4	(13.8,15.0)	0.21
No	1526	52	10.7	(10.2,11.2)	
How often native language spoken at home?	2867				
Very often	1892	66	10.7	(10.2, 11.1)	
Somewhat often	516	18	14.4	(13.3, 15.4)	0.28
Neither often nor rarely	86	3	14.7	(12.6, 16.8)	
Somewhat rarely	172	6	18.8	(16.6, 20.9)	
Very rarely	172	6	18.3	(16.2, 20.5)	
Language of interview	2951				
English	2626	89	12.8	(12.4,13.3)	0.11
Hindi, Punjabi, Gujarati	325	11	9.9	(9.0, 10.7)	
MEDIA BEHAVIOR					
How often do you read Indian newspapers, magazines, books?	2938				
Very often	823	28	10.1	(9.5, 10.8)	0.21
Somewhat often	735	25	11.5	(10.7, 12.2)	
Neither often nor rarely	176	6	13.3	(11.8, 14.9)	
Somewhat rarely	441	15	13.9	(12.8, 15.0)	
Very rarely	764	26	15.4	(14.5, 16.3)	
SOCIAL CUSTOMS					
How often do you eat Indian food?	2944				
Very often	2478	81	11.8	(11.4, 12.2)	
Somewhat often	340	14	16.0	(14.6, 17.3)	0.15
Neither often nor rarely	56	2	16.4	(13.4, 19.5)	
Somewhat rarely	47	2	16.2	(12.4, 19.9)	
Very rarely	23	1	13.8	(9.2, 18.5)	
How open would you be to your child marrying outside of cultural group?	2799				
Very open	953	36	14.3	(13.6, 15.1)	
Moderately open	824	28	11.4	(10.7, 12.2)	0.10
Neither open or against	488	17	11.9	(11.0, 12.8)	
Moderately against	272	9	12.0	(10.7, 13.3)	
Strongly against	262	9	11.6	(10.5, 12.8)	
Do you observe the traditional holidays that are important in your culture and religion?	2935				
Yes, almost always	942	33	11.9	(11.2, 12.6)	0.10
Yes, much of the time	692	23	12.0	(11.2, 12.8)	
Yes, some of the time	967	32	12.8	(12.0, 13.5)	
No, rarely or never	334	12	14.4	(13.1, 15,7)	

SOCIAL CONTACTS					
How often do you keep in contact with family and friends in India?	2922				
Very often	1774	57	10.2	(9.7, 10.6)	
Somewhat often	678	23	14.9	(14.0, 15.8)	0.26
Neither often nor rarely	93	4	15.7	(13.5, 18.0)	
Somewhat rarely	169	7	17.2	(15.4, 19.0)	
Very rarely	208	9	17.5	(15.9, 19.0)	
ETHNIC IDENTITY					
Self-assessed cultural identity	2852				
Full Indian	696	24	7.6	(7.1, 8.1)	
Indian first-American second	480	16	12.3	(11.3, 13.2)	0.32
Equal blend Indian-American	1423	50	14.4	(13.8, 15.0)	
American first-Indian second	148	6	17.1	(15.0, 19.2)	
Full American	105	4	18.7	(16.3, 21.2)	
GENERATIONAL STATUS					
Nativity	2878				
Born in developed country	288	10	15.6	(13.3, 18.0)	0.05
Not born in a developed country	2590	90	12.3	(11.9, 12.7)	
Generational Status	2951				
1st generation	2597	88	11.8	(11.5, 12.2)	0.26
2+ generation**	354	12	24.6	(23.2, 26.0)	

*The N/% is different from Table 2 to reflect missing values. F-test p-value<0.0001 for all items except country of birth with F(1, 2876)=8.59, p-value=0.0034

**Respondents born abroad but immigrated to the US before age 6 were categorized as 2nd generation

Table 2-4. Promax obliquely rotated two-factor solution (standardized regression coefficients)

	Factor 1	Factor 2
Social Contacts		
8. How often keep in contact with family and friends in India	**0.7880**	-0.2501
Media Behavior		
4. How often read Indian newspapers, magazines, books	**0.6329**	-0.0152
Generational status		
10. Generational status/Born in developed country	**0.5939**	-0.0114
Language Use		
2. How often native language spoken at home	**0.5278**	0.3916
Social Customs		
5. How often eat Indian food	**0.5016**	0.2014
Ethnic Identity		
9. Self-assessed cultural identity	**0.4821**	0.0725
Language Use		
3. Language of interview	-0.1503	**0.7570**
Social Customs		
6. How open to child marrying outside cultural group	-0.0703	**0.7177**
Language Use		
1. English as primary language	0.2464	**0.5688**
Social Customs		
7. Do you observe the traditional holidays important in your culture	0.0958	**0.5216**

Factor 1: Items 2, 4, 5, 8, 9, 10; Factor 2: Items 1, 3, 6, 7. Estimated correlation Factor 1 & 2 is 0.23.

Table 2-5. Standardized parameter estimates for confirmatory factor analytic model

Item	Null (all items)	Factor 1	Factor 2
Factor 1: Frequency			
2. How often native language spoken at home	0.71	1.00	-
5. How often eat Indian food	0.45	0.60	-
4. How often read Indian newspapers, magazines, books	0.43	0.57	-
10. Generational status/Nativity	0.39	0.52	-
9. Self-assessed cultural identity	0.35	0.50	-
8. How often keep in contact with family and friends in India	0.38	0.49	-
Factor 2: Social Behaviors			
1. English as primary language	0.53		1.00
6. How open to child marrying outside cultural group	0.36		0.72
7. Do you observe the traditional holidays important in your culture	0.37		0.72
3. Language of interview	0.34		0.55

	Factor 1	Factor 2
Factor 1	1.00	
Factor 2	0.080	1.00

For the 1-factor model, the goodness-of-fit df=35, chi-square=1002.69, CFI=0.65. For the 2-factor model with correlated residuals, the goodness-of-fit df=29, chi-square=392.66, CFI=0.89. The correlated residuals for Factor 1 were home language preference and preference for Indian food (r = 0.41), frequency of contact with family/friends in India and generational status/nativity (r = 0.32), and preference for Indian media and frequency of contact with family/friends in India (r = 0.33); the correlated residuals for Factor 2 were English fluency and respondent choice of language in the interview (r = 0.35) and interview language and openness of one's child marrying outside one's cultural group (r = 0.33).

Table 2-6a. Means, standard deviations, and item-scale correlations for the acculturation scale core items treated as a single scale (n=2712)

Item	Proportion endorsed by scale					Item		Item-scale correlation*
	1	2	3	4	5	M	SD	
1. English as primary language	52	48	--	--	--	53	50	0.47
2. How often native language spoken at home	66	18	3	6	6	17	30	0.55
3. Language of interview	11	89	--	--	--	89	31	0.28
4. How often read Indian newspapers, magazines, books	28	25	6	15	26	46	40	0.39
5. How often eat Indian food	81	14	2	2	1	7	17	0.45
6. How open to child marrying outside cultural group	9	9	17	28	36	68	32	0.34
7. Do you observe the traditional holidays important in your culture	33	23	32	12	0	42	34	0.31
8. How often keep in contact with family and friends in India	57	23	4	7	9	21	32	0.38
9. Self-assessed cultural identity	24	16	50	6	4	38	26	0.36
10. Generational status/Nativity	86	14	0	0	0	13	33	0.40
						M	SD	Cronbach's alpha
Scale						39	17	0.73

*Item-scale correlations are corrected for overlap. The scale scores were the sum of the 10 items and were formed by linear transformations to a 0-100 distribution.

Table 2-6b: Means, Standard deviations, and item-scale correlations for the Acculturation Scale core items treated as two dimensions

Item	Proportion endorsed by scale					Item		Item-scale correlation*
	1	2	3	4	5	M	SD	
FACTOR 1: frequency								
2. How often native language spoken at home	66	18	3	6	6	17	30	0.46
4. How often read Indian newspapers, magazines, books	28	25	6	15	26	46	40	0.42
5. How often eat Indian food	81	14	2	2	1	7	17	0.45
8. How often keep in contact with family and friends in India	57	23	4	7	9	21	32	0.50
9. Self-assessed cultural identity	24	16	50	6	4	38	26	0.36
10. Generational status/Nativity	86	14	--	--	--	13	33	0.43
						M	**SD**	**Cronbach's alpha**
Scale Factor 1						23	18	0.70
FACTOR 2: social behaviors								
1. English as primary language	52	48	--	--	--	53	50	0.38
3. Language of interview	11	89	--	--	--	89	31	0.41
6. How open to child marrying outside cultural group	9	9	17	28	36	68	32	0.41
7. Do you observe the traditional holidays important in your culture	33	23	32	12	0	42	34	0.29
						M	**SD**	**Cronbach's alpha**
Scale Factor 2						63	24	0.59

*Item-scale correlations are corrected for overlap. The two scale scores were the sum of the items and were formed by linear transformations to a 0-100 distribution.
Factor 1 scale's Pearson product-moment correlations: years in US, r= 0.40; percentage lifetime in US, r= 0.48; age entered US, r= -0.23
Factor 2 scale's Pearson product-moment correlations: years in US, r= 0.21; percentage lifetime in US, r= 0.26; age entered US, r= -0.32

APPENDIX: Chapter 2

Table 2-1. Relationship of percentage lifetime in US with acculturation domains for Asian Indians*

	N	%	Percentage of Lifetime in US (%)	95% CI	Correlation with percentage lifetime
LANGUAGE USE					
English as primary language	2,958				0.26
Yes	1,463	49	37.8	(36.3, 39.4)	
No	1,495	51	26.9	(25.8, 28.0)	
How often native language spoken at home?	2890				0.27
Very often	1988	69	27.7	(26.7, 28.7)	
Somewhat often	493	17	37.4	(34.7, 40.0)	
Neither often nor rarely	86	3	39.9	(34.4, 45.5)	
Somewhat rarely	148	5	47.2	(42.0, 52.4)	
Very rarely	175	6	41.7	(37.6, 45.8)	
Language of interview	2975				0.18
English	2634	88	33.7	(32.6, 34.7)	
Hindi, Punjabi, Gujarati	341	12	22.0	(20.2, 23.7)	
MEDIA BEHAVIOR					
How often do you read Indian newspapers, magazines, books?	2962				0.24
Very often	912	30	25.7	(24.5, 27.0)	
Somewhat often	765	25	29.6	(27.8, 31.4)	
Neither often nor rarely	178	6	35.0	(31.1, 39.0)	
Somewhat rarely	436	15	36.6	(33.9, 39.4)	
Very rarely	671	23	39.9	(37.8, 42.1)	
SOCIAL CUSTOMS					
How often do you eat Indian food?	2968				0.17
Very often	2498	84	30.4	(29.4, 31.3)	
Somewhat often	344	12	41.4	(38.1, 44.7)	
Neither often nor rarely	56	2	44.4	(36.8, 52.0)	
Somewhat rarely	47	2	46.5	(35.3, 57.6)	
Very rarely	23	1	35.2	(26.7, 43.8)	
How open would you be to your child marrying outside of cultural group?	2819				0.10
Very open	962	34	36.7	(34.9, 38.6)	
Moderately open	832	29	29.3	(27.7, 31.0)	
Neither open or against	489	17	31.5	(29.2, 33.8)	
Moderately against	273	9	30.9	(27.8, 34.1)	
Strongly against	263	10	30.4	(27.4, 33.5)	
Do you observe the traditional holidays that are important in your culture and religion?	2959				0.11
Yes, almost always	945	34	30.8	(29.1, 32.5)	
Yes, much of the time	702	23	31.3	(29.4, 33.2)	
Yes, some of the time	974	31	32.9	(31.2, 34.6)	
No, rarely or never	338	12	36.8	(33.9, 40.0)	

SOCIAL CONTACTS					
How often do you keep in contact with family and friends in India?	2945				0.28
Very often	1792	60	26.7	(25.8, 27.7)	
Somewhat often	682	23	37.0	(34.9, 39.1)	
Neither often nor rarely	94	3	43.2	(36.6, 49.7)	
Somewhat rarely	169	6	43.5	(39.0, 48.0)	
Very rarely	208	8	46.2	(42.1, 50.3)	
ETHNIC IDENTITY					
Self-assessed cultural identity	2876				0.30
Full Indian	698	26	21.5	(20.2, 22.8)	
Indian first-American second	487	17	32.7	(30.3, 35.2)	
Equal blend Indian-American	1438	50	36.4	(35.0, 37.8)	
American first-Indian second	148	5	42.2	(37.1, 47.3)	
Full American	105	3	44.1	(38.2, 50.1)	
GENERATIONAL STATUS					
Country of birth	2902				0.14
Born in developed country	73	3	51.1	(43.5, 58.6)	
Not born in a developed country	2829	97	31.4	(30.4, 32.3)	
Generational Status	2951				0.54
1st generation	2843	95	29.2	(28.4, 29.9)	
2+ generation**	108	5	91.1	(89.6, 92.7)	

*The N/% is different from Table 2 to reflect missing values. F-test p-value<0.0001 for all items.
**Respondents born abroad but immigrated to the US before age 6 were categorized as 2nd generation

APPENDIX: Chapter 2

Table 2-2. Relationship of age at immigration to the US with acculturation domains for Asian Indians*

	N	%	Mean age at immigration	95% CI	Correlation with age at immigration
LANGUAGE USE					
English as primary language	2,958				-0.23
Yes	1,463	49	22.6	(22.0, 23.2)	
No	1,495	51	27.8	(27.2, 28.5)	
How often native language spoken at home?	2890				-0.17
Very often	1988	69	26.9	(26.3, 27.4)	
Somewhat often	493	17	23.4	(22.3, 24.5)	
Neither often nor rarely	86	3	21.9	(19.4, 24.4)	
Somewhat rarely	148	5	20.3	(18.3, 22.2)	
Very rarely	175	6	22.7	(21.1, 24.2)	
Language of interview	2975				-0.36
English	2634	88	23.7	(23.3, 24.1)	
Hindi, Punjabi, Gujarati	341	12	36.5	(34.8, 38.2)	
MEDIA BEHAVIOR					
How often do you read Indian newspapers, magazines, books?	2962				-0.13
Very often	912	30	27.2	(26.4, 28.0)	
Somewhat often	765	25	25.9	(25.1, 26.8)	
Neither often nor rarely	178	6	25.1	(22.8, 27.3)	
Somewhat rarely	436	15	23.7	(22.4, 25.0)	
Very rarely	671	23	23.0	(21.9, 24.0)	
SOCIAL CUSTOMS					
How often do you eat Indian food?	2968				-0.14
Very often	2498	84	26.1	(25.6, 26.6)	
Somewhat often	344	12	21.2	(19.9, 22.5)	
Neither often nor rarely	56	2	20.2	(17.1, 23.3)	
Somewhat rarely	47	2	18.0	(14.5, 21.4)	
Very rarely	23	1	22.8	(18.5, 27.1)	
How open would you be to your child marrying outside of cultural group?	2819				-0.14
Very open	962	34	23.5	(22.7, 24.3)	
Moderately open	832	29	25.1	(24.5, 25.8)	
Neither open or against	489	17	25.9	(24.7, 27.2)	
Moderately against	273	9	27.2	(25.4, 29.1)	
Strongly against	263	10	27.9	(26.0, 29.8)	
Do you observe the traditional holidays that are important in your culture and religion?	2959				-0.12
Yes, almost always	945	34	26.7	(25.8, 27.6)	
Yes, much of the time	702	23	25.5	(24.5, 26.5)	
Yes, some of the time	974	31	24.4	(23.7, 25.1)	
No, rarely or never	338	12	22.9	(21.7, 24.2)	

SOCIAL CONTACTS					
How often do you keep in contact with family and friends in India?	2945				-0.04
Very often	1792	60	25.9	(25.4, 26.4)	
Somewhat often	682	23	25.1	(24.1, 26.1)	
Neither often nor rarely	94	3	22.8	(19.3, 26.3)	
Somewhat rarely	169	6	24.9	(22.2, 27.7)	
Very rarely	208	8	22.5	(20.4, 24.7)	
ETHNIC IDENTITY					
Self-assessed cultural identity	2876				-0.05
Full Indian	698	26	26.6	(25.8, 27.4)	
Indian first-American second	487	17	24.9	(23.8, 26.1)	
Equal blend Indian-American	1438	50	24.9	(24.1, 25.6)	
American first-Indian second	148	5	23.9	(21.4, 26.5)	
Full American	105	3	23.7	(20.8, 26.6)	
GENERATIONAL STATUS					
Country of birth	2902				-0.16
Born in developed country	73	3	15.0	(12.5, 17.5)	
Not born in a developed country	2829	97	25.7	(25.2, 26.2)	
Generational Status	2951				-0.42
1st generation	2843	95	26.5	(26.0, 26.9)	
2+ generation**	108	5	2.3	(1.9, 2.6)	

*The N/% is different from Table 1 to reflect missing values. F-test p-value<0.0001 for all items except contact with family/friends with F(4, 2917)=1.84, p-value=0.12 and ethnic identity with F(4, 2847)=2.12, p=0.08.

**Respondents born abroad but immigrated to the US before age 6 were categorized as 2nd generation

APPENDIX: Chapter 2

Table 2-3. Contingency table analysis for acculturation measures with duration of residence in US (years)

Question/Item	Cut point (years)	Sensitivity	Specificity	Correctly classified (%)
Language Use				
1. English as primary language	>= 14	0.46	0.72	59.2
2. How often native language spoken at home	>= 15	0.56	0.71	68.7
3. Language of interview	>= 13	0.41	0.71	44.7
Media Behavior				
4. How often read Indian newspapers, magazines, books	>= 14	0.46	0.70	59.8
Social Customs				
5. How often eat Indian food	>= 16	0.49	0.70	69.7
6. How open to child marrying outside cultural group	>= 16	0.32	0.73	39.9
7. Do you observe the traditional holidays important in your culture	>= 16	0.41	0.70	66.9
Social Contacts				
8. How often keep in contact with family and friends in India	>= 15	0.56	0.70	68.2
Ethnic Identity				
9. Self-assessed cultural identity	>= 12	0.54	0.71	60.8
Generational status				
10. Generational status	>= 16	0.51	0.70	69.3
11. Born in developed country	>= 16	0.96	0.71	72.3

APPENDIX: Chapter 2

Table 2-4. Relationship between mean duration of residence in the US and acculturation items for Asian Indians; stratified by duration of residence in US (<15 or >=15 y) and age at immigration (0-19y, 20-29y, 30-39y, 40+y)

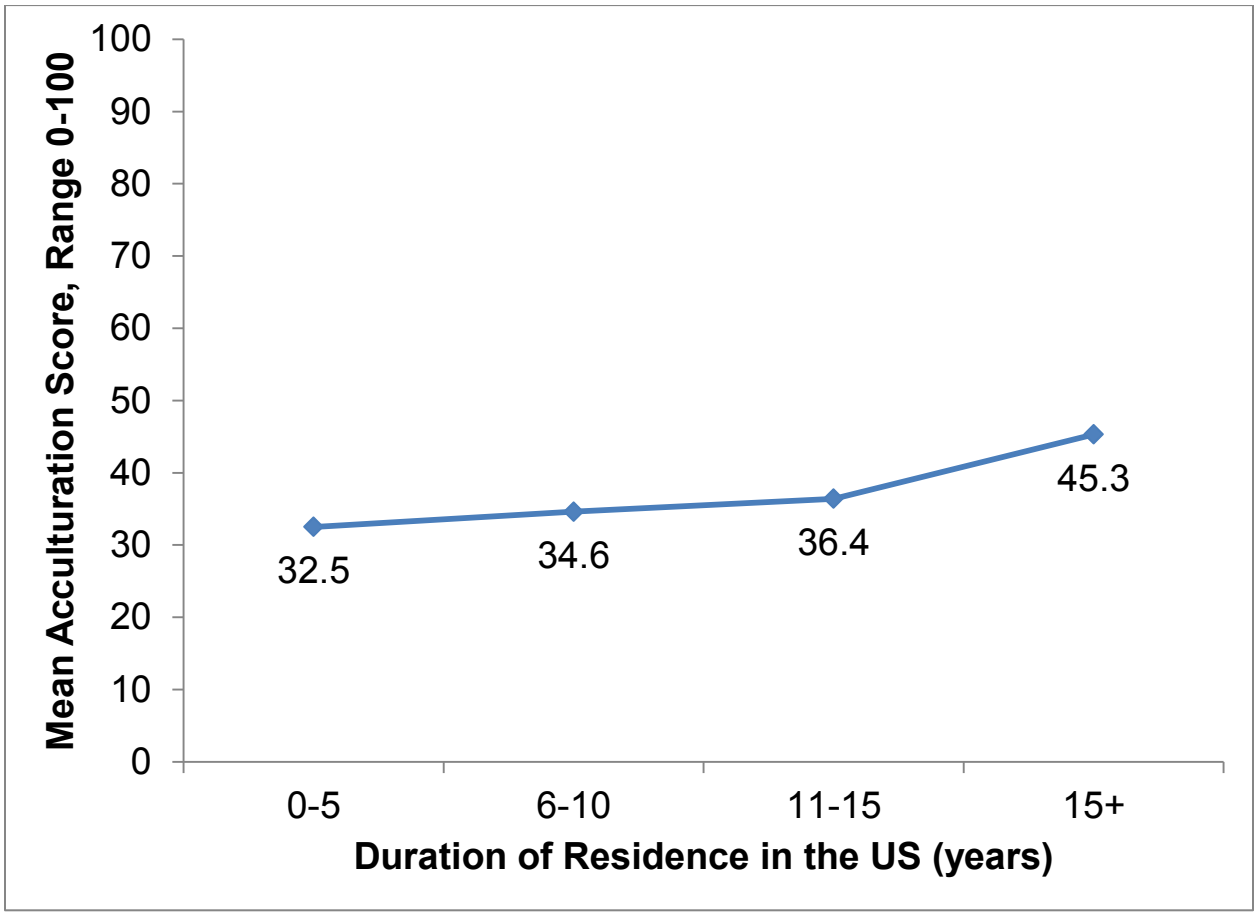
	Less than 15 years lived in US				**Equal to or Greater than 15 years lived in US**			
Age at immigration →	**0-19y**	**20-29y**	**30-39y**	**40+y**	**0-19y**	**20-29y**	**30-39y**	**40+y**
LANGUAGE USE								
English as primary language	r= 0.06	r = 0.07*	r = 0.09	r=0.1	r = -0.02	r = 0.11*	r = 0.15	r=0.1
Yes	8.3	6.2	6.8	6.7	25.8	25.9	25.8	22.0
No	8.2	5.9	6.2	6.0	25.9	24.2	24.0	21.0
How often native language spoken at home?	r= 0.19*	r = 0.09*	r = 0.02	r=0.07	r = 0.16*	r = 0.27*	r = 0.10	r=0.2
Very often	7.6	5.9	6.4	6.5	23.7	23.6	24.3	23.0
Somewhat often	9.6	6.4	6.6	5.9	27.5	26.2	24.5	18.6
Neither often nor rarely	10.0	7.4	5.4	-	23.0	22.5	25.5	-
Somewhat rarely	9.1	6.3	6.2	-	32.0	26.9	27.8	22.3
Very rarely	9.2	6.4	7.1	7.3	26.0	30.7	25.8	32.0
Language of interview	r= 0.09	r= -0.02	r= -0.03	r=0.1	r= -0.01	r= 0.14*	r=0.14	r=0.2*
English	8.1	6.0	6.3	6.3	25.7	25.6	25.1	24.3
Hindi, Punjabi, Guajarati	7.6	6.8	6.8	6.7	23.5	20.4	23.0	20.7
MEDIA BEHAVIOR								
How often do you read Indian newspapers, magazines, books?	r= 0.09	r= 0.06*	r = -0.04	r=0.2*	r= -0.04	r= 0.18*	r= 0.16	r=0.07
Very often	7.0	5.9	6.6	4.7	25.5	23.6	24.5	21.6
Somewhat often	8.3	5.9	6.3	6.5	25.4	25.2	23.7	20.2
Neither often nor rarely	8.8	6.8	5.6	8.0	24.7	23.9	20.3	27.0
Somewhat rarely	9.1	6.6	7.2	6.5	25.0	25.6	26.6	18.0
Very rarely	8.3	6.2	5.8	7.0	24.9	26.8	26.4	23.4
SOCIAL CUSTOMS								
How often do you eat Indian food?	r= -0.04	r= 0.00	r= -0.10	r=0	r= 0.04	r= 0.26*	r= 0.14	r=-.04
Very often	8.2	6.1	6.5	6.1	24.7	24.4	23.4	21.2
Somewhat often	8.1	6.0	6.7	6.3	26.2	28.3	27.5	24.8
Neither often nor rarely	12.2	6.6	4.4	5.0	25.4	27.0	36.0	19.6
Somewhat rarely	8.0	4.6	4.6	-	23.7	39.8	27.9	-
Very rarely	4.5	8.0	1.5	-	27.6	21.0	27.0	17.0
How open would you be to your child marrying outside of cultural group?	r= -0.07	r= -0.03	r= 0.06	r=-0.1	r= 0.05	r= 0.16*	r= 0.24*	r=0.19
Very open	8.0	6.7	5.7	6.6	24.1	22.6	22.7	19.3
Moderately open	9.3	6.3	6.5	6.8	26.3	23.0	19.9	21.0
Neither open or against	7.7	6.1	6.3	6.3	23.9	24.2	25.9	19.3
Moderately against	9.3	5.7	6.6	6.1	26.1	25.1	25.3	20.9
Strongly against	7.7	6.2	6.7	5.7	25.3	26.7	25.7	23.3

Do you observe the traditional holidays that are important in your culture and religion?	r= 0.01	r=0.08	r= -0.03	r=0.1	r= 0.12*	r= 0.11*	r= 0.11	r=0.19
Yes, almost always	8.1	5.9	6.8	5.9	24.2	23.1	24.7	20.8
Yes, much of the time	8.6	6.0	5.8	6.3	24.9	25.8	23.2	20.7
Yes, some of the time	8.5	6.2	6.2	6.3	25.4	26.3	25.3	22.8
No, rarely or never	7.7	6.5	6.9	7.1	26.6	26.0	26.4	24.3
SOCIAL CONTACTS								
How often do you keep in contact with family and friends in India?	r= -0.06	r= 0.05	r= 0.07	r=0.1	r= 0.04	r= 0.10*	r= 0.12	r=0.12
Very often	8.2	6.0	6.3	5.6	25.1	24.5	23.3	20.2
Somewhat often	8.2	6.5	6.4	6.7	24.9	26.1	25.5	22.3
Neither often nor rarely	9.6	5.3	7.3	7.9	25.9	24.2	21.0	21.9
Somewhat rarely	9.0	7.3	6.2	5.9	25.6	26.4	27.1	23.2
Very rarely	6.8	6.3	7.9	6.5	24.7	26.0	26.7	21.4
ETHNIC IDENTITY								
Self-assessed cultural identity	r= 0.07	r= 0.21*	r= 0.20*	r= 0.3*	r= 0.12*	r= 0.23*	r= 0.21*	r= 0.09
Full Indian	7.3	5.2	5.0	4.7	24.4	21.2	21.8	20.9
Indian first-American second	8.8	6.6	7.1	5.3	24.0	24.0	22.2	20.1
Equal blend Indian-American	8.7	6.6	7.0	6.9	24.7	25.5	26.0	22.1
American first-Indian second	7.0	7.7	7.6	7.6	29.2	27.4	29.1	21.6
Full American	7.2	7.6	6.5	7.1	26.0	30.4	26.2	22.0
GENERATIONAL STATUS								
Country of birth	r= 0.02	r= -0.03	r= -0.00	-	r= -0.03	r= 0.03	r= -0.05	-
Born in developed country	8.2	6.1	6.4	6.1	25.1	25.2	24.7	21.3
Not born in a developed country	8.4	5.5	6.5	-	23.7	27.3	21.0	-
Generational Status	r= 0.17*	-	-	-	r= 0.09	-	-	-
1st generation	8.2	6.1	6.4	6.1	25.2	25.2	24.8	21.3
2+ generation**	14.0	-	-	-	24.9	-	-	-

- Survey weights were applied. r = Pearson product-moment correlation of acculturation item with age at immigration category
- Sample Sizes for age at immigration: 0-19 (n=481, 21.1%); 20-29 (n=1690, 54.6%); 30-39 (n=477, 14.4%); 40+ (n=303, 10%)
- Sample sizes for age at immigration and duration of residence: Less than 15y duration: 0-19 (n=166); 20-29 (n=1204); 30-39 (n=339); 40+ (n=227)
- Sample sizes for age at immigration and duration of residence: Equal or greater 15y duration: 0-19 (n=311); 20-29 (n=479); 30-39 (n=133); 40+ (n=75)
- *p<0.05 for correlations with years of duration in US (r); **Respondents born abroad but immigrated to the US before age 6

APPENDIX: Chapter 2

Figure 2-1. Mean acculturation score by Duration of Residence in the US among Asian Indian immigrants, n=2,557. Higher acculturation score correlates with greater acculturation to American culture.



REFERENCES

1. Martin P, Midgley E. Immigration: shaping and reshaping America. *Population.* 2003;58(2):1-46.

2. Clark L, Hofsess L. Acculturation. In: Loue S, ed. *Handbook of Immigrant Health*. New York, NY: Plenum Press; 1998:37-59.

3. Argeseanu Cunningham S, Ruben JD, Venkat Narayan KM. Health of foreign-born people in the United States: A review. *Health & Place.* 2008;14(4):623-635.

4. Facione NC, Giancarlo C, Chan L. Perceived risk and help-seeking behavior for breast cancer. A Chinese-American perspective. *Cancer Nurs.* Aug 2000;23(4):258-267.

5. Wu TY, West B, Chen YW, Hergert C. Health beliefs and practices related to breast cancer screening in Filipino, Chinese and Asian-Indian women. *Cancer Detect Prev.* 2006;30(1):58-66.

6. Parsa P, Kandiah M, Abdul Rahman H, Zulkefli NM. Barriers for breast cancer screening among Asian women: a mini literature review. *Asian Pacific journal of cancer prevention.* 2006;7(4):509-514.

7. Rogler LH, Cortes DE, Malgady RG. Acculturation and mental health status among Hispanics: Convergence and new directions for research. *American Psychologist.* 1991;46(6):585-597.

8. Salant T, Lauderdale DS. Measuring culture: a critical review of acculturation and health in Asian immigrant populations. *Social Science & Medicine.* 2003;57(1):71-90.

9. Gordon MM. *Assimilation in American life: The role of race, religion, and national origins*: Oxford University Press, USA; 1964.

10. Berry J, Sam D. Acculturation and adaptation. In: Berry JW, Segal MH, Kagitcibasi C, eds. *Handbook of cross-cultural psychology: Social behavior and applications.* Vol 3. Boston, MA: Allyn and Bacon; 1997:291–326.

11. Abe-Kim J, Okazaki S, Goto SG. Unidimensional versus multidimensional approaches to the assessment of acculturation for Asian American populations. *Cultur Divers Ethnic Minor Psychol.* Aug 2001;7(3):232-246.

12. Thomson MD, Hoffman-Goetz L. Defining and measuring acculturation: A systematic review of public health studies with Hispanic populations in the United States. *Social Science & Medicine.* 2009;69(7):983-991.

13. Mehta S. Relationship between acculturation and mental health for Asian Indian immigrants in the United States. *Genetic, Social, and General Psychology Monographs.* Feb 1998;124(1):61-78.

14. Mogelonsky M. Asian-Indian Americans. *American Demographics.* 1995;17(8):32-39.

15. McCarthy WJ, Divan HA, Shah DB. Immigrant status and smoking. *Am J Public Health.* Oct 2003;93(10):1616; author reply 1616-1617.

16. Barry DT. Development of a New Scale for Measuring Acculturation: The East Asian Acculturation Measure (EAAM). *Journal of Immigrant Health.* 2001;3(4):193-197.

17. Chung G, Ruth H, Kim B, Abreu J. Asian American Multidimensional Acculturation Scale: Development, Factor Analysis, Reliability, and Validity. *Cultural Diversity and Ethnic Minority Psychology.* 2004;10(1):66-80.

18. Kim BK, Li LC, Ng GF. The Asian American values scale--multidimensional: development, reliability, and validity. *Cultur Divers Ethnic Minor Psychol.* Aug 2005;11(3):187-201.

19. Suinn RM, Rickard-Figueroa K, Lew S, Vigil P. The Suinn-Lew Asian Self-Identity Acculturation Scale: An Initial Report. *Educational and Psychological Measurement.* Summer 1987;47(2):401-407.

20. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the Asian adult population: United States, 2004–2006. Advance data from vital and health statistics; no 394. Hyattsville, MD: National Center for Health Statistics. 2008.

21. McCarthy WJ, Divan H, Shah D, et al. *California Asian Indian Tobacco Survey – 2004.* Sacramento, CA: California Department of Health Services;2005.

22. Anderson J, Moeschberger M, Chen MS, Jr., Kunn P, Wewers ME, Guthrie R. An acculturation scale for Southeast Asians. *Soc Psychiatry Psychiatr Epidemiol.* Jul 1993;28(3):134-141.

23. Shore B. Taking culture seriously. *Human Development.* 2000;45(4):226-228.

24. Hays RD, Revetto JP. Old and new MMPI-derived scales and the short-MAST as screening tools for alcohol disorder. *Alcohol and Alcoholism.* 1992;27(6):685-695.

25. Hays R, Fayers P. Evaluating multi-item scales. In: Fayers PM, Hays RD, eds. *Assessing quality of life in clinical trials: methods and practice*. New York: Oxford University Press, USA; 2005:41-53.

26. Ryan CL, Siebens J. Educational Attainment in the United States: 2009. *Current Population Reports. Report P20-566* http://www.census.gov/prod/2012pubs/p20-566.pdf. Accessed February, 2012.

27. Williams D, Mohammed S. Discrimination and racial disparities in health: evidence and needed research. *Journal of Behavioral Medicine.* 2009;32(1):20-47.

28. Nunnally Jum C, Bernstein Ira H. Psychometric theory: New York: McGraw-Hill; 1978.

29. Nguyen HH, von Eye A. The acculturation scale for Vietnamese adolescents (ASVA): A bidimensional perspective. *International Journal of Behavioral Development.* 2002;26(3):202-213.

30. Abraido-Lanza AF, Armbrister AN, Florez KR, Aguirre AN. Toward a Theory-Driven Model of Acculturation in Public Health Research. *Am J Public Health.* August 1, 2006;96(8):1342-1346.

31. Baker D. Conceptual parameters of acculturation within the asian and pacific islander american populations: applications for nursing practice and research. *Nurs Forum.* Apr 2011;46(2):83-93.

32. Hunt LM, Schneider S, Comer B. Should "acculturation" be a variable in health research? A critical review of research on US Hispanics. *Social Science & Medicine.* 2004;59(5):973-986.

33. Pourat N, Kagawa-Singer M, Breen N, Sripipatana A. Access Versus Acculturation: Identifying Modifiable Factors to Promote Cancer Screening Among Asian American Women. *Medical Care.* 2010;48(12):1088-1096

34. Suinn RM, Ahuna C, Khoo G. The Suinn-Lew Asian Self-Identity Acculturation Scale: Concurrent and Factorial Validation. *Educational and Psychological Measurement.* Winter 1992;52(4):1041-1046.

Chapter 3: The Association of Duration of Residence with Cardiovascular Disease Risk Factors among South Asian Immigrants in the United States: findings from two population-based surveys

ABSTRACT

Objective: To examine the association between duration of residence in the United States (US) and cardiovascular disease (CVD) risk factors among Asian Indian and South Asian adult immigrants. South Asians have greater CVD mortality than the general US population.

Methods: We examined data from the National Health Interview Surveys (NHIS) 2005-2009 and California Health Interview Surveys (CHIS) 2005-2009 using bivariate and multivariate logistic regression.

Results: Duration of residence in the US < 15 years was significantly associated with decreased odds of overweight/obese BMI (OR 0.59; 95% CI: 0.35, 0.98 for 5-<10 years in CHIS), five or more servings of daily fruit and vegetable intake (OR 0.37; 95% CI: 0.15, 0.94 for 10-<15 years in CHIS), and alcohol intake (OR 0.37; 95% CI: 0.23, 0.58 for 0-<5 years; OR 0.49; 95% CI: 0.29, 0.82 for 5-<10 years in NHIS) compared with duration of residence ≥ 15 years among South Asian immigrants after adjusting for age at immigration, gender, marital status, educational attainment +/- household income, health status, health insurance +/- usual source of care, and other confounding health behaviors. Length of residence < 15 years was also significantly associated increased odds of sedentary lifestyle (OR 2.11; 95% CI: 1.17, 3.81 for 10-<15y in CHIS) compared with South Asian immigrants residing in the US ≥ 15 years in adjusted models. Duration of residence in the US was positively associated with hypertension,

high cholesterol, and diabetes, and negatively associated with current smoking, fast food, and soda intake, but these associations did not remain significant after adjusting for confounders. Age at immigration modified the relationship between duration of residence and BMI, binge drinking, and alcohol use. Health behaviors, such as binge drinking, heavy alcohol use, smoking, physical activity, daily fruit and vegetable intake, and overweight/obese BMI were not found to mediate the relationship between duration of residence in the US and hypertension, diabetes, and overweight/obese BMI.

Conclusion: For South Asian immigrants, the duration of residence in the US is an important factor in obesity, physical activity, fruit and vegetable intake, and alcohol use. Future research should examine physical activity and dietary patterns in this population, as well as develop interventions to reduce their risk of acculturation-related overweight and obesity.

Keywords: Asian Americans, immigrants, acculturation, cardiovascular disease risk factors, United States

INTRODUCTION:

South Asians are people with origins in India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and the Maldives. In the United States (US), South Asians are among the fastest growing ethnic/immigrant groups with a growth rate of 70% from the 2000 to the 2010 Census, now consisting of 1-2% of the total population.[1] California is the state with the largest population of South Asians.[2]

Studies have shown that people in South Asian countries have earlier incidence and greater premature mortality from cardiovascular disease (CVD) than people in Western countries, and that this disparity persists for South Asian immigrants.[3-17] Prevalence and mortality rates for South Asians in the US are limited because South Asians are either classified as "Asian" or "Other" race/ethnicity on death certificates and national datasets, or because national surveys are not conducted in South Asian languages.[18] In California, CVD is the leading cause of death in Asian Indians (largest subgroup of South Asians; 90%).[3] Asian Indians have 2-3 times the CHD mortality rate of the total population at all age groups, and young Asian Indian men ages 25-44 years are at particularly high relative risk of death from CHD (three times) than their agemates in the general population.[4] In one study, Asians Indians had more than three times the rate of hospitalization for ischemic heart disease than non-Hispanic Whites in Northern California (relative risk 3.7).[19] Epidemiologic studies have documented that South Asian immigrants have higher prevalence of CVD risk factors, such as diabetes, dyslipidemia, genetic predisposition to central adiposity, metabolic syndrome, physical inactivity, and diets high in saturated fats and low in fruits, vegetables, and fiber than the general population.[6,9,11,20-30]

One possible moderator of CVD risk factors for South Asians living in the US is duration of residence in the US, which has often been used as a proxy measure for acculturation. Duration of residence in the US has been positively associated with atherosclerosis, hypertension, hyperlipidemia, diabetes, obesity, and smoking in immigrants.[31-39] In addition, it has been shown that immigrants who arrive to the US at younger ages may be at higher risk for diabetes and obesity with increasing duration of residence in the US than immigrants who arrive at later ages.[32,38]

The impact of duration of residence in the US or acculturation on the already high CVD risk among South Asians is unclear. Several researchers have postulated that after immigration, South Asians who adopt the diet and physical activity behaviors (i.e., more sedentary than in home country) of a Western lifestyle may have amplified their genetic risk of diabetes and CVD (i.e., gene-environment interaction).[18,40-42] The impact of duration of residence and age at immigration on CVD risk factors has not been studied in South Asian immigrants in the US. Our objective was to examine the relationship of duration of residence on multiple CVD risk factors among South Asian adult immigrants using two population-based surveys.

METHODS:

Data Source

We used two population-based surveys for this study – the National Health Interview Survey (NHIS) and the California Health Interview Survey (CHIS).

NHIS is a nationally representative, annual household interview of the civilian non-institutionalized population in the US conducted by the National Center for Health Statistics

(http://www.cdc.gov/nchs/nhis.htm). NHIS collects data using computer-assisted personal interviewing survey in English, Spanish, or other language if an interpreter is available, with a new sample of respondents interviewed each year. A multistage area probability sampling design is used, and the first stage of the sampling plan consists of a sample of 428 primary sampling units (PSU's) drawn from approximately 1,900 geographically defined PSU's that cover the 50 States and the District of Columbia. A PSU consists of a county, a small group of contiguous counties, or a metropolitan statistical area. Within a PSU, two types of second-stage units are used: area segments and permit segments. Area segments are defined geographically and contain an expected eight, twelve, or sixteen addresses. Permit segments cover housing units built after the 2000 census. The NHIS sample plan oversamples Black persons and Hispanic persons, and Asian persons since 2006. The annual response rate of NHIS is close to 90 percent of the eligible households in the sample. Respondents provide self-reported information about basic measures of health status, utilization of health services, and social and demographic characteristics. In addition, one randomly selected adult per household is asked to complete the Sample Adult Module which elicits more detailed information on health care services, behavior, and health status. The samples are weighted to account for the complex sampling design and for non-response. Public-use datasets are available for NHIS 2005-2009, and for each of the five years, more than 21,000 adults were sampled. Pooling these current years provides 80% power to see an association between the dependent and independent variables for the subsample of Asian Indian adult immigrants (power calculations not shown; an exception for adequate power is high cholesterol which was limited to years 2007 & 2008).[43-47]

CHIS is a representative random-digit dial (RDD) telephone survey of California's non-institutionalized population living in households conducted every other year since 2001. It is the

largest statewide health survey and one of the largest health surveys in the nation. The survey is conducted by the UCLA Center for Health Policy Research with several collaborators, and collects extensive information on health status, health conditions, health-related behaviors, health insurance coverage, access to health care services, and other health related issues for all age groups. CHIS employs a multi-stage sample design to provide estimates for most counties and major racial/ethnic groups. The RDD sample includes telephone numbers assigned to both landline and cellular service. For the landline RDD sample, the state is divided into 56 geographic sampling strata. Within each geographic stratum, residential telephone numbers are selected, and within each household, one adult (age 18 and over) respondent is randomly selected. The CHIS sample design oversamples Koreans and Vietnamese in geographically targeted areas with supplements of group-specific surnames drawn from listed telephone directories. A separate RDD sample for telephone numbers assigned to cellular service helps compensate for the increasing number of households without a landline telephone service for CHIS 2007 and CHIS 2009. CHIS interviews are administered using computer-assisted telephone interviewing and are conducted in English, Spanish, Chinese, Vietnamese, and Korean (no traditional South Asian languages are represented). The overall adult response rate for CHIS 2005-2009 ranges from 20-30%. The overall adult response rate is a composite of the screener completion rate (i.e., success in introducing the survey to a household and randomly selecting an adult to be interviewed: range 20-36%) and the interview completion rate (i.e., success in getting one or more selected persons to complete the interview: range 50-60%). Historically, CHIS response rates have been comparable to response rates of other scientific telephone surveys in California.[48-50] The samples are weighted to account for the complex sampling design and for non-response in order to represent the non-institutionalized population for each sampling stratum and statewide. A person-level weight is created using a raking method so that CHIS estimates

are consistent with population control totals. Raking is an iterative procedure that forces the CHIS weights to sum to known population control totals from an independent data source (e.g., California Department of Finance Population Estimates). The raking procedure uses 11 raking dimensions, which are a combination of demographic variables, geographic variables, household composition, and socio-economic variables. Public-use datasets are available for CHIS 2005, 2007, 2009, and for each of the three years, more than 43,000 adults were sampled. Pooling these years provides 80% power to see an association between the dependent and independent variables for the subsample of South Asian adult immigrants (power calculations not shown; an exception for adequate power is high cholesterol which was limited to 2005).[48-50]

Asian Indian or South Asian Adult Immigrant Subpopulation

NHIS provided survey information for Asian Indians (Asian Indians represent 90 percent of the South Asians in the US[18]), while CHIS provided survey information for South Asians. For both surveys, Asian Indians or South Asians were primarily identified through self-report of race/ethnicity using definitions from the 2000 US Census. In addition, if respondents identified that their origins were from India, Pakistan, Sri Lanka, Bangladesh, Bhutan, or Nepal, they were also considered South Asian. For the NHIS sample, the subpopulation included Asian Indians (4,337/412,811), adults who were at least 18 years old (3,248/4,337), foreign-born respondents to the duration of residence in US question (3,166/4,337), and respondents with non-missing observations for BMI (1,163/1,200 Asian Indians). Only a subsample of the Asian Indian adult immigrant subpopulation (1,056/2,782) was asked questions about CVD risk factors (e.g., BMI) or usual source of care. For the CHIS sample, the subpopulation included South Asian adults (1,272/141,682) who responded to the duration of residence in the US question for foreign-born respondents (1,169/1,272).

Outcome – Cardiovascular Disease Risk Factors

- Hypertension: respondents answered yes-no to questions asking whether they had ever been told by a doctor or healthcare provider that they have hypertension or high blood pressure. Eleven observations were dropped because of unknown status in the CHIS sample (0.9% of the subpopulation).
- Hypercholesterolemia: respondents answered yes-no to questions asking whether they had ever been told by a doctor or healthcare provider that they have high cholesterol. This question was only available in NHIS 2007 & 2008 and CHIS 2005. One observation was dropped from the NHIS sample (0.3% of the subpopulation) and 41 observations from the CHIS sample (10.9% of the subpopulation) because of unknown status.
- Diabetes: respondents answered yes-no to questions asking whether they had ever been told by a doctor or healthcare provider that they have diabetes. Respondents with borderline diabetes were recoded as answering no (NHIS: n=13, 1.2% of the subpopulation; CHIS: n=16, 1.4% of the subpopulation).
- Overweight or Obese: weight and height were self-reported, and body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters squared). BMI was dichotomized into desirable weight ($18.5 \geq BMI > 25$ kg/m^2) or overweight/obese ($BMI \geq 25$ kg/m^2) based on the World Health Organization classification scheme and clinical relevance.[51] Respondents with underweight BMI ($BMI < 18.5$ kg/m^2) were not included in the analysis (CHIS: n=39, 3.3% of the subpopulation).
- Smoking status: respondents reported being a current smoker, former smoker, or never smoker. Four observations were dropped from the NHIS sample for unknown status (0.4% of the subpopulation). Smoking status was dichotomized into current smoker or former/never smoker.

- Alcohol drinking status: In the NHIS sample, respondents reported being a current, former, or never alcohol drinker in the past year. Nine observations were dropped for unknown status (0.9% of the subpopulation). Alcohol status was dichotomized into current or former/never drinker. Respondents who reported having ≥3 alcoholic drinks per day were classified as heavy drinkers. Respondents who reported having ≥ 5 alcoholic drinks in any occasion in the past year were classified as binge drinkers. Both heavy and binge drinking classifications have been used in other studies and have been associated with increased CVD risk.[23,37,52] In the CHIS sample, binge drinking status in the past month was the only alcohol status question that was similarly asked in the pooled years. Respondents were classified as binge drinkers if they reported ≥ 5 alcoholic drinks for men or ≥ 4 alcoholic drinks for women on any occasion in the past month.
- Physical activity: In the NHIS sample, respondents reported their frequency of vigorous or moderate physical activity. Physical activity (PA) was categorized as high (vigorous PA ≥ 2 times/week or moderate PA ≥ 4 times/week), moderate (vigorous activity 1 time/week or moderate activity 1-3 times/week), or sedentary (no vigorous or moderate activity/week) based on validated methods described previously.[37,53] Twenty-four observations were dropped for respondents who were unable to do physical activity or had unknown status (2.3% of the subpopulation). In the CHIS sample, PA was categorized as regular (vigorous PA ≥ 20 minutes or moderate PA ≥ 30 minutes for three or more days in past week), some (any vigorous activity or moderate PA ≥ 10 minutes in past week), or sedentary (no vigorous or moderate PA in past week). Physical activity was dichotomized into sedentary or high-regular/moderate-some physical activity.
- Diet: Information on dietary habits was only available in the CHIS dataset. To assess healthy diet, daily consumption of the recommended amount of fruits and vegetables was

asked, i.e., "During the past month, how many times per day, week or month did you eat fruit? Do not count juices" and "During the past month, how many times did you eat vegetables, like green salad, green beans, or potatoes? Do not include fried potatoes." Participants rated how many and how often they ate fruits or vegetables (1=per day, 2=per week, 3=per month). A variable was derived to indicate frequency of daily fruit and vegetable consumption. As guidelines suggest a minimum of five servings of fruits and vegetables daily for adults[54,55], the variable representing frequency of fruits and vegetables consumed per day was dichotomized (0=ate fruits and vegetables less than five times per day, 1=ate fruits and vegetables five or more times per day). Cardiovascular disease reduction guidelines also suggest ≤ 36 ounces per week of sugar-sweetened beverages, such as soda.[56] Respondents reported frequency of soda intake per week and this variable was dichotomized (0=drank less than or equal to 3 sodas per week, 1=drank more than 4 sodas per week). For CHIS 2007 & 2009, respondents reported fast food intake per week and this variable was dichotomized (0=ate fast food at most once per week, 1=ate fast food twice or more per week).

Predictor Variables – Duration of residence in US (and age at immigration)

Acculturation was determined by the proxy measure duration of residence in the US, which was based on the answer to the question "About how long have you lived in the United States?" Temporal measures, although imperfect, have been used as proxies for acculturation in other studies.[57] Duration of residence in the US was categorized into one of the five following categories for the NHIS and CHIS public-use datasets:<1 year, 1-<5 years, 5-<10 years, 10-<15 years, 15+ years. Based on the distribution of responses, the first two categories were collapsed, resulting in four duration of residence categories used in the analyses. Age at the time of

immigration was calculated by subtracting duration of residence in the US from current age, and categorized into the following groups based on frequency distributions for descriptive statistics (≤ 30, 31-40, 41-50, > 50 years) or treated as a continuous variable in bivariate and multivariate analyses.

Covariates

Numerous variables were assessed in this analysis. Some were considered to be independent predictors for cardiovascular disease risk factors and others were considered important to include because they may attenuate associations between duration of residence in the US and CVD risk factors. We considered socio-demographic characteristics, health status/illness burden, and measures of access to health care.

Socio-demographic characteristics included sex, marital status, level of educational attainment, and annual household income. Marital status was recoded into six categories for the NHIS sample (married, living with partner, divorced, widowed, separated, never married) from an original eight categories (married-spouse in household, married-spouse not in household, widowed, divorced, separated, never married, living with partner, and unknown marital status), and four categories for the CHIS sample (married, living with partner, divorced/widowed/separated, never married). Educational attainment represented the highest level of education completed, and was recoded into four categories: less than high school graduate, high school diploma or associate degree, bachelor's degree, and masters or professional degree. These categories were chosen based on the literature about education level and high-risk health behaviors, as well as what is known about the educational attainment of Asian Indians or South Asians. Annual household income was reported as four categories of the

federal poverty level in CHIS: 0-99%, 100-199%, 200-299%, and 300+% of federal poverty level. Income was only reported in NHIS 2007 & 2008 and not included in models using the NHIS sample.

We defined illness burden by using self-reported health status (excellent, very good, good, fair, poor), which has previously been shown to be associated with mortality in a multiethnic cohort.[58] We measured access to care using the proxies of having health insurance (yes or no) or a usual source of care (yes or no). Usual source of care was only reported in CHIS 2005 & 2009; therefore, this variable was not included in analyses using the CHIS sample. Missing, refused, and did not know observations from the NHIS sample were dropped from the analyses, and included 2 for marital status (0%), 34 for educational attainment (1.2%), 5 for health status (0.2%), 25 for health insurance (0.9%), and 2 for usual source of care (0.2%) in the subpopulation.

Statistical Analysis

We performed frequencies and cross-tabulations to describe the prevalence of baseline characteristics. Chi-square tests were used to assess differences in sample characteristics and CVD risk factors by duration of residence. Bivariate logistic regressions were performed to estimate the association of duration of residence in the US with each CVD risk factor. Multivariate binary logistic regression analyses were performed to estimate the odds of each CVD risk factor with duration of residence in the US, adjusted forage at immigration, socio-demographic characteristics, illness burden, and health access. The reference category for duration of residence in the US for bivariate and multivariate analyses was ≥ 15 years because it was the most prevalent group in the NHIS and CHIS samples. Based on the frequency

distributions in the subpopulation, we dichotomized marital status into married or not married, educational attainment into less than college degree or greater than or equal to college degree, annual household income into 0-199% federal poverty level or 200% or more of the federal poverty level, and health status into poor/fair/good health or excellent/very good health. Although age at immigration and duration of residence were correlated (r=0.46 in the NHIS sample; r=0.46 in the CHIS sample, $p<0.001$), there was low multicollinearity determined by a variance inflation factor (VIF=1.01 in the NHIS sample; VIF=1.11 in the CHIS sample), allowing simultaneous assessment of both variables in the models. However, adding current age with these variables resulted in high levels of multicollinearity (VIF > 5 for both the NHIS and CHIS samples), which was expected because current age is the sum of duration residence and age at immigration. Age and duration of residence in US were correlated in the subpopulation (r=0.52 in the NHIS sample; r=0.51 in the CHIS sample, $p<0.001$). Therefore, separate analyses were conducted that included duration of residence and current age in the first model and duration of residence and age at immigration in the second model. The results of the two models were comparable[c]; as such, we only reported the results of the second model to ensure comparability with other studies that included age as a covariate. We found no significant multicollinearity among the other variables.

Several models were assessed with additional potential confounders because health behaviors (i.e., confounders) might influence the association of duration of residence in the US with CVD risk factors (e.g., hypertension, diabetes, obesity). For hypertension, heavy drinking (in the NHIS sample) or binge drinking (in the CHIS sample) was included as a confounder. For

[c] When comparing models that included age and duration of residence vs. age at immigration and duration of residence, the point estimates (adjusted odds ratios) differed at the 100th decimal point for the duration of residence categories and the point estimates were identical for the other covariates in the model.

diabetes, overweight/obese BMI, heavy or binge drinking, sedentary lifestyle, and daily fruit/vegetable intake were included as confounders. For obesity, heavy or binge drinking, sedentary lifestyle, and daily fruit/vegetable intake were included as confounders. Mediator analyses were conducted using the Karlson/Holm/Breen tests to determine if these health behaviors (as discussed above) mediated the relationship of hypertension, diabetes, or obesity with duration of residence in the US.

We also tested the interaction between age at immigration and duration of residence to examine whether age at immigration modified the relationship between duration of residence in the US and CVD risk factors. Duration of residence was dichotomized into less than 15 years in the US or greater than or equal to 15 years and age at immigration was centered for the moderator analyses.

The analytic sample was limited to Asian Indian or South Asian adult immigrants who had non-missing values for the covariates; the sample size for each CVD risk factor model is reported in the results since it varied by outcome. Sample weights were applied to account for the complex sampling design and adjusted to account for the pooled data of the NHIS and CHIS samples. Data were not weighted in mediating variable analyses due to limitations in the statistical package. Of note, bootstrapped percentile and bias-corrected methods were used to calculate 95% confidence intervals, but these confidence intervals were not reported due to limitations in the statistical package with use of survey weights; however, bootstrapped confidence intervals were similar to survey weighted intervals. All analyses were performed in STATA 12.0 (College Station, TX), and two-tailed *P* values of <0.05 were considered statistically significant.

RESULTS:

The majority of South Asian immigrants in the NHIS and CHIS samples resided in the US for ≥ 15 years, and over half of all immigrants arrived at younger than 40 years of age (Table 3-1). The NHIS and CHIS samples were comparable in their distribution of characteristics for Asian Indian or South Asian adult immigrants. In both samples, the mean age was 40 years old, and the majorities were male, married, highly educated, and insured. The prevalence of CVD risk factors varied among the two samples, with the NHIS Asian Indian immigrant sample having higher rates of high cholesterol, diabetes mellitus, overweight/obese BMI, binge drinkers, and sedentary lifestyle than the CHIS South Asian immigrant sample (Appendix Table 3-1). Prevalence of self-reported hypertension, high cholesterol, diabetes, and overweight/obese BMI significantly increased with greater duration in the US for the NHIS sample (Figure 3-1a). In addition, Asian Indians who had lived more years in the US had higher rates of being a former smoker, being married, having health insurance, and having a usual source of care (but lower rates of college or higher educational attainment and excellent/very good health status) than those who had lived fewer years in the US (results not shown). In comparison, the CHIS sample had significantly higher prevalence rates of hypertension, diabetes, and optimal daily intake of fruits and vegetables with greater duration in the US, and lower rates of weekly fast food intake (Figure 3-1b). Similar to the NHIS sample, South Asians in the CHIS sample who had lived more years in the US had higher rates of being married, having health insurance, and having a usual source of care than more recent immigrants, but lower rates of excellent/very good health status (results not shown).

In the bivariate logistic regression analysis, Asian Indian immigrants residing in the US for < 15 years were less likely to self-report high cholesterol, diabetes, and overweight/obese BMI

compared to those residing in the US for ≥ 15 years in the NHIS sample (Table 3-2a). In addition, recent immigrants (< 5 years) had 2.35 higher unadjusted odds (95% CI: 1.13, 4.90) of current smoking than those in the US for ≥ 15 years. South Asian immigrants residing in the US for < 15 years were less likely to self-report hypertension and eating five or more fruits and vegetables per day compared with those residing in the US for ≥ 15 years in the CHIS sample (Table 3-2b). However, the increased odds of daily fruits and vegetables by duration of residence in the US reflects small differences in overall consumption among South Asian immigrants (1.0 percent of sample eat five or more fruits and vegetables per daily for 0-<5 years; 1.8% for 5-<10 years; 2.1% for 10-<15 years; 6.8% for 15+years; see Figure 3-1b). In addition, immigrants who were in the US for < 5 years were more likely to eat fast food two times or more per week compared with those in the US for ≥ 15 years (unadjusted OR 2.46; 95% CI: 1.20, 5.02); specifically, 41 percent among recent immigrants versus 22 percent among long-term immigrants. South Asian immigrants who resided in the US for 5 to <10 years were less likely to be overweight/obese, but more likely to drink four or more sodas per week than those in the US for ≥ 15 years. Immigrants in the US for 10 to <15 years were less likely to report diabetes, but more likely to be sedentary compared with those in the US for ≥ 15 years.

In the multivariate analysis, duration of residence in the US was only significant for alcohol use among Asian Indian immigrants after adjusting for potential confounders in the NHIS sample (Table 3-3a). Asian Indian immigrants residing in the US for <10 years were less likely to drink alcohol (OR 0.37, 95% CI: 0.23, 0.58 for < 5 years; OR 0.49, 95% CI: 0.29, 0.82 for 5-<10 years immigrants) compared to those residing in the US for ≥ 15 years. Other significant associations with CVD risk factors were consistent with the known literature. For example, men were more likely to be current smokers, drink alcohol, and binge drink than women. Married respondents

were more likely to be overweight/obese and sedentary, but less likely to drink alcohol than non-married respondents. Asian Indian immigrants with a college degree or greater were less likely to be obese and sedentary than those with less than a college degree. Better self-reported health status was associated with decreased odds of reporting high cholesterol, diabetes, and sedentary lifestyle than good/fair/poor health status. Immigrants with health insurance were less likely to be sedentary, but more likely to drink alcohol compared with those without insurance. Asian Indian immigrants who were overweight/obese had 3.02 greater odds (95% CI: 1.72, 5.32) of reporting diabetes relative to those who were desirable weight in the NHIS sample.

In the multivariate analysis using the CHIS sample, duration of residence in the US was significant for overweight/obese BMI, sedentary lifestyle, and eating five or more fruits and vegetables per day (Table 3-3b). South Asian immigrants who resided in the US for 10 to <15 years had 2.11 odds (95% CI: 1.17, 3.81) of being sedentary and 0.37 odds (95% CI: 0.15, 0.94) of eating five or more fruits and vegetables per day than those who resided in the US for ≥ 15 years. Other significant associations included male sex (more likely to report hypertension, diabetes, overweight/obesity, binge drinking; less likely to report ideal fruit/vegetable intake), being married (more likely to report hypertension; less likely to binge drink or drink four or more sodas per week), having a college degree or higher (less likely to be sedentary), and reporting excellent or very good health status (less likely to report hypertension, diabetes, overweight/obese BMI, sedentary lifestyle, and eating fast food two or more times per week). Not surprisingly, South Asian immigrants who were overweight/obese had 2.32 greater odds (95% CI: 1.11, 4.86) of reporting diabetes than those who were ideal weight. Similarly, immigrants who were sedentary had a 1.65 greater odds (95% CI: 1.15, 2.36) of being overweight/obese than those were physically active. Interestingly, having health insurance was

associated with greater odds of reporting hypertension and drinking four or more sodas per week. It is possible that greater diagnosis of hypertension is associated with health insurance because of access to health providers. Also, having a higher income was associated with binge drinking, which may be due to increased resources to pay for several alcoholic drinks in one setting.

Some investigators define BMI at lower cut-offs for Asians, with overweight as BMI $\geq$ 23 kg/m^2 and obese as BMI $\geq$ 25 or 27.5 kg/m^2, though a recent study found no mortality differences in Asians at these lower BMI cut-offs.[29,59-62] Sensitivity analyses with different BMI classifications in the unadjusted and adjusted models found similar trends in the association of obesity status with duration of residence in the US and other covariates regardless of whether BMI was classified as a continuous variable or categorical variable in both samples (BMI $\geq$ 23 kg/m^2 vs. 18.5 $\geq$ BMI > 23 kg/m^2 or BMI $\geq$ 30 kg/m^2 vs. 18.5 $\geq$ BMI > 30 kg/m^2). There may also be differences in predictors of current, former, or non-smokers and high, moderate, or no physical activity among South Asian immigrants. We examined associations with the categorical outcomes for smoking (current, former, non-smoker), and found that men were 16.7 times more likely to be current/former smokers versus nonsmokers than women in the CHIS sample. No other associations were significant. In addition, the results for physical activity were similar for high/regular, moderate/some, or sedentary/no physical activity outcome as when physical activity was a dichotomous outcome (sedentary vs. not). Since hypertension, high cholesterol, and sugar-sweetened beverage intake may be independent risk factors for diabetes[63], we examined models that included hypertension, high cholesterol, and soda intake as confounders for the diabetes outcome, but none of the confounders were significant on multivariate analysis in either the NHIS or CHIS samples.

Mean age at immigration increased linearly with greater duration of residence in the US among Asian Indian or South Asian adult immigrants (Figure 3-2). Since prior research has shown a correlation between age at immigration to the US and some CVD risk factors[32,38], we explored whether age at immigration moderated the association of duration of residence in the US with CVD risk factors through an interaction term. The interaction (years in the US ≥ 15 years*age at immigration) was significant for binge drinking (p=0.009) and BMI (p=0.005 as a continuous outcome) in the CHIS sample, and alcohol use (p=0.005) in the NHIS sample in adjusted models. Therefore, additional analyses were conducted that were stratified by age at immigration (Appendix Table 3-2). South Asian immigrants who arrived at 41-50 years of age and resided in the US for 5-<10 years were 38 times more likely to report binge drinking, and those who arrived at >50 years of age and resided for 10-<15 years were 10 times more likely to report binge drinking in the CHIS sample; however, these estimates may be unstable given their wide confidence intervals and the results should be interpreted with caution. Immigrants who arrived at ≤ 30 years of age and resided in the US for 5-<10 years had lower BMI. In the NHIS sample, there were no significant associations between duration of residence in the US and alcohol use when stratified by age at immigration. Health behaviors (overweight/obesity, smoking, alcohol use, daily fruit/vegetable intake, and sedentary lifestyle) were not found to be significant mediators of the relationship between duration of residence in the US and hypertension, diabetes, and overweight/obese BMI based on the Karlson/Holm/Breen tests (< 10% mediation by confounders on total effect, Appendix Table 3-3).

DISCUSSION:

This is the first study to examine the relationship between duration of residence in the US and multiple CVD risk factors among Asian Indian or South Asian immigrants. Greater duration of

residence was significantly associated with hypertension, high cholesterol, diabetes, overweight/obesity, and fruit and vegetable intake in unadjusted models. Additionally, length of residence in the US was inversely associated with current smoking, fast food intake, soda intake, and sedentary lifestyle in unadjusted models. Overweight/obesity, fruit and vegetable intake, and sedentary lifestyle remained significant after adjusting for confounders in the multivariate models. Alcohol use was also positively associated with greater duration of residence among Asian Indian immigrants in adjusted models. Age at immigration modified the relationship between duration of residence in the US and body mass index, binge drinking, and alcohol use in this population. Specifically, South Asians immigrants who arrived to the US after the age of 40 years old were less likely to binge drink with increasing duration of residence in the US compared with immigrants who arrived before the age of 40 years old.

The results from our unadjusted models are consistent with findings from prior studies that found immigrants who settled in the US for 15 years or longer were more likely to report hypertension[39], high cholesterol[36], diabetes[32], and overweight or obesity[37,64,65] than those who resided in the US for less than 15 years. However, we found that current smoking was less likely in long-term Asian Indian residents than recent immigrants in the bivariate analysis, which differs from prior studies using the same dataset (i.e., NHIS).[36,39] One possible explanation for the decreased odds of current smoking with length of residence is that anti-tobacco policies in the last decade in the US may encourage Asian Indians immigrants to quit smoking.[66] In this study, the prevalence of former smokers increased with greater duration in the US from 6% for recent immigrants (<5 years duration) to 11% for long-term residents (≥ 15 years).

Results from the multivariate analysis are similar to studies that showed sedentary lifestyle was inversely related to greater duration in the US[36,67], and that diabetes and hypertension were not associated with duration of residence among immigrants[36]. Koya et al. posit that a decrease in physical inactivity with increasing length of residence may be due to more leisure time and access to exercise facilities and/or adoption of health beliefs about the benefits of exercise as immigrants live longer in the US.[36] In addition, length of residence in the US was no longer significantly associated with hyperlipidemia, current smoking, and weekly soda and fast food intake among Asian Indians and South Asians when models were adjusted for confounders. There was a significant interaction between age at immigration and duration of residence with BMI among South Asian immigrants in the CHIS sample; however, unlike the results described by Roshania et al., the interaction did not remain significant when BMI was dichotomized into overweight/obese versus desirable BMI.[38]

It is curious that South Asians immigrants would be more likely to be overweight or obese, but also be more physically active and eat more fruits and vegetables, with greater duration of residence in the US. Raj et al. documented large increases in fruit juice intake with increasing duration in the US among Asian Indians, which may contribute to undesirable weight gain, though CHIS respondents were not to include juices in their count of fruit and vegetable intake.[68] One possible explanation may be increased alcohol use or other liquid calories contributing to greater BMI as immigrants live more years in the US, though it seems unlikely that alcohol use (but not heavy alcohol use) or binge drinking alone would fully explain the increased odds of being overweight or obese.[69,70] Another explanation may be that despite being less sedentary and eating more fruits and vegetables, long-term resident South Asian immigrants consume more calories (especially from simple carbohydrates and fat) than recent immigrants[68], which may

offset the beneficial effects of physical activity and diet on BMI. Food preparation may also be a factor. One study found that in South Asian households, prolonged cooking of vegetables is a common practice, which may destroy 90% of the folate and nutritional content.[71] Alternatively, as BMI increases with more years spent in the US, South Asian immigrants may try to curb the increased weight gain by eating a more healthy diet and increasing physical activity. However, physical activity and fruit and vegetable intake were not found to be significant mediators of the relationship between duration of residence and overweight or obese BMI in this study. A longitudinal study may be better equipped to understand the complex relationship between duration of residence and overweight/obesity, physical activity, and fruit and vegetable intake. Regardless, findings from this study indicate that overweight and obesity among South Asians is an important health concern to target, not only for CVD, but also for diabetes and metabolic syndrome, all of which are more prevalent in this population than the general population.[42,72]

There were several limitations in the study design, subpopulation sample, and measures that threaten the internal and external validity of our findings. The use of cross-sectional data made it difficult to disentangle age and duration of residence effects as contributors to the effect of acculturation on CVD risk factors among South Asian immigrants. However, the lack of longitudinal data limits researchers to use available, cross-sectional data sources. The low response rates in CHIS could not rule out that non-responders were different in CVD risk profiles and other characteristics than responders. Low survey response rates are commonly cited as evidence of poor quality data that lack representativeness because of non-response bias. However, several studies examining data quality in CHIS found little to no substantial differences between respondents and non-respondents on health, health-related indicators, and neighborhood characteristics.[73-76] The decision to use CHIS in the analysis was in part because

CHIS provided valuable information on the dietary habits of South Asian immigrants, which is usually unavailable in NHIS and other large surveys.

Neither survey was conducted in any South Asian languages, which may have excluded non-English speaking South Asians who may have been less acculturated, less educated, low-income, and uninsured[28,77], which would likely underestimate the true prevalence rates of CVD risk factors and under- or overestimate associations with duration of residence in the US. Small sample sizes of Asian Indian and South Asian immigrant adults required pooling data from several surveys years in order to have sufficient statistical power. Pooling data may have resulted in bias if there were changes in secular trends in CVD risk prevalence or awareness over the five-year period. Nevertheless, pooling data is common in the literature and estimates are considered reliable when proper adjustments are made to sampling weights. In addition, sensitivity analysis that included a variable representing survey year in the multivariate logistic regression models to adjust for secular differences resulted in similar findings as those reported. In general, it is difficult to mitigate these threats, and reinforces the need for longitudinal datasets with large samples of South Asians conducted in major South Asian languages in order to capture more fully the heterogeneity of the Asian Indian population in the US.

Data from self-report surveys may be inaccurate due to recall bias, social desirability bias, and respondents' lack of knowledge.[78] Some respondents may have been misclassified when assessing the prevalence of CVD risk factors. Self-reports of hypertension, hypercholesterolemia, and diabetes are likely related to one's access to health care, though we tried to mitigate confounding from access to care by controlling for health insurance status and having a usual source of care. Unfortunately, studies that provide laboratory measures for these

conditions are either not population-based or do not have disaggregated Asian immigrant subgroups (e.g., NHANES). However, studies have reported agreement between self-reported diabetes, hypertension, smoking, and alcohol consumption and medical record data or biochemical measures.[79-81] There is less sensitivity between self-reported high cholesterol and medical record data.[82] Survey respondents may have also underestimated weight, overestimated height, and under- or overestimated physical activity.[83,84]

Duration of residence in the US and age at immigration are likely components of acculturation, but do not fully capture this multidimensional construct. However, large, public-use datasets have limited acculturation measures, and temporal measures have been used as proxies for acculturation in other studies.[57] We should note that some researchers have criticized the use of acculturation (and/or acculturation measures) in health research given the conceptual and methodological difficulties in the construct of acculturation, as well as its limitation as a modifiable factor in the promotion of cardiovascular health.[85,86] Our study tried to control for modifiable factors, such as socioeconomic status, health insurance coverage, and usual source of care.

The educational levels of South Asians by migration wave may explain why South Asians with longer duration of residence in the US have lower educational attainment than more recent immigrants. Prior to 1965, Punjabi Sikhs immigrated to the west coast to work as farm laborers and migrant workers (45-55 years of duration of residence in the US for study sample). After 1965, South Asian immigrants were predominantly highly educated professionals from the upper class and came to the US to pursue educational and occupational opportunities (e.g., doctors, engineers in the 1970s).[87] A second wave of immigrants came to the US (in the 1980s; 20-30

years of duration of residence in the US for study sample) and were frequently relatives of their predecessors and generally not professionally educated (e.g., merchant class operating restaurants, grocery, liquor scores).[87] The demand for skilled labor in emerging electronics industries from the technology boom of the 1990s and the Immigration and Naturalization Act of 1990 further promoted the immigration of engineers resulting in the largest influx of South Asians between 1995 and 2000.[88] These differences in educational attainment may influence CVD health behaviors more than acculturation, and we attempted to adjust for education in our models.

Despite controlling for a number of potential confounders in multivariate analysis, this study still had omitted variable bias as there were no data on medication use, social networks, or religious affiliation, all of which may have impacted the relationship of CVD risk factors with duration of residence in the US. Religious affiliation and/or participation may be an important moderator of the acculturation effects on CVD risk factors among South Asian immigrants since several traditional Indian religions (e.g., Hinduism, Jainism) practice vegetarianism, as opposed to more common Western dietary practices of meat-eating, and religious Muslims abstain from eating pork and drinking alcohol.[89-93] It is also important to note that our multivariate analysis likely under-adjusted for confounding due to measurement error of the covariates.

Duration of residence in the US appears to be an important determinant for several CVD risk factors among Asian Indian and South Asian immigrants. Based on the findings, interventions that target recent South Asian immigrants should focus on modifiable health behaviors, such as physical activity, fruit and vegetable intake, smoking status, and binge drinking, to reduce risk of obesity, diabetes, dyslipidemia, metabolic syndrome, and CVD. Similar to most immigrant

groups, this population would benefit from strategies to reduce obesity and further examination of physical activity and dietary practices are warranted.

Table 3-1a. Sample characteristics of Asian Indian adult immigrants, NHIS 2005-2009*

Characteristic	n	% or mean
Age, mean (range:SE) in years	2,782	40.33 (18-85:0.64)
Sex		
Male	1,485	54.4
Female	1,297	45.6
Marital Status		
Married	2,178	79.8
Living with partner	24	0.8
Divorced	44	1.4
Widowed	74	2.5
Separated	35	1.0
Never married	425	14.5
Educational attainment		
Less than high school	215	7.0
High school degree/associates	703	23.6
College degree	903	33.9
Graduate/Professional degree	927	35.6
Health status		
Excellent	1,072	39.3
Very good	901	33.9
Good	637	20.8
Fair	120	4.0
Poor	47	1.9
Health insurance		
Yes	2,374	86.5
No	383	13.5
Usual Source of Care+		
Yes	848	80.8
No	206	19.2
Years lived in the US		
Mean score on 1-4 scale (range:SE), years	2,782	2.67 (1-4:0.07)
0-<5 years	633	23.3
5-<10 years	604	21.9
10-<15 years	463	17.5
15+ years	1,082	37.2
Age at Immigration		
Mean (range:SE), years	2,348	37.65 (14-83:0.58)
≤ 30 years old	1,002	36.3
31-40 years old	762	28.4
41-50 years old	490	16.9
>50 years old	528	18.4

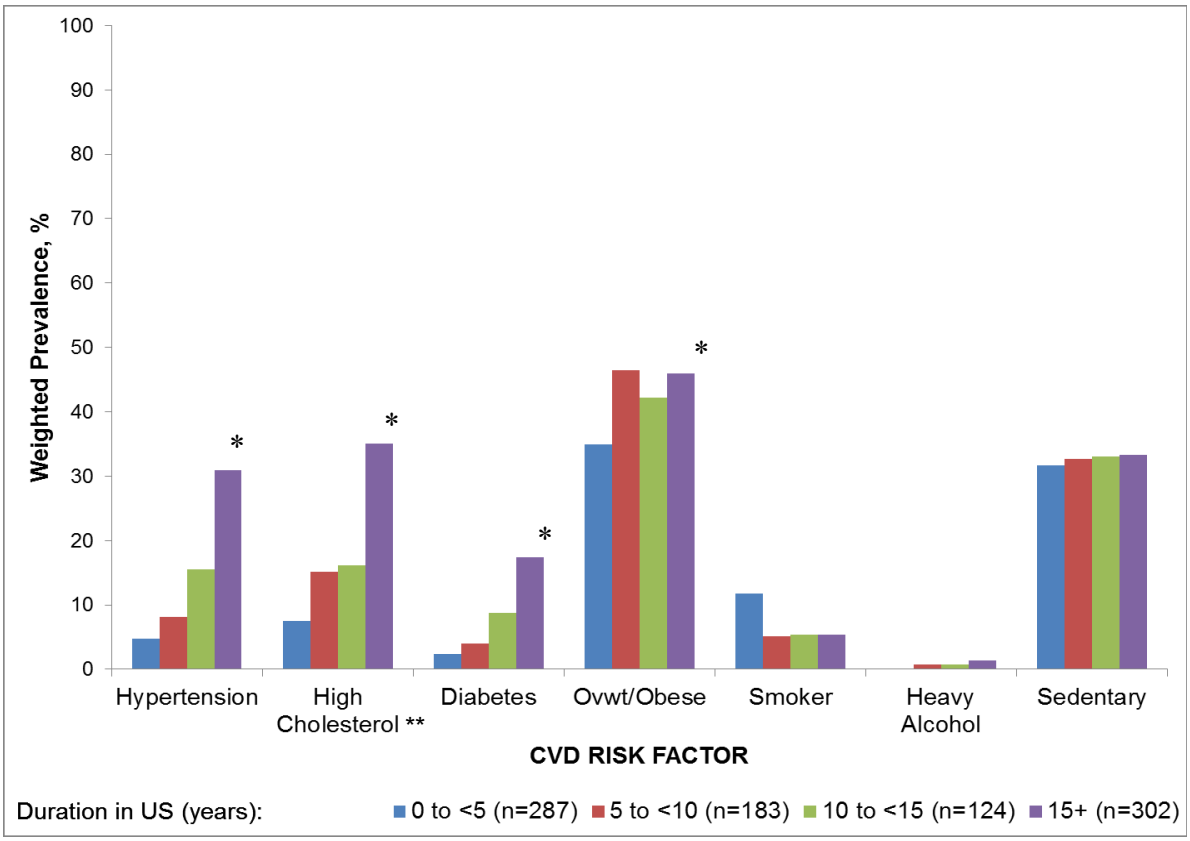
*Percentages based on weighted, unadjusted data. Column totals may not equal 100 due to rounding error or missing observations.
+Only answered by a subsample of Asian Indian adults in NHIS 2005-2009, n=1,056

Table 3-1b. Sample characteristics of South Asian adult immigrants, CHIS 2005, 2007, 2009*

Characteristic	n	% or mean
Age, mean (range:SE) in years	1169	40.05 (18-85: 0.49)
Sex		
Male	617	57.6
Female	552	42.4
Marital Status		
Married	949	76.9
Living with partner	11	0.7
Divorced/Widowed/Separated	89	4.3
Never married	120	18.2
Educational attainment		
Less than high school	28	2.6
High school degree/associates	185	15.9
College degree	388	32.3
Graduate/Professional degree	568	49.2
Income		
0-99% fed poverty level	68	7.3
100-199% fed poverty level	96	7.6
200-299% fed poverty level	100	8.2
300+% fed poverty level	905	77.0
Health status		
Excellent	326	30.8
Very good	417	37.2
Good	340	26.9
Fair	66	3.4
Poor	20	1.6
Health insurance		
Yes	1071	89.4
No	98	10.6
Usual Source of Care**		
Yes	677	88.3
No	75	11.7
Years lived in the US		
Mean score on 1-4 scale (range:SE), years	1169	2.85 (1-4:0.05)
0-<5 years	144	16.6
5-<10 years	217	23
10-<15 years	219	19.2
15+ years	589	41.2
Age at Immigration		
Mean (range:SE), years	1169	37.20 (14-81:0.46)
≤ 30 years old	285	32.9
31-40 years old	418	35.9
41-50 years old	214	15.4
>50 years old	252	15.7

*Percentages based on weighted, unadjusted data. Column totals may not equal 100 due to rounding error or missing observations.
**Variable not available for all survey years: usual source of care (CHIS 2005 &2009)

Figure 3-1a. CVD risk factor prevalence by duration of residence in the US among Asian Indian adult immigrants in NHIS 2005-2009. *Chi-square test across variable was significant (*P*< 0.05). **The sample sizes for high cholesterol in NHIS 2007-2008 were: 0-<5 (n=113), 5-<10 (n=68), 10-<15 (n=53), 15+ (n=139).



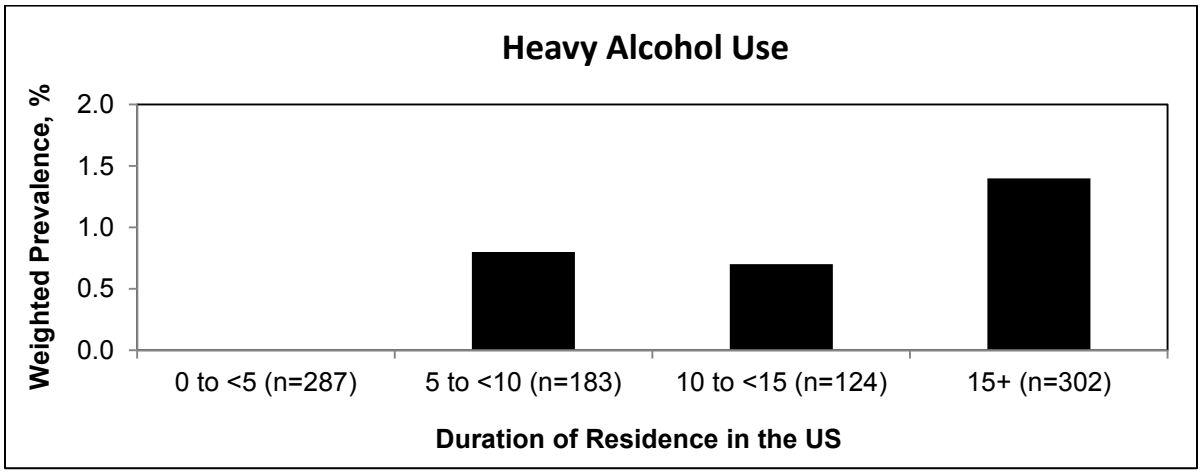
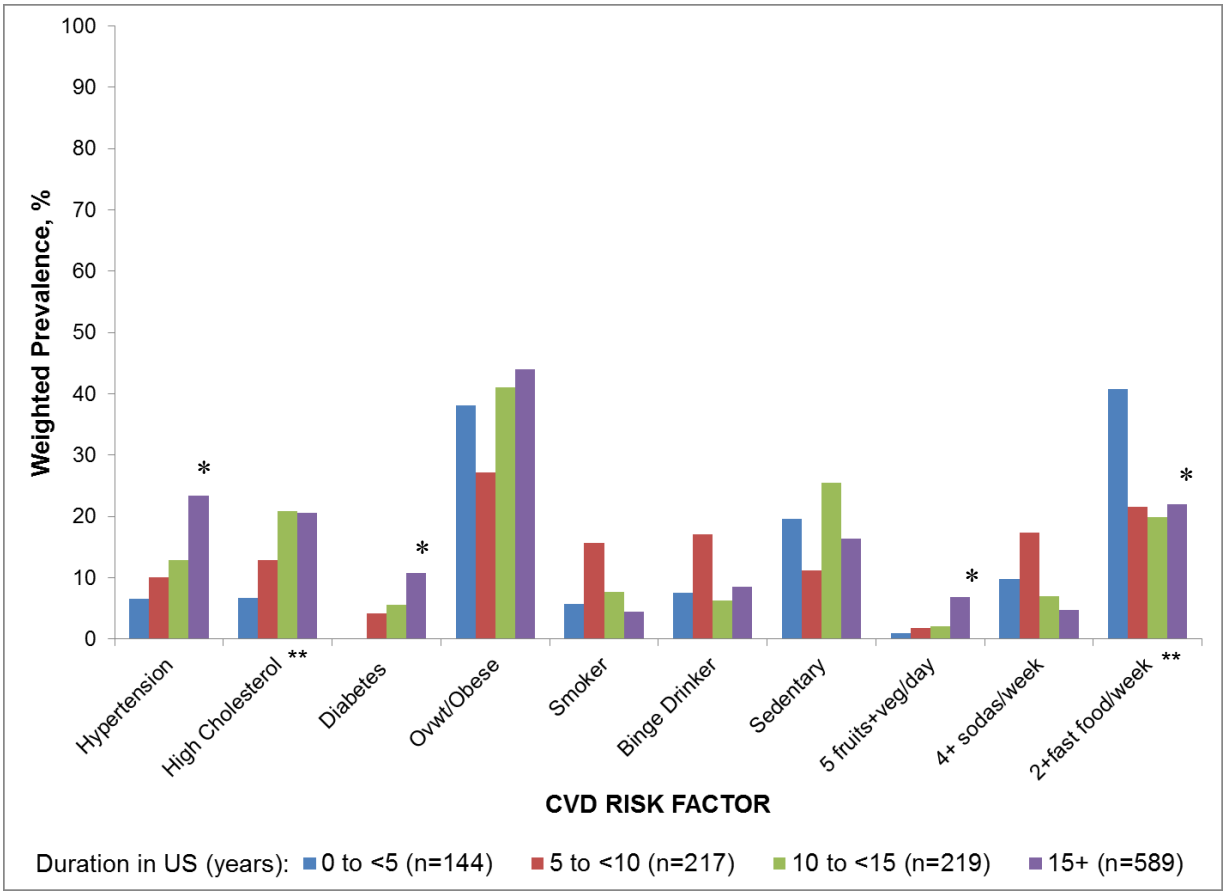


Figure 3-1b. CVD risk factor prevalence by duration of residence in the US among South Asian adult immigrants in CHIS 2005-2009. *Chi-square test variable was significant (*P*< 0.05). **The sample sizes for high cholesterol in CHIS 2005 were: 0-<5 (n=43), 5-<10 (n=75), 10-<15 (n=60), 15+ (n=156). The sample sizes for fast food in CHIS 2007-9 were: 0-<5 (n=87), 5-<10 (n=132), 10-<15 (n=153), 15+ (n=422).



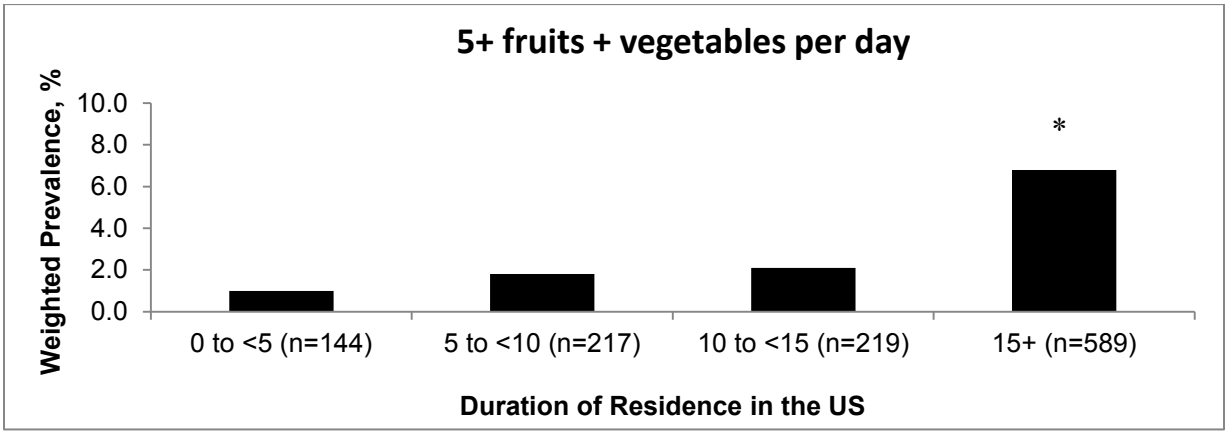


Figure 3-2a. Mean age at immigration by duration of residence in the US among Asian Indian adult immigrants in NHIS 2005-2009

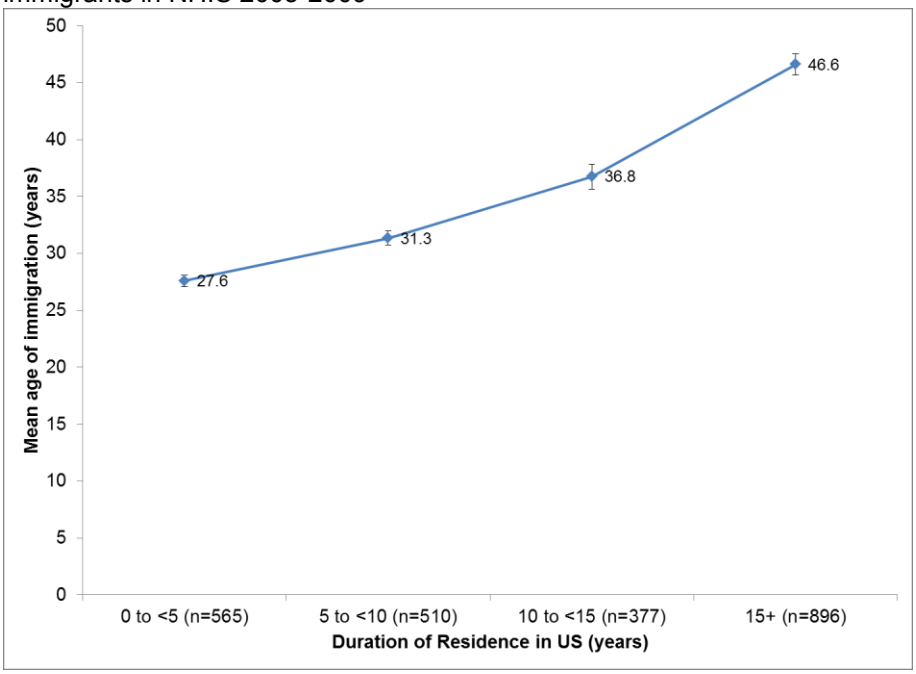


Figure 3-2b. Mean age at immigration by duration of residence in the US among South Asian adult immigrants in CHIS 2005-2009

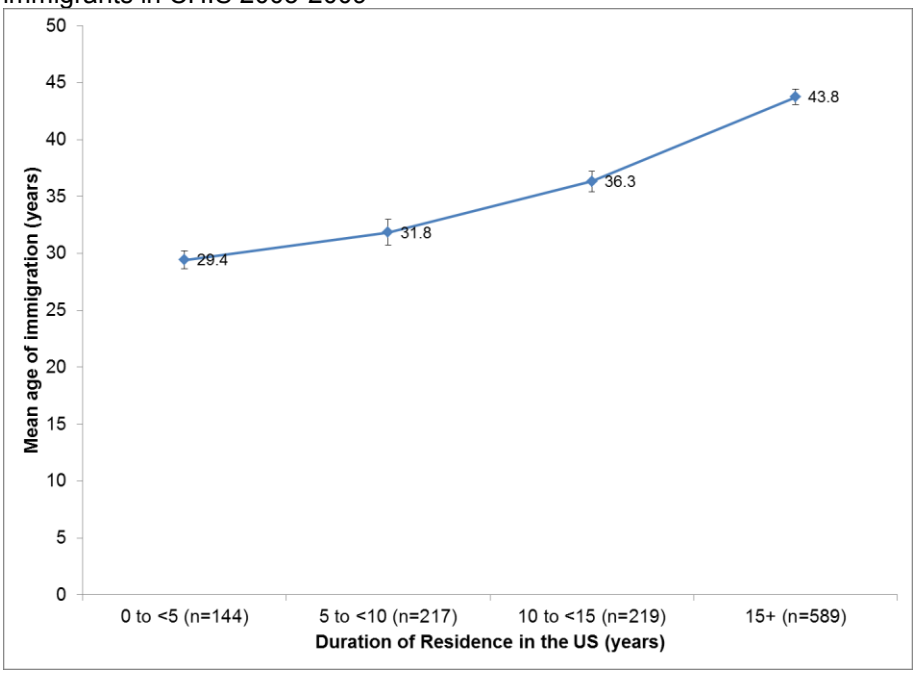


Table 3-2a. Bivariate logistic regression of CVD risk factors among Asian Indian adult immigrants in NHIS 2005-2009

		Duration of years in US, OR (95% CI)			
Outcome	**n**	**0 to <5**	**5 to <10**	**10 to <15**	**15+**
Hypertension*	-	-	-	-	
High Cholesterol	373	**0.15 (0.07, 0.34)**	**0.33 (0.15, 0.74)**	**0.36 (0.15, 0.86)**	1
Diabetes Mellitus	896	**0.11 (0.03, 0.40)**	**0.20 (0.08, 0.49)**	**0.46 (0.22, 0.96)**	1
Overweight/Obese	865	**0.46 (0.32, 0.66)**	0.74 (0.49, 1.12)	**0.62 (0.40, 0.96)**	1
Current Smoker	892	**2.35 (1.13, 4.90)**	0.93 (0.41, 2.12)	1.01 (0.37, 2.77)	1
Alcohol Use	889	0.80 (0.57, 1.12)	0.75 (0.49, 1.15)	0.95 (0.57, 1.58)	1
Binge Drinker	372	1.82 (0.80, 4.13)	1.54 (0.64, 3.71)	0.81 (0.31, 2.14)	1
Heavy Alcohol	604	1	0.56 (0.06, 5.36)	0.50 (0.05, 4.78)	1
Sedentary (no PA)	886	0.92 (0.61, 1.41)	0.97 (0.62, 1.51)	0.99 (0.60, 1.64)	1

*Hypertension – outcome did not vary across duration of years in US categories; unable to perform analysis
OR=unadjusted odds ratio; CI=confidence interval; PA=physical activity. Bold=*p* <0.05

Table 3-2b. Bivariate logistic regression of CVD risk factors among South Asian adult immigrants in CHIS 2005-2009

		Duration of years in US, OR (95% CI)			
Outcome	**n**	**0 to <5**	**5 to <10**	**10 to <15**	**15+**
Hypertension	1158	**0.23 (0.11, 0.50)**	**0.37 (0.17, 0.79)**	**0.49 (0.27, 0.87)**	1
High Cholesterol	334	0.28 (0.07, 1.15)	0.57 (0.25, 1.31)	1.02 (0.37, 2.76)	1
Diabetes Mellitus	1025	1	0.37 (0.07, 1.98)	**0.49 (0.24, 0.97**)	1
Overweight/Obese	1130	0.78 (0.47, 1.30)	**0.48 (0.28, 0.82)**	0.89 (0.56, 1.42)	1
Current Smoker*	-	-	-	-	
Binge Drinker	1169	0.87 (0.15, 4.93)	2.21 (0.95, 5.14)	0.73 (0.30, 1.77)	1
Sedentary (no PA)	1169	1.25 (0.63, 2.46)	0.64 (0.37, 1.10)	**1.75 (1.00, 3.06)**	1
Eats 5+ fruit/veg a day	1169	**0.14 (0.03, 0.63)**	**0.25 (0.06, 0.97)**	**0.29 (0.11, 0.75)**	1
Drinks 4+ soda/week	1169	2.22 (0.76, 4.45)	**4.24 (1.88, 9.54)**	1.51 (0.67, 3.40)	1
Eats 2+ fast food/week	794	**2.46 (1.20, 5.02)**	0.98 (0.45, 2.13)	0.88 (0.36, 2.17)	1

*Current smoker – outcome did not vary across duration of residence in US categories; unable to perform analysis
OR=unadjusted odds ratio; CI=confidence interval; PA=physical activity. Bold=*p*<0.05

Table 3-3a. Multivariate logistic regression of CVD risk factors among Asian Indian adult immigrants in NHIS 2005-2009

	Hyper-tension	High Cholesterol	Diabetes	Overwt/ Obese	Current Smoker	Heavy Alcohol	Sedentary	Alcohol use	Binge Drinker
		n=367	n=838	n=838	n=880	n=598	n=874	n=878	n=365
Years in US									
0-<5 years	x	0.38 (0.13, 1.10)	0.46 (0.11, 1.86)	0.76 (0.47, 1.22)	1.33 (0.54, 3.28)	1	1.41 (0.84, 2.38)	**0.37 (0.23, 0.58)**	0.76 (0.28, 2.10)
5-<10 years	x	0.79 (0.31, 2.00)	0.48 (0.17, 1.33)	0.94 (0.56, 1.60)	0.55 (0.22, 1.36)	0.31 (0.03, 2.94)	1.23 (0.75, 2.00)	**0.49 (0.29, 0.82)**	0.79 (0.31, 2.06)
10-<15 years	x	0.44 (0.18, 1.07)	0.85 (0.39, 1.86)	0.69 (0.42, 1.12)	0.81 (0.25, 2.63)	0.36 (0.04, 3.54)	1.09 (0.64, 1.86)	0.83 (0.46, 1.51)	0.60 (0.21, 1.71)
15+ years	x	1	1	1	1	1	1	1	1
Age at immigration	x	**1.04 (1.01, 1.07)**	**1.05 (1.02, 1.07)**	1.01 (0.99, 1.03)	**0.97 (0.94, 0.99)**	0.95 (0.90, 1.00)	1.00 (0.99, 1.02)	**0.98 (0.96, 0.99)**	**0.94 (0.90, 0.97)**
Sex, male	x	1.28 (0.69, 2.37)	1.45 (0.81, 261)	1.40 (0.99, 1.99)	**15.03 (5.54, 40.78)**	5.54 (0.57, 54.04)	1.03 (0.76, 1.39)	**2.90 (2.13, 3.93)**	**2.63 (1.10, 6.30)**
Married	x	1.35 (0.60, 3.03)	1.38 (0.68, 2.80)	**1.52 (1.05, 2.18)**	0.62 (0.34, 1.15)	0.75 (0.04, 15.81)	**1.71 (1.15, 2.55)**	**0.59 (0.42, 0.84)**	0.57 (0.29, 1.12)
College or higher	x	1.00 (0.51, 1.97)	0.87 (0.45, 1.69)	**0.63 (0.44, 0.92)**	0.64 (0.34, 1.21)	0.48 (0.02, 9.64)	**0.59 (0.39, 0.89)**	1.42 (0.95, 2.11)	0.55 (0.26, 1.01)
Excellent / v.good health	x	**0.35 (0.18, 0.68)**	**0.52 (0.28, 0.96)**	0.78 (0.54, 1.14)	0.63 (0.32, 1.23)	0.20 (0.02, 1.69)	**0.60 (0.38, 0.95)**	1.11 (0.75, 1.63)	0.48 (0.23, 1.01)
Health insurance	x	0.68 (0.26, 1.79)	1.10 (0.45, 2.72)	0.72 (0.43, 1.21)	0.58 (0.25, 1.32)	0.71 (0.03, 17.85)	**0.59 (0.36, 0.96)**	**1.80 (1.03, 3.13)**	0.55 (0.19, 1.56)
Usual source of care	x	3.17 (0.91, 10.97)	1.93 (0.64, 5.83)	1.14 (0.73, 1.81)	1.27 (0.57, 2.80)	0.54 (0.03, 8.69)	0.92 (0.60, 1.42)	0.84 (0.53, 1.35)	2.37 (0.93, 6.01)
Overwt/Obese	x	x	**3.02 (1.72, 5.32)**	x	x	x	x	x	x
Smoker	x	x	0.95 (0.25, 3.60)	0.67 (0.36, 1.28)	x	x	x	x	x
Heavy Alcohol	x	x	1.37 (0.15, 12.31)	1.18 (0.23, 6.18)	x	x	x	x	x
Sedentary	x	x	1.36 (0.71, 2.59)	0.90 (0.66, 1.24)	x	x	x	x	x

OR=adjusted odds ratio, CI=confidence interval, x=not applicable. Hypertension outcome did not vary; unable to perform analysis. Bold=$p< 0.05$

Table 3-3b. Multivariate logistic regression of CVD risk factors among South Asian adult immigrants in CHIS 2005-2009, OR (95% CI)

	Hypertension	**High Cholesterol**	**Diabetes**	**Overwt/ Obese**	**Current Smoker**	**Binge Drinker**	**Sedentary**	**5+ fruit and veg/day**	**4+ soda/week**	**2+ fast food/week**
	n=1158	n=334	n=991	n=1130		n=1169	n=1169	n=1071	n=1169	n=794
Years in US										
0-<5 years	0.74 (0.29, 1.87)	0.44 (0.10, 1.91)	1	0.84 (0.46, 1.53)	x	0.71 (0.11, 4.85)	1.84 (0.84, 4.00)	0.24 (0.04, 1.32)	1.33 (0.42, 4.21)	1.08 (0.47, 2.50)
5-<10 years	0.98 (0.42, 2.28)	0.87 (0.31, 2.49)	0.81 (0.13, 5.09)	**0.59 (0.35, 0.98)**	x	1.12 (0.44, 2.88)	0.91 (0.50, 1.67)	0.36 (0.09, 1.45)	2.61 (0.97, 7.02)	0.60 (0.27, 1.34)
10-<15 yrs	0.82 (0.41, 1.65)	1.55 (0.49, 4.84)	0.68 (0.27, 1.71)	0.83 (0.52, 1.33)	x	0.71 (0.27, 1.82)	**2.11 (1.17, 3.81)**	**0.37 (0.15, 0.94)**	1.18 (0.50, 2.79)	0.53 (0.19, 1.48)
15+ years	1	1	1	1	x	1	1	1	1	1
Age at immigration	**1.08 (1.06, 1.10)**	**1.03 (1.00, 1.06)**	**1.06 (1.02, 1.09)**	1.00 (0.99, 1.02)	x	0.99 (0.96, 1.02)	1.01 (0.99, 1.03)	**1.03 (1.00, 1.06)**	**0.98 (0.94, 3.44)**	**0.93 (0.91, 0.96)**
Sex, male	**1.55 (1.06, 2.27)**	1.47 (0.68, 3.19)	**2.80 (1.39, 5.62)**	**1.53 (1.08, 2.18)**	x	**8.35 (3.60, 19.37)**	0.84 (0.55, 1.28)	**0.34 (0.18, 0.65)**	1.83 (0.98, 3.44)	1.53 (0.83, 2.82)
Married	**1.82 (1.06, 3.09)**	1.22 (0.40, 3.70)	2.01 (0.83, 4.86)	1.72 (0.98, 3.04)	x	**0.21 (0.08, 0.55)**	1.47 (0.79, 2.74)	0.85 (0.31, 2.33)	**0.32 (0.14, 0.72)**	1.34 (0.71, 2.53)
College or higher	1.30 (0.75, 2.28)	0.79 (0.28, 2.19)	1.67 (0.72, 3.84)	0.68 (0.41, 1.14)	x	1.24 (0.49, 3.15)	**0.55 (0.32, 0.95)**	2.08 (0.95, 4.58)	0.57 (0.27, 1.16)	0.81 (0.41, 1.62)
200+% fpl	0.75 (0.35, 1.63)	5.26 (0.95, 29.23)	0.50 (0.16, 1.58)	0.87 (0.49, 1.52)	x	**3.20 (1.17, 8.77)**	1.04 (0.55, 1.96)	1.01 (0.27, 3.84)	1.58 (0.51, 4.94)	0.68 (0.30, 1.53)
Excellent / v.good health	**0.55 (0.34, 0.89)**	0.67 (0.29, 1.56)	**0.20 (0.10, 0.41)**	**0.54 (0.38, 0.77)**	x	0.94 (0.45, 1.97)	**0.55 (0.35, 0.86)**	1.00 (0.41, 2.43)	0.76 (0.32, 1.79)	**0.35 (0.19, 0.62)**
Health insurance	**1.47 (0.65, 3.29)**	1.77 (0.40, 7.78)	0.24 (0.04, 1.46)	1.40 (0.75, 2.61)	x	1.46 (0.55, 3.87)	0.56 (0.28, 1.11)	1	**3.99 (1.50, 10.61)**	1.71 (0.78, 3.75)
Overwt/Obese	x	x	**2.32 (1.11, 4.86)**	x	x	x	x	x	x	x
Smoker	x	x	0.96 (0.26, 3.52)	1.08 (0.52, 2.25)	x	x	x	x	x	x
Binge drinker	0.64 (0.28, 1.47)	x	1.80 (0.54, 6.02)	0.89 (0.44, 1.83)	x	x	x	x	x	x
Sedentary	x	x	0.96 (0.42, 2.18)	**1.65 (1.15, 2.36)**	x	x	x	x	x	x
5+ fruits and veg per day	x	x	0.70 (0.19, 2.62)	1.25 (0.48, 3.22)	x	x	x	x	x	x

OR=adjusted odds ratio, CI=confidence interval, x=not applicable, fpl=federal poverty level. Current smoker outcome did not vary; unable to perform analysis.
Bold, $p < 0.05$

APPENDIX: Chapter 3

Table 3-1a. Asian Indian immigrant sample characteristics by outcome, NHIS 2005-2009*

Characteristic	n	%
Heart Disease (ever told)+		
Yes	23	2.5
No	1,033	97.5
Hypertension+		
Yes	161	15.9
No	895	84.1
High Cholesterol**+		
Yes	76	20.4
No	297	79.6
Diabetes Mellitus+		
Yes	90	8.7
No	966	91.3
Body mass index (BMI, kg/m2)+		
Mean (range:SE)	896	24.71 (18.5-54.5:0.14)
BMI ≥ 18.5 & BMI<25 (ideal)	584	55.1
BMI ≥ 25 (overweight/obese)	433	44.9
Smoking status+		
Current	79	7.3
Former	81	8.3
Never	892	84.4
Alcohol status+		
Binge Drinker: (5+ on any day in year)**+		
Yes	68	14.2
No	362	85.8
Heavy Alcohol Use: 2+ drinks/day in past year+		
Yes	8	0.7
No	1,039	99.3
Current Drinker+		
Yes	434	44.8
No (Never/ Former)	613	55.2
Physical Activity+		
High/ Regular	489	49.2
Moderate/ Some	184	18.2
Sedentary	373	32.6

*Percentages based on weighted, unadjusted data. Column totals may not equal 100 due to rounding error or missing observations.
**Variable not available for all survey years: High Cholesterol (NHIS 2007-2008); Binge Drinker (NHIS all years, but only n=430 of subpopulation responded to question)
+Only answered by a subsample of Asian Indian adults in NHIS 2005-2009, n=1,056

APPENDIX: Chapter 3

Table 3-1b. South Asian immigrant sample characteristics by outcome, CHIS 2005, 2007, 2009*

Characteristic	n	%*
Heart Disease (ever told)		
Yes	56	3.4
No	1113	96.6
Hypertension		
Yes	207	15.5
No	951	84.5
High Cholesterol**		
Yes	64	16.9
No	270	83.1
Diabetes Mellitus		
Yes	94	6.4
No	1075	93.6
Body mass index (BMI, kg/m2)		
Mean (range:SE)	1130	24.17 (18.5-42.2:0.14)
BMI ≥ 18.5 & BMI<25 (ideal)	674	61.4
BMI ≥ 25 (overweight/obese)	456	38.6
Smoking status		
Current	66	7.8
Former	121	7.8
Never	982	84.3
Alcohol status		
Binge Drinker: (5+ on any day in year)		
Yes	79	9.6
No	1090	90.1
Physical Activity		
High/Regular	315	25.8
Moderate/Some	620	56.8
Sedentary	234	17.4
Diet-5+ fruits/veg per day		
Yes	50	3.8
No	1119	96.2
Diet-4+ sodas/week		
Yes	66	8.9
No	1103	91.1
Diet-2+fast food/week**		
Yes	181	24.5
No	613	75.5

*Percentages based on weighted, unadjusted data. Column totals may not equal 100 due to rounding error or missing observations.
**Variable not available for all survey years: High Cholesterol (CHIS 2005); Fast Food (CHIS 2007 & 2009)

APPENDIX: Chapter 3

Table 3-2. Adjusted odds ratios (binge drinking) and coefficients (BMI) for CVD risk factors overall and stratified by age at immigration (for CVD risk factors that were significant on interaction models)

CHIS - adjusted models					
BINGE DRINKING					
	Overall	<=30 y.o	31-40 y.o.	41-50 y.o.	>50 y.o.
	n=1169	n=285	n=377	n=116	n=219
Years in US					
0-<5 yrs	0.7 (0.1, 4.9)	0.4 (0.0, 3.8)	1.0	1.0	7.8 (0.7, 89.7)
5-<10 yrs	1.1 (0.4, 2.9)	0.2 (0.0, 1.1)	3.6 (0.8, 15.2)	**38.2 (3.2, 458.5)**	1.0
10-<15 yrs	0.7 (0.3, 1.8)	0.3 (0.0, 3.7)	0.6 (0.1, 5.0)	2.0 (0.2, 15.4)	**10.2 (2.2, 47.7)**
15+ yrs	1.0	1.0	1.0	1.0	1.0
CHIS - adjusted models					
BMI CONTINUOUS (kg/m^2)					
	Overall	<=30 y.o	31-40 y.o.	41-50 y.o.	>50 y.o.
	n=1130	n=264	n=409	n=211	n=246
Years in US					
0-<5 yrs	-0.7 (-1.6, 0.2)	-1.1 (-2.2, 0.1)	-1.0 (-2.4, 0.4)	-0.1 (-2.4, 2.3)	0.2 (-5.5, 6.0)
5-<10 yrs	**-1.1 (-1.8, -0.4)**	**-2.1 (-3.4, -0.8)**	-0.4 (-1.5, 0.6)	-0.6 (-2.0, 0.9)	0.9 (-5.4, 2.3)
10-<15 yrs	-0.2 (-1.0, 0.5)	-0.5 (-2.0, 0.9)	-0.4 (-1.5, 0.7)	-0.3 (-1.8, 1.3)	-0.6 (-2.7, 1.5)
15+ yrs	reference	reference	reference	reference	reference
NHIS - adjusted models					
ALCOHOL USE					
	Overall	<=30 y.o	31-40 y.o.	41-50 y.o.	>50 y.o.
	n=878	n=379*	n=242*	n=105*	n=152
Years in US					
0-<5 yrs	**0.4 (0.2, 0.6)**	0.1	0.5	0.5	0.6 (0.1, 3.4)
5-<10 yrs	**0.5 (0.3, 0.8)**	0.3	0.3	0.1	2.0 (0.5, 7.7)
10-<15 yrs	0.8 (0.5, 1.5)	0.2	0.7	1.2	1.8 (0.5, 6.1)
15+ yrs	1.0	1.0	1.0	1.0	1.0

*missing SE/CI because analysis encountered stratum with single sampling unit (instead of at least two sampling units). Bold=$p<0.05$

APPENDIX: Chapter 3

Table 3-3. Models of the mediating effects of health behaviors on the relationships between duration of residence in the US and CVD risk factor

NHIS Sample 2005-2009

Diabetes*

	Full model coefficient	Reduced Model coefficient	Percentage total effect mediated	Percentage confounder mediates total effect			
				Ovwt/ Obese BMI	Heavy alcohol	Current smoker	Sedentary
Duration in US (years)	0.40**	0.41**	2.0	4.1	-0.7	0.2	-1.6

Overweight/Obese BMI*

	Full model coefficient	Reduced Model coefficient	Percentage total effect mediated	Percentage confounder mediates total effect		
				Heavy alcohol	Current smoker	Sedentary
Duration in US (years)	0.09	0.09	8.5	6.5	-0.4	2.4

*adjusted for age at immigration, sex, marital status, educational attainment, health status, health insurance, and usual source of care; survey weights not used

** $p < 0.05$

CHIS Sample 2005-2009

Hypertension*

	Full model coefficient	Reduced Model coefficient	Percentage total effect mediated by binge drinker
Duration in US (years)	-0.02	-0.03	3.5

Diabetes*

	Full model coefficient	Reduced Model coefficient	Percentage total effect mediated	Percentage confounder mediates total effect				
				Ovwt / Obese BMI	Binge drinker	Current smoker	5+ fruit/veg intake	Sedentary
Duration in US (years)	0.60**	0.63**	3.8	-0.1	2.0	1.3	0.1	0.5

Overweight/Obese BMI*

	Full model coefficient	Reduced Model coefficient	Percentage total effect mediated	Percentage confounder mediates total effect			
				Binge drinker	Current smoker	5+ fruit/veg intake	Sedentary
Duration in US (years)	0.05	0.05	5.9	3.7	-0.9	7.1	-3.9

*adjusted for age at immigration, sex, marital status, educational attainment, annual household income, health status, and health insurance; survey weights not used

** $p < 0.05$

REFERENCES

1. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the Asian adult population: United States, 2004–2006. Advance data from vital and health statistics; no 394. Hyattsville, MD: National Center for Health Statistics. 2008.

2. U.S. Census Bureau and India Abroad Center for Political Awareness. Indian-American Population by State. http://www.indianembassy.org/ind_us/census_2000/ia_population_map_2001.pdf. Accessed July 9, 2009.

3. Palaniappan L, Mukherjea A, Holland A, Ivey SL. Leading causes of mortality of Asian Indians in California. *Ethn Dis.* Winter 2010;20(1):53-57.

4. Palaniappan L, Wang Y, Fortmann SP. Coronary heart disease mortality for six ethnic groups in California, 1990-2000. *Ann Epidemiol.* Aug 2004;14(7):499-506.

5. Joshi P, Islam S, Pais P, et al. Risk factors for early myocardial infarction in South Asians compared with individuals in other countries. *JAMA.* Jan 17 2007;297(3):286-294.

6. Chiu M, Austin PC, Manuel DG, Tu JV. Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007. *Canadian Medical Association Journal.* May 18, 2010;182(8):E301-E310.

7. Tillin T, Forouhi NG, Davey-Smith G, McKeigue PM, Chaturvedi N. Cardiovascular Disease Mortality in Relation to Childhood and Adulthood Socio-Economic Markers in British South Asian Men. *Heart.* 2008;94:476–481.

8. Forouhi NG, Sattar N, Tillin T, McKeigue PM, Chaturvedi N. Do known risk factors explain the higher coronary heart disease mortality in South Asian compared with European men? Prospective follow-up of the Southall and Brent studies, UK. *Diabetologia.* Nov 2006;49(11):2580-2588.

9. Barnett AH, Dixon AN, Bellary S, et al. Type 2 diabetes and cardiovascular risk in the UK south Asian community. *Diabetologia.* Oct 2006;49(10):2234-2246.

10. Sheth T, Nair C, Nargundkar M, Anand S, Yusuf S. Cardiovascular and cancer mortality among Canadians of European, south Asian and Chinese origin from 1979 to 1993: an analysis of 1.2 million deaths. *Canadian Medical Association Journal.* 1999;161(2):132-138.

11. Anand SS, Yusuf S, Vuksan V, et al. Differences in risk factors, atherosclerosis, and cardiovascular disease between ethnic groups in Canada: the Study of Health Assessment and Risk in Ethnic groups (SHARE). *Lancet.* Jul 22 2000;356(9226):279-284.

12. Harding S, Rosato M, Teyhan A. Trends for coronary heart disease and stroke mortality among migrants in England and Wales, 1979–2003: slow declines notable for some groups. *Heart.* April 1, 2008;94(4):463-470.

13. Gholap N, Davies M, Patel K, Sattar N, Khunti K. Type 2 diabetes and cardiovascular disease in South Asians. *Prim Care Diabetes.* Apr 2011;5(1):45-56.

14. Balarajan R. Ethnicity and variations in the nation's health. *Health trends.* 1995;27(4):114-119.

15. Gill P, Kai J, Bhopal R, Wild S. Health care needs assessment: black and minority ethnic groups. *Health Care Needs Assessment. The epidemiologically based needs assessment reviews. Third Series. Abingdon: Radcliffe Publishing Ltd.* 2007.

16. Gunarathne A, Patel JV, Gammon B, Gill PS, Hughes EA, Lip GYH. Ischemic Stroke in South Asians. *Stroke.* June 1, 2009;40(6):e415-e423.

17. Gunarathne A, Patel JV, Potluri R, et al. Increased 5-year mortality in the migrant South Asian stroke patients with diabetes mellitus in the United Kingdom: The West

Birmingham Stroke Project. *International Journal of Clinical Practice.* 2008;62(2):197-201.

18. Palaniappan LP, Araneta MRG, Assimes TL, et al. Call to Action: Cardiovascular Disease in Asian Americans. A Science Advisory From the American Heart Association. *Circulation.* August 23, 2010;122:1242–1252.

19. Klatsky AL, Tekawa I, Armstrong M, Sidney S. The risk of hospitalization for ischemic heart disease among Asian Americans in northern California. *Am. J. Public Health.* 1994;84(10):1672-1675.

20. Yates T, Davies MJ, Gray LJ, et al. Levels of physical activity and relationship with markers of diabetes and cardiovascular disease risk in 5474 white European and South Asian adults screened for type 2 diabetes. *Prev Med.* Sep-Oct 2010;51(3-4):290-294.

21. Misra R, Patel T, Kotha P, et al. Prevalence of diabetes, metabolic syndrome, and cardiovascular risk factors in US Asian Indians: results from a national study. *Journal of Diabetes and its Complications.* 2010;24(3):145-153.

22. Mohanty SA, Woolhandler S, Himmelstein DU, Bor DH. Diabetes and cardiovascular disease among Asian Indians in the United States. *J Gen Intern Med.* May 2005;20(5):474-478.

23. Ye J, Rust G, Baltrus P, Daniels E. Cardiovascular Risk Factors among Asian Americans: Results from a National Health Survey. *Ann. Epidemiol.* 2009;19(10):718-723.

24. Jonnalagadda SS, Diwan S. Health behaviors, chronic disease prevalence and self-rated health of older Asian Indian immigrants in the U.S. *J Immigr Health.* Apr 2005;7(2):75-83.

25. Misra KB, Endemann SW, Ayer M. Leisure time physical activity and metabolic syndrome in Asian Indian immigrants residing in Northern California. *Ethn. Dis.* Fall 2005;15(4):627-634.

26. Thorpe L, Upadhyay U, Chamany S, et al. Prevalence and control of diabetes and impaired fasting glucose in New York City. *Diabetes Care.* Jan 2009;32(1):57-62.

27. Venkataraman R, Nanda NC, Baweja G, Parikh N, Bhatia V. Prevalence of diabetes mellitus and related conditions in Asian Indians living in the United States. *Am J Cardiol.* Oct 1 2004;94(7):977-980.

28. Ivey SL, Mehta KM, Fyr CL, Kanaya AM. Prevalence and correlates of cardiovascular risk factors in South Asians: population-based data from two California surveys. *Ethn Dis.* Autumn 2006;16(4):886-893.

29. Razak F, Anand SS, Shannon H, et al. Defining Obesity Cut Points in a Multiethnic Population. *Circulation.* April 24, 2007;115(16):2111-2118.

30. Flowers E, Molina C, Mathur A, et al. Prevalence of metabolic syndrome in South Asians residing in the United States. *Metabolic Syndrome and Related Disorders.* 2010;8(5):417-423.

31. Lear SA, Humphries KH, Hage-Moussa S, Chockalingam A, Mancini GBJ. Immigration presents a potential increased risk for atherosclerosis. *Atherosclerosis.* Aug 2009;205(2):584-589.

32. Oza-Frank R, Stephenson R, Venkat Narayan K. Diabetes Prevalence by Length of Residence Among US Immigrants. *Journal of Immigrant and Minority Health.* 2009:1-8.

33. Kaushal N. Adversities of acculturation? Prevalence of obesity among immigrants. *Health Econ.* Mar 2009;18(3):291-303.

34. Lauderdale DS, Rathouz PJ. Body mass index in a US national sample of Asian Americans: effects of nativity, years since immigration and socioeconomic status. *Int J Obes Relat Metab Disord.* Sep 2000;24(9):1188-1194.

35. Sanchez-Vaznaugh EV, Kawachi I, Subramanian SV, Sanchez BN, Acevedo-Garcia D. Differential effect of birthplace and length of residence on body mass index (BMI) by education, gender and race/ethnicity. *Soc Sci Med.* Oct 2008;67(8):1300-1310.

36. Koya DL, Egede LE. Association between length of residence and cardiovascular disease risk factors among an ethnically diverse group of United States immigrants. *J Gen Intern Med.* Jun 2007;22(6):841-846.

37. Goel MS, McCarthy EP, Phillips RS, Wee CC. Obesity Among US Immigrant Subgroups by Duration of Residence. *JAMA: The Journal of the American Medical Association.* December 15, 2004;292(23):2860-2867.

38. Roshania R, Venkat Narayan KM, Oza-Frank R. Age at Arrival and Risk of Obesity Among US Immigrants. *Obesity.* 2008;16(12):2669-2675.

39. Singh GK, Siahpush M. Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: an analysis of two national data bases. *Hum Biol.* Feb 2002;74(1):83-109.

40. Mukhopadhyay B, Sattar N, Fisher M. Diabetes and cardiac disease in South Asians. *The British Journal of Diabetes & Vascular Disease.* 2005;5(5):253-259.

41. Patel DJ, Winterbotham M, Britt RP, et al. Coronary risk factors in people from the Indian subcontinent living in West London and their siblings in India. *The Lancet.* 1995;345(8947):405-409.

42. Misra A, Khurana L. The metabolic syndrome in South Asians: epidemiology, determinants, and prevention. *Metab Syndr Relat Disord.* Dec 2009;7(6):497-514.

43. National Center for Health Statistics. Data File Documentation, National Health Interview Survey, 2005 National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland 2006.

44. National Center for Health Statistics. Data File Documentation, National Health Interview Survey, 2006 National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland 2007.

45. National Center for Health Statistics. Data File Documentation, National Health Interview Survey, 2007 National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland 2008.

46. National Center for Health Statistics. Data File Documentation, National Health Interview Survey, 2008 National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland 2009.

47. National Center for Health Statistics. Data File Documentation, National Health Interview Survey, 2009 National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland 2010.

48. California Health Interview Survey. CHIS 2007 Adult Survey. UCLA Center for Health Policy Research. Los Angeles, CA: August 2009.

49. California Health Interview Survey. CHIS 2005 Adult Survey. UCLA Center for Health Policy Research. Los Angeles, CA: February 2010.

50. California Health Interview Survey. CHIS 2009 Adult Survey. UCLA Center for Health Policy Research. Los Angeles, CA: April 2011.

51. World Health Organization. Global Database on Body Mass Index, BMI Classification. 2004; http://apps.who.int/bmi/index.jsp?introPage=intro_3.html. Accessed July 9, 2009.

52. Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA. Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. *BMJ: British Medical Journal.* 2011;342:d671.

53. Kushi LH, Fee RM, Folsom AR, Mink PJ, Anderson KE, Sellers TA. Physical activity and mortality in postmenopausal women. *JAMA: the journal of the American Medical Association.* 1997;277(16):1287-1292.

54. August K, Sorkin D. Racial/Ethnic Disparities in Exercise and Dietary Behaviors of Middle-Aged and Older Adults. *J. Gen. Intern. Med.* 2011;26(3):245-250.

55. Centers for Disease Control and Prevention. Nutrition for everyone: Fruits and vegetables. http://www.cdc.gov/nutrition/everyone/fruitsvegetables/index.html Accessed April 2, 2011.

56. Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and Setting National Goals for Cardiovascular Health Promotion and Disease Reduction: The American Heart Association's Strategic Impact Goal Through 2020 and Beyond. *Circulation.* February 2, 2010;121(4):586-613.

57. Salant T, Lauderdale DS. Measuring culture: a critical review of acculturation and health in Asian immigrant populations. *Social Science & Medicine.* 2003;57(1):71-90.

58. McGee DL, Liao Y, Cao G, Cooper RS. Self-reported health status and mortality in a multiethnic US cohort. *American Journal of Epidemiology.* 1999;149(1):41-46.

59. Shiwaku K, Anuurad E, Enkhmaa B, Kitajima K, Yamane Y. Appropriate BMI for Asian populations. *The Lancet.* 2004;363(9414):1077(letter).

60. World Health Organization expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet.* Jan 10 2004;363(9403):157-163.

61. Zheng W, McLerran DF, Rolland B, et al. Association between Body-Mass Index and Risk of Death in More Than 1 Million Asians. *New England Journal of Medicine.* 2011;364(8):719-729.

62. Misra A, Chowbey P, Makkar B, Vikram N, Wasir J, Chadha+ D. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. *JAPI.* 2009;57:163-170.

63. Conen D, Ridker PM, Mora S, Buring JE, Glynn RJ. Blood pressure and risk of developing type 2 diabetes mellitus: The Women's Health Study. *Eur Heart J.* Dec 2007;28(23):2937-2943.

64. Oza-Frank R, Cunningham SA. The weight of US residence among immigrants: a systematic review. *Obesity Reviews.* 2010;11(4):271-280.

65. Antecol H, Bedard K. Unhealthy assimilation: Why do immigrants converge to American health status levels? *Demography.* 2006;43(2):337-360.

66. McGoldrick DE, Boonn AV. Public Policy to Maximize Tobacco Cessation. *American Journal of Preventive Medicine.* 2010;38(3):S327-S332.

67. Kandula NR, Lauderdale DS. Leisure time, non-leisure time, and occupational physical activity in Asian Americans. *Ann Epidemiol.* Apr 2005;15(4):257-265.

68. Raj S, Ganganna P, Bowering J. Dietary habits of Asian Indians in relation to length of residence in the United States. *J Am Diet Assoc.* Sep 1999;99(9):1106-1108.

69. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men. *New England Journal of Medicine.* 2011;364(25):2392-2404.

70. Sayon-Orea C, Martinez-Gonzalez MA, Bes-Rastrollo M. Alcohol consumption and body weight: a systematic review. *Nutr. Rev.* 2011;69(8):419-431.

71. Matthews J, Wood J. Megaloblastic anaemia in vegetarian Asians. *Clinical & Laboratory Haematology.* 1984;6(1):1-7.

72. Enas EA, Mohan V, Deepa M, Farooq S, Pazhoor S, Chennikkara H. The Metabolic Syndrome and Dyslipidemia Among Asian Indians: A Population With High Rates of Diabetes and Premature Coronary Artery Disease. *Journal of the CardioMetabolic Syndrome.* 2007;2(4):267-275.

73. CHIS 2003 study benchmarking key estimates for CHIS with those from major federal health surveys. *CHIS Data Quality* http://www.chis.ucla.edu/dataquality5.html. Accessed April 16, 2012.

74. Groves RM. Nonresponse Rates and Nonresponse Bias in Household Surveys. *Public Opinion Quarterly.* January 1, 2006;70(5):646-675.

75. CHIS 2005 Using Neighborhood Characteristics to Assess Nonresponse Bias. *CHIS Data Quality* http://www.chis.ucla.edu/dataquality4.html. Accessed April 16, 2012.

76. CHIS 2007 Nonresponse Analysis. *CHIS Data Quality* http://www.chis.ucla.edu/dataquality3.html. Accessed April 16, 2012.

77. Kandula N, Tirodkar M, Lauderdale DS, Makoul G, Paracha MW, Baker D. Awareness, Perception, and Knowledge of Heart Disease Risk and Prevention among South Asian Immigrants. *J. Gen. Intern. Med.* Apr 2009;24:29-29.

78. Newell SA, Girgis A, Sanson-Fisher RW, Savolainen NJ. The accuracy of self-reported health behaviors and risk factors relating to cancer and cardiovascular disease in the general population: A critical review. *American Journal of Preventive Medicine.* 1999;17(3):211-229.

79. Del Boca FK, Darkes J. The validity of self-reports of alcohol consumption: state of the science and challenges for research. *Addiction.* 2003;98:1-12.

80. Okura Y, Urban LH, Mahoney DW, Jacobsen SJ, Rodeheffer RJ. Agreement between self-report questionnaires and medical record data was substantial for diabetes, hypertension, myocardial infarction and stroke but not for heart failure. *Journal of Clinical Epidemiology.* 2004;57(10):1096-1103.

81. Patrick DL, Cheadle A, Thompson DC, Diehr P, Koepsell T, Kinne S. The validity of self-reported smoking: a review and meta-analysis. *Am. J. Public Health.* 1994;84(7):1086-1093.

82. Natarajan S, Lipsitz SR, Nietert PJ. Self-report of high cholesterol: determinants of validity in U.S. adults. *American Journal of Preventive Medicine.* 2002;23(1):13-21.

83. Gorber SC, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obesity Reviews.* 2007;8(4):307-326.

84. Prince SA, Adamo KB, Hamel ME, Hardt J, Gorber SC, Tremblay M. A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *Int. J. Behav. Nutr. Phys. Act.* Nov 6, 2008;5(1):56-79.

85. Hunt LM, Schneider S, Comer B. Should "acculturation" be a variable in health research? A critical review of research on US Hispanics. *Social Science & Medicine.* 2004;59(5):973-986.

86. Pourat N, Kagawa-Singer M, Breen N, Sripipatana A. Access Versus Acculturation: Identifying Modifiable Factors to Promote Cancer Screening Among Asian American Women. *Medical Care.* 2010;48(12):1088-1096

87. Agarwal P. *Passage from India: Post 1965 Indian immigrants and their children: Conflicts, concerns, and solutions*. Palos Verdes, CA: Yuvati Publications; 1991.

88. Saxenian A. Silicon Valley's New Immigrant High-Growth Entrepreneurs. *Economic Development Quarterly.* February 1, 2002;16(1):20-31.

89. Pollard TM, Carlin LE, Bhopal R, Unwin N, White M, Fischbacher C. Social networks and coronary heart disease risk factors in South Asians and Europeans in the UK. *Ethn Health.* Aug 2003;8(3):263-275.

90. Netto G, Bhopal R, Lederle N, Khatoon J, Jackson A. How can health promotion interventions be adapted for minority ethnic communities? Five principles for guiding the development of behavioural interventions. *Health Promotion International.* June 1, 2010;25(2):248-257.

91. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. *Int J Obes.* 2011;35(2):167-187.

92. Grace C, Begum R, Subhani S, Kopelman P, Greenhalgh T. Prevention of type 2 diabetes in British Bangladeshis: qualitative study of community, religious, and professional perspectives. *BMJ.* November 4, 2008;337(3):a1931-a1937.

93. Raymond C, Sukhwant BAL. The drinking habits of Sikh, Hindu, Muslim and white men in the West Midlands: a community survey. *Addiction.* 1990;85(6):759-769.

Chapter 4: The Association of Religiosity with BMI among Asian Indian immigrants in California

ABSTRACT

Objective: To examine the association between religiosity and body mass index among Asian Indian immigrants residing in California

Methods: We examined cross-sectional survey data from 3,228 Asian Indians in the California Asian Indian Tobacco Survey using bivariate and multivariate regression.

Results: High self-identified religiosity was significantly associated with higher BMI after adjusting for socio-demographic and acculturation measures. Highly religious Asian Indians had 1.53 greater odds (95% CI: 1.18, 2.00) of being overweight or obese than low religiosity immigrants, though this varied by religious affiliation. Religiosity was associated with greater odds of being overweight/obese for Hindus (OR 1.54; 95% CI: 1.08, 2.22) and Sikhs (OR 1.88; 95% CI: 1.07, 3.30), but not for Muslims (OR 0.69; 95% CI: 0.28, 1.70).

Conclusion: Religiosity in Hindus and Sikhs, but not immigrant Muslims, appears to be independently associated with greater body mass index among Asian Indians. If this finding is confirmed, future research should identify mechanisms by which religiosity affects obesity risk.

Keywords: religion, Hinduism, Asian Americans, Islam, body mass index, California, United States

INTRODUCTION:

Asian Indians are among the fastest growing ethnic/immigrant groups in the US, with a growth rate of 70% from the 2000 to the 2010 Census, now consisting of 1-2% of the total population.[1] California is the state with the largest population of Asian Indians.[2] Asian Indians have greater risk of obesity-related conditions, including higher baseline prevalence of cardiovascular disease and diabetes-mellitus, than other racial/ethnic groups in the United States.[3-10] Reasons for the disparity appear to be multi-factorial: physical inactivity, poor diet, and a genetic predisposition to insulin resistance and central obesity.[11-16]

Religiosity may be an influential factor in Asian Indians' risk for obesity and obesity-related conditions. Asian Indians are a heterogeneous community in terms of religious affiliations, which may affect their smoking, drinking, and dietary practices.[8,9] Religiosity in diverse ethnic groups has been associated with significantly greater body weight and/or obesity in cross-sectional and longitudinal studies.[17-21] However, these studies have not included Asian Indians or traditional Asian Indian religions, such as Hinduism, Sikhism, or Islam. Our objective was to examine the association of religiosity with obesity among a multi-religious group of Asian Indians.

METHODS:

Data Source

The 2004 California Asian Indian Tobacco Use Survey (CAITS) was a 27-minute multilingual (English, Gujarati, Hindi, or Punjabi) telephone survey administered to 3,228 randomly selected adults, aged 18 years old or above, of Asian Indian background with residence in California.[22]

Respondents provided information about basic measures of health status, utilization of health services, tobacco use behavior, acculturation, and socio-demographics. Surnames for CAITS were compiled from names from Social Security[23] and through the Vital Statistic Office for the Department of Health Services for the years 1998-2002 in California. From a stratified random sample design, the household response rate was 67%, and the response rate for the randomly selected interviewee was 81%. The final adult response rate was 54% (household response rate of 67% x random adult response rate of 81%). For more information about how the sample was selected and survey design, please see McCarthy et al. (2005).[22] We received institutional review board exemption from the University of California, Los Angeles for this study.

Focal Dependent/Outcome Variable

Body mass index (BMI) was calculated from self-reported weight and height. There were 106 missing observations for BMI, and an additional 113 observations were dropped for a BMI < 18.5 kg/m^2 (or underweight) because of its association with malnutrition, eating disorders, or other health problems (n=219, 6.8% parent sample). In multivariate analysis, BMI was dichotomized as desirable (18.5 ≥ BMI > 25 kg/m^2) or overweight/obese (BMI ≥ 25 kg/m^2) based on the World Health Organization classification scheme and clinical relevance.[24]

Focal Independent/Predictor Variable

Religiosity was assessed as a composite of three measures: "I believe that I am a religious person," "My spiritual beliefs are the foundation of my approach to life," and "I observe the traditional holidays that are important in my culture and religion," which are domains of religious commitment, religious beliefs, and religious participation, respectively. Responses for

the first two items were on a 5-point Likert scale that ranged from strongly agree to strongly disagree. The responses for the third item were on a four-point scale: yes, almost always; yes, much of the time; yes, some of the time; no, rarely or never.

The composite consisted of factor scores resulting from a principal components analysis of these three items (Cronbach's alpha=0.64). There were 384 missing observations of the religiosity composite (10.7% parent sample). Religiosity was reported in quintiles, and to facilitate interpretation, was dichotomized into higher religiosity comprised of the top quintile and lower religiosity comprised of the bottom four quintiles. Dichotomization was based on the differences in demographics between the highest religiosity quintile versus the bottom four quintiles that may potentially confound the focal relationship between religiosity and BMI (see Appendix Table 4-1). Specifically, the highest religiosity quintile had a greater proportion of respondents who were married, had less than a college degree education, made less than or equal to $100K annual household income, and reported good/fair/poor health status (versus excellent/very good health status) than the bottom four religiosity quintiles.

Covariates

Numerous variables were assessed in this analysis. Some were considered to be independent predictors for BMI and others were considered important to include because they may attenuate associations between religiosity and BMI. We considered socio-demographic characteristics, health status/illness burden, and measures of access to health care. Socio-demographic characteristics included age (in years), sex, marital status, level of educational attainment, and annual household income. We defined illness burden by using self-reported health status

(excellent, very good, good, fair, poor), which has previously been shown to be associated with mortality in a multiethnic cohort[25], and cigarette smoking status (current, past, never). We measured access to care using a proxy for having health insurance (having health care coverage or government plan). Missing, refused, and did not know observations were dropped from the analysis, and included 29 missing for age (0.9% sample), 15 for marital status (0.5%), 6 for educational attainment (0.2%), 467 for income (14.5%), 2 for health status (0.1%), 27 for health insurance (0.8%), and 3 for smoking status (0.1%).

Acculturation was assessed two ways. The first measure was percentage of lifetime in the US calculated from years lived in the US divided by current age of the respondent multiplied by 100. Years lived in the US (or percentage of lifetime in US) was answered only by respondents not born in the US, and 44 missing observations were dropped (1.4% of respondents not born in US). Percentage of lifetime in the US may be a better temporal measure than years lived in the US because the former may better quantify the proportion of lifetime exposure to American culture.

The second measure of acculturation was from a scale of 11 questions that were included in six domains of acculturation. The domains were language use (3 questions), media behavior (1 question), social customs (3 questions), social contacts (1 question), cultural identity (1 question), and generational status (2 questions). These domains have been included in existing scales of acculturation in the Asian population.[26-28] Appendix Table 4-2 provides a description of the core items and possible responses. The acculturation scale was standardized on a 0-100 scale, with higher scores indicating greater acculturation to American culture (mean 39.1, standard deviation 17.4, median 37.6, Cronbach's alpha 0.73); additional information about the

psychometrics of this scale are detailed in Chapter 2. A total of 2,712 respondents had completed scale scores (82.5% of the sample), and non-respondents were not demographically different from respondents. The correlation between percentage of lifetime in the US and the acculturation scale was r = 0.4.

Statistical Analysis

We performed frequencies and cross-tabulations to describe the prevalence of baseline characteristics in the full sample. Bivariate linear and logistic regression analyses were performed to estimate the association of religiosity with body mass index. Multivariate binary logistic regression analyses were performed to estimate the odds of being classified as overweight or obese with greater religiosity, adjusted for socio-demographic characteristics, illness burden, and acculturation. Based on frequency distributions in the sample, we dichotomized marital status to married or not married, educational level to less than college degree or greater than or equal to college degree, health status to poor/fair/good health or excellent/very good health, and smoking status to current smoker or not current smoker. Income was omitted from the model due to the large percentage of missing observations for the variable. Insurance status was omitted from the model as all persons with overweight/obese BMI had health insurance. Our analytic sample was limited to 2,219 Asian Indian adult immigrants who had non-missing values for the focal dependent variable, focal independent variable, and covariates. The analytic sample was demographically similar to the full sample, except the analytic sample had slightly more married respondents (73% in full vs. 79% in analytic), had no respondents born in the US, had slightly less acculturated respondents by scale (median 38, mean 39, standard deviation 17 in full sample vs. median 35, mean 36, standard deviation 16 in

analytic sample), and significantly fewer atheists/agnostics (7% in full vs. 0.1% in analytic; most atheists/agnostics were US born). We tested for and found no significant multicollinearity among the variables. Multivariate logistic regression models were also stratified by religious affiliation from the analytic sample. Religious affiliation was categorized as Hinduism, Sikhism, Islam, Agnostic/Atheists, or Other. Other religious affiliation included Christianity, Judaism, Jainism, Zoroastrianism, and Buddhism.

To be able to generalize to all Asian Indians in California, post-stratification adjustment weights were used in the analyses to correct for nonresponse (i.e., refusals) and for noncoverage (i.e., surname omitted from sample frame). The post-stratification adjustment was stratified by gender and age grouping, and counties were grouped by 12 California regions used in previous tobacco control research to generate more stable weights.[22]

We conducted mediator analysis using the Sobel-Goodman mediation and Karlson/Holm/Breen tests to determine if smoking status, health status, or educational attainment mediated the focal relationship between religiosity and BMI. Data were not weighted in mediator analyses due to limitations in the statistical package. Moderator analysis (or interaction analysis) examining whether acculturation moderated the focal relationship was also conducted, and continuous variables were centered for the analysis. We considered a 2-tailed P value of ≤ 0.05 statistically significant for all analyses. Of note, bootstrapped percentile and bias-corrected methods were used to calculate 95% confidence intervals, but these confidence intervals were not reported due to limitations in the statistical package to use survey weights; however, bootstrapped confidence

intervals were similar to survey weighted intervals. All analyses were conducted with STATA 12.0 (College Station, TX).

RESULTS:

The distribution of characteristics for Asian Indian immigrants in California in the full sample is reported in Table 4-1 (and Appendix Table 4-1 and Appendix Table 4-3). The mean age was 37 years, and the majority of the sample was married, highly educated, and insured. The mean acculturation scale score was 39 indicating most respondents were less acculturated to American culture. More than half of the respondents were highly religious based on responses to the religious commitment, beliefs, and participation questions. Specifically, most Asian Indians responded that they strongly or somewhat agree with the belief that they were a religious person (79 percent) and that their spiritual beliefs were the foundation to their approach to life (84 percent). Eighty-eight percent of respondents observed traditional holidays important in their culture and religion at least some of the time. Demographic differences were also notable among the religiosity quintiles. Respondents in the second highest or highest religiosity quintile were more likely to be older, female, married, have less than a college education, have less annual household income, not have health insurance, not be a current smoker, and be born outside the US compared with Asian Indians in the lower three religiosity quintiles.

The majority of the sample practiced Hinduism, followed by Sikhism, other religions, and Islam. Seven percent of the respondents identified themselves as agnostic or atheist. Approximately 40% of the sample was overweight or obese, and the mean BMI was 24.4 kg/m^2. Hindus had the lowest mean BMI at 24.1 kg/m^2 (34% overweight/obese) and Sikhs had the highest mean BMI at

25.2 kg/m^2 (52% overweight/obese). Mean BMI was greater among the highly religious compared with the less religious, and this association was consistent and significant among respondents affiliated with Hinduism, Sikhism, and other religions, but not with Muslims (Figure 4-1).

In the multivariate analysis, those in the highest religiosity quintile had 1.53 greater odds of being overweight/obese relative to those in the lower four religiosity quintiles among Asian Indians (95% CI: 1.18, 2.00; see Table 4-2).This increased odds persisted for Hindus (OR 1.54, 95% CI: 1.08, 2.22) and Sikhs (OR 1.88, 95% CI: 1.07, 3.30) in stratified analysis. Interestingly, highly religious Muslims had a decreased odds of being overweight/obese relative to less religious Muslims (OR 0.69, 95% CI: 0.28, 1.70), but this relationship was not significant, likely due to inadequate power from small sample size. A more detailed distribution of the bivariate relationship between religiosity and BMI among Muslims is provided in Appendix Figure 4-1. In the full sample, other known predictors for overweight/obese BMI demonstrated consistent associations, such as being male and married, while there were protective associations with college degree or higher education and excellent/very good health status. Acculturation based on scale or percentage of lifetime in the US had a null association with BMI in adjusted models. It is noteworthy that smoking status was unrelated to overweight/obesity status.

Some investigators define BMI at lower cut-offs for Asians, with overweight as BMI $\geq$ 23 kg/m^2 and obese as BMI $\geq$ 25 or 27.5 kg/m^2, though a recent study found no mortality differences in Asians at these lower BMI cut-offs.[29-31] Sensitivity analyses with different BMI classifications in the unadjusted and adjusted models found similar trends in the association of obesity status

with religiosity and other covariates regardless of whether BMI was classified as a continuous variable or categorical variable (BMI $\geq$ 23 kg/m^{2}vs. 18.5 $\geq$ BMI > 23 kg/m^2 or BMI $\geq$ 30 kg/m^{2}vs. 18.5 $\geq$ BMI > 30 kg/m^2). In addition, sensitivity analyses with different religiosity classifications in the unadjusted and adjusted models found similar trends with BMI regardless of classification as religious quintiles, religiosity factor scores, a different dichotomization of religiosity quintiles (top three quintiles vs. bottom two), or three-item religiosity continuous scale (or 2-item religious scale with religious commitment and belief in the scale, Cronbach's alpha=0.63). Likewise, we found similar values in the adjusted odds ratios for different acculturation classifications, such as years lived in the US (instead of percentage of lifetime in the US) and acculturation scale categories (0-20, >20-40, >40-60, >60-100 scale score). None of the acculturation scale categories were significantly associated with overweight/obesity. We examined age categories (18-29y, 30-39y, 40-49y, 50+y) in the multivariate models, and found that respondents aged 40 years and above had approximately twice the increased odds (adjusted OR ~ 2.0) of being overweight/obese than Asian Indians who were 18-29 years old, and this trend persisted for Hindus and Sikhs. Given that respondents without a high school diploma may be different from respondents with a high diploma, we examined models with educational attainment dichotomized at high school diploma; our results were similar to the models with educational attainment dichotomized at college degree. We also found no statistically significant associations between annual household income categories (<$20K, $20-$50K, $50-$75K, $75-100K, >$100K) and overweight/obesity.

The relationship between religiosity and acculturation was linear based on the acculturation scale and percentage of lifetime in the US (see Figure 4-2 and 4-3). Mean religiosity factor score

decreased with greater acculturation scale score or percentage of lifetime in the US. Since prior research has shown a correlation between acculturation and obesity, we examined if acculturation moderated the association of religiosity with obesity through an interaction term. However, the interaction was not significant in adjusted models (high religiosity*acculturation scale, OLS coefficient -0.005, p=0.8; high religiosity*percentage of lifetime in US, OLS coefficient -0.001, p=0.9). Educational attainment was found to be a significant mediator of the relationship between religiosity and obesity based on the Sobel-Goodman and Karlson/Holm/Breen mediation tests (the proportion of the total effect that was mediated ranged from 0.13 for BMI as a continuous variable to 0.20 for overweight/obesity categorical variable). However, smoking status and health status were not found to be significant mediators based on the Sobel-Goodman tests (the proportion of the total effect that was mediated was <0, or -0.002 for both smoking and health status).

DISCUSSION:

High religiosity was associated with higher body mass index among Asian Indian adult immigrants in California, and the magnitude of this association varied by religious affiliation. Asian Indian immigrants who were male, married, less educated, and had less favorable health status also had greater odds of being overweight or obese. Previous literature has supported that the positive association between religiosity and obesity is due to the low prevalence of smoking among religious individuals, which may cause increased levels of obesity due to the role of smoking as an appetite suppressant.[32] However, we observed that smoking status was not associated with BMI, contrary to past literature, and thus smoking was not a mechanism by which religiosity might have increased Asian Indians' risk of overweight/obesity. Our findings

are consistent with prior cross-sectional analyses[17,19,20,33] and with recent studies by Feinstein et al. who found that religious involvement was associated with greater obesity in a nationally representative, multi-ethnic sample of older adults (i.e., MESA study) and young adults (i.e., CARDIA longitudinal study).[18,21] Lauderdale et al. examined BMI in Asian Americans and limited their study sample to persons aged 18-59 years.[10] They excluded persons aged 60 years and older because health effects of BMI may differ for the elderly and may increasingly reflect the consequences of ill-health with increasing age.[10] When we limited our analyses to respondents age < 60 years (91 percent of total), the associations of religiosity with body mass index were similar to those reported in Table 4-2 (Full sample adjusted OR: 1.59, 95% CI: 1.19-1.11; Hindus adjusted OR: 1.68, 95% CI: 1.16-2.45; Sikhs adjusted OR: 1.82, 95% CI: 0.95-3.47; Muslims adjusted OR: 0.57, 95% CI: 0.21-1.56; Other adjusted OR: 1.41, 95% CI: 0.44-4.46).

Several theories have been proposed to explain the finding that greater religiosity is associated with increased risk of obesity. In their 2006 analysis, Cline and Ferraro posit that two reasons for this association is the relative emphasis that religious organizations place on avoiding vices such as smoking, compared with the scant attention paid to avoiding the sin of gluttony, and the possibility that religiosity leads to obesity to a lesser extent than obesity leads to religiosity, as religious organizations may offer a welcoming environment for those who are obese and seek protection from social stigma.[17] One longitudinal analysis suggested that religious individuals are more likely to become obese because religious organizations rarely address dietary over-consumption and religious gatherings often center around food and drink.[34]

Immigration and exposure to an obesogenic culture in the US may also increase obesity among Asian Indians in the US. Foreign-born immigrants from diverse ethnic backgrounds have a greater likelihood of being overweight or obese with increasing duration of residence in the US, possibly due to less healthy lifestyle practices, such as eating habits.[10,35-46] As immigrants acculturate to a new culture, they may cease engaging in traditional cultural practices, including traditional religious practices. We found decreasing religiosity with greater acculturation to American culture among Asian Indian immigrants, and high religiosity was an independent factor associated with being overweight/obese even after controlling for acculturation. Educational attainment was found to be a significant mediator in our analysis, but did not fully explain the positive association between religiosity and overweight/obesity.

In our multivariate subgroup analyses, we found significant positive associations between high religiosity and being overweight/obese for Asian Indians practicing Hinduism or Sikhism. However, Asian Indians who practiced Islam are less likely to be overweight/obese, though this association was not significant, possibly due to the small sample size of Muslims. One explanation may be the greater proportion of Muslims who were current smokers (7.8%) compared with Hindus (4.2%) or Sikhs (1.9%), though smoking prevalence is relatively low for all groups and may not adequately explain the "protective" association of higher religiosity with being overweight/obese among Muslims. This difference may also be due to their different religious practices. More specifically, Muslims who are highly religious will not drink alcohol compared with Hindus or Sikhs who may drink heavily during religious and social gatherings, which may be positively associated with weight gain.[47-49] Alternatively, practicing Hindus and Sikhs adhere to a vegetarian diet, but foods high in saturated fat and refined sugar associated

with increased obesity risk are commonplace at religious ceremonies conducted in temples and gurdwaras.[12,50,51] Highly religious Muslims will observe at least five daily ritual prayers that involve changes in body position (i.e., standing, bowing, prostration, sitting).[52] In two ethnographic studies of South Asian immigrants (one in Chicago, other in Britain), Muslims said that performing the daily ritual prayer was both a healthy form and main source of exercise, though we were not able to identify any studies that correlated these daily prayers with physical activity measures or weight changes.[53,54] In addition, religious Muslims observe the annual thirty days of fasting during the month of Ramadan, which entails no food or drink between the hours of sunrise and sunset. Some studies have suggested that Ramadan fasting is associated with a decrease in body weight and/or BMI during the month[55-57], but these changes in weight and/or BMI do not appear to persist after the weeks to months following Ramadan[57,58]. While measures of diet, alcohol, physical activity, and other health behaviors were not available in the dataset, these behaviors deserve further examination to better understand how religious affiliation may differentially impact obesity risk among traditional Asian Indian religious groups.

Our analyses had several limitations. The cross-sectional nature of the data precluded drawing causal inferences about religiosity and BMI. Self-reporting of height and weight data may underestimate one's true BMI leading to measurement error, though it is unlikely to be differential on religiosity status.[59] In addition, the composites used for religiosity and acculturation may not be the most valid or reliable measures of these constructs, which would weaken associations with BMI. Our sample was well educated and may not adequately capture associations between socioeconomic status, religiosity, and obesity. However, the sample was not demographically different from South Asians in the California Health Interview Study

despite the fact that three South Asian languages were used to better capture the heterogeneity of the Asian Indian population in California than an English-only survey (i.e., South Asian refers to people with origins from India, Pakistan, Bangladesh, Nepal, Sri Lanka). This may be because fewer low-income Asian Indians respond to telephone surveys, regardless of what language they speak.

We had inadequate sample size to detect significant differences in either harmful or protective associations of religiosity with obesity among the different religious subgroups. This study was originally designed to assess smoking prevalence among Asian Indians residing in California, and those associated lifestyle behaviors. Respondents were informed up-front of the purpose and scope of the research. It is likely that persons who smoked may have been less likely to participate due to stigmatizing behavior. By the same token, nonsmokers may have been reluctant to participate because they may have perceived the research as being relevant only to smokers. Some of these stigmatizing behaviors or perception of values could be associated with religiosity.

We were unable to control for genetic history, physical activity, dietary practices, exposure to lifestyle counseling on healthy behaviors by healthcare providers, or the built environment as these measures were not included as part of the study, and so uncontrolled confounding may still remain if factors are associated with religiosity and BMI in our study population. For example, studies have found associations between the neighborhood environment and obesity. People who live in resource poor settings (or disadvantaged populations) may have worse environments with respect to food choices and stores (convenience stores instead of large grocery stores),

places to exercise, traffic or crime-related safety.[60] Alternatively, better neighborhood physical activity and food environments were associated with lower BMI in the MESA Neighborhood Study even after adjustment for multiple measures of socioeconomic position and race/ethnicity.[61] Asian Indian immigrants, especially recent immigrants, are likely to live in neighborhoods with high proportions of other immigrants or residents from the same ethnic groups. Through neighborhood-linked social networks and institutions (e.g., places of worship), these ethnic enclaves may reinforce norms regarding healthy and unhealthy behaviors. Neighborhood structural characteristics, such as presence of ethnic food stores relevant for diet, may also play a role in obesity risk. A study using MESA data found that living in an ethnic enclave (high neighborhood immigrant composition) was associated lower consumption of high-fat foods among Hispanics and Chinese, but with being less physically active among Hispanics after adjustment for age, gender, income, education, neighborhood poverty, and acculturation.[62]

Strengths of this study were the large random sample size of California-resident Asian Indians, and new health information on this population including acculturation, religious affiliation, and religiosity measures. Religiosity may be an especially important concept to understand with respect to the risk for obesity in Asian Indians because Asian Indians who may be socially and linguistically isolated from the majority community may derive social support from the religious community (especially recent immigrants, those with low English fluency, and women). It is possible that for Asian Indians, in particular, attendance at worship provides important opportunities for interaction with others sharing similar beliefs and ethnicities.[63] In fact, one study showed that South Asians reported twice the level of religiosity as White populations.[64] Tirodkar et al. found that the presence of spirituality as a concept of health was significant for

South Asian immigrants, especially Muslims.[53] It is likely that religiosity is not only an important factor for obesity risk and obesity-related illnesses, but also an essential concept to include in any health promotion strategies targeted at Asian Indians or South Asians in the US. Several church-based pilot health promotion interventions among African-Americans have shown improvements in participants' weight reduction efforts and consequent achievement of desirable body mass index.[65-67] Similar to African-American churches, religious institutions, such as temples, gurdwaras, and mosques could represent promising community venues in which to implement lifestyle change intervention strategies because of their central role in spiritual guidance, communication, social support, networking, dietary practices, and South Asian cultural life.[65,66,68]

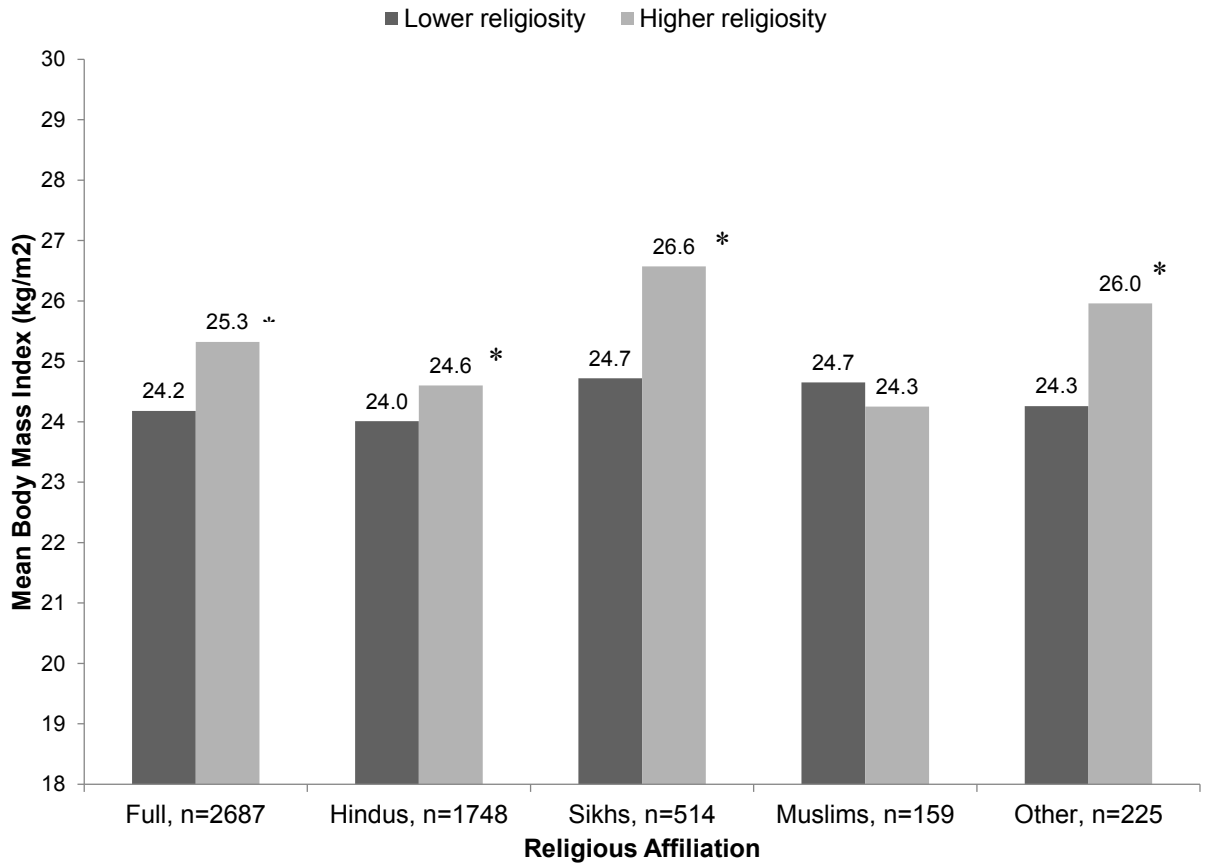
Table 4-1. Characteristics of Asian Indian adults in California, CAITS 2004, n=3,228*

Characteristic	n	Weighted % or mean (SE)
Age, mean in years	3199	37.03 (0.26)
18-29 years	829	37.3
30-39 years	1192	28.1
40-49 years	574	16.9
50+ years	604	17.6
Sex		
Male	1782	52.0
Female	1446	48.0
Marital Status		
Married	2502	73.4
Divorced	78	2.3
Widowed	60	1.8
Separated	21	0.6
Never married	514	20.5
Member of unmarried couple	38	1.4
Educational attainment		
Less than high school	158	5.6
High school degree	192	6.5
Some college/tech	279	10.2
College degree	998	31.3
Graduate/Professional degree	1604	46.4
Annual household income		
<$20K	240	9.5
$20-$50K	454	17.6
$50-$75K	447	17.0
$75-100K	599	22.4
>$100K	1021	33.5
Health status		
Excellent	1232	38.4
Very good	1174	36.1
Good	631	19.4
Fair	147	4.8
Poor	42	1.2
Health insurance		
Yes	2903	89.5
No	298	10.5
Cigarette smoking status		
Current smoker	168	5.4
Past smoker	342	9.4
Never smoker	2715	85.2
Birth Country		
USA	233	7.2

Other	2993	92.8
Years lived in the US, mean**	2951	12.48 (0.20)
Percentage lifetime in US, mean**	2951	32.23 (0.48)
Acculturation scale -11-item, 0-100 range, mean***	2712	39.02 (0.38)
0-20 scale score	318	12.3
>20-40 scale score	1187	43.2
>40-60 scale score	864	31.8
>60-100 scale score	343	12.7

*Column totals may not sum to 100% due to rounding error or missing observations.
**Respondents limited to those not born in the US
***Acculturation scale, alpha = 0.73, median = 37.6, standard deviation = 17.4

Figure 4-1. Distribution of mean body mass index by religiosity level



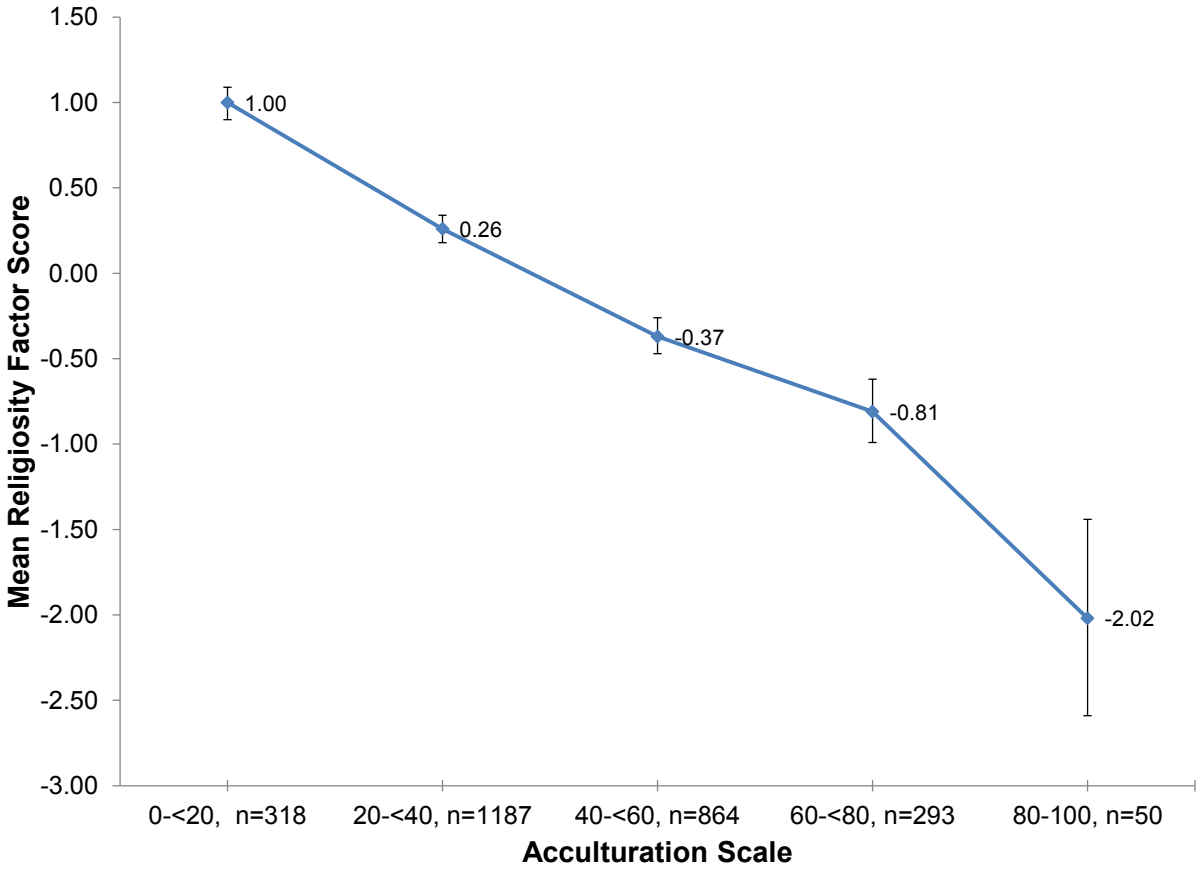
*t-test, $p<0.05$ comparing mean BMI by religiosity within religious affiliation

Table 4-2.Logistic regression unadjusted and adjusted odds ratio (OR) examining the association of religiosity with body mass index-based overweight/obesity status in Asian Indian immigrants in California, (95%CI)

	Unadj. OR	Adjusted OR				
	Full sample n=2687	**Full n=2213**	**Hindus n=1472**	**Sikhs n=449**	**Muslims n=120**	**Other n=152**
High religiosity	1.74** (1.40, 2.16)	1.53** (1.18, 2.00)	1.54* (1.08, 2.22)	1.88* (1.07, 3.30)	0.69 (0.28, 1.70)	1.46 (0.48, 4.41)
Acculturation scale		1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	0.99 (0.98, 1.01)	1.01 (0.98, 1.04)	0.99 (0.97, 1.02)
Percentage life in US		1.01* (1.00, 1.01)	1.00 (1.00, 1.01)	1.01 (1.00, 1.02)	0.98 (0.96, 1.00)	1.01 (0.99, 1.04)
Age		1.02** (1.01, 1.03)	1.02** (1.01, 1.03)	1.02* (1.00, 1.04)	1.00 (0.97, 1.03)	1.00 (0.97, 1.03)
Male sex		1.69** (1.38, 2.07)	1.51** (1.17, 1.95)	2.01** (1.30, 3.11)	1.72 (0.66, 4.51)	2.11 (0.92, 4.86)
Married		1.84** (1.37, 2.48)	1.80** (1.22, 2.66)	1.41 (0.78, 2.54)	1.70 (0.55, 5.25)	8.09** (2.49, 26.8)
College degree or higher		0.54** (0.41, 0.71)	0.49** (0.33, 0.74)	0.80 (0.49, 1.29)	1.31 (0.47, 3.69)	0.64 (0.15, 2.77)
Excellent/very good health status		0.72* (0.58, 0.91)	0.69** (0.52, 0.91)	0.90 (0.56, 1.45)	0.78 (0.32, 1.92)	0.40 (0.15,1.06)
Current smoker		1.21 (0.69, 2.11)	1.28 (0.65, 2.52)	2.45 (0.41, 14.8)	1.15 (0.27, 4.88)	0.69 (0.14, 3.42)

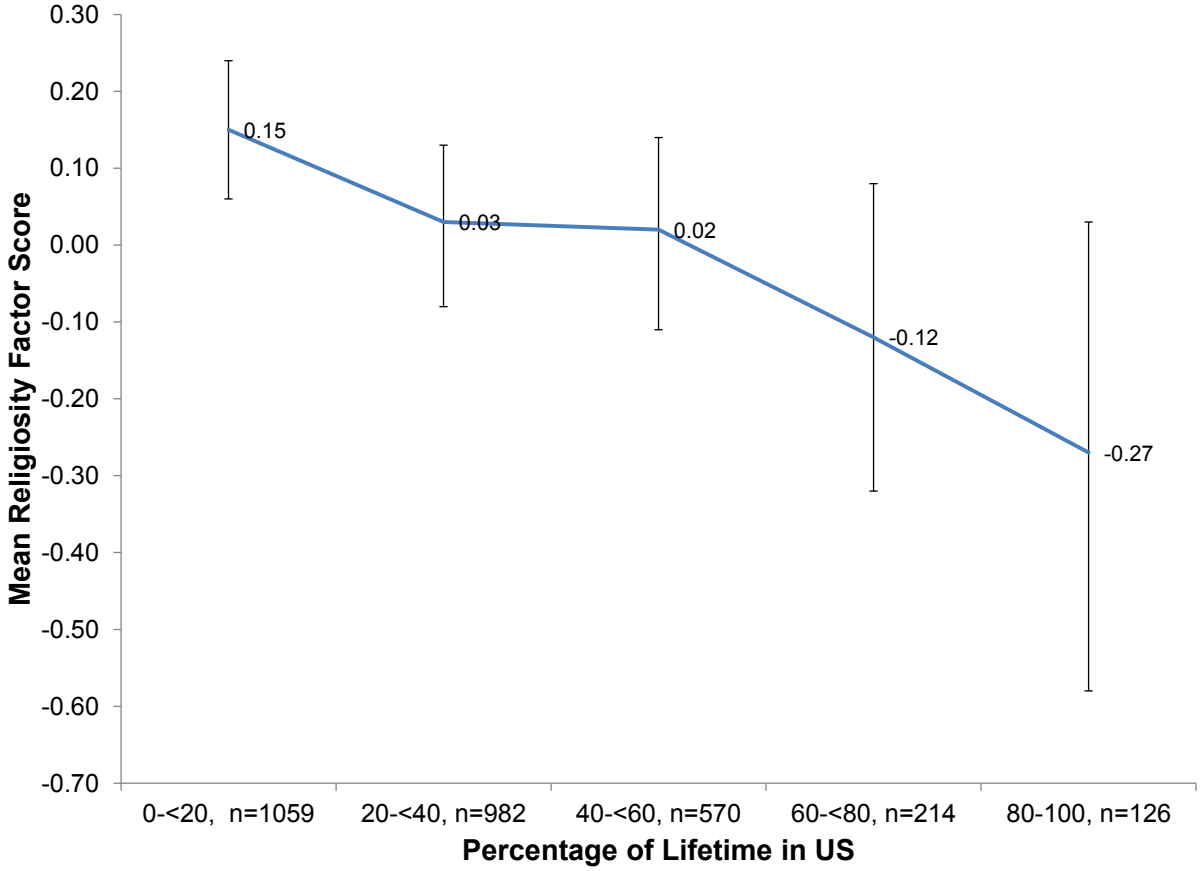
*p<0.05; **p<0.005; CI=confidence interval
High religiosity defined as the highest religiosity quintile (vs. bottom four quintiles)
Other religious affiliation includes: Christianity, Judaism, Zoroastrianism, Jainism, Buddhism

Figure 4-2. Mean religiosity factor score, by acculturation scale categories



ologit nonlinear F (1, 2487) = 313.82, p<0.0001, n=2,488

Figure 4-3. Mean religiosity factor score, by percentage of lifetime in US categories



ologit nonlinear F (1, 2658) = 10.87, p=0.001, n=2,659

APPENDIX: Chapter 4

Table 4-1. Characteristics by religiosity quintile, n=2,884

	Religiosity Quintiles				
	Lowest	Low	Middle	High	Highest
Characteristic	**n=549**	**n=511**	**n=632**	**n=670**	**n=522**
Age, mean in years	34.18	35.93	36.07	38.02	40.72
Sex, %					
Male	66.0	53.4	48.0	45.4	39.3
Female	34.0	46.7	52.0	54.6	60.7
Marital Status, %					
Married	61.8	71.9	74.4	80.4	82.8
Not married	38.2	28.1	25.6	19.6	17.2
Educational attainment, %					
Less than college degree	14.5	13.3	17.7	25.8	38.1
College, graduate, prof degree	85.5	86.7	82.3	74.3	62.0
Annual household income, %					
≤ $100K	57.2	65.3	64.8	71.2	79.5
> $100K	42.9	34.7	35.2	28.9	20.5
Health status, %					
Excellent/very good	76.3	76.4	76.6	74.4	68.8
Good/fair/poor	23.7	23.6	23.4	25.6	31.2
Health insurance					
Yes	94.5	92.1	91.3	88.5	81.5
No	5.5	7.9	8.8	11.5	18.5
Smoking status, %					
Current smoker	8.7	5.6	4.0	4.1	2.0
Past/never smoker	91.3	94.4	96.0	95.9	98.0
Birth Country					
USA	10.4	7.2	7.1	5.0	3.2
Other	89.6	92.8	92.9	95.0	96.9
Years lived in the US, mean	12.36	12.99	12.11	11.50	11.99
Percentage of lifetime in US, mean	34.39	34.00	31.59	29.20	28.71
Acculturation scale, 0-100 range, mean	48.09	43.00	39.51	34.26	26.21

APPENDIX: Chapter 4

Table 4-2. Acculturation scale core items, lower-level domains, and responses

Items	Responses
LANGUAGE USE	
1. English as primary language	0=No 1=Yes
2. How often native language spoken at home?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
3. Language of interview	0=Hindi, Punjabi, Gujarati 1=English
MEDIA BEHAVIOR	
4. How often do you read Indian newspapers, magazines, books?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
SOCIAL CUSTOMS	
5. How often do you eat Indian food?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
6. How open are you to your child marrying outside of cultural group?	1=Strongly against 2=Moderately against 3=Neither open or against 4=Moderately open 5=Very open
7. Do you observe the traditional holidays in your culture/ religion?	1=Yes, almost always 2=Yes, much of the time 3=Yes, some of the time 4=No, rarely or never
SOCIAL CONTACTS	
8. How often do you keep in contact with family/ friends in India?	1=Very often 2=Somewhat often 3=Neither often nor rarely 4=Somewhat rarely 5=Very rarely
ETHNIC IDENTITY	
9. What is your cultural identity?	1=Full-Indian 2=Indian first-American second 3=Equal blend of Indian-American 4=American first-Indian second 5=Full American
GENERATIONAL STATUS	
10. What is your generational status?	1=1st generation 2=2nd+generation
11. Were you born in a developed country?	0=No 1=Yes

APPENDIX: Chapter 4

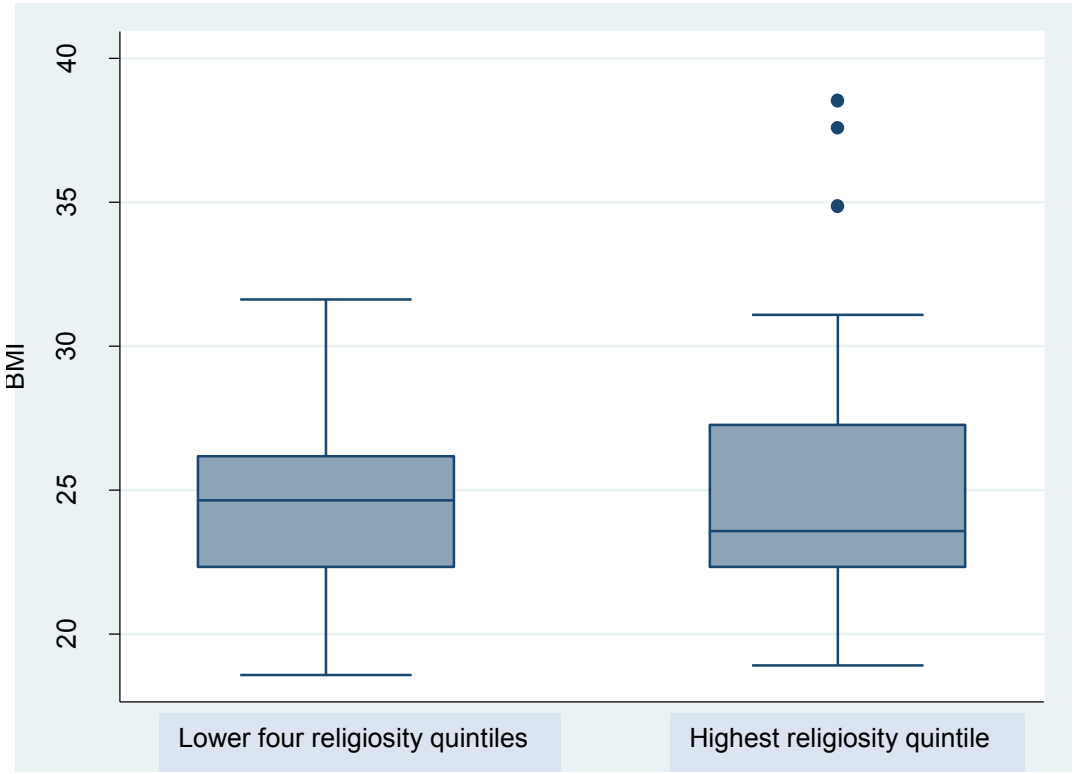
Table 4-3: Distribution of responses to religiosity and BMI questions, CAITS 2004 (n=3,228)*

Characteristic	N	Weighted % or mean (SE)
Religious commitment		
I believe that I am a religious person		
Strongly agree	1262	42.9
Somewhat agree	1091	36.4
Neither agree or disagree	256	8.2
Somewhat disagree	220	7.3
Strongly disagree	145	5.3
Religious beliefs		
My spiritual beliefs are the foundation to my approach to life		
Strongly agree	1567	53.6
Somewhat agree	888	30.3
Neither agree or disagree	210	6.8
Somewhat disagree	143	5.2
Strongly disagree	120	4.1
Religious participation		
I observe the traditional holidays that are important in my culture and religion		
Yes, almost always	1013	33.2
Yes, much of the time	756	22.9
Yes, some of the time	1059	21.7
No, rarely or never	383	12.2
Religious affiliation		
Hinduism	1950	59.8
Sikhism	574	19.6
Islam	180	5.8
Other**	246	8.0
Atheism/Agnosticism	220	6.7
Religiosity Quintiles		
Lowest quintile	549	18.9
2nd lowest quintile	511	17.3
Middle quintile	632	21.8
2nd highest quintiles	670	23.4
Highest quintile	522	18.6
Body mass index (BMI, kg/m2), mean	3009	24.39 (0.07)
BMI>=23	1930	26.27 (0.08)
BMI>=25***	1179	27.72 (0.10)
BMI>=30	180	32.93 (0.34)

*Column totals may not sum to 100% due to rounding error or missing observations.
**Other religious affiliation: Christianity, Judaism, Jainism, Zoroastrianism, Buddhism
***Percentage overweight/obese by religious affiliation: Hindus 34.0%, Sikhs 51.7%, Muslims 41.6%, Other 42.1%, Atheists/Agnostics 40.1%

APPENDIX: Chapter 4

Figure 4-1. Distribution of BMI with higher/ lower religiosity among Muslims (n=159)



BMI= body mass index defined as BMI ≥ 18.5 kg/m^2. The figure shows a wider distribution of BMI for respondents in the the highest religiosity quintile compared to lower four religiosity quintiles, and most observations are concentrated below BMI ≤ 25 kg/m^2 for the former. By contrast, in the unadjusted (bivariate) model examining the association between religiosity and overweight/ obese BMI among Muslims, higher religiosity had an odds ratio=0.49 (95% CI: 0.23, 1.04); the adjusted model odds ratio for higher religiosity=0.69 (95% CI: 0.29, 1.70).

REFERENCES

1. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the Asian adult population: United States, 2004–2006. Advance data from vital and health statistics; no 394. Hyattsville, MD: National Center for Health Statistics. 2008.
2. U.S. Census Bureau and India Abroad Center for Political Awareness. Indian-American Population by State. http://www.indianembassy.org/ind_us/census_2000/ia_population_map_2001.pdf. Accessed July 9, 2009.
3. Enas EA, Garg A, Davidson MA, Nair VM, Huet BA, Yusuf S. Coronary heart disease and its risk factors in first-generation immigrant Asian Indians to the United States of America. *Indian Heart J.* Jul-Aug 1996;48(4):343-353.
4. Mukhopadhyay B, Forouhi NG, Fisher BM, Kesson CM, Sattar N. A comparison of glycaemic and metabolic control over time among South Asian and European patients with Type 2 diabetes: results from follow-up in a routine diabetes clinic. *Diabet Med.* Jan 2006;23(1):94-98.
5. Prayaga S. Asian Indians and coronary artery disease risk. *Am J Med.* Mar 2007;120(3):e15; author reply e19.
6. Baweja G, Nanda NC, Parikh N, Bhatia V, Venkataraman R. Prevalence of stroke and associated risk factors in Asian Indians living in the state of Georgia, United States of America. *Am J Cardiol.* Jan 15 2004;93(2):267-269.
7. Mohanty SA, Woolhandler S, Himmelstein DU, Bor DH. Diabetes and cardiovascular disease among Asian Indians in the United States. *J Gen Intern Med.* May 2005;20(5):474-478.

8. Eliasi JR, Dwyer JT. Kosher and Halal: Religious observances affecting dietary intakes. *Journal Of The American Dietetic Association.* Jul 2002;102(7):911-913.

9. McCaffree J. Dietary restrictions of other religions. *Journal Of The American Dietetic Association.* July 2002(102):912.

10. Lauderdale DS, Rathouz PJ. Body mass index in a US national sample of Asian Americans: effects of nativity, years since immigration and socioeconomic status. *Int J Obes Relat Metab Disord.* Sep 2000;24(9):1188-1194.

11. Bedi US, Singh S, Syed A, Aryafar H, Arora R. Coronary Artery Disease in South Asians: An Emerging Risk Group. *Cardiology in Review.* 2006;14(2):74-80

12. Deedwania P, Singh V. Coronary artery disease in South Asians: evolving strategies for treatment and prevention. *Indian Heart J.* Nov-Dec 2005;57(6):617-631.

13. Kalra P, Srinivasan S, Ivey S, Greenlund K. Knowledge and practice: the risk of cardiovascular disease among Asian Indians. Results from focus groups conducted in Asian Indian communities in Northern California. *Ethn Dis.* Autumn 2004;14(4):497-504.

14. Arrieta A, Russell LB. Effects of Leisure and Non-Leisure Physical Activity on Mortality in US Adults over Two Decades. *Ann. Epidemiol.* Dec 2008;18(12):889-895.

15. Misra A, Vikram NK. Insulin resistance syndrome (metabolic syndrome) and obesity in Asian Indians: evidence and implications. *Nutrition.* 2004;20(5):482-491.

16. Uppaluri CR. Heart disease and its related risk factors in Asian Indians. *Ethn Dis.* Winter 2002;12(1):45-53.

17. Cline KMC, Ferraro KF. Does religion increase the prevalence and incidence of obesity in adulthood? *J. Sci. Stud. Relig.* Jun 2006;45(2):269-281.

18. Feinstein M, Liu K, Ning H, Fitchett G, Lloyd-Jones DM. Burden of cardiovascular risk factors, subclinical atherosclerosis, and incident cardiovascular events across dimensions of religiosity: The multi-ethnic study of atherosclerosis. *Circulation.* Feb 9 2010;121(5):659-666.

19. Ferraro KF. Firm Believers? Religion, Body Weight, and Well-Being. *Review of Religious Research.* 1998;39(3):224-244.

20. Lapane KL, Lasater TM, Allan C, Carleton RA. Religion and cardiovascular disease risk. *Journal of Religion and Health.* 1997;36(2):155-164.

21. Feinstein M, Liu K, Ning H, Fitchett G, Lloyd-Jones DM. Incident obesity and cardiovascular risk factors between young adulthood and middle age by religious involvement: The Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Preventive Medicine.* Feb 1, 2012;54(2):117-121.

22. McCarthy WJ, Divan H, Shah D, et al. *California Asian Indian Tobacco Survey – 2004.* Sacramento, CA: California Department of Health Services;2005.

23. Lauderdale DS, Kestenbaum B. Asian American ethnic identification by surname. *Population Research and Policy Review.* 2000;19(3):283-300.

24. World Health Organization. Global Database on Body Mass Index, BMI Classification. 2004; http://apps.who.int/bmi/index.jsp?introPage=intro_3.html. Accessed July 9, 2009.

25. McGee DL, Liao Y, Cao G, Cooper RS. Self-reported health status and mortality in a multiethnic US cohort. *American Journal of Epidemiology.* 1999;149(1):41-46.

26. Abe-Kim J, Okazaki S, Goto SG. Unidimensional versus multidimensional approaches to the assessment of acculturation for Asian American populations. *Cultur Divers Ethnic Minor Psychol.* Aug 2001;7(3):232-246.

27. Anderson J, Moeschberger M, Chen MS, Jr., Kunn P, Wewers ME, Guthrie R. An acculturation scale for Southeast Asians. *Soc Psychiatry Psychiatr Epidemiol.* Jul 1993;28(3):134-141.

28. Chung G, Ruth H, Kim B, Abreu J. Asian American Multidimensional Acculturation Scale: Development, Factor Analysis, Reliability, and Validity. *Cultural Diversity and Ethnic Minority Psychology.* 2004;10(1):66-80.

29. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. *Int J Obes.* 2011;35(2):167-187.

30. World Health Organization expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet.* Jan 10 2004;363(9403):157-163.

31. Zheng W, McLerran DF, Rolland B, et al. Association between Body-Mass Index and Risk of Death in More Than 1 Million Asians. *New England Journal of Medicine.* 2011;364(8):719-729.

32. Kim KH, Sobal J, Wethington E. Religion and body weight. *Int J Obes Relat Metab Disord.* Apr 2003;27(4):469-477.

33. Gillum RF. Frequency of attendance at religious services, overweight, and obesity in American women and men: the Third National Health and Nutrition Examination Survey. *Ann Epidemiol.* Sep 2006;16(9):655-660.

34. Krause N, Liang J, Shaw BA, Sugisawa H, Kim HK, Sugihara Y. Religion, death of a loved one, and hypertension among older adults in Japan. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences.* 2002;57(2):S96-S107.

35. Akresh IR. Overweight and obesity among foreign-born and U.S.-born Hispanics. *Biodemography Soc Biol.* Fall 2008;54(2):183-199.

36. Argeseanu Cunningham S, Ruben JD, Venkat Narayan KM. Health of foreign-born people in the United States: A review. *Health & Place.* 2008;14(4):623-635.

37. Barcenas CH, Wilkinson AV, Strom SS, et al. Birthplace, years of residence in the United States, and obesity among Mexican-American adults. *Obesity (Silver Spring).* Apr 2007;15(4):1043-1052.

38. Goel MS, McCarthy EP, Phillips RS, Wee CC. Obesity Among US Immigrant Subgroups by Duration of Residence. *JAMA: The Journal of the American Medical Association.* December 15, 2004;292(23):2860-2867.

39. Gordon-Larsen P, Harris KM, Ward DS, Popkin BM. Acculturation and overweight-related behaviors among Hispanic immigrants to the US: the National Longitudinal Study of Adolescent Health. *Soc Sci Med.* Dec 2003;57(11):2023-2034.

40. Kaplan MS, Huguet N, Newsom JT, McFarland BH. The association between length of residence and obesity among Hispanic immigrants. *Am J Prev Med.* Nov 2004;27(4):323-326.

41. Kaushal N. Adversities of acculturation? Prevalence of obesity among immigrants. *Health Econ.* Mar 2009;18(3):291-303.

42. Koya DL, Egede LE. Association between length of residence and cardiovascular disease risk factors among an ethnically diverse group of United States immigrants. *J Gen Intern Med.* Jun 2007;22(6):841-846.

43. Roshania R, Narayan KM, Oza-Frank R. Age at arrival and risk of obesity among US immigrants. *Obesity (Silver Spring).* Dec 2008;16(12):2669-2675.

44. Sanchez-Vaznaugh EV, Kawachi I, Subramanian SV, Sanchez BN, Acevedo-Garcia D. Differential effect of birthplace and length of residence on body mass index (BMI) by education, gender and race/ethnicity. *Soc Sci Med.* Oct 2008;67(8):1300-1310.

45. Singh GK, Siahpush M. Ethnic-immigrant differentials in health behaviors, morbidity, and cause-specific mortality in the United States: an analysis of two national data bases. *Hum Biol.* Feb 2002;74(1):83-109.

46. Song YJ, Hofstetter CR, Hovell MF, et al. Acculturation and health risk behaviors among Californians of Korean descent. *Prev Med.* Jul 2004;39(1):147-156.

47. Breslow RA, Smothers BA. Drinking Patterns and Body Mass Index in Never Smokers. *American Journal of Epidemiology.* February 15, 2005;161(4):368-376.

48. Raymond C, Sukhwant BAL. The drinking habits of Sikh, Hindu, Muslim and white men in the West Midlands: a community survey. *Addiction.* 1990;85(6):759-769.

49. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men. *New England Journal of Medicine.* 2011;364(25):2392-2404.

50. Jonnalagadda SS, Diwan S. Regional variations in dietary intake and body mass index of first-generation Asian-Indian immigrants in the United States. *J Am Diet Assoc.* Sep 2002;102(9):1286-1289.

51. Bes-Rastrollo M, van Dam RM, Martinez-Gonzalez MA, Li TY, Sampson LL, Hu FB. Prospective study of dietary energy density and weight gain in women. *Am. J. Clin. Nutr.* Sep 1 2008;88(3):769-777.

52. Reza MF, Urakami Y, Mano Y. Evaluation of a new Physical Exercise Taken from Salat (Prayer) as a Short-Duration and Frequent Physical Activity in the Rehabilitation of Geriatric and Disabled Patients. *Annals of Saudi Medicine.* 2002;22(3/4):177-180.

53. Tirodkar MA, Baker DW, Makoul GT, Khurana N, Paracha MW, Kandula NR. Explanatory Models of Health and Disease Among South Asian Immigrants in Chicago. *J Immigr Minor Health.* April 2011;13(2):385-394.

54. Greenhalgh T, Helman C, Chowdhury AMm. Health beliefs and folk models of diabetes in British Bangladeshis: a qualitative study. *BMJ.* Mar 1998;316(7136):978-983.

55. Temizhan A, Tandogan I, Dönderici Ö, Demirbas B. The effects of Ramadan fasting on blood lipid levels. *Am J Med.* Sep 2000;109(4):341-342.

56. Ziaee V, Razaei M, Ahmadinejad Z, et al. The changes of metabolic profile and weight during Ramadan fasting. *Singapore medical journal.* 2006;47(5):409-414.

57. Khaled BM, Belbraouet S. Effect of Ramadan fasting on anthropometric parameters and food consumption in 276 type 2 diabetic obese women. *Int. Diabetes Dev. Ctries.* 2009;29(2):62.

58. Khaled BM, Bendahmane M, Belbraouet S. Ramadan fasting induces modifications of certain serum components in obese women with type 2 diabetes. *Saudi medical journal.* 2006;27(1):23.

59. Merrill RM RJ. Validity of self-reported height, weight, and body mass index: findings from the National Health and Nutrition Examination Survey, 2001-2006 . *Prev Chronic Dis.* 2009;6(4):A121.

60. Lovasi GS, Hutson MA, Guerra M, Neckerman KM. Built Environments and Obesity in Disadvantaged Populations. *Epidemiol. Rev.* November 1, 2009;31(1):7-20.

61. Mujahid MS, Roux AVD, Shen M, et al. Relation between Neighborhood Environments and Obesity in the Multi-Ethnic Study of Atherosclerosis. *American Journal of Epidemiology.* June 1, 2008;167(11):1349-1357.

62. Osypuk TL, Diez Roux AV, Hadley C, Kandula NR. Are immigrant enclaves healthy places to live? The Multi-ethnic Study of Atherosclerosis. *Social Science & Medicine.* 2009;69(1):110-120.

63. Pollard TM, Carlin LE, Bhopal R, Unwin N, White M, Fischbacher C. Social networks and coronary heart disease risk factors in South Asians and Europeans in the UK. *Ethn Health.* Aug 2003;8(3):263-275.

64. Williams ED, Steptoe A, Chambers JC, Kooner JS. Psychosocial risk factors for coronary heart disease in UK South Asian men and women. *J Epidemiol Community Health.* Dec 2009;63(12):986-991.

65. Fitzgibbon ML, Stolley MR, Ganschow P, et al. Results of a faith-based weight loss intervention for black women. *J Natl Med Assoc.* Oct 2005;97(10):1393-1402.

66. Kennedy BM, Paeratakul S, Champagne CM, et al. A pilot church-based weight loss program for African-American adults using church members as health educators: a comparison of individual and group intervention. *Ethn Dis.* Summer 2005;15(3):373-378.

67. Oexmann MJ, Ascanio R, Egan BM. Efficacy of a church-based intervention on cardiovascular risk reduction. *Ethn Dis.* Fall 2001;11(4):817-822.

68. Kim K, Sobal J, Wethington E. Religion and body weight. *Int. J. Obes.* Apr 2003;27(4):469-477.

Chapter 5: CONCLUSION

The three preceding chapters illustrate the opportunities and challenges in the conceptualization and operationalization of acculturation (Chapter 2), the association of duration of residence in the US with multiple CVD risk factors using population-based surveys (Chapter 3), and the association of religiosity with obesity (Chapter 4) among South Asian adults in the US.

Chapter 1 provided a brief literature review of the acculturation construct, the measurement of acculturation in health studies, and evidence that acculturation may impact health. In Chapter 2, we attempted to validate temporal measures with acculturation items representing different domains of acculturation found in psychometric scales. However, the acculturation scale and its validation with temporal measures have conceptual and methodological limitations. The acculturation scale items and temporal measures were based on unidirectional concepts of acculturation for South Asians, or the linear process of relinquishing one's beliefs and customs from South Asian culture in order to gain the beliefs and customs of American culture. As described in Chapter 1, several scholars have noted that the acculturation process for immigrants is usually more complex than the linear model would have us assume and is typically influenced by the social, economic, and political context.

Future work should expand the concept of acculturation and its measures. Conceptually, the acculturation construct is a process that involves several dimensions and components, such as cultural practices, values, and identification, which collectively impact health beliefs and behaviors. In addition, one's social context, such as social networks, neighborhoods, and xenophobic discrimination, likely influences the magnitude and process of cultural change

among immigrants. Furthermore, the social environment (and other social determinants of health) likely impact health in broader ways than simply influencing an individual's cultural orientation. Acculturation frameworks should discuss how social determinants of health impact the relationship between acculturation and health. For example, we know that many immigrants, including South Asians, often settle in ethnic enclaves when initially migrating to the US.[1] However, place and migration influences have not been extensively studied in immigrant health, and if and how higher concentrations of immigrants in a neighborhood benefits or harms one's health. Ethnic enclaves have been associated with lower intake of high-fat foods[1], lower levels of depression[2], and improved access to health care[3]. In contrast to these positive health aspects, ethnic enclaves have also been associated with lower levels of physical activity and higher levels of obesity.[1,4] The impact of ethnic enclaves may differ depending on the immigrant's educational attainment, language skills, and generational status.

In addition to place of residence, conceptual frameworks that describe the association of acculturation with South Asian immigrant health should also include discrimination and immigration policy. Studies have documented that perceived discrimination is associated with lower levels of physical and mental health, poor access to quality healthcare, and certain deleterious health behaviors across several immigrant groups.[5] Anti-immigration policies, and the resulting discrimination that often precedes or follows these policies, may limit health, education, and employment access for immigrants. The health effects of the xenophobia and Homeland Security measures post-9/11 for South Asians and other people who looked Muslim are lacking in the literature. Lauderdale found that in the six-month period following 9/11, women who had Arab- or Muslim-sounding names in California experienced a rise in poor birth outcomes.[6] Kandula et al. found that the most prevalent CHD risk factor reported by a

community-sample of low-income South Asians in Chicago was stress that was related to their socioeconomic position and immigration status.[7] Research that examines the impact of rising discrimination against South Asians on health behaviors and chronic disease outcomes is warranted.

In practice, researchers should consider how social determinants of health, such as neighborhood characteristics, discrimination, and immigration policies, intersect and affect the economic and social integration of South Asian (or any ethnic) immigrants and their health. This question may be especially interesting to study in the South Asian diaspora, which has brought a heterogeneous community to the US based on different educational attainments, languages, culture, faiths, and exposure to Western lifestyles. For example, future research should look at how, for whom, and under what conditions ethnic/immigrant enclaves are health protective by examining the pathways through which these neighborhoods are hypothesized to impact health outcomes (i.e., through social support relationships, cultural institutions, and social resources). Additionally, research studies may want to focus on how immigration policies and/or perceived discrimination impact the relationship between health and acculturation for different socioeconomic groups and generations of South Asians in the US. Given that acculturation is not a modifiable health factor, understanding how acculturation intersects with modifiable indicators, such as socioeconomic status/environment and health care access/utilization, is valuable in determining health outcomes and designing health interventions.

Chapter 1 also provided a literature review and conceptual models of how acculturation and religiosity may influence CVD risk factors, such as obesity. These models are empirically tested in Chapter 3 and 4 where the relationship between CVD risk factors and duration of residence in

the US, acculturation, and religiosity are examined in multivariate regression models. Our results indicate that overweight and obesity are important health concerns to target because of the association of obesity with cardiovascular disease and diabetes mellitus risk, both of which are prevalent among South Asians.

Proxy measures of acculturation, such as duration of residence in the US, nativity, or language use, are prominent in large surveys and datasets like NHIS and CHIS. As described above, proxy measures would be more valid in understanding acculturation impacts on health if they were reported within a social context. For instance, duration of residence in the US may be less of a marker of integration depending on place of residence, prior exposure to Western lifestyle, language skills, and socioeconomic position. However, it is difficult to tease out pathways that link culture, religion, and sociocultural change with health among South Asian immigrants using pooled, cross-sectional data. Research on CVD risk among South Asians in the US requires longitudinal studies to examine how social factors, such as acculturation and religiosity, influence the dietary and physical activity practices in this population, and if this varies by religious affiliation, educational attainment, or other social determinants of health. For example, we know that greater educational attainment has consistently been linked to better health behaviors and health outcomes. It is also known that the different waves of South Asian migration to the US varied by educational attainment, and that this difference may influence how they adapt to American culture. One question that may be answered with a longitudinal cohort, such as the Metabolic Syndrome and Atherosclerosis in South Asians Living in America (MASALA) study, is if and how greater duration of residence in the US is associated with greater fruit and vegetable intake and physical activity, and if this varies with educational attainment and other sociodemographics among the South Asian diaspora in the US.[8,9] The

MASALA study also appears to be superior to NHIS and CHIS in that it includes objective measures of CVD risk factors, such as measured waist-to-hip ratios and biochemical markers, which would obviate self-report bias in analyses of the data. Longitudinal objective data also would also allow comparisons with other studies, such as the MESA longitudinal study or the NHANES cross-sectional data, to examine if there are differential trajectories in health and CVD risk among different racial/ethnic/immigrant populations.

As with the datasets used in this dissertation, the South Asian populations surveyed in large datasets often have small numbers of elderly, women, recent immigrants, non-English speakers, and those of lower socioeconomic status (i.e., lower educational attainment and income). Survey designs that oversample these populations are especially important given that these demographic characteristics have been associated with poorer health care access, reduced health care utilization and poorer health outcomes. Additionally, religiosity and acculturation may impact the health of these South Asian immigrants differently than the majority samples found in large surveys (e.g., young, professional, English-speaking, men); understanding these differences may be useful in interventions to reduce CVD and diabetes mellitus risk for this under-represented population.

Chapter 4 tried to tease apart religiosity, one possible co-factor, in Asian immigrant health. Our results not only showed that most South Asians are highly religious, but older, less acculturated women were among the most religious subgroup, which also puts them at a higher risk for being overweight/obese. This subgroup may be a good target population for a pilot intervention aimed at reducing CVD risk factors, such as obesity. We plan to share our findings with local South Asian community-based and faith-based organizations. Grace et al. found that local religious

leaders (imams) and institutions (mosques) serving the Bangladeshi, Muslim community in the UK believed in the resonance between Islamic teachings and healthy lifestyles, and said that a healthy lifestyle (eating fruits and vegetables, controlling portion sizes, looking after your body, and partaking in physical activity) was crucial to health.[10] Religious leaders were seen as trusted sources of information, could reach large sections of the community, approved of conventional outdoor exercise (including walking), and were keen to incorporate discussion of ways to prevent chronic disease into their teaching.[10] The support of healthy behaviors by religious leaders may be essential in a community with strong religious and family values. South Asian religious institutions may be important venues to implement culturally-tailored lifestyle change interventions based on our findings.

REFERENCES

1. Osypuk TL, Diez Roux AV, Hadley C, Kandula NR. Are immigrant enclaves healthy places to live? The Multi-ethnic Study of Atherosclerosis. *Social Science & Medicine.* 2009;69(1):110-120.

2. Vega W, Ang A, Rodriguez M, Finch B. Neighborhood Protective Effects on Depression in Latinos. *American Journal of Community Psychology.* 2011;47(1):114-126.

3. Gresenz CR, Rogowski J, Escarce JJ. Community Demographics and Access to Health Care among U.S. Hispanics. *Health Services Research.* 2009;44(5p1):1542-1562.

4. Wen M, Maloney T. Latino Residential Isolation and the Risk of Obesity in Utah: The Role of Neighborhood Socioeconomic, Built-Environmental, and Subcultural Context. *Journal of Immigrant and Minority Health.* 2011;13(6):1134-1141.

5. Viruell-Fuentes EA, Miranda PY, Abdulrahim S. More than culture: Structural racism, intersectionality theory, and immigrant health. *Social Science & Medicine.* (Available online 9 February 2012).

6. Lauderdale DS. Birth outcomes for Arabic-named women in California before and after September 11. *Demography.* 2006;43(1):185-201.

7. Kandula N, Tirodkar M, Lauderdale D, Khurana N, Makoul G, Baker D. Knowledge Gaps and Misconceptions About Coronary Heart Disease Among US South Asians. *American Journal of Preventive Medicine.* 2010;38(4):439-442.

8. Shah A, Hernandez A, Mathur D, Budoff MJ, Kanaya AM. Adipokines and body fat composition in South Asians: results of the Metabolic Syndrome and Atherosclerosis in South Asians Living in America (MASALA) study. *Int J Obes.* 2011 (Epub).

9. Wang ET, de Koning L, Kanaya AM. Higher protein intake is associated with diabetes risk in south asian indians: the Metabolic Syndrome and Atherosclerosis in South Asians Living in America (MASALA) study. *J Am Coll Nutr.* Apr 2010;29(2):130-135.

10. Grace C, Begum R, Subhani S, Kopelman P, Greenhalgh T. Prevention of type 2 diabetes in British Bangladeshis: qualitative study of community, religious, and professional perspectives. *BMJ.* November 4, 2008;337(3):a1931-a1937.