Journal of the American Heart Association

ORIGINAL RESEARCH

Heterogeneity of Cardiovascular Disease Risk Factors Among Asian Immigrants: Insights From the 2010 to 2018 National Health Interview Survey

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BACKGROUND: The Asian population is the fastest-growing immigrant population in the United States. Prior studies have examined the Asian immigrant population as a homogenous group. We hypothesized that there will be heterogeneity in cardiovascular disease risk factors among Asian immigrant subgroups (Indian subcontinent, Southeast Asia, Asia) compared with the non-Hispanic White population.

METHODS AND RESULTS: A cross-sectional analysis of the 2010 to 2018 National Health Interview Survey was conducted among 508 941 adults who were born in Asian regions or were non-Hispanic White and born in the United States. Generalized linear models with Poisson distribution were fitted to compare the prevalence of self-reported hypertension, overweight/obesity, diabetes mellitus, high cholesterol, physical inactivity, and current smoking among Asian immigrants compared with White adults, adjusting for known confounders. We included 33 973 Asian immigrants from Southeast Asia (45%), Asia (29%), the Indian subcontinent (26%), and 474 968 White adults. Compared with non-Hispanic White adults, Indian subcontinent immigrants had the highest prevalence of overweight/obesity (prevalence ratio, 1.22; 95% CI, 1.19–1.25); Southeast Asian immigrants had the highest prevalence of high cholesterol (prevalence ratio, 1.16; 95% CI, 1.10–1.23); Indian subcontinent (prevalence ratio, 1.69; 95% CI, 1.49–1.93) and Southeast Asian (prevalence ratio, 1.38; 95% CI, 1.26–1.52) immigrants had a higher prevalence of diabetes. All Asian immigrant subgroups were more likely to be physically inactive and less likely to smoke than White adults.

CONCLUSIONS: We observed significant heterogeneity in cardiovascular disease risk factors among Asian immigrants and a varied prevalence of risk factors compared with non-Hispanic White adults. Providers caring for Asian immigrants should provide tailored and culturally informed care to improve the cardiovascular health of this diverse group.

Key Words: Asian immigrant ■ cardiovascular disease ■ disparities ■ Indian subcontinent ■ NHIS ■ risk factors ■ Southeast Asian

Cardiovascular disease (CVD) is the leading cause of mortality in the United States.[1] By 2030, ≈40% of the US population is projected to have some form of CVD, and the total direct medical cost is projected to triple, from $273 billion in 2010 to $818 billion by 2030.[2] Racial/ethnic minorities in the United States are disproportionately affected by CVD and its risk factors.[3] To reduce cardiovascular disparities and enhance the quality of care for racial and ethnic minorities, cultural values and preferences must be considered and incorporated into care delivery.

Asian immigrants are the fastest-growing population in the United States,[4,5] and grew from 491 000 in 1960 to about 12.8 million in 2014.[4] Furthermore, it

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This study was presented at the American Heart Association's Scientific Sessions, November 13 to 17, 2020.

Supplementary Material for this article is available at https://www.ahajournals.org/doi/suppl/10.1161/JAHA.120.020408

For Sources of Funding and Disclosures, see page 10.

JAHA is available at: www.ahajournals.org/journal/jaha

CLINICAL PERSPECTIVE

What Is New?

- Cardiovascular disease risk factors vary among Asian immigrant subgroups (Indian subcontinent, Southeast Asia, and Other Asia) and as compared with non-Hispanic White adults.
- Asian immigrants from all 3 subgroups were more likely to report physical inactivity and less likely to report current smoking than non-Hispanic White adults.
- Asian immigrants from the Indian subcontinent were more likely to report overweight/obesity, the Southeast Asian group was more likely to report high cholesterol, and Indian subcontinent and Southeast Asian groups were more likely to report diabetes mellitus.

What Are the Clinical Implications?

- Asian immigrants are the fastest-growing immigrant group in the United States, yet health promotion and prevention programs for this population have not kept pace with this growth.
- There is a need to disaggregate data for Asian immigrant subgroups about cardiovascular disease risks, which should be considered when setting priorities for future cardiovascular disease prevention and reduction programs.
- As we move to more personalized models of health care, disaggregating data based on racial and ethnic characteristics is critical.

Nonstandard Abbreviations and Acronyms

NCHS	National Center for Health Statistics
NHIS	National Health Interview Survey
PIR	poverty-income ratio
PR	prevalence ratio

is projected that there will be 34 million Asian immigrants in the United States by 2050.[5] Between 2010 and 2017, 41% of immigrants arriving in the United States were from Asian countries.[6] The majority (66%) of the Asian population in the United States is foreign born.[7] Although Asian immigrants represent diverse communities, cultures, and countries, most are from China, India, and the Philippines.[8] Nearly half of all Asian immigrants live in Western US states; about one third live in California alone.[8] In Nevada, Arizona, North Dakota, North Carolina, and Georgia, the number of Asian immigrants doubled between 2000 and 2012.[7] The rapid growth of Asian immigrants in the United States from diverse cultural and ethnic backgrounds has implications for health-service use and delivery. Prior studies have also documented a high burden of CVD mortality, outcomes, and risk factors among the Asian population.[1,5,9,10] In 2010, the American Heart Association issued a call to action, highlighting a substantial gap in the understanding of the CVD pattern and risks among Asian immigrants.[5]

Much of our knowledge on CVD in Asian immigrants in the United States has been determined by studies that have aggregated Asian subgroups or examined one subgroup alone.[11] Yet, substantial variability exists in the CVD prevalence, incidence, risk, and health-seeking behavior among Asian subgroups.[3,5,11–13] The increased prevalence of CVD is attributed to the higher rates of conventional CVD risk factors such as hypertension, obesity, diabetes mellitus, high cholesterol, physical inactivity, and smoking. Compared with the White population, Filipino immigrants have higher odds of hypertension, and Asian Indian immigrants have higher odds of diabetes mellitus and physical inactivity.[14] Also, South Asian immigrants from the Indian subcontinent (ie, primarily India, Pakistan, Bangladesh, Sri Lanka, and Nepal) were reported to have a higher prevalence of CVD risk factors, such as obesity, hyperlipidemia, and diabetes mellitus[15] than the White population of European ancestry.[3,16] The proportionate mortality rate for ischemic heart disease was higher among Asian Indian and Filipino populations than among the non-Hispanic White population.[12] The Asian Indian population have a 3- to 4-times higher risk of developing coronary heart disease than the White American population, which is 6 times higher than that of the Chinese American and 20 times higher than the Japanese American population.[10] Furthermore, using data from California, coronary heart disease was observed to be the leading cause of death in the Asian Indian population.[17] A recent study using 2011 to 2014 data from the National Health and Nutrition Examination Survey also identified a higher prevalence of diabetes mellitus and obesity among the foreign-born Asian population than among the non-Hispanic White population.[18] Although these studies suggest considerable CVD disparities, a gap still exists in the examination of heterogeneity of risk factors among nationally representative Asian subgroups in the United States. A greater understanding of the CVD risk profile among Asian subgroups is imperative to identify and tailor culturally sensitive and effective CVD risk reduction strategies.

Despite the continued growth of the Asian subpopulation, most of the studies on CVD aggregate the Asian population into a homogenous group, potentially missing critical heterogeneity in disease burden, risk, and sociocultural factors.[19] Hence,

this study aimed to examine the heterogeneity in CVD risk factors among Asian immigrant subgroups (Indian subcontinent, Southeast Asia, and Other Asia) and compare it to the US-born non-Hispanic White population using the 2010 to 2018 National Health Interview Survey (NHIS). We hypothesized that there would be significant heterogeneity in CVD risk factors among Asian immigrant subgroups compared with the non-Hispanic White population.

METHODS

Data Source and Study Population

We used a cross-sectional design to analyze data from the 2010 to 2018 NHIS, conducted by the National Center for Health Statistics (NCHS).[20] The NHIS data used in this article are available in the public domain by the NCHS,[20] and supporting materials on data analysis will be available on request from the authors. The NHIS is a cross-sectional population-based survey of civilian, noninstitutionalized US adults aged 18 years and older.[21] Face-to-face interviews are conducted by the study team, and one randomly selected adult per household completes the Sample Adult Module to provide detailed data on healthcare services, behavior, and health status. A detailed description of the design and methodology used for the NHIS is published elsewhere.[20,21] This study was exempt from institutional review board review because it used deidentified data available in the public domain published by the NCHS.

Sample

All respondents who self-identified their race as Asian and were born in Asian countries were considered Asian immigrants. Because visa documentation is not required, the foreign-born immigrants included people who were naturalized citizens, legal permanent residents, undocumented immigrants, refugees, and those with visas such as students and temporary workers.[22–24] The region-of-birth data were identified by the NHIS question, "Where were you born?" Within this variable, 3 mutually exclusive regions were identified for Asian immigrants: Indian subcontinent (including Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Pakistan, India, Nepal, Pakistan, Sri Lanka or Ceylon, and Tibet), Southeast Asia (including Borneo, Brunei, Burma or Myanmar, Cambodia, Christmas Island, Hong Kong, Indonesia, Laos, Malaysia, Philippines, Singapore, Taiwan, Thailand, and Vietnam) and Other Asia (including Asia, Asia Minor, China, Japan, Mongolia, North Korea, and South Korea). We could not differentiate the data on specific countries of origin for the Asian subgroups because they are protected and not publicly available.[21] Respondents who self-identified as non-Hispanic White and were born in the United States were considered for the comparison group because in CVD health disparities research, ethnic minorities in the United States are often compared with the White population,[25] and the sample size of the non-Hispanic White population was also large enough to allow meaningful comparisons.

Measurements

The outcomes of interest for the study were the prevalence of the following 6 self-reported CVD risk factors: hypertension, overweight/obesity, diabetes mellitus, high cholesterol, physical inactivity, and current smoking status.

CVD Risk Factors

Hypertension, diabetes mellitus, and high cholesterol were defined as a participant's affirmative response to the question: "Have you ever been told by a doctor or health professional that you had: hypertension, also called high blood pressure; diabetes mellitus or sugar diabetes mellitus; or high cholesterol?" Body mass index (BMI) was calculated using respondents' self-reported height and weight without shoes to develop 4 categories: underweight, normal weight, overweight, and obesity. BMI was then categorized as a dichotomous variable, normal weight, or overweight/obesity.[3,26] Overweight/obesity was defined as a BMI ≥25 kg/m^2 for non-Hispanic White people and BMI ≥23 kg/m^2 for Asian immigrants, per World Health Organization guidelines.[27] Among people who assented to having "ever smoked at least 100 cigarettes in [their] entire life," current smoking was defined as an affirmative response to the question: "Do you now smoke cigarettes every day, some days, or none at all?" Participants who indicated that they smoked every day and some days were categorized as current smokers. Physical activity was defined on the basis of participants' responses to questions on how often and how long during their leisure time they engaged in at least 10 minutes of vigorous-intensity activities or light-to-moderate activities. Participants were classified as physically inactive if they reported engaging in no exercise or not meeting the American Heart Association physical activity guidelines: <150 minutes a week of light-to-moderate physical activity and <75 minutes a week of vigorous physical activity, or an equivalent combination of both.[24] Vigorous-intensity physical activity in minutes accounted for twice the estimate of minutes of moderate intensity physical activity. To obtain the equivalent amount of moderate and vigorous-intensity physical activity, the 2008 adult physical activity guidelines were used, which were in effect during data collection.[28]

Covariates

The covariates for this study included: age in years, sex (men/women), education (high school and below, some college, and bachelor's degree or higher), marital status (currently married/not married), employment status (employed/not employed), health insurance status (with/without insurance), and availability of usual place to go for health care when sick (yes/no), length of US residency (<10/≥10 years), and poverty-income ratio (PIR) as a proxy for income. The PIR was calculated and recoded by the NCHS defined as the midpoint family income divided by the poverty level in dollars, as defined by the US Census Bureau for the corresponding survey year. The NCHS categorized PIR into poor (PIR<1, below the federal poverty level), near poor (PIR=1 to 2, between 100% and 200% below the federal poverty level), and not poor/near poor (PIR>2, 200% above the federal poverty level).

Statistical Analysis

Data from the 2010 to 2018 NHIS were pooled to enhance reliability and merged, taking into consideration the complex survey design, sampling weights, and analysis recommendations from the NCHS.[29] Survey-weighted χ^2 tests and ANOVA were used to assess differences in categorical and continuous variables, respectively, between the 3 Asian immigrant subgroups and the non-Hispanic White group. We used survey-weighted generalized linear models with a Poisson distribution and a log link to obtain the prevalence and prevalence ratios in the unadjusted, age-adjusted, and fully adjusted models.[30,31] We compared the age-adjusted prevalence of CVD risk factors among the Asian immigrant subgroups with the non-Hispanic White group. Additionally, for each outcome, fully adjusted models were fitted adjusting for sociodemographic (age, sex, education, employment, poverty income ratio) and healthcare access characteristics (insurance status and usual place to go when sick). Statistical analyses were performed with Stata version 15.0 (StataCorp, College Station, TX).

RESULTS

Sample Characteristics

A total of 508 941 participants including 33 973 Asian immigrants from the Indian subcontinent (n=8871, 26%), Southeast Asia (n=15 349, 45%), and Other Asia (n=9753, 29%) and an non-Hispanic White group (n=474 968, 93%) were included. When weighted to the US population, total participants represented a US population of 199 060 231 Asian immigrants and US-born non-Hispanic White participants. The mean (SE) age of all participants was 41 (0.09) years. Asian immigrants from the Indian subcontinent were the youngest (mean age, 39 years; SE, 0.36), and Southeast Asian immigrants (mean age, 47 years; SE, 0.27) were the oldest. There were significant differences in all sociodemographic (sex, employment status, education, and PIR) and healthcare access (health insurance and usual place to go when sick) characteristics examined across Asian immigrant subgroups and the non-Hispanic White group. For each Asian immigrant subgroup, there was a significantly higher proportion of participants with ≥10 years of US residence versus <10 years of US residence (Table 1).

We found significant differences in participants' characteristics on all of the CVD risk factors except current smoking. The descriptive data identified that the proportion of hypertension was highest among the non-Hispanic White group, and diabetes mellitus and high cholesterol were highest among participants from Southeast Asia. The majority of the participants from Other Asian countries were underweight and normal weight, Indian subcontinent participants were overweight, and non-Hispanic White participants were obese (Table 2).

Adjusted Prevalence and Prevalence Ratio of CVD Risk Factors

The age-adjusted prevalence of hypertension, overweight/obesity, diabetes mellitus, high cholesterol, physical inactivity, and smoking across the Asian immigrant subgroups compared with the US-born non-Hispanic White group are presented in Figure . The unadjusted and fully adjusted prevalence (Figure S1) and prevalence ratios are presented in Table 3.

Overall, we observed that in the age-adjusted models, with the exception of physical inactivity, the prevalence of CVD risk factors was lower among the Other Asian subgroup compared with the non-Hispanic White group and also lower than those from the Indian subcontinent and Southeast Asia. Specifically, hypertension was highest among the non-Hispanic White participants (34%) and lowest among the Other Asian participants (24%); overweight/obesity was highest among the Asian participants from the Indian subcontinent (76%) and lowest among Other Asian participants (52%). Diabetes mellitus was highest among those from the Indian subcontinent (14%) and lowest among Other Asian participants (7%). High cholesterol was highest among Southeast Asian participants (36%) and lowest among Other Asian participants (25%). Physical inactivity was higher among Asian immigrants (Indian subcontinent=54%, Other Asian=54%, Southeast Asian=53%) than in the non-Hispanic White participants (48%). Current smoking was highest among

Table 1. Sample Characteristics for Asian Immigrants and White Population, 2010 to 2018, National Health Interview Survey, N=508 941

Characteristics	Total, N=508 941	US-Born Non-Hispanic White, n=474 968; 93%	Asian Immigrants (n=33 973; 7%)			*P* Value
			Indian Subcontinent, n=8871; 26%	Southeast Asia, n=15 349; 45%	Asia, n=9753; 29%	
Age, y, mean (SE)	40.80 (0.09)	40.6 (0.10)	39.3 (0.36)	46.8 (0.27)	44.9 (0.40)	<0.001
Sex, %						<0.001
Women	51.07	50.89	47.63	57.24	56.68	
Married, %						<0.001
Currently married	54.69	53.71	78.49	66.28	67.99	
Not married	45.31	46.29	21.51	33.72	32.01	
Education, %						<0.001
≤ High school	45.01	45.77	22.27	36.26	34.79	
Some college	26.10	26.62	10.11	22.86	16.09	
≥ Bachelor's degree	28.89	27.62	67.62	40.88	49.12	
Poverty-income ratio, %						<0.001
Below poverty level, PIR <1	9.32	9.10	12.10	11.85	16.37	
Between 100% and 200%, PIR 1–1.99	15.81	15.74	14.03	18.94	16.86	
>200% above poverty level, PIR ≥2	74.88	75.15	73.87	69.21	66.78	
Employment status, %						<0.001
Employed	66.69	66.74	69.12	68.05	59.65	
Health insurance status, %						<0.001
Insured	91.54	91.71	90.14	88.29	86.59	
Have a usual place to go when sick, %						<0.001
Do not have a usual place	68.43	68.26	71.59	72.65	69.97	
Have a usual place	31.57	31.74	28.41	27.35	30.03	
Length of US residence, %						<0.001
<10 y	…	…	12.52	9.16	8.85	
≥10 y	…	…	16.53	32.87	20.08	

Indian subcontinent: Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Pakistan, India, Nepal, Pakistan, Sri Lanka or Ceylon, Tibet. Southeast Asia: Borneo, Brunei, Burma or Myanmar, Cambodia, Christmas Island, Hong Kong, Indonesia, Laos, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Asia: Asia, Asia Minor, China, Japan, Mongolia, North Korea, South Korea. PIR indicates poverty-income ratio.

the non-Hispanic White participants (7%) and lowest among the Asian participants from the Indian subcontinent (2%). The prevalence of CVD risk factors for the Asian immigrant subgroups were significantly (*P*<0.001) different from the non-Hispanic White group, except for the Southeast Asian group in hypertension prevalence (Figure 1).

In the fully adjusted models examining the CVD risk factors, we observed that compared with the non-Hispanic White group, the Asian group from the Indian subcontinent were less likely to self-report hypertension (prevalence ratio [PR], 0.80; 95% CI, 0.73–0.88) and current smoking (PR, 0.40; 95% CI, 0.34–0.48) and more likely to have overweight/obesity (PR, 1.22; 95% CI, 1.19–1.25), self-reported diabetes mellitus (PR, 1.69; 95% CI, 1.49–1.93), and be physically inactive (PR, 1.32; 95% CI, 1.26–1.38). Compared with the non-Hispanic White participants, Southeast Asian participants were less likely to report current smoking (PR, 0.49; 95% CI, 0.45–0.56) and more likely to report diabetes mellitus (PR, 1.38; 95% CI, 1.26–1.52), high cholesterol (PR, 1.16; 95% CI, 1.10–1.23), and physical inactivity (PR, 1.14; 95%

Table 2. Cardiovascular Disease Risk Factors for Asian Immigrants and White Population, 2010 to 2018, National Health Interview Survey, N=508 941

Characteristics	Total, N=508 941	US-Born Non-Hispanic White, n=474 968, 93%	Asian Immigrants, n=33 973; 7%			*P* Value
			Indian Subcontinent, n=8871, 26%	Southeast Asia, n=15 349, 45%	Asia, n=9753, 29%	
Hypertension, %	33.76	34.30	16.61	31.15	20.79	<0.001
Diabetes mellitus, %	9.55	9.59	8.59	11.30	6.30	<0.001
High cholesterol, %	31.42	31.72	20.79	33.41	21.91	<0.001
BMI, %						<0.001
Underweight	1.86	1.72	2.52	3.42	7.69	
Normal weight	34.35	34.26	25.94	36.79	45.11	
Overweight	33.33	33.14	42.25	36.26	32.21	
Obesity	30.46	30.88	29.29	23.52	14.99	
Physical activity, %						<0.001
No exercise at all	27.86	27.91	27.93	28.56	27.93	
Not meeting guideline	20.58	20.43	22.88	23.69	22.88	
Meeting guideline	51.56	51.66	49.19	47.75	49.19	
Current smokers, %	40.64	40.64	40.94	40.64	39.53	>0.05

Indian subcontinent: Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Pakistan, India, Nepal, Pakistan, Sri Lanka or Ceylon, Tibet. Southeast Asia: Borneo, Brunei, Burma or Myanmar, Cambodia, Christmas Island, Hong Kong, Indonesia, Laos, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Asia: Asia, Asia Minor, China, Japan, Mongolia, North Korea, South Korea. BMI indicates body mass index.

CI, 1.10–1.17). The Other Asian participants were more likely to report physical inactivity (PR, 1.14; 95% CI, 1.09–1.19) and less likely to report hypertension (PR, 0.72; 95% CI, 0.67–0.77), overweight/obesity (PR, 0.83, 95% CI, 0.80–0.87), diabetes mellitus (PR, 0.80, 95% CI, 0.70–0.91), high cholesterol (PR, 0.83; 95% CI, 0.77–0.90),

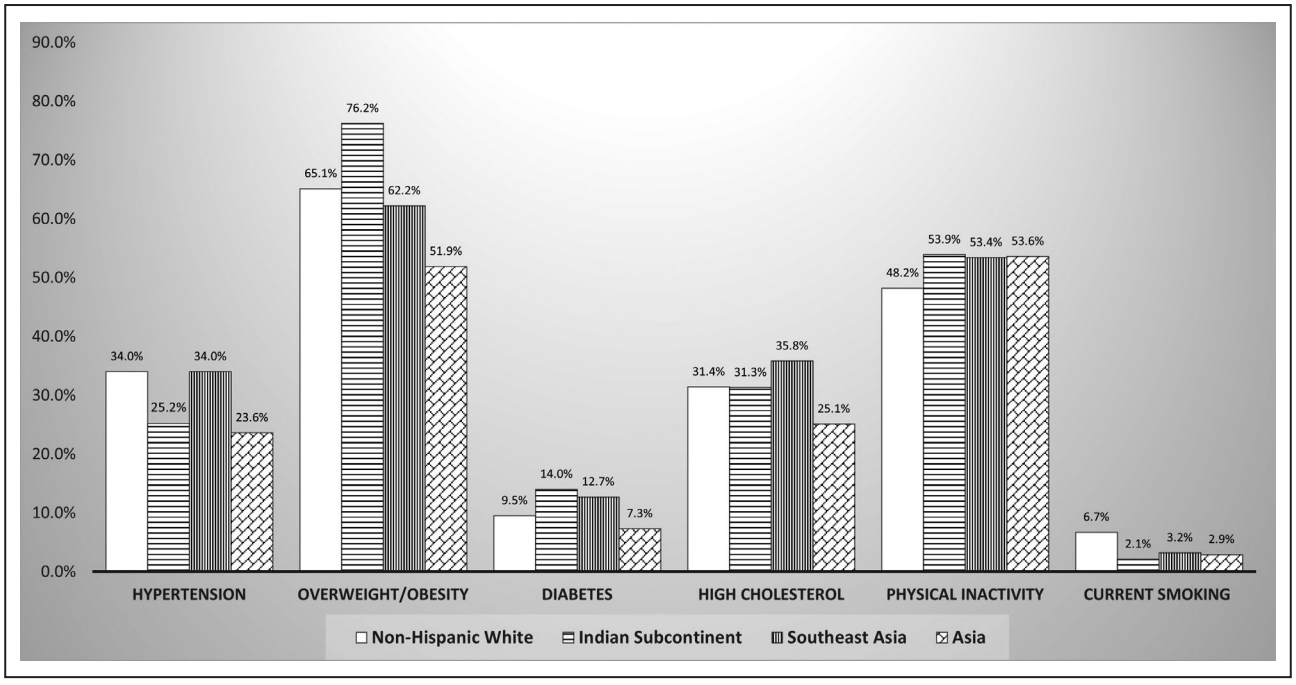

Figure 1. Age-adjusted prevalence of cardiovascular disease risk factors.
All prevalence for Asian immigrant groups are statistically significantly (*P*<0.001) different than the non-Hispanic White group except for the Southeast Asian group in hypertension prevalence. Indian Subcontinent: Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Pakistan, India, Nepal, Pakistan, Sri Lanka or Ceylon, Tibet. Southeast Asia: Borneo, Brunei, Burma or Myanmar, Cambodia, Christmas Island, Hong Kong, Indonesia, Laos, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Asia: Asia, Asia Minor, China, Japan, Mongolia, North Korea, South Korea.

Table 3. Prevalence and Prevalence Ratios of CVD Risk Factors Among Asian Immigrant Subgroups as Compared With the US-Born NH White Population

CVD Risk Factors	US-Born non-Hispanic White		Asian Immigrants					
			Indian Subcontinent		Southeast Asia		Asia	
	Prevalence %, (95% CI)	Prevalence Ratio (95% CI)	Prevalence % (95% CI)	Prevalence Ratio (95% CI)	Prevalence % (95% CI)	Prevalence Ratio (95% CI)	Prevalence %, (95% CI)	Prevalence Ratio (95% CI)
Hypertension								
Unadjusted	34.3 (33.9–34.7)	1.0	16.6 (14.9–18.3)	0.48 (0.44–0.54)‡	31.2 (29.6–32.7)	0.91 (0.86–0.96)‡	20.8 (18.8–22.8)	0.61 (0.55–0.67)‡
Adjusted	34.0 (33.6–34.4)	1.0	27.2 (24.8–29.6)	0.80 (0.73–0.88)‡	35.0 (33.4–36.5)	1.03 (0.98–1.08)	24.4 (22.7–26.1)	0.72 (0.67–0.77)‡
Overweight/obesity								
Unadjusted	65.1 (64.8–65.5)	1.0	73.4 (71.6–75.2)	1.13 (1.10–1.15)‡	61.9 (60.2–63.6)	0.95 (0.92–0.98)‡	51.1 (48.9–53.4)	0.78 (0.75–0.82)‡
Adjusted	65.0 (64.7–65.3)	1.0	79.2 (77.3–81.1)	1.22 (1.19–1.25)‡	63.8 (62.1–65.5)	0.98 (0.96–1.01)	54.1 (51.8–56.4)	0.83 (0.80–0.87)‡
Diabetes mellitus								
Unadjusted	9.6 (9.4–9.8)	1.0	8.6 (7.4–9.8)	0.90 (0.78–1.03)	11.2 (10.2–12.4)	1.18 (1.07–1.30)‡	6.3 (5.4–7.2)	0.66 (0.57–0.76)‡
Adjusted	9.5 (9.3–9.6)	1.0	16.1 (14.0–18.1)	1.69 (1.49–1.93)‡	13.1 (11.8–14.3)	1.38 (1.26–1.52)‡	7.6 (6.6–8.6)	0.80 (0.70–0.91)‡
High cholesterol								
Unadjusted	31.7 (31.3–32.1)	1.0	20.8 (18.5–23.1)	0.66 (0.59–0.73)‡	33.4 (31.4–35.4)	1.05 (0.99–1.12)	21.9 (19.9–23.9)	0.69 (0.63–0.76)‡
Adjusted	31.5 (31.1–31.8)	1.0	31.6 (28.6–34.7)	1.01 (0.91–1.11)	36.5 (34.4–38.6)	1.16 (1.10–1.23)‡	26.2 (24.2–28.3)	0.83 (0.77–0.90)‡
Physical inactivity								
Unadjusted	48.3 (47.8–48.9)	1.0	47.1 (44.9–49.2)	0.97 (0.93–1.02)	52.2 (50.6–53.9)	1.08 (1.05–1.12)‡	50.8 (48.8–52.8)	1.05 (1.01–1.09)*
Adjusted	48.0 (47.5–48.5)	1.0	63.1 (60.3–65.9)	1.32 (1.26–1.38)‡	54.6 (52.9–56.2)	1.14 (1.10–1.17)‡	54.6 (52.2–56.9)	1.14 (1.09–1.19)‡
Current smoking								
Unadjusted	6.7 (6.5–6.8)	1.0	2.1 (1.7–2.4)	0.31 (0.26–0.36)‡	3.0 (2.7–3.4)	0.45 (0.41–0.51)‡	3.3 (2.8–3.7)	0.49 (0.43–0.56)‡
Adjusted	8.4 (8.2–8.5)	1.0	3.4 (2.8–4.0)	0.40 (0.34–0.48)‡	4.2 (3.7–4.6)	0.49 (0.45–0.56)‡	4.4 (3.8–5.0)	0. 53 (0.46–0.60)‡

Reference group is US-born non-Hispanic White. Adjusted model: adjusted for age, sex, education, employment, insurance status, usual place to go when sick and poverty income ratio. Indian subcontinent: Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Pakistan, India, Nepal, Pakistan, Sri Lanka or Ceylon, Tibet. Southeast Asia: Borneo, Brunei, Burma or Myanmar, Cambodia, Christmas Island, Hong Kong, Indonesia, Laos, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam. Asia: Asia, Asia Minor, China, Japan, Mongolia, North Korea, South Korea. CVD indicates cardiovascular disease.

*$P<0.05$.

†$P<0.01$.

‡$P<0.001$.

and current smoking (PR, 0.53; 95% CI, 0.46–0.60) than their non-Hispanic White counterparts (Table 3).

In summary, based on the fully adjusted model, the comparison of the likelihood of significantly higher or lower prevalence of each CVD risk factor among Asian subgroups compared with the non-Hispanic White group are presented in Figure 2. Compared with the non-Hispanic White group, hypertension prevalence was lower among immigrants from the Indian subcontinent and Other Asian subgroups. Compared with the non-Hispanic White group, the prevalence of overweight and obesity was higher among immigrants from the Indian subcontinent and lower among the Other Asian group. Diabetes mellitus prevalence was higher among immigrants from the Indian subcontinent and Southeast Asia, whereas it was lower in the Other Asian subgroup. The prevalence of high cholesterol was higher among Southeast Asian subgroup and lower among Other Asian subgroup than in the non-Hispanic White group. All of the Asian-immigrant subgroups we examined had higher prevalence of physical inactivity and lower prevalence of current smoking than the non-Hispanic White group.

DISCUSSION

The study examined the heterogeneity in CVD risk factors among Asian immigrant subgroups as compared with the non-Hispanic White group. The findings of the study are consistent with other studies, which have suggested heterogeneity in CVD risk factors among Asian immigrant subgroups compared with non-Hispanic White groups. The findings support previous calls[3,5,11,13] to disaggregate data on Asian immigrants and have implications for CVD prevention by focusing on specific risk factors and underlying health behavior that are subgroup specific.

Asian immigrants from the Indian subcontinent were more likely to be overweight/obese compared with the non-Hispanic White group in this study, an observation that is consistent with previous studies.[3,16,18] Obesity is an established risk factor for diabetes mellitus. It is well known that Asian immigrants have a higher odds of diabetes mellitus,[32] even with lower BMI than the non-Hispanic White population.[3] This phenomenon may be because Asian immigrants tend to have a higher percent of body fat for the same BMI compared with their non-Hispanic White counterparts.[33] Despite the higher prevalence of diabetes mellitus among Asian immigrants, they are less likely than the non-Hispanic

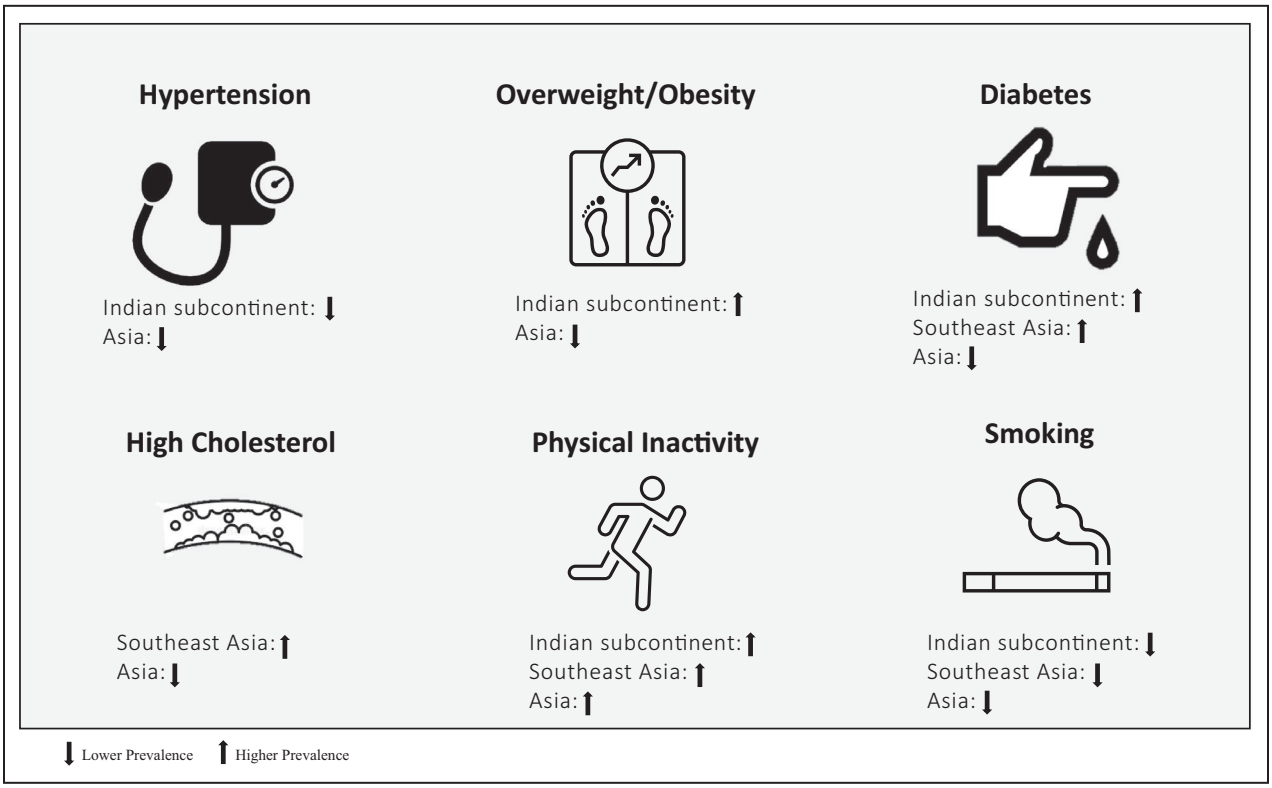

Figure 2. Cardiovascular disease risk factors among the Asian immigrant subgroups as compared with the non-Hispanic White group.
Direction of prevalence (higher or lower) as compared with the non-Hispanic White group from the fully adjusted model with statistically significant findings. Fully adjusted model: adjusted for age, sex, education, employment, insurance status, usual place to go when sick, and poverty-income ratio.

White population to receive diabetes mellitus screening.[34] A prior study reported a higher prevalence of diabetes mellitus among a South Asian group compared with other race/ethnicity groups in the United States[15]; this is consistent with the findings of this study. Hence, there is a greater need to focus on the Asian population from the Indian subcontinent in developing tailored interventions for diabetes mellitus awareness, screening, prevention, and management programs. A recent review has highlighted the need for additional studies examining diabetes mellitus among Asian American immigrants in light of the limited studies on diabetes mellitus in this population.[35]

Limited data exist on the prevalence of high cholesterol and physical inactivity among Asian immigrant subgroups. The South Asian subgroup has been identified as having a higher risk of developing atherosclerotic disease and reporting higher related hospitalization and mortality rates when compared with other racial/ethnic minority groups in the United States.[36,37] Although significant differences in high cholesterol prevalence were not identified between the South Asian/Indian subcontinent and the White group, this study identified that the Southeast Asian group may require more intensive monitoring because they are also more likely to report high cholesterol than Other Asian subgroups. Asian American immigrants are less likely than other ethnic groups to follow public health recommendations for physical activity,[38,39] as identified in this study. There is a great need to develop effective interventions to promote physical activity adoption and maintenance among Asian immigrants.

The findings in this study of a lower prevalence of smoking among Asian immigrants than the White population was consistent with some prior reports.[18,40] Yet, other studies suggest that the prevalence of smoking among specific Asian subgroups varies and can be higher than that of the US population.[41,42] There are significant differences in smoking-related social norms between various Asian countries and the United States. Particularly, the sex-specific smoking norm of Asian countries likely influences smoking behavior among immigrants in the United States. For instance, in most Asian countries, social norms dictate more men smoke, but not women,[43] except for Japanese women.[44] Additionally, Asian immigrants with lower education have a higher prevalence of smoking and lower quit rates.[44] Hence, Asian men with lower education should be targeted by public health antismoking educational programs.

In this study, a higher prevalence of hypertension was seen among the Southeast Asian subgroup than the Other Asian subgroup, although the difference was not significant compared with the non-Hispanic White group. Previously, Filipino immigrants were observed to have the highest prevalence of hypertension compared with Other Asian immigrants.[38] Initiatives to increase awareness, screening, and support programs need to be implemented not just for Southeast Asian immigrants but all Asian immigrants to promote a heart-healthy lifestyle. Overall, CVD prevalence and mortality are lower among Asian American immigrants[45]; this is suggestive of a healthy immigrant effect.[46] Nevertheless, the change in lifestyle after moving to the United States, including consuming an unhealthy diet, physical inactivity, and subsequent obesity, are common among Asian immigrant subgroups and may lead to a higher risk for CVD compared with the non-Hispanic White population. Some of the major contributors to these disparities in CVD risk factors include the heterogeneity in national origin, religion, socioeconomic status, education, immigration history, health literacy, and health-seeking behavior, which influence health-promoting knowledge, beliefs, and the overall health of these immigrant groups in the United States. Combined with linguistic and cultural barriers, health literacy is a critical determinant of immigrant health,[47] and has been observed to be lower among Asian immigrants,[48] often varying among Asian subgroups. Health literacy is vital; it provides individuals with motivation and the ability to understand and use the information to promote health or manage disease conditions.

Preventive health care is a critical area requiring special attention for Asian immigrants. Although Asian immigrants are the fastest-growing immigrant group in the United States, health promotion and prevention programs for this population have not kept pace with this growth. Although participants with health insurance were higher in this population than previously reported,[49] Asian immigrants generally report less use of preventive and acute healthcare services and high use of emergency services once their health conditions worsen.[49] Although this practice is common in some Asian countries of origin, with limited medical resources and the need to pay out of pocket, Asian immigrants would benefit from receiving preventative and early screening of risk factors when they immigrate to the United States. Lower perceived vulnerability, higher perceived benefits of complementary therapy, and lower perceived benefits of Western medication can also factor into increasing CVD burden and risks among Asian immigrants. Clinicians are at the forefront of implementing primary and secondary CVD prevention strategies for Asian immigrants in communities and hospitals. Hence, increasing our understanding of Asian populations and their CVD risk profile among clinicians is imperative to design and tailor interventions that are culturally sensitive and effective for CVD prevention and management in the United States.

This study provides valuable insights into the heterogeneity and disparities that exist in the reporting of

CVD risk factors among Asian immigrants. Additional studies are needed to understand the CVD burden and the risks among Asian subgroups. For instance, future studies considering sex differences while examining CVD risk factors among Asian immigrant subgroups may provide additional insights about high-risk groups. There is also a need to prospectively examine the effect of acculturation and the length of US residence among Asian immigrant subgroups to elucidate the process and mechanisms contributing to CVD risk disparities. Longitudinal studies, such as the Mediators of Atherosclerosis in South Asians Living in America study,[15] a cohort study examining CVD in the South Asian population, are needed to examine Other Asian subgroups. Further studies should also focus on implementing promising interventions using rigorous methodologies to add to the growing body of knowledge and practice of CVD risk reduction interventions and their effectiveness among Asian immigrant subgroups considering the specific risk burden.

The study has some limitations. First, the outcomes were primarily obtained from self-reported diagnoses of CVD risk factors and may be subject to social desirability or healthcare access bias, resulting in an underestimation of the true prevalence of CVD risk factors among study participants. We were unable to compare the prevalence of CVD risk factors among Asian immigrants using population-based studies that obtained objective clinical measures (ie, National Health and Nutrition Examination Survey) and self-report (ie, NHIS). Although the National Health and Nutrition Examination Survey obtains clinical markers, it does not include the country or region of birth of participants to enable the identification of Asian immigrants as we did in this study. Second, Asian immigrant subgroups included in the study were preclassified by the NHIS data set and may have included subpopulations with diverse ethnicities, religions, and cultures into one subgroup. Additionally, Asian immigrants who were not either English or Spanish speaking were likely missed in the NHIS, thus limiting generalizability. Third, because this was a cross-sectional study, no causal inferences could be made as to whether these CVD risk factors were acquired before or after migration to the United States. Fourth, secondary data analysis limited the availability of data to examine potential confounders such as diet. Despite these limitations, this study makes use of a large nationally representative sample of civilian, noninstitutionalized Asian immigrant subgroups and a US-born non-Hispanic White population for comparison of the prevalence of CVD risk factors. The strength of using NHIS is that it oversamples for Asian immigrants compared with other immigrant groups. Additionally, the study pooled data from 9 years to increase statistical power and provide meaningful comparison across groups. This study is population based and addresses an existing gap in health disparities research and provides novel insights on the CVD risk profiles of Asian immigrant subgroups in the United States, and emphasizes the necessity of team-based interventions that are culturally sensitive and effective for CVD prevention. As we move to more personalized models of health care, disaggregating data based on racial and ethnic characteristics becomes increasingly important. This will require a more granular approach to collecting and analyzing data as well as to ensure that this information does not drive stereotyping and stigmatizing behavior.

CONCLUSIONS

Asian immigrants from all 3 subgroups, Indian subcontinent, Southeast Asia, and Other Asia, were more likely to report physical inactivity and less likely to report current smoking than their non-Hispanic White counterparts. Asian immigrants from the Indian subcontinent were more likely to report overweight/obesity and Southeast Asian immigrants were more likely to report high cholesterol. Immigrants from both the Indian subcontinent and Southeast Asia were more likely to report diabetes mellitus. This study supports the need to disaggregate data for Asian immigrant subgroups on CVD risk profiles, which should be considered when setting priorities for future CVD prevention and reduction programs for specific Asian immigrant populations.

ARTICLE INFORMATION

Received December 7, 2020; accepted April 23, 2021.

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Sources of Funding

None.

Disclosures

Dr Turkson-Ocran is supported by the Strategically Focused Research Network Award from the American Heart Association: 17SFRN33590069. The remaining authors have no disclosures to report.

Supplementary Material

Figure S1

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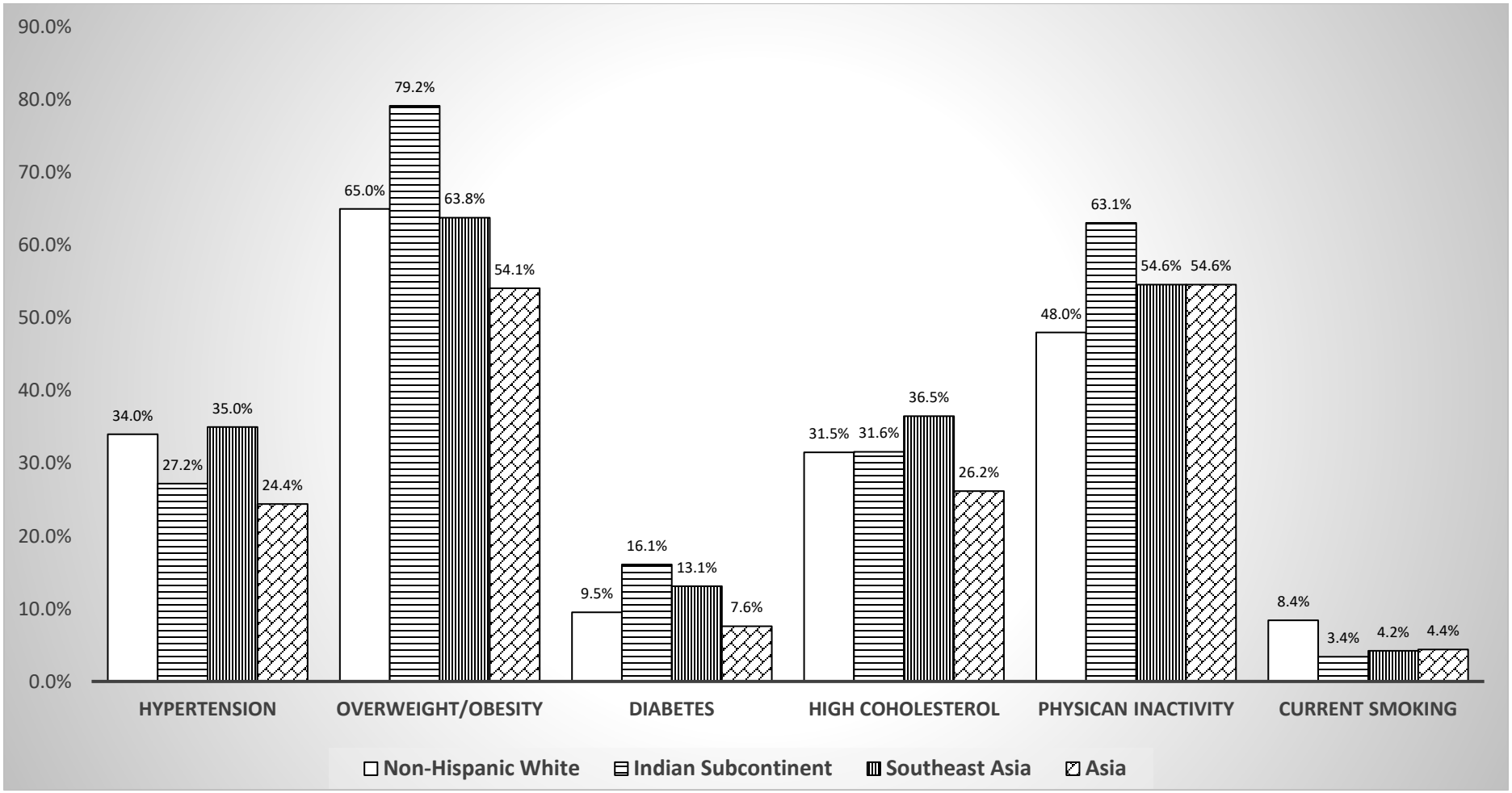
SUPPLEMENTAL MATERIAL

Figure S1. Fully-Adjusted Prevalence of Cardiovascular Disease Risk Factors.



Indian Subcontinent: Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Pakistan, India, Nepal, Pakistan, Sri Lanka or Ceylon, Tibet
Southeast Asia: Borneo, Brunei, Burma or Myanmar, Cambodia, Christmas Island, Hong Kong, Indonesia, Laos, Malaysia, Philippines, Singapore, Taiwan, Thailand, Vietnam
Asia: Asia, Asia Minor, China, Japan, Mongolia, North Korea, South Korea
Fully-adjusted model: adjusted for age, sex, education, employment, insurance status, usual place to go when sick and poverty income ratio