# RISK FACTORS AND PREVENTION OF CARDIOVASCULAR DISEASE AMONG ASIAN-INDIAN MEN IN A U.S. MANAGED CARE ORGANIZATION

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ABSTRACT OF THE DISSERATION

RISK FACTORS AND PREVENTION OF CARDIOVASCULAR DISEASE AMONG ASIAN-INDIAN MEN IN A U.S. MANAGED CARE ORGANIZATION

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Researchers have reported higher rates of cardiovascular disease (CVD) clinical risk factors including diabetes mellitus (DM), hypertension, and dyslipidemia in Asian-Indians. We sought to examine lifestyle/behavioral CVD risk factors overall and by vegetarian/non-vegetarian status, as well as CVD clinical risk factors in Asian-Indian men compared to white non-Hispanic men (WNH). Eligible men were recruited from Kaiser Permanente Southern and Northern California into the California Men's Health Study (CMHS) Cohort between 2002-2003.

Asian-Indians more often reported a healthy BMI (18.5-24.9), and consumed <30% calories from fat compared to WNHs. Among healthy weight men, Asian-Indians were less likely to eat 5 or more fruit and vegetables a day. Overall, Asian-Indians were more likely to have never smoked and to abstain from alcohol. Asian-Indians were less likely to report moderate/vigorous physical activity $\geq$ 3.5 hours/week.

Vegetarians more often consumed a lower fat diet compared to non-vegetarians [Adjusted Odds Ratio (AOR) = 3.22; (95% Confidence Interval) (95% CI) 2.80-3.71]. Vegetarians reported consuming more fruits and vegetables; however a statistically significant difference was not detected among Asian-Indians. Further, WNH vegetarians reported less sedentary activity [AOR = 0.65; 95% CI 0.54-0.78] and more moderate/vigorous physical activity [AOR = 1.87; 95% CI 1.55-2.25] than WNH non-vegetarians, however this was not the case among Asian-Indians.

We found Asian-Indians had higher rates of DM and dyslipidemia compared to WNHs. Asian-Indians more often had lower mean systolic, diastolic and low-density lipoprotein (LDL) levels compared to WNHs. Although control of hypertension and dyslipidemia was similar in the two populations, overall only 50% of men had LDL and triglyceride levels under the target values for control.

Our examination of lifestyle related CVD risk factors found evidence for both potentially protective and harmful health behaviors among Asian-Indian men. Overall, we found that WNH vegetarians lead a healthier lifestyle (consuming lower fat diets and more fruits and vegetables, and participating in more physical activity and less sedentary behaviors) compared to non-vegetarians. Finally, our examination of clinical CVD risk factors found evidence for increased clinical risk factors (DM and dyslipidemia) and clustering of clinical risk factors for CVD among Asian-Indians.

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# INTRODUCTION

## Burden of Disease

Nationally, and in California, cardiovascular disease (CVD) is the number one cause of death accounting for roughly a third of all deaths, among all persons regardless of race/ethnicity.[1,2] CVD mortality is decreasing nationally, but at a much slower rate among the South Asian population compared to other racial/ethnic groups.[3] Asian-Indians, the largest subset in the South Asian population, disproportionately suffer from coronary heart disease (Odds Ratio (OR)=1.77 95% Confidence Interval (95% CI) 1.43-2.21).[4] In addition, the leading cause of death among Asian-Indians in California is CVD, accounting for 42.1% of deaths in this population.[5]

## Cardiovascular Disease and Cardiovascular Disease Risk Factors in the Asian-Indian Population

Researchers have reported disproportionately higher rates of CVD and CVD clinical risk factors including diabetes mellitus (DM), hypertension, and dyslipidemia in Asian-Indians. [6-10] Several studies have been conducted evaluating the prevalence of DM, stroke and coronary heart disease (CHD) among Asian-Indians in the U.S. compared to other racial/ethnic groups in the U.S. [6-9,11-14] Four studies have estimated the prevalence of DM in Asian-Indians, with the following rates: 18.3%,[9] 17.6%,[8] 29%, [7] and 10%.[6] Compared to other race/ethnicities in the nation, the higher rates are almost twice that of Hispanics (9.3%), Blacks (8.2%) and four times that of Caucasians (4.8%).[15,16] In two of these studies, sex-specific rates of DM were higher in Asian-Indian men compared to Asian-Indian women (18.3% vs 13.6%) [9] and (20% vs. 13.8%).[8] In a more recent study, the age-adjusted odds ratio of reporting diabetes in Asian-Indians compared to white non-Hispanics was higher (OR=2.70, 95% CI 1.72-4.23).[10]

Other CVD risk factors including fasting blood glucose levels, triglyceride levels, and hypercholesterolemia have been shown to be elevated in the Asian-Indian U.S. population with the following rates respectively 62.7%, [8] 42.3%, [8] and 52%.[6] These rates are more than twice that reported for Mexican Americans, African Americans and whites.[17] Two population-based studies in California reported a high proportion of deaths in Asian-Indians were due to CHD.[12,14] They observed higher standardized mortality ratios and proportional mortality ratios for CHD in Asian-Indian men and women (161 per 100,000 and 144 per 100,000) compared to other ethnic groups (white, Hispanic, African-American, Chinese, and Japanese).[12]

Explanations for these increased rates have not been well elucidated and the Asian-Indian population may have a different set of susceptibility factors. Additionally, Asian-Indians may have distinct dietary patterns, health behaviors, clinical CVD risk factors and genetics compared to other racial/ethnic groups. Consequently, there is a need to address CVD-related risk factors in the Asian-Indian population.

**Lifestyle Risk Factors and Health behaviors for CVD Risk**

The American Heart Association (AHA) recommends leading a healthy lifestyle to prevent CVD.[18] Harmful lifestyle and behavioral CVD risk factors include tobacco use, high fat diets, low fruit and vegetable intake, high sodium diet, physical inactivity, obesity, and excess alcohol intake.[19] These risk factors are modifiable as increasing physical activity, decreasing red meat and increasing fruit, vegetable, fish, and whole grain consumption can help prevent, control or delay CVD, DM, hypertension, and dyslipidemia onset. [18] Migrant studies of Asian-Indians into Western Countries demonstrate that prolonged exposure to known CVD risk factors such as western diets, "high in fat, low in fiber" and sedentary lifestyles result in increased blood pressure, body weight, blood sugars and blood lipids.[20] By contrast, little is known about lifestyle/behavioral CVD risk factors among Asian-Indians living in the U.S. compared to white non-Hispanics.

Three published studies in the U.S. have evaluated lifestyle and health behaviors of CVD risk in the Asian-Indian population.[6,21,22] Two studies collected information on diet, physical activity, smoking habits, and chronic diseases.[21,22] The third study compared data from two population-based surveys in California.[6] All studies found Asian-Indians reported relatively healthy weights but had low levels of physical activity.[6,21,22] However, these studies had small sample sizes, no comparison group to examine differences in lifestyle CVD risk factors, and did not explore the relationships within BMI categories.[6,21,22] Studies of Asian-Indian migration into Canada and England, found that as immigrants acculturate they adopt unhealthy lifestyles, including a westernized diet "high in fat, low in fiber", as well sedentary behaviors.

The purpose of the first study of this dissertation was to evaluate lifestyle/behavioral CVD risk factors in Asian-Indian men compared to white non-Hispanic men, the majority racial/ethnic group in the California Men's Health Study (CMHS) cohort and in the nation. Analyses were conducted among healthy weight and overweight/obese men to evaluate the effect of BMI on these behaviors. For these analyses, data were obtained from a 24-page baseline questionnaire, which collected information on demographics, health and lifestyle, other

existing health conditions, medications/drug use, physical activity, tobacco use, diet/supplement use, county of origin, duration of U.S. residency, and income.

**Vegetarian diets and CVD risk**

Vegetarian diets, high in fruit and vegetable consumption, have been shown to reduce the risk of CVD by lowering body weights, decreasing cholesterol levels, and reducing inflammatory markers responsible for atherosclerosis.[23-26] Although a high prevalence of Asian-Indians consume a vegetarian diet, (estimated at 50%), the leading cause of death among Asian-Indians in California is CVD.[5] In addition, research on Asian-Indians in the U.S. has shown higher rates of clinical CVD risk factors including, DM, hypertension, and dyslipidemia.[6-10] These contradictory observations in Asian-Indians, a high prevalence of CVD and a high prevalence of those consuming a vegetarian diet, have created a need to evaluate diet in this population.

There have been few studies examining diet and CVD clinical risk factors among the Asian-Indian population in the U.S. [27-34] Four of these studies found Asian-Indian diets to be high in fat and carbohydrates, and therefore not cardio-protective. [27-29,31] In addition, Rastogi et al. found an inverse association between increased vegetable intake and decreased ischemic heart disease among the Asian-Indian population in the U.S.[30] In six of the published eight studies, Asian-Indians were grouped into vegetarians or non-vegetarians;[27,29,30,32-34] however only three of these studies evaluated a vegetarian or non-vegetarian diet in relation to clinical CVD risk factors.[32-34] Schoelfield et al. observed that Asian-Indian vegetarians had higher fasting blood glucose levels compared to Americans.[32] Enas et al. found heart disease rates to be similar between vegetarian and non-vegetarian Asian-Indians.[34] In another study comparing vegetarian and non-vegetarian Asian-Indians lipid profiles were similar between the two groups; however higher diabetes rates were observed among vegetarians.[33] The purpose of the second study of this dissertation was to assess whether differences in CVD clinical and lifestyle risk factors between Asian-Indians & white non-Hispanics (WNHs) are modified by a vegetarian diet.

**Clinical CVD risk Factors**

Almost all of the studies evaluating clinical CVD risk factors in Asian-Indians relied on self-report of medical conditions, thus, the prevalence of any CVD risk factor in these populations maybe underestimated or

overestimated.[6,8-10] Two of the aforementioned studies used publicly available data sources, the U.S. Census and California Mortality Data, which may not be accurate, due to errors in documentation. [12,14] For example, these data sources are known for incorrect reporting of ethnicity. In order to minimize these reporting errors, using electronic medical records to evaluate medical condition is more reliable. A more recent study by Holland et al. used electronic medical records to evaluate CVD in Asians subgroups, but did not evaluate CVD clinical risk factors, medication or control of these risk factors.[4] To our knowledge, no studies have investigated medication use for clinical CVD risk factors, and clustering of CVD risk factors in the Asian-Indian population from a large managed care organization. The purpose of the third study of this dissertation was to evaluate CVD clinical risk factors, clustering of CVD clinical risk factors, and control of CVD clinical risk factors in Asian-Indian men compared to white non-Hispanic men.

Chapter 1: A Comparison of Lifestyle and Behavioral Cardiovascular Disease Risk Factors between Asian-Indian and White non-Hispanic men

**Introduction**

Cardiovascular disease (CVD) is the number one cause of death among all major racial/ethnic groups in the U.S. [1,2] Although CVD mortality is decreasing nationally, it is decreasing at a much slower rate among the South Asian population compared to other groups. [3] Asian-Indians, a subset of the South Asian population, is the second fastest growing Asian population in California, with an estimated 550,000 people, according to the 2010 U.S. Census.[35,36] A recent study found that the leading cause of death among Asian-Indians in California is CVD.[5] There have been few population-based studies conducted in the U.S. evaluating clinical and lifestyle CVD risk factors in the Asian-Indian population.[6-9,11,12,14,21,22] Researchers have reported disproportionately higher rates of CVD and CVD clinical risk factors including diabetes mellitus (DM), hypertension, and dyslipidemia in Asian-Indians. [6-10] Explanations for these increased rates have not been well elucidated and the Asian-Indian population may have a different set of susceptibility factors.

Examining modifiable lifestyle risk factors and health behaviors is important because increasing physical activity, decreasing red meat and increasing fruit, vegetable, fish, and whole grain consumption can help prevent, control or delay CVD, DM, hypertension, and dyslipidemia onset. [18] Although many Asian-Indians are perceived as having a healthy lifestyle, they disproportionately suffer from peripheral vascular disease, coronary heart disease and stroke. [4] Furthermore, migrant studies of Asian-Indians into western countries demonstrate that prolonged exposure to known CVD risk factors such as western diets and sedentary lifestyles result in increased blood pressure, body weight, blood sugars and blood lipids. [20] By contrast, little is known about lifestyle/behavioral CVD risk factors among Asian-Indians living in the U.S. compared to white non-Hispanics.

The purpose of this study was to evaluate lifestyle/behavioral CVD risk factors in Asian-Indian men compared to white non-Hispanic men, the majority racial/ethnic group in the California Men's Health Study (CMHS) cohort and in the nation. The CMHS cohort is based in two large managed care organizations where

barriers to health care should be minimized. Thus, this study presents an ideal setting to examine the role of lifestyle factors that may contribute to health disparities among Asian-Indians without the confounding effect of insurance coverage. Analyses were conducted among healthy weight and overweight/obese men to evaluate the effect of BMI on these behaviors.

## METHODS

### Study Cohort

This study was a cross-sectional study nested within the CMHS, a large multiethnic cohort of 84,170 men. Details of the study cohort, recruitment, and data collection were reported previously by Enger, et al.[37] To be eligible men had to be members of Kaiser Permanente Southern California (KPSC) or Kaiser Permanente Northern California (KPNC), the two largest managed care organizations in California, for at least one year, and ages 45-69 at recruitment which took place between January 2002 and December 2003. Men were recruited by direct mailing using a two-step process. Potential participants were first mailed an introductory letter and short screening questionnaire. A 24-page questionnaire was mailed to those who completed the screening questionnaire. The baseline survey obtained information on demographics, height, weight, health status, and lifestyle behaviors. The study was approved by the Institutional Review Boards of KPSC and KPNC.

### Race/Ethnicity

CMHS participants were asked about their racial/ethnic backgrounds and were permitted to select multiple options. For these analyses, the Asian-Indian category included men who reported Asian-Indian and Asian-Indian plus another race. White non-Hispanic race/ethnicity was defined as respondents who selected "White-European" or "White-Middle Eastern" and did not report Hispanic ethnicity.

### Acculturation

Acculturation, previously defined in this cohort by Ahmed, et al.[38] was categorized into: first generation (respondent born outside the U.S.), second generation (at least one parent of the respondent born outside the U.S. and the respondent was born in the U.S.) and third generation (parent(s) and respondent born in

the U.S.). Among those who were first generation, duration of residence in the U.S. was categorized into: ≤ 15 years, 16-25 years, and > 25 years.

**Ascertainment of Reported Clinical, Lifestyle and Behavioral Risk Factors**

Body Mass Index (BMI) was calculated from weight (kilograms) and height (meters) (kilograms/meter$^2$) and categorized into: underweight (<18.5), healthy weight (18.5-24.9), overweight (25-29.9) and obese (≥ 30), based on the guidelines established by the National Institutes of Health. [39] Clinical CVD risk factors included reports that a doctor or health professional had told the participant they had one or more of the following conditions: diabetes, high blood pressure, and high cholesterol/ triglycerides. CVD was defined as ever having at least one of the following: angina, aortic aneurysm, congestive heart failure/heart failure, heart attack and stroke.

Diet was assessed using a semi-quantitative food frequency questionnaire developed for the Women's Health Initiative, [40-42] and modified for men's health. [43] The following variables were evaluated: total daily calories (kcal/day), < 30% of calories from fat, fruit and vegetable consumption (servings/day), and multivitamin use for 3 days or more/week (yes/no). Frequency of total alcohol consumption included beer, liquor, red wine, white wine. Smoking status was queried in men who reported having smoked at least 100 cigarettes in their lifetime.

Men reported their frequency and duration of moderate and vigorous recreational, household and work-related physical activities with questions adapted from the CARDIA Physical Activity History (PAH). [44,45] The CARDIA PAH has indirect validity against aerobic capacity and percent fat, and a strong inverse relationship with most cardiovascular disease risk factors. [46,47] Moderate/vigorous physical activity was defined as ≥ 3.5 hours/week in moderate activities or 3 METS or greater. Sedentary lifestyle was defined as ≥ 6 hours/day outside of work spent watching television, sitting at a computer, or reading.

**Statistics**

Frequency distributions were used to describe demographic, dietary and physical activity patterns in the population. Bivariate analyses, using 2-sided t-tests for continuous variables and 2 X 2 contingency tables, for categorical data were used to assess the association between lifestyle/behavioral factors and within categories of BMI (healthy and overweight/obese) by race/ethnicity. Unconditional multivariable logistic regression models were used to estimate adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) to assess the differences in lifestyle/behavioral CVD risk factors by race/ethnicity within BMI categories. The underweight category was too small to provide stable estimates, therefore results were not reported. The overweight and obese categories were combined due to small numbers. All multivariable models included age, education, income and marital status. Analyses were conducted using SAS, Version 9.2 (SAS Institute, Inc., Cary North Carolina. 2002-2008).

**Results**

A total of 52,503 Asian-Indians (n=602) and white non-Hispanics (n=51,901) were left in the cohort after excluding men of other race/ethnicities. Among those who reported being Asian-Indian, 9% (n=55/602) reported being of mixed race (data not shown). Table 1 compares Asian-Indians with white non-Hispanics on demographic characteristics. While Asian-Indians were more likely than white non-Hispanics to have a graduate degree (50.7% vs. 30.6% respectively), they were more likely to report an annual household income below $40,000 (22.3% vs. 15.3%). A higher proportion of Asian-Indians were married compared to white non-Hispanics (91.4% vs. 81.0%). In contrast to white non-Hispanics, almost all of the Asian-Indians (94.4%) reported being first generation immigrants, with over 75% of them having resided in the U.S. for over 16 years. Over 90% of the white non-Hispanics were second generation or higher.

Self-report of clinical risk factors found more Asian-Indians were at a healthy weight compared to white non-Hispanics (47.0% vs. 24.5%); whereas white non-Hispanics were almost four times more likely to be obese (26.6% vs. 7.0%) (Table 2). Despite similar age distributions, Asian-Indians reported higher levels of CVD (17.8% vs. 11.4%) and diabetes (20.4% vs. 9.7%) compared to white non-Hispanics. The proportion of those reporting hypertension and high cholesterol was similar.

Characteristics of health behaviors by race/ethnicity are displayed in Table 3. Overall, Asian-Indians reported a lower mean caloric intake and consumed < 30% of calories from fat. Asian-Indians were less likely to consume 5 servings of fruit and vegetables a day and take multivitamins. There were no differences in reports of sedentary lifestyle. Asian-Indians reported less moderate/vigorous physical activity compared to white non-Hispanics. In addition, Asian-Indians reported lower alcohol consumption and results by subtype of alcohol were similar (data not shown). Fewer Asian-Indians reported ever having smoked; however only a narrow difference in current smoking was seen (8.1% vs. 9.9%).

Stratification by BMI changed the results slightly (Table 3). Asian-Indians of a healthy weight were less likely to consume 5 or more fruits and vegetables a day compared to white non-Hispanic healthy weight men. Additionally, the adjusted odds ratios for consuming < 30% of calories from fat, moderate/vigorous physical activity, and total alcohol intake among healthy weight Asian-Indians were attenuated in contrast to overweight/obese men. Among healthy weight men, a larger difference in current smoking was reported (6.7% vs. 11.0%).

Health behaviors and lifestyle risk factors were evaluated by acculturation status among Asian-Indians (Figure 1). With duration of residence, we found an increase in health behaviors associated with CVD risk. For example, 100% of the second generation Asian-Indians reported a non-vegetarian diet, and more second generation Asian-Indians reported being current and former smokers versus never smokers. Caloric intake increased with generational status ranging from 1519.3 kcal/day among recent first generation immigrants to 2992 kcal/day in second generation Asian-Indians (data not shown). The healthiest lifestyle patterns were observed in the first generation Asian-Indians who more often reported eating a low fat diet and participating in more moderate/vigorous physical activity (60.0%). Similar results were found for all comparisons when the white non-Hispanics included and excluded white Middle Eastern men.

**Discussion**

As found in previous studies, Asian-Indians in the CMHS reported more diabetes and CVD compared to white non-Hispanics despite being substantially thinner. Because these comparisons were made in an insured population with equivalent access to the same source of care, the differences between groups are unlikely to be due to differential care or diagnostic labeling. We identified some health behaviors by BMI among Asian-Indians that are protective for CVD (lower fat intake, lower levels of smoking and alcohol). On the other hand, lower levels of physical activity and fruit and vegetable consumption may account for some of the disparity found in reported CVD and diabetes prevalence in this Asian-Indian population. As in previous reports from migrant populations, longer residence in the U.S. appears to be associated with the acquisition of a less healthy lifestyle.

Three published studies in the U.S. have evaluated lifestyle and health behaviors of CVD risk in the Asian-Indian population.[6,21,22] Two studies collected information on diet, physical activity, smoking habits, and chronic diseases.[21,22] The third study compared data from two population-based surveys in California.[6] Similar to our results, all studies found Asian-Indians reported relatively healthy weights but had low levels of physical activity.[6,21,22] However, these studies had small sample sizes, no comparison group to examine differences in lifestyle CVD risk factors, and did not explore the relationships within BMI categories.[6,21,22] The earlier investigations observed that Asian-Indians reported diets high in fat. In our study, Asian-Indians had a lower fat diet regardless of BMI status compared to white non-Hispanics. This difference in finding may be due to the cultural diversity within the Asian-Indian population. Studies of Asian-Indian migration into Canada and England, found that as immigrants acculturate they adopt unhealthy lifestyles, including a westernized diet "high in fat, low in fiber", as well as sedentary behaviors. We observed this phenomenon in this cohort as well.

Our study has several strengths. A large population of Asian-Indians resides in California which provided a large sample of Asian-Indian men in this cohort to evaluate lifestyle and behavioral CVD risk factors. All of the study subjects were enrolled in prepaid health plans known for their commitment to prevention, and had equal access to health care. This study has several potential limitations. This study was limited to men enrolled in a managed care organization, thus limiting the generalizability to the entire Asian-Indian population within the U.S. We did not have longitudinal reports of health behaviors since the survey was conducted at

baseline; therefore behavior change cannot be assessed. The survey data was subject to recall bias. BMI may not be the best assessment for CVD risk in Asian-Indians, since they have been shown to have higher levels of abdominal adiposity compared to other racial/ethnic groups. [48,49] It has been suggested to use lower BMI cutoff points for obesity in the Asian population.[49,50] In addition, the dietary questionnaire may not have captured the Asian-Indian diet adequately. For example, differences in ingredients, recipes and cooking methods may not have been captured appropriately for the Indian diet, and consequently may underestimate or overestimate fat and vegetable intake.

Our results may be limited by our assessment of acculturation, which did not include commonly assessed factors such as immigrants' values, beliefs and behaviors. These factors influence lifestyle and behavioral choices, including diet and physical activity. Despite this potential limitation in our measure, we found an increased risk for CVD lifestyle behaviors by acculturation status.

In conclusion, our results add to the very limited literature on Asian-Indian health in the U.S. Our examination of lifestyle-related CVD risk factors found evidence for both potentially protective and harmful health behaviors among Asian-Indian men regardless of BMI status. With the fast growing Asian-Indian population in California, health care providers need to be cognizant of the high prevalence of CVD and lifestyle risk factors in the Asian-Indian population. Future research should examine the role of genetics, control of clinical CVD risk factors, CVD incidence and outcomes among the Asian-Indian population in the U.S.

**Table 1: Demographic Characteristics of Asian-Indians and White non-Hispanics in the California Men's Health 2002-2003**

| | Asian-Indian (N=602) n (%) | White non-Hispanic (N=51,901) n (%) | P-Value * |
|---|---|---|---|
| **Age (years)** | | | |
| 45-49 | 103 (17.1) | 6699 (12.9) | .02 |
| 50-54 | 112 (18.6) | 9797 (18.9) | |
| 55-59 | 115 (19.1) | 12,007 (23.1) | |
| 60+ | 272 (45.2) | 23,398 (45.1) | |
| **Education** | | | |
| High School or less | 60 (10.0) | 6908 (13.3) | < .001 |
| Vocational/Some College | 74 (12.3) | 17,521 (33.8) | |
| College | 160 (26.6) | 11,447 (22.1) | |
| Graduate Degree | 305 (50.7) | 15,897 (30.6) | |
| Missing | 3 (0.5) | 128 (0.2) | |
| **Household income (annual $)** | | | |
| 0-39,999 | 134 (22.3) | 7963 (15.3) | < .001 |
| 40,000-60,000 | 97 (16.1) | 9116 (17.6) | |
| 60,000-80,000 | 85 (14.1) | 9355 (18.0) | |
| 80,000+ | 272 (45.2) | 23,354 (45.0) | |
| Missing | 14 (2.3) | 2113 (4.1) | |
| **Marital Status** | | | |
| Married/living with partner | 550 (91.4) | 42,037 (81.0) | < .001 |
| Other (divorced, separated, widowed, never married) | 48 (8.0) | 9696 (18.7) | |
| Missing | 4 (0.7) | 168 (0.3) | |
| **Acculturation** | | | |
| 1st Generation $\leq$ 15 years | 106 (17.6) | 346 (0.7) | < .001 |
| 1st Generation 16-25 years | 157 (26.1) | 680 (1.3) | |
| 1st Generation > 25 years | 305 (50.7) | 3209 (6.2) | |
| 2nd Generation or higher | 27 (4.5) | 47,135 (90.8) | |
| Missing | 7 (1.2) | 531 (1.0) | |

* P values (2-sided) are based on $x^2$ test for heterogeneity

**Table 2: Self-Reported Clinical Characteristics among Asian-Indians and White non-Hispanics in the California Men's Health 2002-2003**

| | Asian-Indian (N=602) (%) | White non-Hispanic (N=51,901) (%) | P-Value* |
|---|---|---|---|
| **BMI** | | | |
| < 18.5 ---Underweight | 1.5 | 0.5 | < .001 |
| 18.5 to 24.9 -- Healthy Weight | 47.0 | 24.5 | |
| 25.0 to 29.9 -- Overweight | 42.2 | 46.1 | |
| 30 + -- Obese | 7.0 | 26.6 | |
| **Diabetes** | 21.3 | 9.8 | < .001 |
| **Hypertension** | 36.0 | 36.0 | .97 |
| **High Cholesterol** | 42.5 | 41.5 | .61 |
| **Cardiovascular Disease**[†] | 17.8 | 11.4 | < .001 |

[*] P values based (2-sided) $x^2$ test for heterogeneity

[†] Includes angina, aortic aneurysm, congestive heart failure/heart failure, heart attack and stroke

**Table 3: Health Behaviors in Asian-Indians and White, non-Hispanics in the California Men's Health 2002-2003**

| Health Behaviors | Healthy weight BMI=18.5-24.9 (n = 12,990) | | Overweight/Obese BMI ≥ 25.0 (n = 38,020) | | Total (n=51,010) | |
|---|---|---|---|---|---|---|
| | Asian-Indian (n=283 ) | White non-Hispanic (n=12,701) | Asian-Indian (n=296 ) | White non-Hispanic (n=37,724) | Asian-Indian (n=579) | White non-Hispanic (n=50,425) |
| | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |
| **Total Calories (kcal/day)** | | | | | | |
| Mean (SD) | 1409.6 (830.2) | 2135.3 (848.1) | 1547.0 (995.6) | 2210.2 (1023.4) | 1479.8 (920.3) | 2191.3 (982.7) |
| p-value* | <.001 | | <.001 | | <.001 | |
| **< 30% calories from fat** | | | | | | |
| Yes | 155 (54.8) | 4645 (36.6) | 155 (52.4) | 9145 (24.2) | 310 (53.5) | 13,790 (27.4) |
| No | 128 (45.2) | 8056 (63.4) | 141 (47.6) | 28,579 (75.8) | 269 (46.5) | 36,635 (72.7) |
| p-value† | <.001 | | <.001 | | <.001 | |
| Adj. OR, CI‡ | 2.02 (1.58-2.56) | | 3.39 (2.68-4.30) | | 2.91 (2.46-3.45) | |
| **Fruit and Vegetable Consumption (5 a day)** | | | | | | |
| Yes | 83 (29.8) | 4646 (36.7) | 92 (31.2) | 11,747 (31.2) | 175 (30.5) | 16,393 (32.6) |
| No | 196 (70.3) | 8018 (63.3) | 203 (68.8) | 25,853 (68.8) | 399 (69.5) | 33,871 (67.4) |
| p-value† | 0.02 | | 0.98 | | 0.28 | |
| Adj. OR, CI‡ | 0.68 (0.52-0.89) | | 0.84 (0.65-1.08) | | 0.78 (0.65-0.94) | |
| **Multivitamin Use for 3 Days or more/week** | | | | | | |
| Yes | 134 (47.3) | 7114 (56.0) | 133 (44.9) | 17,531 (46.5) | 267 (46.1) | 24,645 (48.8) |
| No | 149 (52.7) | 5587 (44.0) | 163 (55.1) | 20,193 (53.5) | 312 (53.9) | 25,870 (51.1) |
| p-value† | <.05 | | <.05 | | <.001 | |
| Adj. OR, CI‡ | 0.72 (0.56-0.91) | | 0.73 (0.58-0.93) | | 0.74 (0.62-0.87) | |

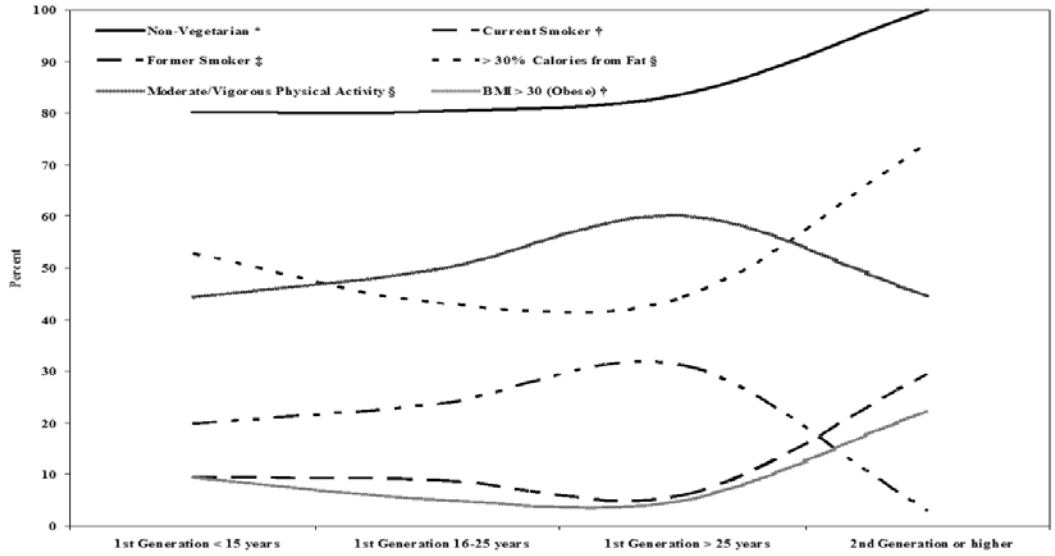
| Health Behaviors (con't) | Asian-Indian (n=283 ) | White non-Hispanic (n=12,701) | Asian-Indian (n=296 ) | White non-Hispanic (n=37,724) | Asian-Indian (n=579) | White non-Hispanic (n=50,425) |
|---|---|---|---|---|---|---|
| **Sedentary Behaviors outside of Work** | | | | | | |
| Yes | 67 (25.5) | 2835 (23.4) | 88 (32.5) | 12,216 (34.1) | 155 (29.0) | 15,051 (31.4) |
| No | 196 (74.5) | 9270 (76.6) | 183 (67.5) | 23,633 (65.9) | 379 (71.0) | 32,903 (68.6) |
| p-value † | 0.44 | | 0.58 | | 0.24 | |
| Adj. OR, CI‡ | 1.30 (0.97-1.73) | | 1.08 (0.83-1.40) | | 1.07 (0.88-1.29) | |
| **Moderate/Vigorous Physical Activity (≥ 3.5 hrs per week 3 METS or greater)** | | | | | | |
| Yes | 154 (55.2) | 9606 (75.7) | 155 (53.3) | 23,580 (62.6) | 261 (45.8) | 33,186 (65.9) |
| No | 125 (44.8) | 3080 (24.3) | 136 (46.7) | 14,082 (37.4) | 309 (54.2) | 17,162 (34.1) |
| p-value† | <.001 | | <.001 | | <.001 | |
| Adj. OR, CI‡ | 0.35 (0.27-0.45) | | 0.56 (0.47-0.76) | | 0.52 (0.44-0.62) | |
| **Total Alcohol** | | | | | | |
| < 1 per month | 138 (48.8) | 3439 (27.1) | 127 (42.9) | 11,923 (31.6) | 265 (45.8) | 15,362 (30.5) |
| 1-3 per month | 34 (12.0) | 926 (7.3) | 32 (10.8) | 3120 (8.3) | 66 (11.4) | 4046 (8.0) |
| 1-4 per week | 60 (21.2) | 2813 (22.2) | 68 (23.0) | 8484 (22.5) | 128 (22.1) | 11,297 (22.4) |
| 5+ per week | 51 (18.0) | 5523 (43.5) | 69 (23.3) | 14,197 (37.6) | 120 (20.7) | 19,720 (39.1) |
| p-value† | <.001 | | <.001 | | <.001 | |
| Adj. OR, CI (5+/week) ‡ | 0.21 (0.15-0.29) | | 0.45 (0.33-0.61) | | 0.33 (0.26-0.41) | |
| **Smoking Status** | | | | | | |
| Never | 192 (67.8) | 6264 (49.4) | 181 (61.2) | 15,317 (40.7) | 373 (64.4) | 21,581 (42.9) |
| Current | 19 (6.7) | 1393 (11.0) | 28 (9.5) | 3600 (9.6) | 47 (8.1) | 4993 (9.9) |
| Former | 72 (25.4) | 5024 (39.6) | 87 (29.4) | 18,721 (49.7) | 159 (27.5) | 23,745 (47.2) |
| p-value† | <.001 | | <.001 | | <.001 | |
| Adj. OR, CI (former vs. never) ‡ | 0.57 (0.34-0.94) | | 0.48 (0.37-0.63) | | 0.46 (0.38-0.56) | |

* P values based on t-test for continuous variables

† P values based (2-sided) $x^2$ test for heterogeneity

‡ All ORs adjusted for age, education, income, and marital status

Figure 1: Health Behaviors by Acculturation Status in Asian-Indian (n=602)




**Legend for Figure 1:**

* P value = 0.03, based (2-sided) $x^2$ test for heterogeneity,

† P value < .001, based (2-sided) $x^2$ test for heterogeneity

‡ P value = 0.04, based (2-sided) $x^2$ test for heterogeneity

§ P value = .01, based (2-sided) $x^2$ test for heterogeneity

Chapter 2: Health Behaviors in Asian-Indian and White, Non-Hispanic Vegetarian Males in the California Men's Health Study (CMHS)

**Introduction**

In the U.S., cardiovascular disease (CVD) is the number one cause of death among all major racial/ethnic groups. [1,2] An important pathophysiological mechanism of atherosclerosis, and CVD, is inflammation which can be a function of a poorly controlled diet and a sedentary lifestyle.[51] Research has shown that western diets and sedentary lifestyles increase blood pressure, body weight, blood sugars and blood lipids.[20] Conversely, vegetarian diets, high in fruit and vegetable consumption, have been shown to reduce the risk of cardiovascular disease (CVD) by lowering body weights, decreasing cholesterol levels, and reducing inflammatory markers. [23-26]

Although a high prevalence of Asian-Indians consume a vegetarian diet, (estimated at 50% in the U.S.), the leading cause of death among Asian-Indians in California is CVD.[5] In addition, research on Asian-Indians in the U.S. has shown higher rates of clinical CVD risk factors including, diabetes mellitus (DM), hypertension, and dyslipidemia.[6-10] These contradictory observations in Asian-Indians, a high prevalence of CVD and a high prevalence of those consuming a vegetarian diet, have created a need to evaluate diet in this population.

The purpose of this study was to assess whether differences in CVD clinical and lifestyle risk factors between Asian-Indian & white non-Hispanics (WHN) are modified by a vegetarian diet. We used data from the California Men's Health Study (CMHS) cohort which is based in two large managed care organizations where barriers to health care and preventive services should be minimized. This cohort presents an ideal opportunity to examine risk factors that may contribute to the CVD disparities among Asian-Indian men without the confounding effect of insurance coverage.

**Methods**

Study Cohort

This cross-sectional study was nested within the CMHS cohort, a multiethnic cohort of 84,170 men. Details of the study cohort, recruitment, and data collection were reported previously by Enger, et al. [37] Eligibility criteria included being members of Kaiser Permanente Southern California (KPSC) or Kaiser Permanente Northern California (KPNC), the two largest managed care organizations in California, for at least one year. Men, ages 45-69, were recruited by direct mailing using a two-step process between January 2002 and December 2003. An introductory letter and short screening questionnaire were mailed to potential participants. Those who completed the screening questionnaire were then mailed a 24-page baseline survey. Information on demographics, height, weight, health status, and lifestyle behaviors were included in the survey. In order to ensure generalizability to the California population, the CMHS participants were compared to the men in the California Health Interview Survey (CHIS), a population-based telephone survey of 55,000 California residents in 2001.[52] Distributions of participants were generally similar for demographic factors.[37] The Asian-Indian population in the CMHS has been previously described by Ghai et al.[53] The study was approved by the Institutional Review Boards of KPSC and KPNC.

Measures

Race/ethnicity was self-reported by respondents. For these analyses, the Asian-Indian category included men who reported Asian-Indian and Asian-Indian plus another race. White non-Hispanic race/ethnicity was defined as respondents who selected "White-European" or "White-Middle Eastern" and did not report Hispanic ethnicity.

Diet was assessed using a semi-quantitative food frequency questionnaire developed for the Women's Health Initiative,[40-42] and modified for men's health. [43] Similar to a previous analyses, the following variables were evaluated: total daily calories (kcal/day), < 30% of calories from fat, fruit and vegetable consumption (servings/day), and multivitamin use for 3 days or more/week (yes/no), total alcohol consumption and smoking status. [53] A vegetarian diet was defined as not eating chicken, turkey, beef, pork, ham, lamb or any ground meat. In both Asian-Indian and white non-Hispanic men, the number of people who ate fish combined with a

vegetarian diet was small (5 Asian-Indians, 311 white non-Hispanics), therefore we categorized them as vegetarian.

Body Mass Index (BMI) was calculated from weight (kilograms) and height (meters) (kilograms/meter$^2$) and categorized into: underweight (<18.5), healthy weight (18.5-24.9), overweight (25-29.9) and obese ($\geq$ 30), based on the guidelines established by the National Institutes of Health. [39] Clinical CVD risk factors included self-reports that a doctor or health professional told the participant they had one or more of the following conditions: diabetes, high blood pressure, and high cholesterol/ triglycerides. CVD was defined as reporting ever had at least one of the following: angina, aortic aneurysm, congestive heart failure/heart failure, heart attack and stroke.

Men reported their frequency and duration of moderate and vigorous recreational, household and work-related physical activities with questions adapted from the CARDIA Physical Activity History (PAH). [44,45] The CARDIA PAH has indirect validity against aerobic capacity and percent fat and a strong inverse relationship with most cardiovascular disease risk factors. [46,47] Moderate/vigorous physical activity was defined as $\geq$ 3.5 hours/week in moderate activities or 3 METS or greater. Sedentary lifestyle was defined as $\geq$ 6 hours/day outside of work spent watching television, sitting at a computer, or reading.

Acculturation was previously defined in this study population and categorized into: first generation (respondent born outside the U.S.) plus duration of residence, and second generation (at least one parent of the respondent born outside the U.S. and the respondent born in the U.S.) or higher (i,e,, third generation (parent(s) and respondent born in the U.S.). [53]

**Statistics**

Bivariate analyses, using 2-sided t-tests for continuous variables and 2 X 2 contingency tables for categorical data were used to assess the association between demographics, clinical CVD risk factors and lifestyle/behavioral factors by a vegetarian/non-vegetarian diet within each racial/ethnic group. Unconditional

multivariable logistic regression models were used to estimate adjusted odds ratios (AORs) and 95% confidence intervals (CIs) to assess the differences between vegetarian and non-vegetarian diet within each racial/ethnic group. All multivariable models included age, education, income and marital status. Analyses were conducted using SAS, Version 9.2 (SAS Institute, Inc., Cary North Carolina. 2002-2008).

**Results**

A total of 52,503 Asian-Indians (n=602) and white non-Hispanics (n=51,901) were included in these analyses. Overall, Asian-Indians were more likely than white non-Hispanics to have a graduate degree (50.7% vs. 30.6% respectively), to report an annual household income below $40,000 (22.3% vs. 15.3%) and to be married (91.4% vs. 81.0%) (data not shown). Almost all of the Asian-Indians (94.4%) reported being first generation immigrants (data not shown), whereas over 90% of the white non-Hispanics were second generation or higher (data not shown). Vegetarians accounted for 1.4% (736/51,901) of white non-Hispanics and 20.4% (124/602) of Asian-Indians (Table 1). Age was not associated with diet among Asian-Indians, but among white non-Hispanics, a vegetarian diet was associated with younger age (< 55) (45.1% vs. 31.6%, $p < 0.001$). Overall, in both groups vegetarians reported higher educational attainment, with at least a college degree compared to non-vegetarians (73.1% vs. 52.8%, $p < 0.001$). In contrast to white non-Hispanics, all Asian-Indian vegetarians were first generation immigrants, with a majority residing in the U.S. $\geq$ 16 years (77.0%).

Overall, more Asian-Indians were at a healthy weight compared to white non-Hispanics (47.0% vs. 24.5%); whereas white non-Hispanics were almost four times more likely to be obese (26.6% vs. 7.0%) (data not shown). Despite similar age distributions, Asian-Indians reported higher levels of CVD (17.8% vs. 11.4%) and diabetes (20.4% vs. 9.7%) compared to white non-Hispanics (data not shown). The proportion of those reporting hypertension and high cholesterol was similar (data not shown). As shown in Table 2, white non-Hispanic vegetarians compared with non-vegetarians were more likely to be at a healthy weight (51.5% vs. 24.7%, $p < 0.001$) and less likely to report hypertension (24.6% vs. 36.1%, $p< 0.001$), diabetes (3.9% vs. 9.9%, $p < 0.001$), high cholesterol (31.1% vs. 41.7%, $p < 0.001$) and having had a CVD event (8.2% vs. 11.5%, $p < 0.05$). Similarly, Asian-Indian vegetarians were less likely to report hypertension (25.8% vs. 38.7%, $p <0.001$) and high cholesterol (33.9% vs. 44.8%, $p <0.001$). However, there were no significant differences between Asian-

Indian vegetarians & non-vegetarians in reports of BMI, or CVD events. The prevalence of reported diabetes was considerably higher among Asian-Indians compared with white non-Hispanics ((128/602) 21.3% vs. (5072/51901) 9.8%), and Asian-Indian non-vegetarians reported the highest prevalence (22.8%). In addition, reports of CVD were higher among Asian-Indians compared with white non-Hispanics ((107/602) 17.7% vs. (5957/51901) 11.5%), however no differences in CVD events were found between Asian-Indian vegetarians & non-vegetarians.

We compared the characteristics of health behaviors by a vegetarian/non-vegetarian diet among Asian-Indian and white non-Hispanic men (Table 3). Regardless of race/ethnicity, vegetarians consumed fewer calories a day compared to non-vegetarians. Vegetarians in both racial/ethnic groups consumed a lower fat diet (< 30 % calories from fat) compared to non-vegetarians [Adjusted Odds Ratio (AOR) = 3.22; 95% CI 2.80-3.71] (Table 3). Vegetarians reported consuming more fruits and vegetables; however a significant difference wasn't detected among Asian-Indians. Although, white non-Hispanic vegetarians reported less sedentary activity [AOR = 0.65; 95% CI 0.54-0.78] and more moderate/vigorous physical activity [AOR = 1.87; 95% CI 1.55-2.25] than non-vegetarians, this was not the case among the Asian-Indian population. Vegetarians in both groups were less likely to report alcohol use or current/ever smoking compared to non-vegetarians.

**Discussion**

As expected from a recent review article examining the literature on plant based diets and CVD,[54] vegetarians were less likely to report having diabetes, hypertension, high cholesterol, or a CVD event compared to non-vegetarians. Vegetarians were also more likely to report being at a healthy weight compared to non-vegetarians. Among white non-Hispanics these results were significant; however among Asian-Indians results were only significant for hypertension and high cholesterol. Because these comparisons were made in an insured population with equivalent access to the same source of care, the differences between groups are unlikely to be due to differential care or diagnostic labeling.

We found that white non-Hispanic vegetarians lead a healthier lifestyle (consuming lower fat diets and more fruits and vegetables, and participating in more physical activity and less sedentary behaviors) compared

to non-vegetarians. This was not the case in the Asian-Indian population with the exception of consuming fewer calories. These results suggest in the white non-Hispanic population, a vegetarian diet seems to be motivated by a general commitment to a healthy lifestyle. Conversely, a vegetarian diet among Asian-Indians may reflect cultural and traditional practices. In addition, there are inherited regional variations of diet based on regional agricultural produce and cooking methods carried over from the Indian sub-continent. Similarly there are differences in religious practices which follow distinct dietary patterns. [55] Therefore, a person from northern India will have a different vegetarian diet compared to someone from southern India.

There have been few studies examining diet and CVD clinical risk factors among the Asian-Indian population in the U.S. [27-32] Three of these studies found Asian-Indian diets to be high in fat and carbohydrates, and therefore not cardio-protective. [27-29,31] Rastogi et al. [30] found an inverse association between increased vegetable intake and decreased ischemic heart disease among the Asian-Indian population in the U.S. Schoelfield et al. observed that Asian-Indian vegetarians had higher fasting blood glucose levels compared to Americans.[32] Enas et al. found heart disease rates to be similar between vegetarian and non-vegetarian Asian-Indians.[34] In another study lipid profiles were similar between vegetarian and non-vegetarian Asian-Indians; however higher diabetes rates were observed among vegetarians.[33] Our study adds to this limited literature with findings suggestive that the cardio-protection associated with a vegetarian lifestyle may be attenuated among Asian-Indians due to smaller differences between vegetarians & non-vegetarians in fruit and vegetable intake and activity levels

Our study has several strengths. This cohort had a large sample of Asian-Indian men to evaluate lifestyle and behavioral CVD risk factors. All of the study subjects were enrolled in prepaid health plans known for their commitment to prevention, and had equal access to health care. This study has several potential limitations. This study was limited to men enrolled in a managed care organization, thus limiting the generalizability of results. The self-reported interview data is inherently limited by recall bias. The dietary questionnaire may not have captured the Asian-Indian diet adequately. For example, differences in ingredients, recipes and cooking methods may not have been appropriate for the Indian diet, and consequently may

underestimate or overestimate fat and vegetable intake.

In conclusion, our results add to the limited knowledge on dietary patterns and clinical CVD risk factors on Asian-Indians in the U.S. We found that, in general, vegetarian Asian-Indians do not lead a cardio-protective lifestyle; in contrast white non-Hispanic vegetarians lead a heart healthy lifestyle. Adoption of a heart healthy lifestyle may help reduce disparities between Asian-Indians and other racial/ethnic groups.

Table 1: Demographic Characteristics of Asian-Indian Men and White non-Hispanic Men in the California Men's Health Study

| | Asian-Indian Men (N=602) | | White non-Hispanic Men (N=51,901) | | Total | |
|---|---|---|---|---|---|---|
| | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) |
| Total | 124 (20.6) | 478 (79.4) | 736 (1.4) | 51,165 (98.6) | 860 (1.6) | 51,643 (98.4) |
| Age (years) | | | | | | |
| 45-49 | 17 (13.7) | 86 (18.0) | 144 (19.6) | 6,555(12.8) | 161 (18.7) | 6,641 (12.9) |
| 50-54 | 19 (15.3) | 93 (19.5) | 188 (25.5) | 9,609 (18.8) | 207 (24.1) | 9,701 (18.8) |
| 55-59 | 31 (25.0) | 84 (17.6) | 156 (21.2) | 11,851 (23.2) | 187 (21.7) | 11,935 (23.1) |
| 60+ | 57 (46.0) | 205 (42.9) | 248 (33.7) | 23,150 (45.2) | 305 (35.5) | 23,365 (45.2) |
| p-value* | 0.24 | | < .001 | | < .001 | |
| Education | | | | | | |
| High School or less | 7 (5.7) | 53 (11.1) | 41 (5.6) | 6,867 (13.5) | 48 (5.6) | 6920 (13.4) |
| Vocational/Some College | 7 (5.7) | 67 (14.1) | 176 (23.9) | 17,345 (33.9) | 183 (21.3) | 17,412 (33.8) |
| College | 39 (31.7) | 121 (25.4) | 183 (24.9) | 11,264 (22.1) | 222 (25.9) | 11,385 (22.1) |
| Graduate Degree | 70 (56.9) | 235 (49.4) | 335 (45.6) | 15,562 (30.5) | 405 (47.2) | 15,797 (30.7) |
| Missing | 1 | 2 (0.4) | 1 (0.1) | 127 (0.2 ) | 2 | 129 |
| p-value* | 0.01 | | < .001 | | < .001 | |
| Household income (annual $) | | | | | | |
| 0-39,999 | 37 (30.1) | 97 (20.9) | 132 (18.8) | 7,831 (16.0) | 169 (20.4) | 7,928 (16.0) |
| 40,000-60,000 | 13 (10.6) | 84 (18.1) | 115 (16.3) | 9,001 (18.3) | 128 (15.5) | 9,085 (18.4) |
| 60,000-80,000 | 19 (15.5) | 66 (14.2) | 117 (16.6) | 9,238 (18.8) | 136 (16.4) | 9,304 (18.8) |
| 80,000+ | 54 (43.9) | 218 (46.9) | 340 (48.3) | 23,014 (46.9) | 394 (47.6) | 23,232 (46.9) |
| Missing | 1 | 13 (2.7) | 32 (4.3) | 2,081 (4.1) | 33 | 2,094 |
| p-value* | 0.06 | | 0.07 | | $\leq$ .001 | |

| | Asian-Indian Men (N=602) | | White non-Hispanic Men (N=51,901) | | Total | |
|---|---|---|---|---|---|---|
| | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) |
| Marital Status | | | | | | |
| Married/living with partner | 119 (96.0) | 431 (90.9) | 515 (70.2) | 41,522 (81.4) | 634 (73.9) | 41,953 (81.5) |
| Other (divorced, separated, widowed, never married) | 5 (4.0) | 43 (9.1) | 219 (29.8) | 9,477 (18.6) | 224 (26.1) | 9,520 (18.5) |
| Missing | 0 | 4 (0.8) | 2 (0.3) | 166 (0.3) | 2 | 170 |
| p-value* | 0.07 | | < .001 | | < .001 | |
| Acculturation (years) | | | | | | |
| 1st Generation $\leq$ 15 | 27 (21.8) | 79 (16.5) | 8 (1.1) | 338 (0.7) | 35 (4.0) | 417 (0.8) |
| 1st Generation 16-25 | 34 (27.6) | 123 (26.1) | 16 (2.2) | 664 (1.3) | 50 (5.9) | 787 (1.5) |
| 1st Generation > 25 | 62 (50.4) | 243 (51.5) | 51 (7.0) | 3,158 (6.2) | 113 (13.3) | 3,401 (6.7) |
| $\geq$ 2nd Generation | 0 | 27 (5.7) | 655 (89.7) | 46,480 (91.8) | 655 (76.8) | 46,507 (91.0) |
| Missing | 1 | 6.0 | 6 | 525 | 7 | 531 |
| p-value* | 0.07 | | < .001 | | < .001 | |

* p-value based (2-sided) $x^2$ test for heterogeneity

Table 2: Self-Reported Clinical Characteristics among Asian-Indian and White non-Hispanic Men in the California Men's Health 2002-2003

| | Asian-Indian Men (N=602) | | White non-Hispanic Men (N=51,901) | | Total | |
|---|---|---|---|---|---|---|
| | Vegetarian | non-Vegetarian | Vegetarian | non-Vegetarian | Vegetarian | non-Vegetarian |
| | n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |
| Total | 124 (20.6%) | 478 (79.4%) | 736 (1.4%) | 51,165 (98.6%) | | |
| BMI | | | | | | |
| < 18.5 Underweight | 1 (0.8) | 8 (1.7) | 4 (0.5) | 259 (0.5) | 5 (0.6) | 267 (0.5) |
| 18.5 to <25.0 Healthy Weight | 55 (45.4) | 228 (48.8) | 372 (51.5) | 12,329 (24.7) | 427 (50.7) | 12,557 (24.9) |
| 25.0 to < 30.0 Overweight | 59 (48.8) | 195 (41.8) | 274 (38.0) | 23,662 (47.4) | 333 (39.5) | 23,857 (47.3) |
| 30 + Obese | 6 (5.0) | 36 (7.7) | 72 (10.0) | 13,716 (27.5) | 78 (9.3) | 13,752 (27.3) |
| Missing | 3 | 11 | 14 | 1199 | 17 | 1210 |
| p-value* | 0.42 | | < .001 | | < .001 | |
| Diabetes | | | | | | |
| Yes | 19 (15.3) | 109 (22.8) | 29 (3.9) | 5,043 (9.9) | 48 (5.6) | 5,152 (10.0) |
| No | 105 (84.7) | 369 (77.2) | 707 (96.1) | 46,122 (90.1) | 812 (94.4) | 46,491 (90.0) |
| p-value* | 0.07 | | < .001 | | < .001 | |
| Hypertension | | | | | | |
| Yes | 32 (25.8) | 185 (38.7) | 181 (24.6) | 18,483 (36.1) | 213 (24.8) | 18,668 (36.2) |
| No | 92 (74.2) | 293 (61.3) | 555 (75.4) | 32,682 (63.9) | 647 (75.2) | 32,975 (63.8) |
| p-value* | < .05 | | < .001 | | < .001 | |
| High Cholesterol | | | | | | |
| Yes | 42 (33.9) | 214 (44.8) | 229 (31.1) | 21,312 (41.7) | 271(31.5) | 21,526 (41.7) |
| No | 82 (66.1) | 264 (55.2) | 507 (68.9) | 29,853 (58.4) | 589 (68.5) | 30,117 (58.3) |
| p-value* | < .05 | | < .001 | | < .001 | |

| | Asian-Indian Men (N=602) | | White non-Hispanic Men (N=51,901) | | Total | |
|---|---|---|---|---|---|---|
| | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) |
| Cardiovascular Disease** | | | | | | |
| Yes | 19 (15.3) | 88 (18.4) | 60 (8.2) | 5,878 (11.5) | 79 (9.2) | 5,966 (11.6) |
| No | 105 (84.7) | 390 (81.6) | 676 (91.8) | 45,287 (88.5) | 781 (90.8) | 45,677 (88.4) |
| p-value* | 0.42 | | < .05 | | < .05 | |

* p-value based (2-sided) $x^2$ test for heterogeneity

**Defined as having angina, aortic aneurysm, CHF/heart failure, heart attack and stroke

Table 3: Health Behaviors in Asian-Indian and White, non-Hispanic Men in the California Men's Health 2002-2003

| | Asian-Indian Men (N=602) | | White non-Hispanic Men (N=51,901) | | Total | |
|---|---|---|---|---|---|---|
| | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) |
| Total | 124 (20.6%) | 478 (79.4%) | 736 (1.4%) | 51,165 (98.6%) | | |
| Total Calories (kcal/day) | | | | | | |
| Mean (SD) | 1216 (763.0) | 1554.1 (949) | 2115.0 (869.8) | 2191 (990.5) | 1985.3 (911.3) | 2185 (992) |
| < 30% calories from fat | | | | | | |
| Yes | 91 (73.4) | 229 (47.9) | 386 (52.5) | 13,790 (27.0) | 477 (55.5) | 14,019 (27.2) |
| No | 33 (26.6) | 249 (52.1) | 350 (47.5) | 37,375 (73.0) | 383 (44.5) | 37,624 (72.8) |
| p-value | < .001 | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) | 3.19 (1.97-5.15) | | 2.89 (2.49-3.36) | | 3.22 (2.80-3.71) | |
| Fruit and Vegetable Consumption (5 a day) | | | | | | |
| Yes | 44 (35.5) | 137 (29.0) | 407 (55.5) | 16,469 (32.3) | 451 (52.6) | 16,606 (32.3) |
| No | 80 (64.5) | 336 (71.0) | 327 (44.5) | 34,531 (67.7) | 407 (47.4) | 34,867 (67.7) |
| p-value | 0.16 | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) | 1.27 (0.82-1.97) | | 2.54 (2.18-2.96) | | 2.21 (1.93-2.55) | |
| Multivitamin Use for 3 Days or more/week | | | | | | |
| Yes | 59 (47.6) | 215 (45.0) | 446 (60.6) | 27,628 (54.0) | 505 (58.7) | 27,843 (53.9) |
| No | 65 (52.4) | 263 (55.0) | 290 (39.4) | 23,537 (46.0) | 355 (41.3) | 23,800 (46.1) |
| p-value | 0.60 | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) | 1.12 (0.74-1.70) | | 1.31 (1.13-1.53) | | 1.22 (1.06-1.40) | |

| | Asian-Indian Men (N=602) | | White non-Hispanic Men (N=51,901) | | Total | |
|---|---|---|---|---|---|---|
| | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) | Vegetarian n (%) | non-Vegetarian n (%) |
| Sedentary Behaviors outside of Work | | | | | | |
| Yes | 31 (27.9) | 132 (30.0) | 151 (21.5) | 15,379 (31.6) | 182 (22.4) | 15,511 (31.6) |
| No | 80 (72.1) | 308 (70.0) | 552 (78.5) | 33,241 (68.4) | 632 (77.6) | 33,549 (68.4) |
| Missing | 0.67 | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) | 0.92 (0.56-1.49) | | 0.65 (0.54-0.78) | | 0.70 (0.59-0.83) | |
| Moderate/Vigorous Physical Activity (≥ 3.5 hrs per week 3 METS or greater) | | | | | | |
| Yes | 69 (57.0) | 253 (53.6) | 582 (79.2) | 33,458 (65.5) | 651 (76.1) | 33,711 (65.4) |
| No | 52 (43.0) | 219 (46.4) | 153 (20.8) | 17,621 (34.5) | 205 (23.9) | 17,840 (34.6) |
| p-value | 0.50 | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) | 1.14 (0.74-1.75) | | 1.87 (1.55-2.25) | | 1.54 (1.30-1.81) | |
| Total Alcohol | | | | | | |
| < 1 per month | 93 (75.0) | 187 (39.1) | 309 (42.0) | 15,604 (30.5) | 402 (46.7) | 15,791 (30.6) |
| 1-3 per month | 10 (8.1) | 57 (11.9) | 68 (9.2) | 4,090 (8.0) | 78 (9.1) | 4,147 (8.0) |
| 1-4 per week | 13 (10.5) | 118 (24.7) | 186 (25.3) | 11,414 (22.3) | 199 (23.1) | 11,532 (22.3) |
| 5+ per week | 8 (6.5) | 116 (24.3) | 173 (23.5) | 20,057 (39.2) | 181 (21.1) | 20,173 (39.1) |
| p-value | < .001 | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) 5+/week vs. < 1/month | 0.14 (0.07-0.31) | | 0.42 (0.35-0.51) | | 0.34 (0.28-0.40) | |
| Smoking Status | | | | | | |
| Never | 103 (83.1) | 285 (59.6) | 429 (58.4) | 21,715 (42.5) | 532 (61.9) | 22,000 (42.7) |
| Current | 2 (1.6) | 48 (10.0) | 24 (3.2) | 5,168 (10.1) | 26 (3.0) | 5,216 (10.1) |
| Former | 19 (15.3) | 145 (30.3) | 282 (38.4) | 24,176 (47.4) | 301 (35.1) | 24,321 (47.2) |
| p-value | < .001* | | < .001 | | < .001 | |
| Adjusted ORs (95% CIs) Current vs. Never | 0.13 (0.03-0.56) | | 0.26 (0.17-0.41) | | 0.23 (0.15-0.36) | |

* exact test

All ORs adjusted for age, education, income, and marital status

Chapter 3: Clinical Cardiovascular Disease Risk Factors in Asian-Indian and White, Non-Hispanic men in the California Men's Health Study (CMHS)

**Introduction**

The Asian-Indian population has become the second fastest growing Asian population in California, with an estimated 550,000 included in the 2010 Census [35,36] [6-8,11-14,21,22] Several studies have found disproportionately higher rates of CVD clinical risk factors including diabetes mellitus (DM), hypertension, and dyslipidemia in Asian-Indians.[6-10] In the U.S., however, there have been few population-based studies evaluating CVD clinical risk factors identified from electronic clinical databases in this population.

An important pathophysiological pathway of atherosclerosis and CVD for example is one in which excess weight as measured by abdominal obesity, contributes to insulin resistance, which in turn is associated with multiple cardiovascular risk factors including glucose intolerance, dyslipidemia, and hypertension.[56-60] Although Asian-Indians are more often classified as having a healthy body mass index (BMI), [48,49] epidemiologic studies have found that Asian-Indians are more likely to have excessive central adiposity. [61,62] In addition, Asian-Indians tend to be more sedentary and less physically active compare to white non-Hispanics.[53] With the increased rates of CVD among Asian-Indians, an unanswered question remains whether clustering of CVD clinical risk factors and control of CVD risk factors differ between Asian-Indian and white non-Hispanic populations.

The purpose of this study was to evaluate CVD clinical risk factors in Asian-Indian men compared to white non-Hispanic men, the majority racial/ethnic group in the California Men's Health Study (CMHS) cohort, and in the nation. The CMHS cohort is based in two large managed care organizations where barriers to health care should be minimized. Thus, this study presents an ideal setting to examine the role of clinical CVD risk factors that may contribute to health disparities among Asian-Indian men without the confounding effect of insurance coverage.

**Methods**

Study Cohort

This study was a cross-sectional analysis within the CMHS, a large multiethnic cohort of 84,170 men. Details of the study cohort, recruitment, and data collection were reported previously by Enger, et al.[37] To be eligible men had to be members of Kaiser Permanente Southern California (KPSC) or Kaiser Permanente Northern California (KPNC), the two largest managed care organizations in California, for at least one year, and ages 45-69 at recruitment which took place between January 2002 and December 2003. Men were recruited by direct mailing using a two-step process. Potential participants were first mailed an introductory letter and short screening questionnaire. A 24-page questionnaire was mailed to those who completed the screening questionnaire. The baseline survey obtained information on demographics, height, weight, health status, and lifestyle behaviors. Electronic clinical and administrative databases captured inpatient and outpatient diagnoses (according to the *International Classification of Disease, Ninth Review, Clinical Modification ICD-9-CM*), laboratory, pharmacy and blood pressure values. For these analyses, only men from Kaiser Permanente Southern California (N=23,360) were evaluated. The study was approved by the Institutional Review Boards of KPSC and KPNC.

Race/Ethnicity

CMHS participants were asked about their racial/ethnic backgrounds and were permitted to select multiple options. For these analyses, the Asian-Indian category included men who reported Asian-Indian and Asian-Indian plus another race. White non-Hispanic race/ethnicity was defined as respondents who selected "White-European" or "White-Middle Eastern" and did not report Hispanic ethnicity.

Clinical Definitions

Any diagnosis for diabetes, hypertension or dyslipidemia was captured for all subjects from the medical record as of December 31, 2010. The following ICD-9 codes were used: 250.1-250.9 for diabetes mellitus, 401-403; 405 for hypertension and 272.0-272.4 for dyslipidemia, to analyze the prevalent conditions.

Pharmacotherapy for CVD Clinical Risk Factors

We defined pharmacotherapy for a CVD risk factor with a filled prescription for at least 30 days' supply of medication for diabetes, hypertension or hyperlipidemia between January 1, 2003 and December 31, 2010. Medications were categorized based on the first 6 digits of the GPI code, and were classified into diabetes, hypertension or cholesterol drugs. All medications were classified as "yes" or "no" pharmacotherapy by disease type.

Measures of CVD Risk Factor Control

Laboratory values and blood pressures obtained between January 1, 2008 and December 31, 2010 were used to define the extent of risk factor control. The mean of available laboratory values and blood pressure readings obtained during this time period was calculated for each individual and was used to define control according to KPSC clinical practice guidelines and to calculate Framingham Risk Scores. The average of these individual means was tabulated for the two ethnic groups. Among patients with diabetes, mean hemoglobin A1c (HgA1c) levels and LDL levels were evaluated. We categorized hemoglobin A1c (HgA1c) levels into $\geq$ 7.0 as uncontrolled vs. controlled (< 7.0) and LDL levels into controlled ( $\leq$ 100 ) vs. uncontrolled (> 100) . Among those with hypertension, the mean systolic and diastolic values were reported by race/ethnicity. Blood pressure was categorized by systolic value $\geq$140 (uncontrolled) and by diastolic value $\geq$ 90 (uncontrolled). Similarly for cholesterol, among those with a dyslipidemia diagnosis, we evaluated the mean LDL, HDL and triglyceride levels. The following were defined as uncontrolled: high triglycerides (>150 mg/dl), low HDL cholesterol (<40 mg/dl) and high LDL cholesterol ($\geq$ 100 mg/dl) among those with diabetes or ( $\geq$ 130 mg/dl) among those without diabetes.

**Covariates**

Ascertainment of Self-Reported Lifestyle and Behavioral Risk Factors from the Baseline Survey

Body Mass Index (BMI) was calculated from weight (kilograms) and height (meters) (kilograms/meter$^2$) and categorized into: underweight (<18.5), healthy weight (18.5-24.9), overweight (25-29.9) and obese ($\geq$ 30), based on the guidelines established by the National Institutes of Health. [39] Smoking status

defined as ever, current and never was queried in men reporting having smoked at least 100 cigarettes in their lifetime.

Men reported their frequency and duration of moderate and vigorous recreational, household and work-related physical activities with questions adapted from the CARDIA Physical Activity History (PAH).[44,45] The CARDIA PAH has indirect validity against aerobic capacity and percent fat and a strong inverse relationship with most cardiovascular disease risk factors.[46,47] Physical activity was divided into two levels: moderate/vigorous ($\geq$ 3.5 hours/week in activities of 3 METS or greater), and vigorous ($\geq$ 3.5 hours/week in activities of 6 METS or greater. Sedentary lifestyle was defined as $\geq$ 6 hours/day outside of work spent watching television, sitting at a computer, or reading.

**Statistics**

Frequency distributions were used to describe a diagnosis of each clinical CVD risk factor, diabetes, hypertension and dyslipidemia, in the population. Bivariate analyses, using 2-sided t-tests for continuous variables and 2 X 2 contingency tables for categorical data, were used to assess the association between clinical CVD risk factors, medication prescriptions and levels of control and race/ethnicity. Unconditional multivariable logistic regression models were used to estimate adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were used to assess the differences in clinical CVD risk factors by race/ethnicity. All multivariable models included ageand BMI. Analyses were conducted using SAS, Version 9.2 (SAS Institute, Inc., Cary North Carolina. 2002-2008).

We calculated the Framingham Risk Score (FRS) published by Wilson et al.[63] The FRS predicts the 10-year probability of coronary heart disease (CHD) based on the following risk factors: total cholesterol, HDL, blood pressure, diabetes, and smoking. This method assumes the magnitude of association (β-coefficients) between each risk factor and CHD is similar in different populations. These factors were adjusted to the Asian-Indian and white non-Hispanic men in the CMHS cohort and to the disease free survival in the Framingham population (0.90015). We used the original β-coefficients from the Wilson equation to calculate the 10-year coronary heart risk differences for each participant in the cohort. We then reported the mean FRS by Asian-

Indian and white non-Hispanic men. In addition, we used the recalibration method developed for Asian-Indians based on the disease free survival of CHD in India (0.865185) and developed by Chow et al. to calculate the risk in Asian-Indians and white non-Hispanics of our cohort.[64]

**Results**

A total of 23,360 men, Asian-Indians (n=229) and white non-Hispanics (n=23,131), remained in the KPSC cohort after excluding men of other race/ethnicities. Table 1 compares Asian-Indians with white non-Hispanics on demographic characteristics. No differences were found for age or household income, while Asian-Indians were more likely than white non-Hispanics to have a graduate degree (54.1% vs. 30.3%, p-value < .001 respectively). A higher proportion of Asian-Indians were married compared to white non-Hispanics (91.3% vs. 80.4%). In contrast to white non-Hispanics, almost all of the Asian-Indians (93.9%) reported being first generation immigrants, with over 75% of them having resided in the U.S. for over 16 years. Over 90% of the white non-Hispanics were second generation or higher. Asian-Indians reported less moderate/vigorous physical activity compared to white non-Hispanics (51.5% vs. 63.4%, p-value < .001). There were no differences in sedentary behavior. Fewer Asian-Indians reported ever having smoked (29.7% vs. 45.5%, p-value <.001); however there was no difference in current smoking between the two groups.

Table 2 depicts the follow-up time and prevalence of diabetes, hypertension and dyslipidemia in the population. The person-years in both groups were similar between Asian-Indians and white non-Hispanics (7.2 vs. 6.9, respectively). Additionally there was a low percentage of death in both populations, and more white non-Hispanics disenrolled during the follow-up time frame. As expected, the percentage of subjects with diabetes, hypertension and dyslipidemia diagnoses increased between the baseline survey and December 31, 2010.

Clinical risk factors from electronic records found more Asian-Indians had a diagnosis of diabetes (38.9% vs. 18.8%, p-value <.001) and dyslipidemia (74.7% vs. 64.6%, p-value <.05) compared to white non-Hispanics (Table 3). The proportion of those diagnosed with hypertension was similar between the two groups (62.4% vs. 58.3%, p-value <.21). Cardiovascular risk factors tended to cluster together in the Asian-Indian population

compared to white non-Hispanics, with a greater difference in those having all three diagnosis among those with hypertension and dyslipidemia (50.3% vs. 26.2%, p-value <.001 and 42.1% vs. 23.6%, p-value <.001, respectively).

Table 4 depicts treatment with pharmacotherapy for each CVD clinical risk factor by race/ethnicity. Overall, filling at least one prescription with a 30 days supply or greater for each CVD risk factor was similar between both groups. Over 95% of the population diagnosed with diabetes was prescribed medications for diabetes. Slightly more Asian-Indians were on injectable insulin compared to white non-Hispanics (10.1% vs. 7.8%). For hypertension, 80% of the population overall with a diagnosis was prescribed medication. However, more Asian-Indians with a dyslipidemia diagnosis were prescribed cholesterol medication (83.1% vs. 75.4%, p-value <.05) compared to white non-Hispanics.

Control of diabetes, hypertension and dyslipidemia were evaluated by race/ethnicity (Table 5). We only evaluated men who had laboratory values or blood pressure measurements for each diagnosis (76 Asian-Indians, 3592 white non-Hispanics with diabetes; 114 Asian-Indians, 9811 white non-Hispanics with hypertension; 131 Asian-Indians, 10,513 white non-Hispanics with dyslipidemia). Among those with diabetes, there were no differences in the mean A1c levels between the two groups, and slightly more Asian-Indians had HgA1c levels $\geq$ 7 (not controlled), compared to white non-Hispanics (44.7% vs. 35.7%, p-value =.11). The adjusted odds ratios for HgA1c control suggested that Asian-Indians were nearly half as likely to be under control in contrast to white non-Hispanics. Among those with hypertension, the mean systolic and diastolic values were lower in Asian-Indians compared to white non-Hispanics (126.5 vs. 128.6, p-value 0.01; 72.0 vs. 74.3, p-value < 0.0001, respectively). Similarly, mean LDL levels were significantly lower among Asian-Indians compared to white non-Hispanics (113.4 vs. 120.2, p-value < 0.0001). There were no differences in mean HDL or triglyceride levels. Roughly 50% of men, in both racial/ethnic groups, have LDL and triglyceride levels above recommended levels, despite the high prevalence of pharmacotherapy for dyslipidemia.

There were slight differences in the mean 10-year CHD FRS with 9.2% in Asian-Indians and 9.4% in white non-Hispanics. The 10-year CHD risk was slightly higher in both groups when using the Indian population calibration method, with Asian-Indians at 12.3% and white non-Hispanics at 12.7% (table 6).

**Discussion**

As found in previous studies, Asian-Indians in the CMHS had a higher rate of diabetes and dyslipidemia compared to white non-Hispanics. Pharmacotherapy for CVD risk factors was similar between the two groups. Asian-Indians more often had lower mean systolic, diastolic and LDL levels compared to white, non-Hispanics. Although control of hypertension and dyslipidemia was similar in the two populations, overall only 50% of men had LDL and triglyceride levels under the target values. On the other hand, control of diabetes was significantly lower in Asian-Indians when the models were adjusted. The 10-year CHD risks in the population were similar in the Framingham method, however when accounting for the Asian-Indian recalibration, the scores increased in both Asian-Indians and white non-Hispanics. Because these comparisons were made in an insured population with equivalent access to the same source of care, the differences between groups are unlikely to be due to differential care or diagnostic labeling.

Previously published studies have found increased rates of diabetes, dyslipidemia and hypertension among the Asian-Indian population.[6-10,28,48,65,66] These studies were limited in their data sources and used self-reported interview data to identify those with diabetes, dyslipidemia and hypertension. To our knowledge, this is the first study to evaluate clinical CVD risk factors and their measure of control, based on medication and laboratory values, in a clinical setting among Asian-Indians.

In our study, the 10-year risk of CHD was calculated at 9.2% among Asian-Indians. Our findings do not explain the increased risk of CHD rates in Asian-Indians, despite the higher prevalence of DM in this population. Similar to our study, other studies have found that the higher rates of CHD among Asian-Indians cannot be explained fully by traditional risk factors.[67,68] Several studies have reported positive correlations between plasma lipoprotein (a) (Lp(a)) levels and CAD.[69-71] Elevated Lp(a) has been shown to be a risk factor

for premature CAD in Asian-Indians and is driven by genetics and ethnicity.[70-72] Therefore, our study suggests that Asian-Indians may have distinct CAD risk factors compared to white non-Hispanics in the U.S.

Our study has several strengths. Diagnosis of clinical risk factors was obtained from the health plan electronic medical records. This is more reliable than self-reported interview data used in other studies. Targets for risk factor control were based on the health plan's clinical practice guidelines. All of the study subjects were enrolled in a prepaid health plan known for its commitment to prevention and had equal access to health care. Finally access to prescription data allowed us to create an indicator for pharmacotherapy for each condition. This study has several potential limitations. This study was limited to men enrolled in a managed care organization, thus, limiting the generalizability to the entire Asian-Indian U.S.-based population. Although we have longitudinal reports of the medical records since 2004, the prevalence of CVD risk factors was high at study entry and the incidence of each condition was too low to evaluate the data longitudinally. Therefore, we conducted cross-sectional analyses of the data. Similarly, the low incidence of CVD events in the study cohort precluded our evaluation of differences in between Asian-Indians and white non-Hispanic subjects. In addition, not all the men in the cohort had laboratory values. For these analyses, men without laboratory data or blood pressure values during the 3 year measurement period were not included in the models assessing control. Additionally, our definition of pharmacotherapy was limited to at least one prescription fill of at least a 30 day supply of medication and may overestimate our results. Although KPSC provides a comprehensive pharmacy benefit to the majority of its members, about 10% of members fill their prescriptions outside the system, and we are unable to identify these patients which will underestimate our results.

In conclusion, our results add to the very limited literature on Asian-Indian health in the U.S. Our examination of clinical CVD risk factors found evidence of increased risk factors for CVD among Asian-Indian men. With the fast growing Asian-Indian population in California, health care providers need to be cognizant of the higher prevalence of clustering of CVD risk factors in the Asian-Indian population. Future research should examine the role of genetics, treatment patterns, and potentially risk prediction models on CVD incidence and outcomes among the Asian-Indian population in the U.S.

**Table 1: Characteristics of Asian-Indian and White Non-Hispanic Men in the Asian-Indian Population**

| | Asian-Indian (N=229) n (%) | White, Non-Hispanic (N=23,131) n (%) | Total (N=23,360) | P-Value |
|---|---|---|---|---|
| **Age at baseline survey recruited into cohort (years)** | | | | |
| 45-49 | 37 (16.2) | 2962 (12.8) | 2999 | 0.57 |
| 50-54 | 46 (20.1) | 4432 (19.2) | 4478 | |
| 55-59 | 52 (22.7) | 5328 (23.0) | 5380 | |
| 60+ | 94 (41.0) | 10,382 (44.9) | 10,476 | |
| **Education** | | | | |
| High School or less | 12 (5.2) | 3112 (13.5) | 3124 | <.0001 |
| Vocational/Some College | 25 (10.9) | 8061 (34.8) | 8086 | |
| College | 67 (29.3) | 4885 (21.1) | 4952 | |
| Graduate Degree | 124 (54.1) | 7018 (30.3) | 7142 | |
| Missing | 1 (0.4) | 55 (0.2) | | |
| **Household Income (annual $)** | | | | |
| 0-39,999 | 41 (17.9) | 3761 (16.3) | 3802 | 0.96 |
| 40,000-60,000 | 42 (18.3) | 4202 (18.2) | 4244 | |
| 60,000-80,000 | 42 (18.3) | 4249 (18.4) | 4291 | |
| 80,000+ | 99 (43.2) | 9952 (43.0) | 10051 | |
| Missing | 5 (2.2) | 967 (4.2) | 972 | |
| **Marital Status** | | | | |
| Married/living with a partner | 209 (91.3) | 18,604 (80.4) | 18,813 | <.0001 |
| Other (divorced, separated, widowed, never married) | 17 (7.4) | 4445 (19.2) | 4462 | |
| Missing | 3 (1.3) | 82 (0.4) | | |

**Table 1: Characteristics of Asian-Indian and White Non-Hispanic Men in the Asian-Indian Population (Con't)**

| | Asian-Indian (N=229) n (%) | White, Non-Hispanic (N=23,131) n (%) | Total (N=23,360) | P-Value |
|---|---|---|---|---|
| **Acculturation** | | | | |
| 1st Generation < 15 years | 36 (15.7) | 154 (0.7) | 190 | <.0001 |
| 1st Generation 16-25 years | 54 (23.6) | 361 (1.6) | 415 | |
| 1st Generation > 25 years | 125 (54.6) | 1573 (6.8) | 1698 | |
| 2nd Generation or higher | 12 (5.2) | 20,823 (90.0) | 20,835 | |
| Missing | 2 (0.9) | 220 (1.0) | 222 | |
| **Cigarette Smoking** | | | | |
| Never | 137 (59.8) | 10,143 (43.9) | 10,280 | <.0001 |
| Current | 24 (10.5) | 2418 (10.5) | 2442 | |
| Past | 68 (29.7) | 10,530 (45.5) | 10,598 | |
| **Moderate/Vigorous Physical Activity (> 3.5 hrs per week 3 METS or greater)** | | | | |
| Yes | 118 (51.5) | 14,675 (63.4) | 14,793 | <.001 |
| No | 109 (47.6) | 8408 (36.3) | 8517 | |
| Missing | 2 (0.9) | 48 (0.2) | | |
| **Sedentary Behaviors Outside of Work** | | | | |
| Yes | 61 (26.6) | 7225 (31.2) | 7268 | .21 |
| No | 151 (65.9) | 14,768 (63.8) | 14,919 | |
| Missing | 17 (7.4) | 1138 (4.9) | | |

**Table 2: Follow-up Time and Prevalence of Diabetes, Hypertension and Dyslipidemia in Asian-Indian and White Non-Hispanic Men in the CMHS cohort from Baseline Survey to December 31,2010**

| | Asian-Indian (N=229) n (%) | White, Non-Hispanic (N=23,131) n (%) |
|---|---|---|
| **Follow-up of men through December 31, 2010** | | |
| Person-Years mean (SD) | 7.2 (2.3) | 6.9 (2.4) |
| Deaths | 2 (0.9) | 404 (1.7) |
| Disenrollment | 47 (20.5) | 6401 (27.7) |
| Total Population Remaining | 180 (78.6) | 16,326 (70.6) |
| **Diabetes** | | |
| Prevalence at baseline* | 46 (20.1) | 2241 (9.7) |
| Prevalence as of December 31, 2010** | 89 (38.9) | 4352 (18.8) |
| **Hypertension** | | |
| Prevalence at baseline* | 73 (31.9) | 8356 (36.1) |
| Prevalence as of December 31, 2010** | 143 (62.5) | 13,486 (58.3) |
| **Dyslipidemia** | | |
| Prevalence at baseline* | 128 (55.9) | 10,029 (43.4) |
| Prevalence as of December 31, 2010** | 171 (74.7) | 14,942 (64.6) |

*determined from the self-report baseline survey
**determined from the electronic medical record

**Table 3: Prevalence of Diabetes, Hypertension and Dyslipidemia between Asian-Indian and white non-Hispanic men in the CMHS cohort 2000-2010**

| | **Asian-Indian (N=229)** n (%) | **White, Non-Hispanic (N=23,131)** n (%) | **Total (N=23,360)** | **P-Value** |
|---|---|---|---|---|
| **Diabetes** | | | | |
| Yes (ICD-9 diagnosis in the Medical Record) | 89 (38.9) | 4352 (18.8) | 4441 | < 0.001 |
| No (ICD-9 Diagnosis in Medical Record) | 140 (61.1) | 18,779 (81.2) | 18,919 | |
| 1 other CVD risk factor* | 13 (14.6) | 673 (15.5) | 332 | 0.86 |
| 2 other CVD risk factors** | 72 (80.9) | 3528 (81.1) | 3600 | |
| **Hypertension** | | | | |
| Yes (ICD-9 diagnosis in the Medical Record) | 143 (62.4) | 13,486 (58.3) | 13,632 | 0.21 |
| No (ICD-9 Diagnosis in Medical Record) | 86 (37.6) | 9645 (41.7) | 9731 | |
| 1 other CVD risk factor* | 51 (35.7) | 7380 (54.7) | 7431 | < 0.001 |
| 2 other CVD risk factors** | 72 (50.3) | 3528 (26.2) | 3600 | |
| **Dyslipidemia** | | | | |
| Yes (ICD-9 diagnosis in the Medical Record) | 171 (74.7) | 14,942 (64.6) | 15,113 | <.05 |
| No (ICD-9 Diagnosis in Medical Record) | 58 (25.3) | 8189 (35.4) | 8247 | |
| 1 other CVD risk factor* | 56 (32.7) | 7397 (49.5) | 7099 | < 0.001 |
| 2 other CVD risk factors** | 72 (42.1) | 3528 (23.6) | 3600 | |

*a clinical diagnosis with1 of the other 2 clinical diagnoses
** a clinical diagnosis with the other 2 clinical diagnoses

**Table 4: Pharmacotherapy for Diabetes, Hypertension and Dyslipidemia between Asian Indian and White non-Hispanic Men between 1/1/2008-12/31/2010**

| | **Asian-Indian (N=229)** n (%) | **White, Non-Hispanic (N=23,131)** n (%) | **Total (N=23,360)** | **P-Value** |
|---|---|---|---|---|
| **Diabetes Medications** | | | | |
| Insulin and Oral Medications | 9 (10.1) | 334 (7.8) | 343 | 0.43 |
| Oral Medication only | 77 (86.5) | 3794 (87.2) | 3871 | |
| | | | 4441 | |
| Diabetes Mellitus diagnosis and any diabetes medication | 88 (98.9) | 4219 (96.9) | 4307 | 0.29 |
| Diabetes Mellitus diagnosis and no diabetes medication | 1 (1.1) | 133 (3.1) | 134 | |
| Total Diabetes Diagnosis | 89 | 4352 | | |
| **Hypertension (HTN) Medications** | | | | |
| HTN diagnosis and HTN medication | 129 (81.6) | 11,616 (79.5) | 11,745 | 0.26 |
| HTN diagnosis and no HTN medication | 14 (8.9) | 1870 (12.8) | 1884 | |
| No HTN diagnosis and HTN medication | 15 (9.5) | 1117 (7.6) | 1132 | |
| Total HTN Diagnosis | 158 | 14,603 | 13,632 | |
| **Cholesterol Medications** | | | | |
| Dyslipidemia diagnosis and any dyslipidemia medication | 148 (83.1) | 12,043 (75.4) | 12,191 | 0.05 |
| Dyslipidemia diagnosis and no dyslipidemia medication | 23(12.9) | 2899 (18.2) | 2922 | |
| No Dyslipidemia diagnosis and dyslipidemia medication | 7 (3.9) | 1030 (6.4) | 1037 | |
| Total dyslipidemia Diagnosis | 178 | 15,972 | 15,113 | |

**Table 5: Control of Diabetes, Hypertension and Dyslipidemia in Asian Indian and White non-Hispanic Men between 1/1/2008-12/31/2010**

| | Asian-Indian (N=229) n (%) | White, Non-Hispanic (N=23,131) n (%) | Total (N=23,360) | P-Value |
|---|---|---|---|---|
| **HgA1c among Diabetics last 2 years (1/1/2008-12/31-2010)** | | | | |
| Mean A1c Value (SD) | 7.0 (0.8) | 6.8 (0.9) | | 0.10* |
| Controlled A1c < 7 | 42 (55.3) | 2308 (64.3) | 2,350 | 0.11 |
| Uncontrolled A1c ≥ 7 | 34 (44.7) | 1284 (35.7) | 1,318 | |
| Total with a diagnosis of diabetes | 76 | 3592 | | |
| Crude OR (95% CI) | 0.71 (0.44-1.13) | | | |
| Adj. OR (95% CI)** | 0.52 (0.32-0.85) | | | |
| **Hypertension** | | | | |
| Mean Systolic Values (SD) | 126.5 (9.8) | 128.63 (9.6) | | 0.01* |
| Controlled Systolic < 140 | 108 (94.7) | 8819 (89.9) | 8,927 | 0.09 |
| Uncontrolled Systolic ≥ 140 | 6 (5.3) | 992 (10.1) | 998 | |
| Total with a diagnosis of hypertension | 114 | 9811 | 9,925 | |
| Crude OR (95% CI) | 0.61 (0.28-1.31) | | | |
| Adj. OR (95% CI)** | 0.64 (0.29-1.9) | | | |
| Mean Systolic Values (SD) | 72.0 (7.3) | 74.3 (7.2) | | <.0001* |
| Controlled diastolic < 90 | 114 (100.0) | 9678 (98.6) | 9,792 | 0.21 |
| Uncontrolled diastolic ≥ 90 | 0 (0.0) | 133 (1.4) | 133 | |
| Total with a diagnosis of hypertension | 114 | 9811 | 9,925 | |
| Crude OR (95% CI) | Invalid | | | |
| Adj. OR (95% CI)** | Invalid | | | |

**Table 5: Control of Diabetes, Hypertension and Dyslipidemia in Asian Indian and White non-Hispanic Men between 1/1/2008-12/31/2010**

| | Asian-Indian (N=229) n (%) | White, Non-Hispanic (N=23,131) n (%) | Total (N=23,360) | P-Value |
|---|---|---|---|---|
| **LDL** | | | | |
| Mean LDL Values (SD) among those with dyslipidemia dx | 113.4 (23.0) | 120.2 (24.9) | | <.0001* |
| Mean LDL Values (SD) among those with diabetes dx | 101.1 (19.9) | 104.0 (21.5) | | 0.24 |
| Controlled LDL (defined as ≤ 100 in diabetics and ≤ 130 in non-diabetics) | 76 (58.0) | 5978 (56.9) | 6,054 | 0.79 |
| Uncontrolled LDL (defined as >100 in diabetics and >130 in non-diabetics) | 55 (42.0) | 4535 (43.1) | 4,590 | |
| Total with a diagnosis of dyslipidemia | 131 | 10513 | 10,644 | |
| Crude OR (95% CI) | 1.02 (0.71-1.46) | | | |
| Adj. OR (95% CI)** | 0.98 (0.69-1.42) | | | |
| **HDL** | | | | |
| Mean HDL Values (SD) among those with dyslipidemia dx | 44.7 (9.5) | 45.6 (10.6) | | 0.31* |
| Controlled HDL (defined as ≥ 40) | 93 (71.0) | 6887 (65.5) | 6,980 | 0.19 |
| Uncontrolled HDL (defined as < 40) | 38 (29.0) | 3624 (34.5) | 3,662 | |
| Total with a diagnosis of dyslipidemia | 131 | 10513 | 10,644 | |
| Crude OR (95% CI) | 0.71 (0.48-1.05) | | | |
| Adj. OR (95% CI)** | 1.04 (0.69-1.57) | | | |
| **Triglycerides** | | | | |
| Mean Triglyceride Values (SD) among those with dyslipidemia dx | 159.2 (61.2) | 161.7 (75.9) | | 0.69* |
| Controlled Triglycerides (defined as < 150) | 68 (51.9) | 5386 (51.2) | 5,454 | 0.88 |
| Uncontrolled Triglycerides (defined as ≥ 150) | 63 (48.1) | 5127 (48.8) | 5,190 | |
| Total with a diagnosis of dyslipidemia | 131 | 10513 | 10,644 | |
| Crude OR (95% CI) | 0.92 (0.64-1.31) | | | |
| Adj. OR (95% CI)** | 1.33 (0.92-1.92) | | | |

* p-value t-test

**Models adjusted for age and BMI

**Table 6: Distribution of Framingham Risk Factors and Framingham Risk Score in Asian-Indians and White non-Hispanics**

| **Distribution of Risk Factors in the CMHS for Framingham** | **β-coefficients for CHD prediction with Total Cholesterol categories** | **Asian-Indian (N=229) %** | **White, Non-Hispanic (N=23,131)** n (%) |
|---|---|---|---|
| Age (years) | 0.4826 | 57.8 | 58.4 |
| Total Cholesterol, mg/dl ( %) | | | |
| <160 | -0.65945 | 3.6 | 1.8 |
| 160-199 | Referent | 58.8 | 48.5 |
| 200-239 | 0.17692 | 35.6 | 41.5 |
| 240-279 | 0.50539 | 1.0 | 7.5 |
| ≥ 280 | 0.65713 | 1.0 | 0.8 |
| HDL-Cholesterol ( %) | | | |
| <35 | 0.49744 | 10.0 | 13.6 |
| 35-44 | 0.2431 | 20.4 | 21.9 |
| 45-49 | Referent | 18.9 | 17.0 |
| 50-59 | -0.5107 | 43.8 | 39.8 |
| ≥ 60 | -0.4866 | 7.0 | 7.6 |
| Blood Pressure (BP) (Systolic mm HG/Diastolic mm HG) ( %) | | | |
| Optimal BP (<120 /<80) | -0.00226 | 55.9 | 56.3 |
| Normal BP (120-129/80-84) | referent | 24.9 | 20.8 |
| High Normal BP (130-139/85-89) | 0.28325 | 15.7 | 17.4 |
| Stage 1 Hypertension (140-159/90-99) | 0.52168 | 3.5 | 5.3 |
| Stage 2 Hypertension (≥ 160/≥100) | 0.61859 | 0 | 0.3 |
| Diabetes ( %) | 0.42839 | 38.9 | 18.8 |
| Smoking ( %) | 0.52337 | 10.5 | 10.5 |
| Mean 10-Year Framingham Risk Score | | | |
| Survival = 0.90015 | | 9.2 | 9.5 |
| Survival =0.865185 | | 12.3 | 12.7 |

## Summary Remarks

In conclusion, our results add to the very limited literature on Asian-Indian health in the U.S. Our examination of lifestyle related CVD risk factors found evidence for both potentially protective and harmful health behaviors among Asian-Indian men regardless of BMI status. We found that in general vegetarian Asian-Indians do not lead a cardio-protective lifestyle; in contrast white non-Hispanic vegetarians lead a heart healthy lifestyle. Adoption of a heart healthy lifestyle may help reduce disparities between Asian-Indians and other racial/ethnic groups. Our examination of clinical CVD risk factors found evidence for some increased CVD clinical risk factors and clustering for CVD clinical risk factors among Asian-Indian men. However, our results cannot fully explain the disparity in CVD clinical risk factors among the Asian-Indian population. Although we found some increased risk of CVD risk factors in the Asian-Indian population, the results are still inconclusive.

There have been a few studies evaluating CVD risk factors among Asian-Indians in the U.S. To our knowledge, this was the first study to evaluate medications and control of risk factors in a managed care organization. Identifying reasons for this disparity of CVD and diabetes in Asian-Indians needs to be further explored. With the fast growing Asian-Indian population in California, health care providers need to be cognizant of the higher prevalence of CVD lifestyle risk factors and clustering of CVD risk factors in the Asian-Indian population. Future research should examine the role of genetics, treatment patterns, and potentially risk prediction models on CVD incidence and outcomes among the Asian-Indian population in the U.S.

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