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BHANUJA DUB Date

Socio-Ecological Framework and Prevalence of Cardio-Metabolic Disorders between Northern and Southern Indian Immigrants in the United States

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2013

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Abstract

Socio-Ecological Framework and Prevalence of Cardio-Metabolic Disorders between Northern and Southern Indian Immigrants in the United States

By Bhanuja Dub

Background: Asian Indians are at increased risk for cardio-metabolic disorders compared to those of European decent, most particularly hypertension, dyslipidemia, and type 2 diabetes. There are limited, if any, published results regarding the association between multilevel risk factors and prevalence of these health outcomes among Asian Indian immigrants living in the United States.

Purpose: Utilizing the Socio-Ecological Framework, this study aimed to analyze individual interpersonal, and community level psychosocial risk factors and the association with hypertension, dyslipidemia, and type 2 diabetes using data from a population based study of South Asian immigrants to the United States.

Methods: This study consisted of secondary data analysis of baseline data from 757 Indian born participants from the MASALA study. Backward stepwise logistic regression analyses were conducted for each primary health outcome to determine the relationships between Northern versus Southern Indian region of origin and multilevel correlates of interest to primary health outcomes, adjusting for key covariates.

Results: Odds of having hypertension were associated with being older (OR=1.09, p<.001), lacking access to healthcare (OR=0.51, p=.042), and higher anger levels (OR=1.05, p=.045). Odds of having elevated triglycerides were associated with being male (OR=.56, p=.001), and lower consumption of total fat (OR=.98, p=.008). Odds of having decreased HDL levels were associated with being male (OR=.51, p<.001), being older (OR=1.03, p=.006), having a longer duration of residence in the United States (OR=1.3, p=.007), higher consumption of fat (OR=1.04, <.001), and higher anger levels (OR=1.06, p=.010). Odds of having type 2 diabetes were associated with being male (OR=.48, p<.001), increasing age (OR=1.05, p<.001), and higher anger levels (OR=1.06, p=.030).

Conclusion: Findings indicate that there are differences in state of origin in the prevalence of hypertension, decreased HDL levels, and elevated triglyceride levels. There may be other environmental factors or factors related to migration to the U.S. that may be affecting these differences. Understanding any differences in multilevel risk factors that can contribute to cardio-metabolic disorders among this population can help inform future culturally competent interventions aiming to prevent and treat heart disease.

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Contents

Introduction

Background

The Asian diaspora makes up 5.6% of the total United States population. However, this racial/ethnic minority group is the fastest growing with a rate four times that of the total population. This trend is projected to double, with the Asian population in the United States accounting for 9.3% in 2060 [1, 2]. Asian individuals, more specifically South Asians, are at increased risk for cardio-metabolic disorders compared to those of European decent, most particularly hypertension[3, 4] (a disease in which blood flows through the arteries at a higher than normal pressure causing them to be weakened and eventually damaged), dyslipidemia[4, 5] (a disorder of lipoprotein metabolism where an abnormal amount of lipids such as cholesterol and triglycerides can damage arteries and increase risk of heart disease), and type 2 diabetes[6, 7] (an endocrine disorder in which blood glucose levels are higher than normal due to defects in insulin production or action).

According to the National Health and Nutrition Examination Survey (NHANES), 25.6% of Asian adults (20 and over) living in the United States had hypertension compared to 29.1% of the total U.S. population in 2011-2012 [8]. Likewise, approximately 1 in 10 Asian adults had dyslipidemia in comparison to 12.9% in the general U.S. population [9, 10]. Further, type 2 diabetes prevalence among Asians Americans (20 years and older) was 16.3% in comparison to 11.9% of the total U.S. population [11]. While it may seem that the Asian American population is relatively healthier in comparison to the total U.S. population, these patterns are distorted by aggregation of distinct and varied Asian subgroups that disguise heterogeneity of these cardio-metabolic disorders. Disaggregation and examination of these subgroups has shown that certain ethnic

minorities classified under the Asian population have increased prevalence of these disorders, particularly those of Asian Indian decent [12-14].

Theoretical Framework

The Social Ecological Framework (SEF) is a theoretical framework that differentiates influences at multiple levels stratified by individual factors, interpersonal interactions, organizational factors and community-level characteristics [15-18]. It emphasizes the dynamic interaction between the individual and environment that can have direct or indirect influences on health. There are four main assumptions made under SEF that include these interactions [17, 18] and are as follows:

(1) Health outcomes are influenced by factors involving the physical and social environment as well as personal attributes. Health promotion strategies should target all of these factors.

(2) Environments are multidimensional and complex, and therefore can be characterized by social and physical components as well objective/subjective and proximal/distal qualities.

(3) People are just as complex as environments and should be studied from levels ranging from the individual to a population at large. Health promotion interventions can have greater efficacy when involving these multiple levels.

(4) There is a symbiotic relationship between people and the environment in that they influence and are influenced by each other. The environment can influence individual and population health, and people can modify the healthfulness of their surroundings.

Proposal

There are limited, if any, published results regarding the association between multilevel risk factors and prevalence of hypertension, dyslipidemia, and type 2 diabetes among Asian

Indian immigrants living in the United States. Previous literature has indicated historical geographical differences in the prevalence of cardio-metabolic disorders between Indians residing in Northern and Southern regions of India [19-25]. The current study aimed to:

1. Examine the differences in cardio-metabolic disorders (i.e. hypertension, dyslipidemia, and type 2 diabetes) between Northern and Southern Indian immigrants in the U.S.
2. Examine the differences in individual, interpersonal, and community level risk factors between Northern and Southern Indian immigrants in the U.S.
3. Conduct an analysis to determine if the aforementioned risk factors contribute to cardio-metabolic disorders (i.e. hypertension, dyslipidemia, and type 2 diabetes) among Northern and Southern Indian immigrants in the U.S.

This study consisted of secondary data analysis of baseline data from 757 Indian born participants from the "Mediators of Atherosclerosis in South Asians Living in America" (MASALA) study. Utilizing the study's questionnaires, this analysis applied the Socio-Ecologic Framework to measure differences between individual levels of anger, anxiety and depression, social support and discrimination on interpersonal level, and perceived neighborhood cohesion concerning an individual's neighborhood on the community level. It is also pertinent to note that interactions may exist between the multilevel risk factors, socio-demographics and health related factors in relation to hypertension, dyslipidemia, and type 2 diabetes that were explored.

Based on the literature, the hypothesis were as follows:

1. Slight differences in prevalence of hypertension, dyslipidemia, and type 2 diabetes will be found between Northern and Southern Indian immigrants.
2. Slight differences at the individual, interpersonal, and community level risk factors will be found between Northern and Southern Indian immigrants.

3. Differences at the individual level will be found to have a strong significant association with the health outcomes while differences at the interpersonal and community levels will be less significantly associated between Northern and Southern Indian immigrants.

This study will provide valuable data on the prevalence and association of cardio-metabolic diseases and multilevel risk factors in the Indian immigrant population. Understanding the risk factors at the multiple levels will allow for culturally competent risk-reduction interventions to limit the progression of these health outcomes.

Literature Review

The Asian Indian population is the third largest Asian group in the United States with a population of over two million [1]. This minority subgroup has grown by approximately 68% between the years 2000 and 2010, with the highest concentrations residing in heavily populated cities such as Chicago and San Francisco [1, 26]. A number of studies in Asian Indian populations have demonstrated a high prevalence of hypertension, dyslipidemia and type 2 diabetes [27-30]. The Diabetes among Indian Americans (DIA) study noted a high prevalence of hypertension (35.6%), increased total cholesterol (43.5%) and type 2 diabetes (17.4%) in Asian Indians from seven U.S. sites [29]. Furthermore, in a community based participatory research study, Cardiovascular Health among Asian Indians (CHAI) in Northern California, the prevalence of hypertension (20.4%) was lower than the national average of 32.6%. However hypercholesterolemia (24%), and type 2 diabetes (10.6%) were higher than the population average of 18.3%, and 4.73%, respectively [27, 30].

While the Asian Indian population as a whole has been shown to have an increased risk of hypertension, dyslipidemia, and type 2 diabetes, there are a number of subgroups within the Asian Indian population that can be observed. India's population as of 2011 is approximately 2.1 billion with a percentage increase of 17.7% since 2001. There are 35 states, each with their own cultural distinctions including language, food, and religion. Further disaggregation based on geographical location in India shows a regional divide in prevalence of cardio-metabolic disorders [19-25].

A cross sectional study of five urban cities across India showed a significant difference in the prevalence of hypertension among men and women regionally. South and West India had the highest prevalence comparably, ranging from 29.1% to 35.6%. The lowest prevalence was found

in North and East India ranging from 22.4% to 27%, respectively [21]. In a meta-analysis involving 142 studies, the overall prevalence of hypertension in India in 2011 was 29.8%, comparable to the U.S population [19]. However, once prevalence was examined regionally, significant differences were noted. The pooled urban prevalence of hypertension was highest in West India at 35.8%, followed by East, South, and North India at 34.5%, 31.8%, and 28.8%, respectively. [19]. When compared to the hypertension prevalence in the U.S. at 29.1%, the prevalence in South India was significantly higher while the prevalence in North India was significantly lower [8, 19, 21].

The Indian Council of Medical Research Study (ICMR-INDIAB) examined the prevalence of dyslipidemia across all regions of India between 2008 and 2010. Results of this study noted that the overall prevalence of low HDL and hypertriglyceridemia were 11.8% and 29.5%, respectively. Results also indicated that the highest prevalence of low HDL was in East India (Jharkhand) at 76.8% and the lowest prevalence was in South India (Tamil Nadu) at 68.9% [23], while the highest hypertriglyceridemia prevalence was found in North India (Chandigarh) at 38.6% and the lowest in was found in West India (Maharashtra) at 22.8% [23]. When compared to the total prevalence of high cholesterol in the United States at 12.9%, India as a nation had a higher prevalence [10, 23].

The ICMR-INDIAB study also measured the prevalence of type 2 diabetes with results indicating that the highest prevalence was found in North (13.6%) and South India (10.4%), while the lowest prevalence was found in East India (5.3%) [25]. Another cross sectional study of five villages across India (North, South, East, West, and Northeast) found that the prevalence of type 2 diabetes was the highest in the Western (16.6%) and Southern (12.2%) regions and lowest in the Northeast Region (5.5%) [24]. India as a whole had a greater prevalence of type 2 diabetes compared to the total U.S. population of 11.9% [11, 24, 25, 31].

Social Ecological Framework (SEF)

While there is a dearth of literature on studies examining cardio-metabolic disorders using SEF, it has been previously used as a model to explain obesity and cardio-metabolic risk in a minority population in the U.S. The Study of Latino Youth (SOL) integrates a number of theoretical constructs including SEF and Social Cognitive Theory (SCT) to create a model linking individual, interpersonal, school, and community levels in order to understand risks associate with childhood obesity and cardio-metabolic status among Latino children in the United States [32, 33]. Results indicated that proximal individual and interpersonal levels were stronger in predicting BMI for children more so than the community and school levels; however, the authors noted the "macro-environment" levels would have benefitted from refinement and expansion of assessment at the community and school levels. Furthermore, it was stated that children may be more influenced at the micro-level and that understanding the impact of distal environments may be more suited for an older population [34]. This framework was useful in understanding the complex and multilevel influences on Latino children's health and may be beneficial in understanding cardio-metabolic disorders among other minority populations in the United States. A number of factors that could explain the differences by region of origin in hypertension, dyslipidemia, and diabetes prevalence among the Indian immigrant population can be stratified by individual, interpersonal, and community levels using SEF.

Individual

Numerous studies have documented the co-morbidities of psychosocial indications of anger, anxiety, and depressions and symptoms of cardio-metabolic disorders. Therefore, these psychosocial indicators may play a strong role as individual risk factors for the health outcomes of hypertension, dyslipidemia, and type 2 diabetes. [35-44] While there is a paucity of research on

the relationship of these psychosocial factors and cardio-metabolic risk factors in the Asian Indian population, there are a number of studies explaining these associations in the U.S. among minority populations.

Psychological distress such as depression and anxiety are known to be associated with hypertension among minority populations in the U.S.[35-39]. A meta-analysis conducted in 2012 concluded that there is 42% increased risk for hypertension among nine depressed cohorts in the U.S. population [37]. Furthermore, a prospective cohort study among adults has shown that young blacks with depressive symptoms were more likely to develop hypertension in comparison to their white counterparts [35]. Another study analyzing co-morbidity of depression and cardiovascular disease (including hypertension as a risk factor) among five ethnic groups (Cuban, Puerto Rican, Mexican, Black and Non-Latino Whites) found that the prevalence of co-morbid depression and hypertension was the highest for Blacks (74.4%) followed by Cubans (69.3%) and Mexican-Americans (66.5%) [36]. Furthermore, anxiety has also been shown to have a bidirectional positive association with hypertension, and longitudinal studies have shown that anxiety increases the risk of hypertension incidence [39]. Increased incidence of hypertension has also been associated with high levels of anger.

Conversely, studies have noted inverse associations between high levels of cholesterol and depression in the U.S, most notably in Black individuals [41], as well as an association between higher triglyceride levels and anger expression style among Black and White men [42]. Furthermore a meta-analysis conducted in 2015 suggested that depressed adults had a 37% increase in developing diabetes[43]. This was further confirmed by the results of a longitudinal study comparing two predominately Black populations in which higher levels of anxiety and depression symptoms were related to incident type diabetes among women but not men [43].

Similarly, a prospective cohort study, Multi-Ethnic Study of Atherosclerosis (MESA) concluded that individuals with high trait anger had a 50% increased risk of developing type 2 diabetes. [44], while a recent study among South Asian immigrants found that independent of socioeconomic status, greater psychological burden was associated with type 2 diabetes [40].

Interpersonal

Literature on the effect of interpersonal factors such as discrimination and social support on cardio-metabolic health outcomes are limited and inconsistent. The majority of the literature documents discrimination as a stressor with chronic health consequences [45-49]. One prospective cohort study found a positive association between hypertension and discrimination among minority women born outside of the United States who were raised in a predominately white neighborhood [45]. However, another study found insignificant associations with racism and hypertension [50]. Furthermore, while an ongoing study of Black individuals in the United States found that psychological stress due to racism may contribute to elevated lipid levels [47], a recent study examining the association between discrimination and cardio-vascular health disorders in South Asian immigrants living in the U.S found no association between type 2 diabetes and discrimination [51].

Social support has been recognized as an important determinant of health; however, the knowledge on the extent of its effect on health outcomes is limited. It is also difficult to ascertain and standardize the level of perceived social support, as cultural depictions tend to differ across different race and ethnic populations [52-54]. A study utilizing data from the National Health and Nutrition Examination survey to determine the association between race and levels of social support found that Blacks without social support were more than twice as likely to have hypertension compared to their white counterparts. Furthermore, Mexican Americans with

higher social support were less likely to develop hypertensive symptoms compared to those with lower social support [54]. Similarly another study found that among Hispanics in the U.S., higher support was related to 14% lower odds of having type 2 diabetes [52]. However a study among black participants found converse results in that social support was not significantly related to hypertension, hypercholesterolemia, nor type 2 diabetes [53].

Community

Research examining the impact of neighborhood social cohesion and cardio-metabolic health is limited and contradictory. The Multi-Ethnic Study of Atherosclerosis (MESA) examined the relationship between hypertension and the neighborhood environment among White, Black, and Hispanic participants. Results indicated that those that lived in neighborhoods with better walkability, availability of healthy foods, greater safety, and more social cohesion were less likely to become hypertensive. However, the associations were no longer significant after adjusting for race/ethnicity, suggesting that social cohesion was independent of ethnic/racial identity [55]. A study examining the association between HDL levels and neighborhood disadvantage among Blacks in the South found no significant association [56], while A recent study examining the association between perceived social cohesion in the neighborhood, and the prevalence hypertension and type 2 diabetes found that higher neighborhood social cohesion was significantly associated with decreased prevalence of hypertension among South Asian women [57, 58].

While there are many evidence-based studies explaining the associations between the psychosocial, interpersonal, community level, and cardio-metabolic disorders individually, there are no studies that combines these strata and examines them cohesively among the Asian Indian immigrant population. Therefore, this study aimed to study individual (anger, anxiety, and

depression), interpersonal (social support and discrimination) and community level (neighborhood social cohesion) risk factors and the association with hypertension, dyslipidemia, and type 2 diabetes using data from a population based study of South Asian immigrants to the United States. The aims of the study were as follows:

1) Examine the differences in cardio-metabolic disorders (i.e. hypertension, dyslipidemia, and type 2 diabetes) between Northern and Southern Indian immigrants in the U.S.
2) Examine the differences in individual, interpersonal, and community level risk factors between Northern and Southern Indian immigrants in the U.S.
3) Conduct an analysis in order to determine if the above mentioned risk factors contribute to cardio-metabolic disorders (i.e. hypertension, dyslipidemia, and type 2 diabetes) among Northern and Southern Indian immigrants in the U.S.

Methods

Study Design, Participants, and Sampling

The current study is a secondary analysis using cross sectional data from Mediators of Atherosclerosis in South Asians Living in America (MASALA). Data collection and assessment began in October 2010 and concluded in March 2013. The eligibility criteria for the study were as follows: (1) South Asian ancestry, defined as having at least three grandparents born in a South Asian country (2) between 40 and 79 years of age and (3) ability to speak and/or read English, Hindi, or Urdu. The exclusion criteria were as follows: (1) diagnosis of any heart disease or history of heart procedures (2) currently undergoing cancer treatment (3) life expectancy of less than 5 years due to medical illness or seriously impaired cognitive function (4) moving out of study region in the next 5 years (5) living in a nursing home and (6) weight exceeding 300 pounds [59].

Sampling frames were created by the clinical site and included nine counties surrounding University of California, San Francisco (UCSF) and seven census tracts surrounding Northwestern University (NWU). Telephone based recruitment methods were employed where names, addresses, and telephone numbers of 10,000 households were obtained from commercial mailing list companies [59]. Random samples of South Asian surnames were created using specific cultural coding algorithms utilizing a five step matching process to classify a person's first and last name, thereby reducing selection bias among participants with uncommon South Asian surnames [59]. All participants were screened by telephone and invited to undergo a 6-hour clinical baseline examination. A total of 3,053 households were contacted and 1801 (59%) individuals were eligible to participate [59]. Of those eligible, 906 participants enrolled in the study, however

for the purpose of this analysis, only 757 participants who identified as being born in India were included.

Measures

Questionnaires and physical exams were administered at baseline to assess risk factors and outcomes [59]. All surveys used in the analysis are included in the appendix. Below, we detail the measures included in the analysis.

Cardio-metabolic Outcomes

Hypertension: Seated resting blood pressure was measured 3 times using an automated blood pressure monitor. The average of the last two readings were used for the analysis. Ankle-brachial blood pressure index was measured using a Doppler apparatus and participants were asked to lay supine in order to gauge systolic blood pressure [59]. Hypertension was classified as a blood pressure reading $\geq$ 140/90 mmHg or taking anti-hypertensive medication [60].

Dyslipidemia: Phlebotomy was administered to obtain 100 mL of blood in order to measure lipids, lipoproteins, and fasting glucose levels [59]. Low HDL Cholesterol was classified as HDL levels < 40 mg/dL for men and < 50 mg/dL for women. High triglycerides were defined as levels $\geq$ 200 mg/dL [61].

Type 2 Diabetes: After a requested 12-hour fast, a 75-g oral glucose load was administered to those not taking glucose lowering medication. Blood samples were drawn 30 minutes and 2 hours post glucose challenge [59] Type 2 diabetes was defined as fasting glucose levels $\geq$ 126 mg/dL, 2 hour glucose levels of $\geq$ 200 mg/dL or any use of glucose lowering medication [59]

Individual Measures

Socio-demographics: Socio-demographic covariates included sex (male/female), age (40-79 years), years lived in the U.S. (years), family income (< or ≥ $100k), education status (< or ≥ Bachelor's Degree), and access to healthcare.

Health-related covariates: Behavioral covariates included smoking status (current/never), drinking at least 1 alcoholic drink a week (yes/no), dietary calories per day (kCals), carbohydrates (kCals), protein (kCals), total fat (kCals), exercise (min/week), body mass index (BMI) (kg/m^2), and waist circumference (cm), [59].

Anger & Anxiety: The Spielberger Trait Anger (STAXI) and Anxiety (STAS) scales were included in a 20-item questionnaire measuring frequency of angry and/ or anxious feelings on a 4-point Likert scale [62, 63]. The scales measured participants' anxiety and anger with items including "I am quick tempered" and "I lack self-confidence". Response options include (1) almost never, (2) sometimes, (3) often, and (4) almost always with scores ranging from 10 to 40 which is computed by the summation of all the scores. [64]

Depressive Symptoms: The Center for Epidemiologic Studies Depression Scale (CES-D) was included in a 15 item questionnaire measuring depressive symptoms on a 4 point Likert scale [65]. Sample items included "I felt fearful" and "I felt depressed". Response options include (1) rarely or none of the time, (2) some or little of the time, (3) a moderate amount of the time, and (4) most of the time with scores ranging from 0 to 60 which is computed by the summation of all the scores. A score of ≥ 16 indicated depressive symptoms [64]. The scale had a Cronbach's alpha of .65, indicating adequate reliability [66].

Interpersonal Psychosocial Measures

Perceived Discrimination: The Detroit Area Study Everyday Discrimination Questionnaire (DAS-DQ) measured various forms of day-to-day mistreatment over past 12 months [48, 67, 68]. Questions were administered on a 6 point Likert scale ranging from (1) almost every day, (2) at least once a week, (3) a few times a month, (4) a few times a year, (5) less than once a year, and (6) never. Sample items included "You are treated with less courtesy than other people" and "You are threatened or harassed" [59]. The scores ranged from 9-54 computed by the summation of all scores [66, 69].

Social Support: The ENRICHD Social Support Instrument (ESSI) measured available social support and administered as a 6-item questionnaire [70]. Questions were administered on a 5 point Likert scale ranging from (1) none of the time, (2) a little of the time, (3) some of the time, (4) most of the time, and (5) all of the time. Sample items included "Is there someone available to give you good advice about a problem?" and "Is there someone available to you who shows you love and affection?" The scores ranged from 6-30 computed by the summation of all scores [59].

Community Psychosocial Measure

Community Cohesion: Neighborhood social cohesion was measured using the Neighborhood Collective Efficacy: Community Cohesion and Informal Social Control Questionnaire [55, 71, 72]. The questionnaire was comprised of 3 categories measuring duration of time living in neighborhood, neighborhood cohesion, and perceived safety. Perceived safety was measured with 1 item asking "How often do you feel safe in your neighborhood" on a 4 point Likert scale ranging from (1) all of the time, (2) most of the time, (3) some of the time, (4) and none of the time. Neighborhood social cohesion was measured with 5 items on a 5 point Likert

scale ranging from (1) Strongly agree, (2) agree, (3) neither agree or disagree, (4) disagree, and (5) strongly disagree. Sample items included "People around here are willing to help their neighbors and "People in this neighborhood can be trusted"[59]. Scores ranged from 5 to 25. The scale had a Cronbach's alpha of .65 indicating adequate reliability [57].

Statistical Analysis

All analysis was conducted in SPSS v.24. First, descriptive analyses were conducted to compare basic demographic characteristics between Northern and Southern Indian immigrants living in the U.S. Chi-square tests and independent sample t-tests were used, as appropriate. Second, bivariate analyses were conducted to examine differences between Northern and Southern Indian immigrants in relation to the multilevel psychosocial correlates of interest, as well as the primary health outcomes. Third, bivariate analyses were conducted to examine the multilevel psychosocial correlates of interest in relation to the primary health outcomes. Specifically, chi-square tests and ANOVAS were used for categorical and continuous variables, as appropriate. Results from the bivariate analyses were used to inform the regression analyses. Statistical significance was deemed at p value $\leq .05$.

Finally, backward stepwise logistic regression analyses were conducted for each of our primary health outcomes to determine the relationships of between Northern versus Southern Indian region of origin and the multilevel correlates of interest to our primary health outcomes, adjusting for key covariates. Based on the importance of socio-demographics in the literature, we forced entry region of origin, age, sex, years in the U.S., family income level, and health insurance status into each health outcome model. We also adjusted for health-related factors (ever smoked, alcohol consumption, calorie, carbohydrate protein, and fat intake, exercise),

individual variables (anger, anxiety, and depression), interpersonal variables (social support and discrimination), and community variable (community cohesion).

Results

Participant Characteristics & Differences Between Northern and Southern Indian Immigrants

Among the 757 participants that identified as Indian, 189 (25%) were categorized as Southern Indian and 568 (75%) were categorized as Northern Indian. Baseline characteristics of the study participants by region are depicted in **Table 1**. On average, Northern Indian immigrants were older ($p < 001$), lived longer in the United States ($p=.002$), and were less likely to have a family income greater than $100,00 ($p<.001$) or educational status greater than Bachelor's degree ($p=.001$) compared to their Southern Indian counterparts. Participants from Northern India also consumed fewer carbohydrates ($p=.015$) but more total fat ($p< 001$) compared to participants from Southern India. No significant differences were observed between Northern and Southern Indian immigrants in relation to the multilevel psychosocial factors of anger, anxiety, depression, perceived discrimination, social support, and community cohesion. In terms of cardio-metabolic risk factors, Northern Indian immigrants had a significantly higher prevalence of hypertension ($p=.003$) while Southern Indian immigrants had a lower total HDL levels ($p<.001$) and higher triglyceride levels ($p=.011$). No significant differences were observed between Northern and Southern Indian immigrants regarding the prevalence of type 2 diabetes.

Cardio-Metabolic Health Outcomes

Tables 2-5 present bivariate analyses examining the multilevel factors in relation to each cardio-metabolic health outcome.

Hypertension

The prevalence of hypertension in the total sample was 41.3% **(Table 2)**. Among those with hypertension, 80.5% were Northern Indian American participants (p=.003), and 59.4% were males (p=.010). Participants who had hypertension also had less access to healthcare in comparison to those that did not have hypertension (p=.008). Hypertensive participants were also older (p<.001), lived longer in the United States (p<.001), had greater family income (p<.001), exercised less frequently (p=.021), and had a greater waist circumference (p<.001) compared to those who were normotensive. There were no significant differences between those with hypertension and those that were normotensive in terms of psychosocial disorders as well as individual, interpersonal, and community level risk factors. In the multivariate logistic regression **(Table 6)**, factors associated with having hypertension included: being older (OR=1.09, p<.001), lacking access to healthcare (OR=0.51, p=.042), and higher anger levels (OR=1.05, p=.045). The total regression model accounted for 22% of the variance in hypertension.

Dyslipidemia

The prevalence of high triglycerides was 28.4% in the total sample **(Table 3).** A higher percentage of participants with elevated triglyceride levels were Northern Indian Americans (p=.011), male (p<.001), and never smoked (p=.027). Compared to those with normal triglyceride levels, those with high triglycerides also had a longer duration of residence in the United States (p=.070), consumed more carbohydrates (p=.012) and less total fat (p<.001), and had a larger waist circumference (p<.001) on average. There were no significant differences between those with elevated triglyceride levels and those that fell in the normal range in terms of the individual, interpersonal, and community level risk factors. In the multivariate logistic regression **(Table 6)**, factors associated with having high triglycerides included: male sex

(OR=.56, p=.001), and lower consumption of total fat (OR=.98, p=.008). The total regression model accounted for 10.5% of the variance in the elevated triglyceride levels.

In the total sample the prevalence of low HDL was 26.3% **(Table 4)**. A higher proportion of participants with decreased HDL levels were male (p=.015) and did not consume alcohol (p=.041). Individuals with low HDL cholesterol were also older (p<.001), had a longer duration of residence in the United States (p<.001), and consumed less calories (p=.001) and carbohydrates (p=.092), but more protein (p=.007). There were no significant differences between those with low HDL levels and those that fell in the normal range in terms of the individual, interpersonal, and community level risk factors. In the multivariate logistic regression **(Table 6)**, factors associated with having low HDL levels included: being male (OR=.51, p<.001), being older (OR=1.03, p=.006), having a longer duration of residence in the United States (OR=1.3, p=.007), higher consumption of fat (OR=1.04, <.001), and higher anger levels (OR=1.06, p=.010). The total regression model accounted for 6.1% of the variance in decreased HDL levels.

Diabetes

Of the total sample the prevalence of type 2 diabetes was 20.2% **(Table 5)**. Compared to those with normal glucose tolerance, those with type 2 diabetes were more likely to be male (p=.001). Individuals with type 2 diabetes were also older (p<.001), lived longer in the United States (p=.001), consumed less carbohydrates (p=.035) and had a larger waist circumference (p<.001) compared to those with normal glucose tolerance. There were no significant differences between individuals with type 2 diabetes and those with normal glucose tolerance in terms of the prevalence of the individual, interpersonal, and community level risk factors. In the multivariable logistic regression (Table 6), factors associated with having type 2 diabetes included: male sex

(OR=.48, p<.001), increasing age (OR=1.05, p<.001), and higher anger levels (OR=1.06, p=.030). The total regression model accounted for 14.3% in the variance of type 2 diabetes.

Discussion

Conclusions

This study aimed to first examine the differences in the prevalence of hypertension, dyslipidemia, and type 2 diabetes between Northern and Southern Indian immigrants. While the findings overall were inconsistent with regional differences in cardio-metabolic risk factors in India, the hypothesized differences among all the health outcomes were validated, with the exception of type 2 diabetes. Results indicated that hypertension was more prevalent among Northern Indian immigrants than their Southern counterparts. This is inconsistent with the literature that found hypertension was much more prevalent among Southern Asian Indians [19, 21] living in India. In terms of dyslipidemia, elevated triglyceride and decreased HDL levels were more prevalent among Southern Indian Americans, which is also inconsistent with the literature that found Southern Asian Indians living in India had the lowest prevalence of decreased HDL levels, and Northern Asian Indians living in India had the highest elevated triglyceride levels [23]. There were no significant differences in prevalence of type 2 diabetes between Northern and Southern Indian Americans. The literature also indicated varying levels of type 2 diabetes regionally in India, with one study indicating that the North had a higher prevalence than the South, while another stating the opposite [24, 25].

This study also aimed to contribute to the limited prior research exploring differences in the individual, interpersonal, and community level risk factors between Northern and Southern Indian immigrants. The literature indicates that, among minority populations in general, differences in these multilevel risk factors contribute to hypertension [35-39, 45, 54, 55, 57], dyslipidemia [41, 42, 47, 53, 56, 57], and type 2 diabetes [40, 43, 44, 51, 52, 57]. However, the results of this study did not find any significant differences in the multilevel risk factors between Northern and

Southern Indians at the bivariate level. The results of our study also did not find significant differences in the psychosocial multilevel risk factors between those exhibiting the cardio-metabolic health outcomes and those that did not at the bivariate level.

The third aim of the study was to determine if the multilevel risk factors contributed to the odds of having hypertension, dyslipidemia, and type 2 diabetes. We found that greater odds of having hypertension were associated with being older, lacking access to healthcare, exercising less, and having higher levels of anger. These findings were in line with the literature that found higher anger levels, decreased physical activity, and less access to healthcare to be associated with hypertension [44, 73]. MESA found that those with higher trait anger were associated with increased risk of hypertension, however the association was much higher. This may suggest that socio-demographic factors may play a larger role in hypertension than that of region of origin or psychosocial factors. Lack of physical activity is a known risk factor for hypertension[74]. A study utilizing the NHANES to found that Asian Indians that did not partake in vigorous activity at least once per week were more likely to report having hypertension in relation to their more active peers [73]. It also found that Asian Indians that had a regular doctor were less likely to report having hypertension [73].

Multivariate analyses also found that having high triglyceride levels was associated with being male, which has also been indicated in prior research [29]. Participants that consumed more total fat were less likely to have elevated triglyceride levels, which is surprisingly counterintuitive. However, the mechanism of developing elevated triglyceride levels is largely based on the consumption of simple sugars and saturated fats [75].It may be that individuals with high triglycerides are consuming higher amounts of unsaturated fats that may in fact be

protective. However, we were unable to assess the components of fat intake to further explore this relationship.

Participants that were male, older, and had a longer duration of residence in the U.S. were more likely to have decreased HDL levels. The model found that males were at a 49% higher risk of having decreased HDL levels in comparison to females, a finding consistent with the literature [29] . Diet and longer duration in the U.S. were also significantly associated with decreased HDL levels. Not surprising is the role of diet, as higher consumption of dietary nutrients is a well-recognized mechanism of decreased HDL levels. Longer duration in the U.S. influences a shift in higher intakes of fats, proteins, and dietary cholesterol among South Asians [76], however a high protein diet has not been associated with lower HDL levels among South Asians in the U.S. [77]. There may be another mechanism that influences the association between high protein consumption and lower HDL levels among this population. Results also indicated that participants with higher anger levels had an increased risk in having decreased HDL levels, a finding in line with the literature [42]. While perceived discrimination was not considered to have a significant association with decreased HDL levels, it is important to note the role it may play as a contributing risk factor, which has been noted in the literature [47].

Having type 2 diabetes was associated with being older and male, a finding consistent with the literature [40, 78]. While not significant at the multivariate level, it is important to note that higher dietary consumption of carbohydrates were associated with increased risk for type 2 diabetes at the bivariate level; not surprising since the mechanism of developing type 2 diabetes is largely associated with increased dietary consumption of carbohydrates[79]. Participants with increased anger levels were more likely to have type 2 diabetes, a finding consistent with the literature [44]. It is also important to note the role of social support on the increased risk of

diabetes. While not significant, increased social support was associated with increased risk of diabetes, a finding contradictory to the literature that largely found increased social support was a protective factor against type 2 diabetes [52, 54].

The lack of association between region of origin and prevalence of the cardio-metabolic health outcomes indicate that there are more factors involved than region of origin that may contribute to hypertension, dyslipidemia, and type 2 diabetes. Northern versus Southern state of origin did not predict differences in these health outcomes when socio-demographic, other health-related factors, and multilevel psychosocial factors were accounted for.

Limitations

This study involved some limitations. While this study aimed to investigate multilevel psychosocial predictors for regional differences in state of origin of the participants, it did not provide a full picture of cardio-metabolic disorders within a subgroup that may have been explained as sufficiently by measuring genetic differences. Any associations observed between psychosocial factors and hypertension, dyslipidemia, and type 2 diabetes prevalence are based on cross-sectional data and therefore causal inferences cannot be implied. In addition, psychosocial factors were potentially subject to recall or social desirability bias as data was self-reported by the participants. While the scales were reliable and validated in other ethnic minorities, they were not created or validated with South Asians in general as seen as less than ideal Cronbach alpha scores. It is also important to note that many psychosocial symptomologies are comorbid, while the study assessed each symptomology on its own. Also, the study is limited to middle aged and older Indian Immigrants that have a high socio-economic attainment in and live in the greater San Francisco and Chicago areas. Potential participants were not included if they had an existing heart disease so the cohort is relatively healthy compared to the rest of the Indian immigrant

population[59]. Therefore, study results will not be generalizable to Indians of lower socioeconomic status in the United States and globally. Lastly, the measures in the MASALA study were not specifically designed with SEF in mind, however we were able to identify psychosocial measures that corresponded to each level of the SEF.

Implications and Future Research

While there are a number of limitations to the study, it is important to note that is the first large exploration of risk factors that influence risk of developing cardiovascular disease among Asian Indian immigrants in the US. This particular study is also, the best of our knowledge, the first portrayal of regional differences in state of origin in terms of cardio-metabolic disorders among Indian immigrants in the U.S., a subpopulation that has one of the highest death rates from heart disease domestically in comparison to other ethnic groups[80].

In summary, the findings from this study indicate that there are differences in state of origin in the prevalence of hypertension, decreased HDL levels, and elevated triglyceride levels. While there were no significant differences in the multilevel risk factors contributing to the differences in state of origin, there may be other environmental factors or factors related to migration to the U.S. that may be playing into effect. Further, while most of the multilevel risk factors did not contribute significantly to the prevalence of the cardio-metabolic health outcomes, it is important to note that anger symptoms are a potentially modifiable risk factor that contributes to hypertension, decreased HDL, and elevated triglyceride levels. Understanding any differences in behavioral, social, and cultural multilevel risk factors that can contribute to cardio-metabolic disorders among this population can help inform future culturally competent interventions aiming to prevent and treat heart disease by addressing the key cardio-metabolic

risk factors. Therefore, an exploration of other key factors that may drive these differences in state of origin between Northern and Southern Indian immigrants is needed.

Appendix

Table 1: *Baseline Characteristics of MASALA Study Population By Region*

	South Indian N = 189 (25%)	**North Indian N = 568 (75%)**	**P value**
Socio-demographics			
Female (%)	80 (42.3%)	269 (47.4%)	.229
Age (M, SD)	53.13 (9.14)	56.33 (9.38)	<.001
Years in the U.S. (M, SD)	25.19 (11.12)	27.93 (10.62)	.002
Family income (≥ $100,000) (%)	150 (81.1%)	334 (60.9%)	<.001
Education status (≥ Bachelor's) (%)	182 (96.3%)	500 (88%)	.001
Access to healthcare (%)	179 (94.7%)	517 (91.3%)	.135
Health-related Factors			
Ever Smoked (%)	33 (17.5%)	90 (15.8%)	.602
Alcohol (1+ drinks/week) (%)	59 (31.2%)	186 (32.7%)	.697
Dietary calories (kCals) (M, SD)	1721.89 (468.50)	1660.7 (504.20)	.143
Carbohydrates (M, SD)	251.11 (26.19)	245.99 (24.53)	.015
Protein (M, SD)	62.70 (9.27)	61.24 (8.90)	.054
Total Fat (M, SD)	51.62 (9.97)	55.42 (9.22)	<.001
Exercise (min/week) (M, SD)	1466.71 ± 1385.46	1277.3 (1,332.87)	.094
BMI (M, SD)	25.70 (3.89)	25.98 (4.34)	.443
Waist circumference (M, SD)	92.07 (8.96)	92.7 (10.34)	.402
Multilevel Psychosocial Factors			
Anger (M, SD)	16.17 (3.70)	15.87 (3.87)	.346
Anxiety (M, SD)	15.94 (4.39)	15.98 (4.38)	.924
Depressive symptoms (M, SD)	7.10 (7.02)	7.60 (7.01)	.401
Perceived discrimination (M, SD)	14.98 (5.15)	14.87 (6.22)	.819
Social support (M, SD)	18.77 (5.05)	19.11 (4.76)	.407
Community Cohesion (M, SD)	17.48 (1.80)	17.26 (1.80)	.146
Health Outcomes			
Blood Pressure			
Systolic (mmHg) (M, SD)	123.95 (14.20)	125.38 (16.58)	.252
Diastolic (mmHg) (M, SD)	74.13 (9.36)	73.32 (9.96)	.326
Hypertension *(%)*	61 (32.3%)	252 (44.4%)	.003
Dyslipidemia			
Total Cholesterol (mg/dL) (M, SD)	186.18 (36.15)	186.33 (36.55)	.960
HDL (mg/dL) (M, SD)	46.57 (11.85)	51.29 (13.62)	<.001
LDL (mg/dL) (M, SD)	111.36 (30.48)	110.13 (32.37)	.650
Triglycerides (mg/dL) (M, SD)	140.66 (78.36)	124.87 (56.26)	.011
Diabetes	--	--	--
Fasting plasma glucose (mg/dL) (M, SD)	98.59 (19.73)	101.75 (25.38)	.078
Diabetes (%)	34 (18.1%)	118 (20.9%)	.407

Table 2: *Characteristics of MASALA Study Population by Hypertension*

	Normal 444 (58.7%)	**Hypertensive 313 (41.3%)**	**P-value**
Socio-demographics			
South Indian (%)	128 (28.8%)	61 (19.5%)	.003
Female (%)	222 (50.0%)	127 (40.6%)	.010
Age (M, SD)	52.46 (8.295)	59.90 (9.20)	<.001
Years in the U.S. (M, SD)	25.55 (10.22)	29.66 (11.15)	<.001
Family income (≥ $100,000) (%)	120 (27.6%)	129 (43.3%)	<.001
Access to healthcare (%)	418 (94.4%)	278 (89.1%)	.008
Health-related Factors			
Ever Smoked (%)	67 (15.1%)	56 (17.9%)	.304
Alcohol (1+ drinks/week) (%)	137 (30.9%)	108 (34.5%)	.291
Dietary calories (kCals) (M, SD)	1680.95 (500.76)	1669.37 (489.42)	.754
Carbohydrates (M, SD)	248.16 (24.41)	246.15 (25.91)	.256
Protein (M, SD)	61.59 (9.18)	61.63 (8.78)	.943
Total Fat (M, SD)	54.40 (9.22)	54.54 (10.01)	.844
Exercise (min/week) (M, SD)	1419.67 (1423.59)	1189.74 (1221.81)	.021
Waist circumference (M, SD)	90.58 (9.14)	95.37 (10.53)	<.001
Multilevel Psychosocial Factors			
Anger (M, SD)	15.89 (3.71)	16.02 (4.01)	.655
Anxiety (M, SD)	15.82 (4.24)	16.18 (4.56)	.260
Depressive symptoms (M, SD)	7.07 (6.76)	8.04 (7.33)	.062
Perceived discrimination (M, SD)	14.97 (6.06)	14.80 (5.84)	.709
Social support (M, SD)	19.00 (4.74)	19.06 (4.97)	.877
Community Cohesion (M, SD)	17.39 (1.76)	17.21 (1.85)	.186

Table 3: *Characteristics of MASALA Study Population by Triglycerides*

	Normal **540 (71.6%)**	**Elevated Triglycerides** **214 (28.4%)**	**P-value**
Socio-demographics			
South Indian (%)	121 (22.4%)	67 (31.3%)	.011
Female (%)	271 (50.2%)	76 (35.5%)	<.001
Age (M, SD)	55.81 (9.55)	54.77 (8.95)	.170
Years in the U.S. (M, SD)	27.71 (10.94)	26.13 (10.42)	.070
Family income (≥ $100,000) (%)	174 (33.4%)	74 (35.2%)	.634
Access to healthcare (%)	504 (93.3%)	191 (90.1%)	.131
Health-related Factors			
Ever Smoked (%)	78 (14.4%)	45 (21.0%)	.027
Alcohol (1+ drinks/week) (%)	172 (31.9%)	72 (33.6%)	.635
Dietary calories (kCals) (M, SD)	1669.21 (493.05)	1693.56 (502.66)	.547
Carbohydrates (M, SD)	245.90 (24.94)	251.05 (25.06)	.012
Protein (M, SD)	61.67 (9.19)	61.53 (8.55)	.848
Total Fat (M, SD)	55.22 (9.42)	52.41 (9.60)	<.001
Exercise (min/week) (M, SD)	1364.80 (1431.62)	1218.19 (1087.33)	.177
Waist circumference (M, SD)	91.40 (10.14)	95.39 (9.08)	<.001
Multilevel Psychosocial Factors			
Anger (M, SD)	15.86 (3.91)	16.14 (3.63)	.383
Anxiety (M, SD)	15.99 (4.43)	15.88 (4.27)	.755
Depressive symptoms (M, SD)	7.36 (7.00)	7.56 (6.80)	.722
Perceived discrimination (M, SD)	14.87 (6.15)	14.96 (5.51)	.859
Social support (M, SD)	18.89 (4.94)	19.40 (4.51)	.194
Community Cohesion (M, SD)	17.29 (1.80)	17.39 (1.78)	.494

Table 4: *Characteristics of MASALA Study Population by HDL levels*

	Normal **558 (73.7%)**	**Decreased HDL Levels** **199 (26.3%)**	**P-value**
Socio-demographics			
South Indian (%)	143 (25.6%)	46 (23.1%)	.482
Female (%)	272 (48.7%)	77 (38.7)	.015
Age (M, SD)	54.42 (9.10)	58.67 (9.60)	<.001
Years in the U.S. (M, SD)	26.07 (10.52)	30.55 (10.92)	<.001
Family income (≥ $100,000) (%)	179 (33.1%)	70 (36.3%)	.432
Access to healthcare (%)	509 (91.5%)	187 (94.0%)	.274
Health-related Factors			
Ever Smoked (%)	87 (15.6%)	36 (18.1%)	.412
Alcohol (1+ drinks/week) (%)	169 (30.3%)	76 (38.2%)	.041
Dietary calories (kCals) (M, SD)	1712.57 (519.02)	1573.85 (407.94)	.001
Carbohydrates (M, SD)	248.21 (25.00)	244.70 (25.05)	.092
Protein (M, SD)	61.08 (8.47)	63.09 (10.27)	.007
Total Fat (M, SD)	54.55 (9.52)	54.19 (9.67)	.647
Exercise (min/week) (M, SD)	1334.02 (1339.44)	1298.18 (13.73.92)	.748
Waist circumference (M, SD)	92.14 (10.31)	93.75 (9.06)	.052
Multilevel Psychosocial Factors			
Anger (M, SD)	15.85 (3.72)	16.21 (4.13)	.248
Anxiety (M, SD)	15.94 (4.25)	16.05 (4.74)	.773
Depressive symptoms (M, SD)	7.43 (7.092)	7.60 (6.78)	.767
Perceived discrimination (M, SD)	15.12 (6.28)	14.28 (4.95)	.089
Social support (M, SD)	18.95 (4.79)	19.25 (4.96)	.452
Community Cohesion (M, SD)	17.30 (1.79)	17.36 (1.83)	.682

Table 5: *Characteristics of MASALA Study Population by Diabetes*

	Normal 601 (79.8%)	**Diabetic 152 (20.2%)**	**P-value**
Socio-demographics			
South Indian (%)	154 (25.6%)	34 (22.4%)	.407
Female (%)	295 (49.1%)	52 (34.2%)	.001
Age (M, SD)	54.62 (9.24)	58.93 (9.14)	<.001
Years in the U.S. (M, SD)	26.57 (10.72)	29.88 (10.79)	.001
Family income (≥ $100,000) (%)	190 (32.6%)	57 (38.8%)	.157
Access to healthcare (%)	554 (92.5%)	140 (92.1%)	.874
Health-related Factors			
Ever Smoked (%)	90 (15.0%)	32 (21.1%)	.069
Alcohol (1+ drinks/week) (%)	193 (32.1%)	50 (32.9%)	.854
Dietary calories (kCals) (M, SD)	1685.94 (493.82)	1633.80 (502.28)	.251
Carbohydrates (M, SD)	248.37 (24.63)	243.55 (26.31)	.035
Protein (M, SD)	61.56 (9.14)	62.04 (8.36)	.557
Total Fat (M, SD)	54.16 (9.30)	55.56 (10.44)	.110
Exercise (min/week) (M, SD)	1317.20 (1326.07)	1355.54 (1416.14)	.754
Waist circumference (M, SD)	91.66 (9.89)	96.06 (9.74)	<.001
Multilevel Psychosocial Factors			
Anger (M, SD)	15.88 (3.81)	16.16 (3.95)	.420
Anxiety (M, SD)	15.98 (4.30)	15.86 (4.69)	.760
Depressive symptoms (M, SD)	7.38 (6.99)	7.58 (6.80)	.750
Perceived discrimination (M, SD)	14.84 (6.12)	15.14 (5.35)	.585
Social support (M, SD)	18.97 (4.89)	19.40 (4.43)	.319
Community Cohesion (M, SD)	17.35 (1.81)	17.20 (1.71)	.365

***Table 6**: Multivariate Tables regarding correlates of Hypertension, Triglycerides, HDL, and Diabetes*

	Hypertension			**Triglycerides**			**HDL**			**Diabetes**		
	OR	**95% CI**	**P – value**	**OR**	**95% CI**	**P - value**	**OR**	**95% CI**	**P-value**	**OR**	**95% CI**	**P-value**
South Indian	0.75	0.51,1.11	.153	1.4	0.96, 2.05	.081	0.96	0.63, 1.45	.833	1.03	0.65,1.63	.915
Female	0.74	0.53, 1.03	.072	.56	0.40, 0.78	.001	0.51	0.35, 0.74	<.001	0.48	0.32, 0.72	<.001
Age	1.09	1.07, 1.12	<.001	.99	0.97, 1.01	.255	1.03	1.01, 1.06	.006	1.05	1.02, 1.07	.<.001
Years in the US	1.01	0.99, 1.03	.495	1.00	0.98, 1.02	.823	1.03	1.01, 1.05	.007	1.01	0.99, 1.03	.340
Family Income $\geq$ $100K	0.91	0.62, 1.33	.622	.88	0.59, 1.31	.521	1.05	0.70, 1.59	.819	0.96	0.62, 1.50	.849
Access to Healthcare	0.51	0.27, 0.98	.042	.65	0.34, 1.3	.200	0.91	0.42, 1.94	.798	0.66	0.31, 1.42	.287
Calories	--	--	--	--	--	--	1.00	1.00, 1.00	.001	1.00	1.00, 1.00	.067
Carbohydrates	--	--	--	--	--	--	--	--	--	--	--	--
Protein	--	--	--	--	--	--	1.04	1.02, 1.06	<.001	1.02	1.00, 1.04	.088
Fat	--	--	--	.98	0.96, 0.99	.008	--	--	--	1.02	1.00, 1.04	.094
Exercise	1.00	1.00, 1.00	.017	--	--	--	--	--	--	--	--	--
Anger	1.05	1.00, 1.09	.045	--	--	--	1.06	1.02, 1.12	.010	1.06	1.01, 1.12	.030
Depression	--	--	--	--	--	--	--	--	--	--	--	--
Discrimination	--	--	--	--	--	--	0.97	0.94, 1.00	.053	--	--	--
Social Support	--	--	--	--	--	--	--	--	--	1.04	1.00, 1.08	.081
	Nagelkerke R^2 = .220			Nagelkerke R^2 = .061			Nagelkerke R^2 = .143			Nagelkerke R^2 = .105		

References

1. Bureau USC. The Asian Population: 2010. 3/3/16 2012:24.

2. Bureau USC. Projections of the Size and Composition of

the U.S. Population: 2014 to 2060. 2015:13.

3. National Heart L, and Blood Institute. Description of High Blood Pressure. 2015.

4. Aoki Y, Yoon SS, Chong Y, Carroll MD. Hypertension, abnormal cholesterol, and high body mass index among non-Hispanic Asian adults: United States, 2011-2012. *NCHS Data Brief.* Jan 2014(140):1-8.

5. Fodor G. Primary prevention of CVD: treating dyslipidaemia. *BMJ clinical evidence.* 2010;2010.

6. Prevention CfDCa. Basics about Diabetes. 2015.

7. Echeverria SE, Mustafa M, Pentakota SR, et al. Social and clinically-relevant cardiovascular risk factors in Asian Americans adults: NHANES 2011–2014. *Preventive Medicine.* 2017;99:222-227.

8. Nwankwo T, Yoon SS, Burt V, Gu Q. Hypertension among adults in the United States: National Health and Nutrition Examination Survey, 2011-2012. *NCHS Data Brief.* Oct 2013(133):1-8.

9. Carroll MD, Kit BK, Lacher DA, Yoon SS. Total and high-density lipoprotein cholesterol in adults: National Health and Nutrition Examination Survey, 2011-2012. *NCHS Data Brief.* Oct 2013(132):1-8.

10. Carroll MD, Kit BK, Lacher DA, Yoon S. Total and high-density lipoprotein cholesterol in adults: National Health and Nutrition Examination Survey, 2011-2012. *NCHS data brief.* 2013;132:1-8.

11. Statistics NCfH. Health, United States, 2015: with special feature on racial and ethnic health disparities. 2016.

12. Hastings KG, Jose PO, Kapphahn KI, et al. Leading Causes of Death among Asian American Subgroups (2003-2011). *PLoS One.* 2015;10(4):e0124341.

13. Jose PO, Frank AT, Kapphahn KI, et al. Cardiovascular disease mortality in Asian Americans. *J Am Coll Cardiol.* Dec 16 2014;64(23):2486-2494.

14. Lee JW, Brancati FL, Yeh HC. Trends in the prevalence of type 2 diabetes in Asians versus whites: results from the United States National Health Interview Survey, 1997-2008. *Diabetes Care.* Feb 2011;34(2):353-357.

15. Bronfenbrenner U. The ecology of human development: Experiments by nature and design. 1979: Cambridge, MA: Harvard University Press.

16. Bronfenbrenner U. Ecological models of human development. *Readings on the development of children.* 1994;2:37-43.

17. Stokols D. Translating social ecological theory into guidelines for community health promotion. *American journal of health promotion.* 1996;10(4):282-298.

18. Stokols D. Establishing and maintaining healthy environments: toward a social ecology of health promotion. *American Psychologist.* 1992;47(1):6.

19. Anchala R, Kannuri NK, Pant H, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens.* Jun 2014;32(6):1170-1177.

20. Guptha S, Gupta R, Deedwania P, et al. Cholesterol lipoproteins and prevalence of dyslipidemias in urban Asian Indians: a cross sectional study. *Indian Heart J.* May-Jun 2014;66(3):280-288.

21. Singh RB, Fedacko J, Pella D, et al. Prevalence and risk factors for prehypertension and hypertension in five Indian cities. *Acta Cardiol.* Feb 2011;66(1):29-37.

22. Gupta R, Guptha S, Sharma KK, Gupta A, Deedwania P. Regional variations in cardiovascular risk factors in India: India heart watch. *World J Cardiol.* 2012;4(4):112-120.

23. Joshi SR, Anjana RM, Deepa M, et al. Prevalence of dyslipidemia in urban and rural India: the ICMR–INDIAB study. *PloS one.* 2014;9(5):e96808.

24. Meshram, II, Vishnu Vardhana Rao M, Sudershan Rao V, Laxmaiah A, Polasa K. Regional variation in the prevalence of overweight/obesity, hypertension and diabetes and their correlates among the adult rural population in India. *Br J Nutr.* Apr 14 2016;115(7):1265-1272.

25. Anjana RM, Pradeepa R, Deepa M, et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: phase I results of the Indian Council of Medical Research-INdia DIABetes (ICMR-INDIAB) study. *Diabetologia.* Dec 2011;54(12):3022-3027.

26. SAALT. A Demographic Snapshot of South Asians in the United States. July 2012 2012:5.

27. Ivey SL, Mehta KM, Fyr CLW, Kanaya AM. Prevalence and correlates of cardiovascular risk factors in South Asians: population-based data from two California surveys. *Ethnicity and Disease.* 2006;16(4):886.

28. 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.

29. 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. *J Diabetes Complications.* May-Jun 2010;24(3):145-153.

30. Ivey S, Patel S, Kalra P, Greenlund K, Srinivasan S, Grewal D. Cardiovascular health among Asian Indians (CHAI): a community research project. *Journal of interprofessional care.* 2004;18(4):391-402.

31. Gujral UP, Narayan KM, Pradeepa RG, et al. Comparing Type 2 Diabetes, Prediabetes, and Their Associated Risk Factors in Asian Indians in India and in the U.S.: The CARRS and MASALA Studies. *Diabetes Care.* Jul 2015;38(7):1312-1318.

32. Ayala GX, Carnethon M, Arredondo E, et al. Theoretical foundations of the Study of Latino (SOL) Youth: implications for obesity and cardiometabolic risk. *Ann Epidemiol.* Jan 2014;24(1):36-43.

33. Isasi CR, Carnethon MR, Ayala GX, et al. The Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth): design, objectives, and procedures. *Ann Epidemiol.* Jan 2014;24(1):29-35.

34. Elder JP, Arredondo EM, Campbell N, et al. Individual, family, and community environmental correlates of obesity in Latino elementary school children. *J Sch Health.* Jan 2010;80(1):20-30; quiz 53-25.

35. Davidson K, Jonas BS, Dixon KE, Markovitz JH. Do depression symptoms predict early hypertension incidence in young adults in the CARDIA study? Coronary Artery Risk Development in Young Adults. *Arch Intern Med.* May 22 2000;160(10):1495-1500.

36. Gonzalez HM, Tarraf W. Comorbid cardiovascular disease and major depression among ethnic and racial groups in the United States. *Int Psychogeriatr.* May 2013;25(5):833-841.

37. Meng L, Chen D, Yang Y, Zheng Y, Hui R. Depression increases the risk of hypertension incidence: a meta-analysis of prospective cohort studies. *J Hypertens.* May 2012;30(5):842-851.

38. Nakagawara M, Witzke W, Matussek N. Hypertension in depression. *Psychiatry research.* 1987.

39. Player MS, Peterson LE. Anxiety disorders, hypertension, and cardiovascular risk: a review. *The International Journal of Psychiatry in Medicine.* 2011;41(4):365-377.

40. Shah AD, Vittinghoff E, Kandula NR, Srivastava S, Kanaya AM. Correlates of prediabetes and type II diabetes in US South Asians: findings from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) study. *Ann Epidemiol.* Feb 2015;25(2):77-83.

41. Shin JY, Suls J, Martin R. Are cholesterol and depression inversely related? A meta-analysis of the association between two cardiac risk factors. *Ann Behav Med.* Aug 2008;36(1):33-43.

42. Finney ML, Stoney CM, Engebretson TO. Hostility and anger expression in African American and European American men is associated with cardiovascular and lipid reactivity. *Psychophysiology.* 2002;39(3):340-349.

43. Demmer RT, Gelb S, Suglia SF, et al. Sex differences in the association between depression, anxiety, and type 2 diabetes mellitus. *Psychosomatic medicine.* 2015;77(4):467.

44. Abraham S, Shah NG, Diez Roux A, et al. Trait anger but not anxiety predicts incident type 2 diabetes: The Multi-Ethnic Study of Atherosclerosis (MESA). *Psychoneuroendocrinology.* Oct 2015;60:105-113.

45. Cozier Y, Palmer JR, Horton NJ, Fredman L, Wise LA, Rosenberg L. Racial discrimination and the incidence of hypertension in US black women. *Ann Epidemiol.* Sep 2006;16(9):681-687.

46. Davis SK, Liu Y, Quarells RC, Din-Dzietharn R. Stress-related racial discrimination and hypertension likelihood in a population-based sample of African Americans: the Metro Atlanta Heart Disease Study. *Ethn Dis.* Autumn 2005;15(4):585-593.

47. Mwendwa DT, Sims RC, Madhere S, et al. The influence of coping with perceived racism and stress on lipid levels in African Americans. *J Natl Med Assoc.* Jul 2011;103(7):594-601.

48. Gee GC, Ro A, Shariff-Marco S, Chae D. Racial discrimination and health among Asian Americans: evidence, assessment, and directions for future research. *Epidemiol Rev.* 2009;31:130-151.

49. Gee GC, Spencer MS, Chen J, Takeuchi D. A nationwide study of discrimination and chronic health conditions among Asian Americans. *American Journal of Public Health.* 2007;97(7):1275-1282.

50. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. *J Behav Med.* Feb 2009;32(1):20-47.

51. Nadimpalli S, Dulin-Keita A, Salas C, Kanaya A, Kandula NR. Associations Between Discrimination and Cardiovascular Health Among Asian Indians in the United States. *Journal of immigrant and minority health.* 2016;18(6):1284-1291.

52. Gallo LC, Fortmann AL, McCurley JL, et al. Associations of structural and functional social support with diabetes prevalence in U.S. Hispanics/Latinos: Results from the HCHS/SOL Sociocultural Ancillary Study. *Journal of Behavioral Medicine.* 2015;38(1):160-170.

53. Hernandez DC, Reitzel LR, Wetter DW, McNeill LH. Social support and cardiovascular risk factors among black adults. *Ethn Dis.* Autumn 2014;24(4):444-450.

54. Bell CN, Thorpe RJ, LaVeist TA. Race/ethnicity and hypertension: the role of social support. *American journal of hypertension.* 2010;23(5):534-540.

55. Mujahid MS, Roux AVD, Morenoff JD, et al. Neighborhood characteristics and hypertension. *Epidemiology.* 2008;19(4):590-598.

56. Barber S, Hickson DA, Wang X, Sims M, Nelson C, Diez-Roux AV. Neighborhood Disadvantage, Poor Social Conditions, and Cardiovascular Disease Incidence Among African American Adults in the Jackson Heart Study. *Am J Public Health.* Dec 2016;106(12):2219-2226.

57. Lagisetty PA, Wen M, Choi H, Heisler M, Kanaya AM, Kandula NR. Neighborhood Social Cohesion and Prevalence of Hypertension and Diabetes in a South Asian Population. *J Immigr Minor Health.* Nov 2 2015.

58. Kandula N. Association of perceived neighborhood social cohesion and hypertension in US South Asians: The Mediators of Atherosclerosis in South Asians Living in America Study. Paper presented at: 142nd APHA Annual Meeting and Exposition (November 15-November 19, 2014), 2014.

59. Kanaya AM, Kandula N, Herrington D, et al. Mediators of Atherosclerosis in South Asians Living in America (MASALA) Study: Objectives, Methods, and Cohort Description. *Clinical Cardiology.* 2013;36(12):713-720.

60. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *Jama.* 2014;311(5):507-520.

61. Health NIo. Third Report of the National Cholesterol Education Program Expert Panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). *Executive Summary. Bethesda, MD, National Institutes of Health, National Heart, Lung and Blood Institute (NIH publ. no. 01-3670).* 2001.

62. Williams JE, Paton CC, Siegler IC, Eigenbrodt ML, Nieto FJ, Tyroler HA. Anger proneness predicts coronary heart disease risk: prospective analysis from the atherosclerosis risk in communities (ARIC) study. *Circulation.* May 2 2000;101(17):2034-2039.

63. Spielberger CD. Preliminary manual for the state-trait anger scale (STAS). *Tampa: University of South Florida Human Resources Institute.* 1980.

64. Shah BM, Shah S, Kandula NR, Gadgil MD, Kanaya AM. Psychosocial Factors Associated with Subclinical Atherosclerosis in South Asians: The MASALA Study. *J Immigr Minor Health.* Feb 20 2016.

65. Radloff LS. The CES-D scale a self-report depression scale for research in the general population. *Applied psychological measurement.* 1977;1(3):385-401.

66. Nadimpalli SB, Dulin-Keita A, Salas C, Kanaya AM, Kandula NR. Associations Between Discrimination and Cardiovascular Health Among Asian Indians in the United States. *J Immigr Minor Health.* Apr 2 2016.

67. Tummala-Narra P, Claudius M. Perceived discrimination and depressive symptoms among immigrant-origin adolescents. *Cultural Diversity and Ethnic Minority Psychology.* 2013;19(3):257.

68. Williams DR, Yan Y, Jackson JS, Anderson NB. Racial Differences in Physical and Mental Health: Socio-economic Status, Stress and Discrimination. *J Health Psychol.* Jul 1997;2(3):335-351.

69. Hahm HC, Ozonoff A, Gaumond J, Sue S. Perceived discrimination and health outcomes a gender comparison among Asian-Americans nationwide. *Womens Health Issues.* Sep 2010;20(5):350-358.

70. Enhancing recovery in coronary heart disease patients (ENRICHD): study design and methods. The ENRICHD investigators. *Am Heart J.* Jan 2000;139(1 Pt 1):1-9.

71. Mair C, Diez Roux AV, Shen M, et al. Cross-sectional and longitudinal associations of neighborhood cohesion and stressors with depressive symptoms in the multiethnic study of atherosclerosis. *Ann Epidemiol.* Jan 2009;19(1):49-57.

72. Mujahid MS, Roux AVD, Morenoff JD, Raghunathan T. Assessing the measurement properties of neighborhood scales: from psychometrics to ecometrics. *American journal of epidemiology.* 2007;165(8):858-867.

73. Mohanty SA, Woolhandler S, Himmelstein DU, Bor DH. Diabetes and cardiovascular disease among Asian Indians in the United States. *Journal of general internal medicine.* 2005;20(5):474-478.

74. Blair SN, Goodyear NN, Gibbons LW, Cooper KH. Physical fitness and incidence of hypertension in healthy normotensive men and women. *Jama.* Jul 27 1984;252(4):487-490.

75. Zhang Z, Gillespie C, Welsh JA, Hu FB, Yang Q. Usual intake of added sugars and lipid profiles among the U.S. adolescents: National Health and Nutrition Examination Survey, 2005-2010. *J Adolesc Health.* Mar 2015;56(3):352-359.

76. Talegawkar SA, Kandula NR, Gadgil MD, Desai D, Kanaya AM. Dietary intakes among South Asian adults differ by length of residence in the USA. *Public Health Nutr.* 2015;20:1-8.

77. Gadgil MD, Anderson CA, Kandula NR, Kanaya AM. Dietary patterns in Asian Indians in the United States: an analysis of the metabolic syndrome and atherosclerosis in South Asians Living in America study. *J Acad Nutr Diet.* Feb 2014;114(2):238-243.

78. 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.

79. Hu FB, van Dam RM, Liu S. Diet and risk of Type II diabetes: the role of types of fat and carbohydrate. *Diabetologia.* Jul 2001;44(7):805-817.

80. Kanaya AM, 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.