



Coronary Heart Disease Mortality for Six Ethnic Groups in California, 1990–2000

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PURPOSE: To investigate ethnic variations in coronary heart disease death in California, the authors examined total and CHD-specific mortality among non-Hispanic white (white), Hispanic, non-Hispanic black (black), Chinese, Japanese, and Asian Indian Americans. Deaths were identified in the California Mortality Database and population information was derived from the 1990 and 2000 censuses.

METHODS: Age-standardized death rates per 100,000 population were calculated for ages 25 to 84 years from 1990 to 2000. Proportional mortality ratios (PMRs) for each sex and age group were calculated by dividing the proportion of deaths due to CHD in each ethnic group by the proportion of deaths due to CHD in the total population.

RESULTS: Blacks had the highest all-cause age-standardized death rates among men (1614) and women (1014). Blacks had the highest CHD death rates among men (272) and women (190). PMRs for CHD were highest in Asian Indian men (161) and women (144), reflective of the higher percentage of CHD deaths compared with all cause deaths in this group. All sex-ethnic groups showed a decline in all cause and CHD mortality compared with the period between 1985 and 1990, except Asian Indian women, who experienced a 16% increase in all cause mortality and 5% increase in CHD mortality.

CONCLUSIONS: There is considerable heterogeneity in CHD mortality among ethnic subgroups, and additional research is needed to guide treatment and prevention efforts. Blacks and Asian Indians in California are identified as particularly high risk populations.

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KEY WORDS: Ethnic Diversity, California, Coronary Heart Disease (CHD) Mortality, Non-Hispanic Black, Asian Indian, Non-Hispanic White, Hispanic, Chinese, Japanese, Proportional Mortality Ratios (PMRs), Standardized Mortality Ratios, Census.

INTRODUCTION

Ethnic diversity in the US is rapidly increasing, and information about differing cardiovascular disease risks among different subgroups is sparse. In the 2000 census, ethnic minorities made up 30% of the total US population (<http://www.census.gov>, 2000 #97). California is one of the most ethnically diverse states in the US. The proportion of Californians classified as non-Hispanic white decreased from 72% in 1980 to 53% in 2000. In turn, the proportion of all ethnic minorities has risen, and the average age of ethnic minority populations has increased over time.

Despite this increasing diversity, most of the knowledge available on cardiovascular disease death rates and risk factors is derived from non-Hispanic white populations.

Limited information is available concerning the mortality from CHD among Asian Pacific Islander subgroups. Until 1985, Asian Pacific Islanders were aggregated in census and mortality data, making it difficult to calculate accurate mortality rates for Asian Pacific Islander subgroups. Chinese migrants in New York City have lower cardiovascular mortality rates than whites (1). Studies of Japanese immigrants also reveal lower rates of CHD death compared with whites (2). Asian Indians have higher rates of CHD mortality when compared with white populations in England (3) and Canada (4). In the US, the proportion of the population accounted for by these non-white ethnic groups is significant and increasing. An understanding of cardiovascular disease patterns among these ethnic minorities in the US would be of great value in directing public health and clinical efforts.

The primary objective of this study is to examine the ethnic differences in coronary heart disease mortality among non-Hispanic white (white), Hispanic, non-Hispanic black (black), Chinese, Japanese, and Asian Indian groups in California from 1990 to 2000, updating and expanding our earlier study on this issue (5). The secondary objective is to examine sex and age group specific differences in CHD mortality among ethnic groups. Our particular focus is on

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the analysis of disaggregated Asian Pacific Islander data, which prior to 1985 had been grouped in census and mortality statistics.

METHODS

We used US Census data from 1990 and 2000 and California mortality data from 1990 to 2000, identifying approximately 1.8 million deaths. Population sizes were calculated by linear interpolation between data collected in the 1990 and 2000 censuses. Numbers of deaths with CHD as the primary cause of death were identified using *International Classification of Diseases, 9th revision* (ICD-9) classification codes 410 to 414 and 427 and ICD-10 codes I20 to I25.9 and I46 to I46.9 from California mortality data. Ethnicity data were obtained from Census data in 1990 and 2000 by self-report. Ethnicity is recorded on death certificates by the funeral director using state guidelines. Both census and death certificates ask a question on Hispanic ethnicity, followed by a question on white or black race. Thus, Hispanics who have identified themselves as white or black are classified as Hispanics in our analysis. Non-Hispanic whites are classified as whites, and non-Hispanic blacks are classified as blacks. The classification of race differs slightly between census and death tapes in that several small subpopulations (e.g., Bangladeshi, Pakistani, and Sri Lankan) are excluded from the group titles “Asian Indian” on the census but are included in the “Indian” category on death tapes (which excludes American Indians).

Analysis

Death rates were calculated by stratifying the population by sex and age (25–44, 45–64, 65–84, and 25–84 years). Age standardization to the total California population in 1995 was performed by the direct method using 20-year age groups within each sex and ethnic group. We also calculated age-specific death rates for ages 25 to 44, 45 to 64, and 65 to 84 years to detect any important differences not revealed in

age-standardized data. Rates are expressed per 100,000 population. We compared the various ethnic groups with the total population as the referent category.

Standardized mortality ratios (SMRs) for each sex and age group were calculated by expressing as a percentage the age-standardized death rate from CHD in each ethnic group divided by the expected death rate. The expected death rate is the comparable rate for the total population. The relative SMR is calculated by dividing the CHD SMR by the all-cause SMR. Relative SMRs express the actual CHD mortality experience of a population relative to its overall mortality experience. Proportional mortality ratios (PMRs) for each sex and age group were calculated by dividing the proportion of deaths due to CHD in each ethnic group by the proportion of deaths due to CHD in the total population and are expressed as a percentage. Calculation of the PMR is useful in that it does not use census data and it provides an indication of the relative importance of CHD as a cause of death in subpopulations.

RESULTS

Population sizes for persons between 25 and 84 years old in California in 1990 and 2000 and the percentages of each ethnic subgroup are given in Table 1, with the ethnic groups listed in order of decreasing population size. The median age is also listed for 2000 and reflects the fact that the age structure of the different populations vary greatly, probably as a result of both different birth rates and differential immigration. The largest percentage increases in population from 1990 to 2000 were seen in the Asian Indian group, with a 100% increase, and the Hispanic and Chinese groups, each with 28% increases.

Numbers of observed deaths, SMRs, relative SMRs and PMRs from CHD and all causes are presented in Table 2. Standardized mortality ratios for CHD were highest among black men and women but relative SMRs and PMRs were either lower or only slightly elevated, consistent with the high SMR for deaths from all causes for this group. Relative

TABLE 1. Population of California aged 25–84 years by sex for total population and six ethnic groups, 1990 and 2000 census data

| Ethnic group | 1990 | | | 2000 | | | Median age [†] | |
|------------------|-----------|-----------|------|------------|------------|------|-------------------------|-------|
| | Men | Women | %* | Men | Women | % | Men | Women |
| Total | 9,004,684 | 9,293,248 | 100 | 10,237,055 | 10,593,077 | 100 | 32.2 | 34.4 |
| White | 5,686,514 | 5,931,094 | 63.5 | 5,429,820 | 5,631,178 | 53.1 | 39.3 | 41.4 |
| Hispanic | 1,912,701 | 1,813,802 | 20.4 | 2,758,172 | 2,690,400 | 26.2 | 24.7 | 25.4 |
| African-American | 575,718 | 624,101 | 6.6 | 622,035 | 672,522 | 6.2 | 30.9 | 33.1 |
| Chinese | 216,302 | 234,684 | 2.5 | 313,320 | 356,384 | 3.2 | 35.9 | 37.5 |
| Japanese | 101,435 | 123,304 | 1.2 | 99,783 | 127,354 | 1.1 | 41.7 | 44.5 |
| Asian Indian | 52,004 | 41,553 | 0.5 | 109,471 | 91,162 | 1.0 | 30.6 | 29.6 |

*The percent of the total population aged 25–84 comprised by each ethnic group (men and women combined). Percentages do not add up to exactly 100, due to rounding.

[†]Median age calculated using Census 2000 data.

TABLE 2. Number of observed deaths, death rates, standardized mortality ratio (SMR) for coronary heart disease (CHD) and all causes of death, and relative standardized mortality ratio (RSMR) and proportional mortality ratio (PMR) for CHD for ages 25–84 by sex for total population and six ethnic groups in California, 1990–2000

| Ethnic group | Sex | Observed deaths | | SMR | | RSMR | PMR |
|--------------------|-------|-----------------|------------|-----|------------|------|-----|
| | | CHD | All causes | CHD | All causes | CHD | CHD |
| Total | Men | 209,977 | 1,007,419 | 100 | 100 | 100 | 100 |
| | Women | 143,508 | 775,722 | 100 | 100 | 100 | 100 |
| Non-Hispanic White | Men | 164,291 | 731,569 | 111 | 107 | 104 | 108 |
| | Women | 109,725 | 581,930 | 107 | 109 | 98 | 102 |
| Hispanic | Men | 19,326 | 124,316 | 67 | 75 | 89 | 75 |
| | Women | 13,845 | 80,007 | 74 | 70 | 106 | 94 |
| Non-Hispanic Black | Men | 13,854 | 88,743 | 124 | 156 | 79 | 75 |
| | Women | 12,420 | 67,733 | 160 | 155 | 103 | 99 |
| Chinese | Men | 2,874 | 16,493 | 48 | 58 | 83 | 84 |
| | Women | 1,752 | 11,636 | 47 | 56 | 84 | 81 |
| Japanese | Men | 1,700 | 8,182 | 60 | 64 | 94 | 100 |
| | Women | 1,011 | 6,799 | 46 | 59 | 78 | 80 |
| Asian Indian | Men | 925 | 2,750 | 92 | 53 | 174 | 161 |
| | Women | 453 | 1,702 | 97 | 59 | 164 | 144 |

SMRs and PMRs for CHD were highest in Asian Indian men and women, reflective of the higher percentage of CHD deaths compared with all cause deaths in this group. The lowest relative SMRs and PMRs for CHD are found in black men and Japanese women. The similarity of relative SMRs and PMRs in this population-based analysis indicates reproducibility in estimates derived separately from census and mortality data.

Table 3 shows the all cause and CHD mortality rates from 1985 to 1990 (5) and 1990 to 2000. Blacks have the highest all-cause age-standardized death rate among both men and

women. The lowest all-cause death rates by sex are found in Asian Indian men and Japanese and Chinese women. Blacks also have the highest CHD death rates among men and women. The lowest CHD death rates are found in Japanese and Chinese men and Japanese women.

All cause and CHD mortality (Table 3) decreased for all sex-ethnic groups except Asian Indian women. All cause and CHD mortality declined more slowly among women than men of all ethnic groups. The greatest decline in all cause and CHD mortality was seen among Chinese men and women. Among men, the Japanese showed the slowest decline in all cause and CHD mortality. The only group that showed increased all cause and CHD mortality was Asian Indian women.

Figure 1 shows CHD SMRs for men and women by ethnicity and age group. Ethnic differences were most marked in women and younger age groups. In all age-sex groups, blacks had the highest SMRs for CHD. Figure 2 presents CHD PMRs for men and women by ethnicity and age group. Asian Indians had the highest PMRs for CHD in all age-sex groups, except for the youngest women. Although the absolute rate for CHD deaths was low in Asian Indians (Table 2), total mortality was also low. CHD was responsible for a higher proportion of deaths in Asian Indians than in other ethnic groups, as reflected in higher PMRs. In most age-sex groups, the Chinese had both the lowest SMRs and PMRs.

DISCUSSION

The major findings of this study are that age-standardized rates for CHD and all cause mortality in California were highest for blacks in all age-sex groups. CHD death rates in all Hispanic, Chinese, and Japanese age-sex groups were low

TABLE 3. Percentage change in all-cause and CHD mortality*, 1985–2000

| | | All-cause mortality rate 1985–1990 | All cause mortality rate 1990–2000 | Percentage change | CHD Mortality rate 85–90 | CHD Mortality rate 90–00 | Percentage change |
|--------------------|-------|------------------------------------|------------------------------------|-------------------|--------------------------|--------------------------|-------------------|
| | | Total | Men | 1200 | 1024 | –15% | 280 |
| | Women | 700 | 657 | –6% | 139 | 119 | –14% |
| Non-Hispanic White | Men | 1243 | 1105 | –11% | 302 | 244 | –19% |
| | Women | 726 | 712 | –2% | 143 | 128 | –10% |
| Hispanic | Men | 856 | 768 | –10% | 175 | 147 | –16% |
| | Women | 478 | 460 | –4% | 97 | 88 | –9% |
| Non-Hispanic Black | Men | 1800 | 1614 | –10% | 316 | 272 | –14% |
| | Women | 1059 | 1014 | –4% | 214 | 190 | –11% |
| Chinese | Men | 773 | 598 | –23% | 155 | 105 | –32% |
| | Women | 446 | 367 | –18% | 73 | 56 | –23% |
| Japanese | Men | 693 | 646 | –7% | 146 | 132 | –10% |
| | Women | 420 | 385 | –8% | 67 | 55 | –18% |
| Asian Indian | Men | 668 | 551 | –18% | 258 | 201 | –22% |
| | Women | 335 | 387 | 16% | 110 | 116 | 5% |

*Age standardized death rates per 100,000 population.

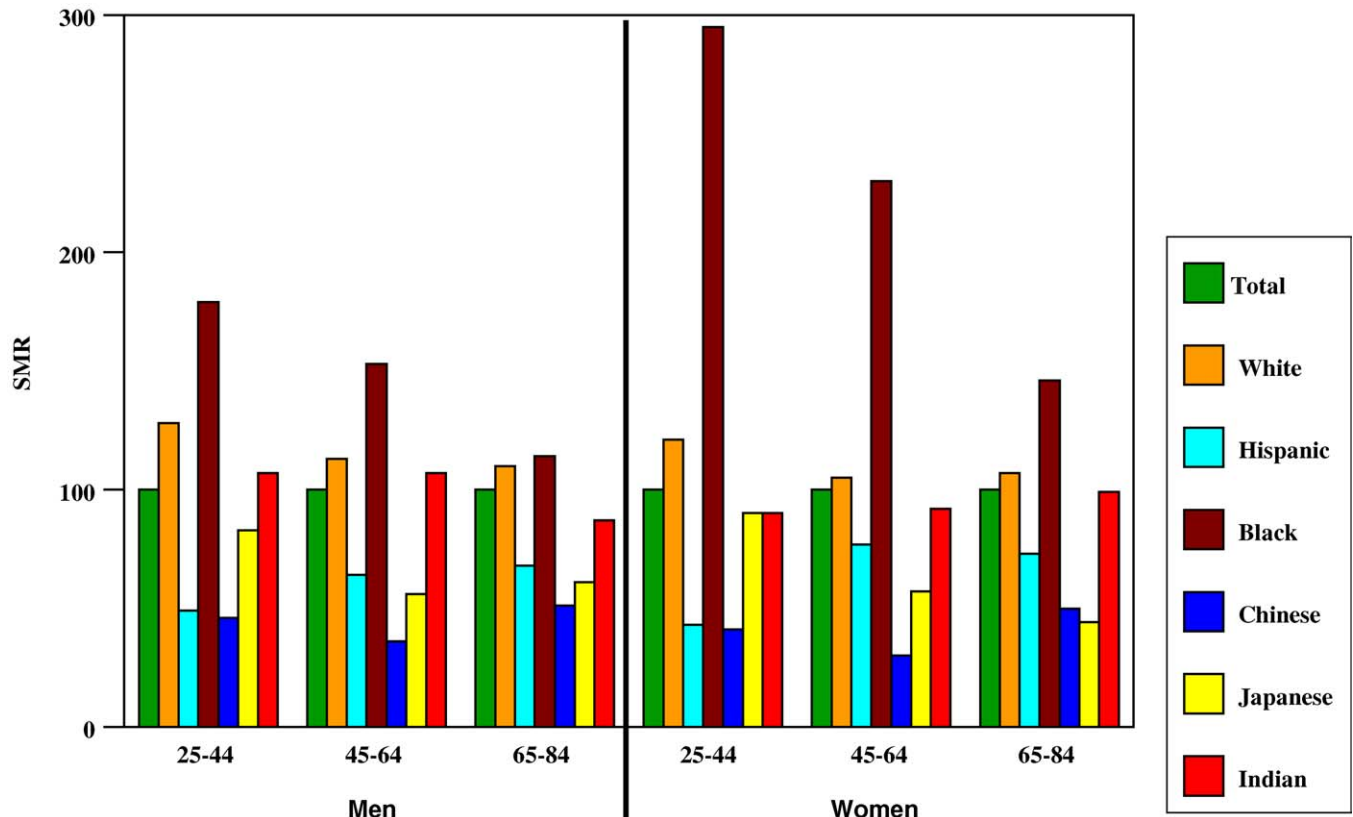


FIGURE 1. CHD standardized mortality ratios (SMRs) for men (left) and women (right) by age group and ethnicity.

in comparison to those for blacks. A higher proportion of all deaths in Asian Indians were due to CHD compared with other ethnic groups. While all other sex-ethnic groups showed a decline in all cause and CHD mortality, only Asian Indian women experienced an increase. These findings underline the importance of CHD as a cause of death for blacks and Asian Indians and reveal that ethnic differences tend to be more marked for women and younger age groups.

We found that the overall burden of mortality was about 50% higher in black men and women when compared with the total population. Greater CHD mortality only accounts for 10% of this excess in men and 20% of the excess deaths in women. The excess mortality from all causes for blacks also reflects higher mortality from cancer (6), infectious diseases (7), and stroke (8). Specific cancer studies have shown higher likelihood of prostate cancer mortality among black men compared with white men (9), and increased breast cancer mortality in black women (10). Infectious diseases account for nearly 10% of the excess all cause mortality rates in blacks compared with whites (7), even after accounting for income and education levels. Differences in stroke mortality between blacks and whites are due to differences in stroke incidence rather than case fatality (11), and only a portion of the excess stroke mortality observed among

blacks can be explained by the higher prevalence of hypertension and diabetes in blacks, and by the lower average socioeconomic status (SES) among blacks (8). Thus, for every major cause of death there are ethnic disparities that result in a higher overall mortality burden for blacks.

CHD rates in blacks compared with whites have changed over time. Studies before 1980 reported that CHD death rates were lower for black than white men and women (12). In the 1980s, the decline in CHD mortality was greater for whites than for blacks (13). In 1989, the age-adjusted death rate for CHD among black men exceeded that of whites for the first time (14). Our study revealed the highest CHD death rates in blacks and other recent studies have reported similar rates for CHD death in blacks (13, 15). Several factors have been proposed to explain the increased CHD mortality for blacks including increased prevalence of risk factors, differential access to care (16), and lower SES (17). Cardiovascular disease risk factors known to be more prevalent in blacks include hypertension (18), diabetes (19), and subclinical atherosclerosis (20). Access to care is limited in blacks and may depend upon a number of factors, among them cultural isolation (21), individual and group attitudes (22), perception of resource availability (23), and SES. Some studies have concluded that socioeconomic

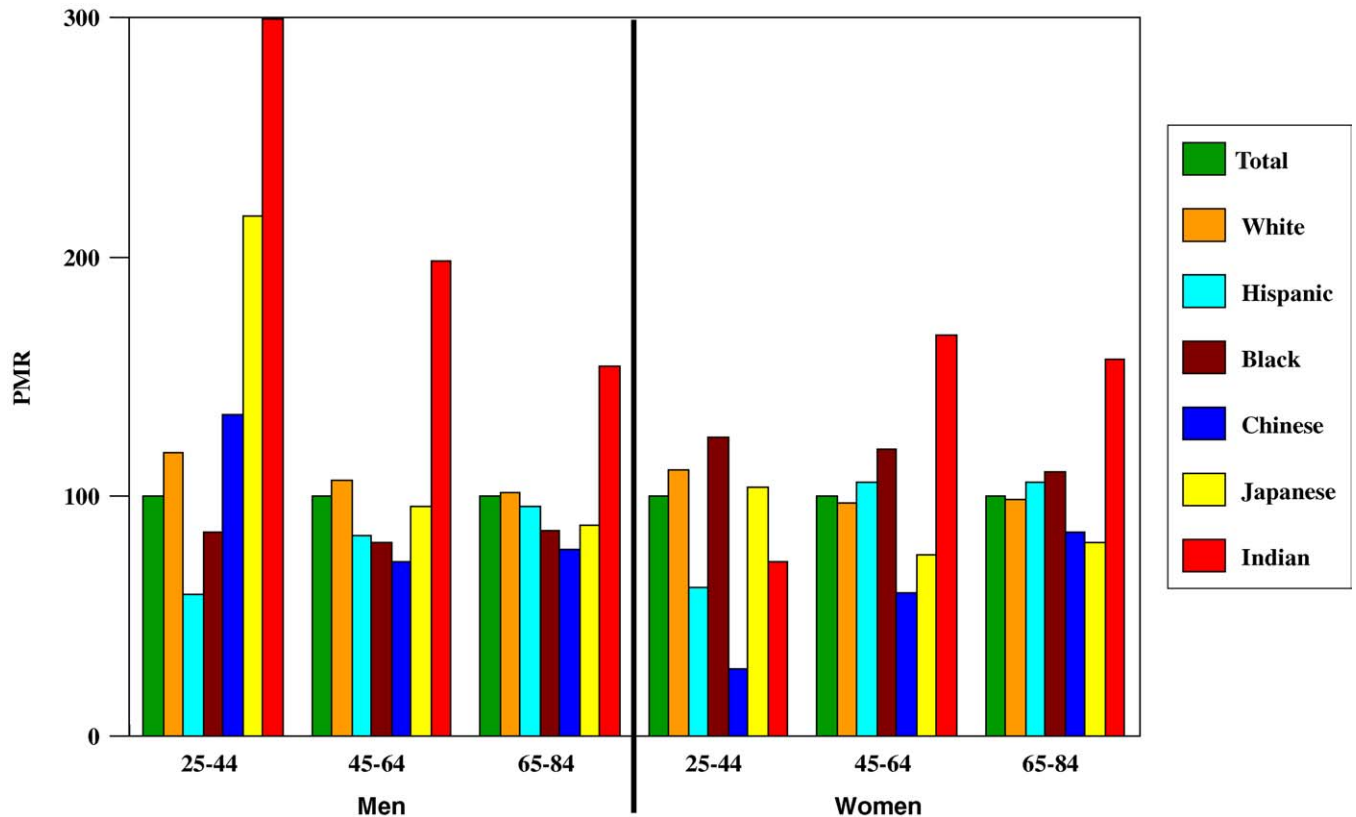


FIGURE 2. CHD proportionate mortality ratios (PMRs) for men (left) and women (right) by age group and ethnicity.

position is the major contributor to differences in death rates between black and white men, (24) while others find that at each level of income, blacks still have higher mortality than whites (25). A combination of these physiological, psychological, and social risk factors influence the higher CHD death rates observed in blacks.

Hispanics have lower all cause and cardiovascular mortality, despite increased diabetes and obesity, lower SES, and barriers to health care. This comparative health advantage has been termed the “Hispanic Paradox” (26). Numerous studies have shown that Hispanics have coronary heart disease mortality rates equal to or lower than their non-Hispanic white counterparts (27, 28). Possible under-reporting of Hispanic deaths due to return migration and healthy migrant effects may contribute to, but do not explain, the paradox. The return migration hypothesis has been examined in US-born Hispanics (who do not engage in return migration), and they are still noted to have lower mortality than US-born non-Hispanic whites (29) in some studies. Other studies have concluded that US-born Hispanics are at greater risk of all-cause and cardiovascular mortality than non-Hispanic whites and Mexico-born Hispanics (30). The alternative hypothesis that selection

of healthier migrants to the United States accounts for the paradox has also been explored (29). Differences in mortality rates among Hispanic subgroups indicate variations by age, gender, acculturation, and country of birth (31). The reasons for the apparent “Hispanic paradox” are thus likely to be multi-factorial and social in origin. Our study confirms lower all cause and CHD death rates for Hispanics in California. Further research on the possible protective effects of Hispanic immigrant status and acculturation factors to explain this lower mortality is warranted, but there is no reason for physicians to ignore known CVD risk factors in Hispanic patients.

Death rates for Chinese migrants to the US do not follow the usual pattern of migrants (an intermediate position between rates of European migrants and Chinese in homeland China). New York Chinese had lower all cause mortality rates than did either New York whites or Chinese in China (32). Lower rates of death from CHD compared with those for people of European origin have been observed in people of Chinese origin living in the United States (5), Hong Kong (33), and mainland China (34). Theories proposed for the lower CHD mortality rates observed in Chinese Americans include lower cholesterol levels and

a dietary pattern of low saturated fat and cholesterol intake (34) as well as differences in angiotensin converting enzyme genotypes (35). Thus, the lower all cause and CHD mortality in Chinese in California may be explained by favorable lifestyle and genetic factors, but much more study is needed.

The epidemiology of cardiovascular disease in Japanese Americans has been extensively studied. The Ni-Hon-San Study (36), which compared CVD rates and risk factors in Japanese men living in Japan, Hawaii, and California, showed that CHD mortality rates in Hawaii were intermediate between rates in Japan and California. Japanese immigrants to Brazil also have lower all cause (37) and coronary heart disease mortality rates than their Brazilian counterparts, but higher rates than native Japanese (38). Cancer is an important cause of death for Japanese in Japan (39) as well as in immigrant populations (40). The results of these studies show that immigrant Japanese, although sharing a common ethnic background, experience different rates of disease when living in diverse geographic and cultural areas (2). The much lower CHD mortality in Japan suggests that there may be strong and important protective factors that reduce the risk of CHD in Japan (41). Our study has shown that compared with other ethnic subgroups in California, all cause and CHD mortality rates are low in Japanese Americans.

While absolute rates for CHD were only slightly lower than for the total population, all cause death rates were much lower for Asian Indians in our study. This results in a proportionate increase in CHD mortality for the Asian Indian population, reflected in higher relative SMRs and PMRs. Previous studies in England (3), Canada (4), and Singapore (42) have shown high absolute as well as proportionate death rates for CHD in Asian Indians, although comparable data for India are not available. There is considerable heterogeneity within immigrant populations from the Indian subcontinent, which includes Asian Indians, Pakistanis, Bangladeshis, and Sri Lankans. Over 90% of the South Asian population in California is Asian Indian. Studies in England have also shown that SES within immigrant populations may be an important risk factor (43), and this may explain some of the differences in absolute CHD rates between England and the US. Concurrent prospective mortality data from India, as well as Indian diaspora populations in different countries, would be helpful in elucidating mechanisms as to why these rates differ.

Several theories have been proposed to explain higher CHD death rates in Asian Indians including metabolic syndrome, diabetes, prothrombotic factors, and abnormal lipoproteins. The metabolic syndrome, characterized by central obesity, impaired fasting glucose, high blood pressure, and a lipid profile of low levels of high-density lipoprotein and high triglyceride levels has been associated with higher CHD rates in Asian Indians (44). Studies have

shown increased prevalence of diabetes (45) and increased diabetes mortality (4) in Asian Indian populations. Prothrombotic risk factors, particularly fibrinogen have been noted (46) and associated with CHD (47) in Asian Indians. There are higher mean Lp(a) levels noted in Asian Indian populations, though the prognostic significance is uncertain (48). The increasing all cause and CHD mortality in Asian Indian women noted in this study is especially concerning, and this group in particular warrants closer observation and intervention. Cohort studies on CHD in South Asians are needed and these should be designed so that data can be combined for future systematic reviews.

A potential limitation of our study is that our analysis was based on death certificates, which may contain errors in the documented cause of death. However, we are not aware of data showing that the rate of such errors varies by ethnic group, although this is possible. However, such errors are unlikely to have an important effect where very large relative differences exist in rates of death from various diseases. Also, census and mortality data are subject to misclassification of ethnicity, which results in understated death rates for certain minority populations (2% for Hispanics, 11% for Asians) and overstated death rates for whites (1%) and blacks (5%) (49). The agreement between relative SMRs (which use census data and mortality data) and PMRs (which use mortality data only) indicate that the influence of these coding differences, if any, is minimal.

A “healthy migrant” effect has been proposed as an explanation for lower mortality among immigrant groups. Based on population increases during this 10-year period, Hispanics, Chinese, and Asian Indians were the major immigrant groups to California. All of these groups had lower all cause mortality rates than the total population. Therefore, relative SMRs and PMRs are important tools for comparison in these populations as this ratio takes into account lower all cause mortality. Due to the large degree of ethnic variation within California, we have used the general population as a comparison group. Comparison with the general population blunts ethnic variations in death rates and SMRs. PMRs are also useful in this case, as it identifies important causes of death for a particular ethnic group.

The burden of coronary heart disease is rising among ethnic minority populations in the United States. Ethnic differences are more prominent in younger age groups, perhaps an artifact due to healthy survivor effects. Our knowledge of the epidemiology of CHD is derived principally from populations of European origin. There is considerable heterogeneity in CHD mortality among ethnic subgroups, and they should be studied and analyzed separately in the future. Further research is required to establish the foundation of knowledge required for effective coronary heart disease prevention in ethnic minority groups.

REFERENCES

1. Fang J, Madhavan S, Alderman MH. Cardiovascular mortality of Chinese in New York City. *J Urban Health*. 1999;76(1):51–61.
2. Benfante R. Studies of cardiovascular disease and cause-specific mortality trends in Japanese-American men living in Hawaii and risk factor comparisons with other Japanese populations in the Pacific region: A review. *Hum Biol*. 1992;64(6):791–805.
3. Balarajan R. Ethnic differences in mortality from ischaemic heart disease and cerebrovascular disease in England and Wales. *BMJ*. 1991;302(6776):560–564.
4. Sheth T, Nair C, Nargundkar M, Anand S, Yusuf S. Cardiovascular and cancer mortality among Canadians of European, south Asian and Chinese origin from 1979 to 1993: an analysis of 1.2 million deaths. *CMAJ*. 1999;161(2):132–138.
5. Wild SH, Laws A, Fortmann SP, Varady AN, Byrne CD. Mortality from coronary heart disease and stroke for six ethnic groups in California, 1985 to 1990. *Ann Epidemiol*. 1995;5(6):432–439.
6. Fang J, Madhavan S, Alderman MH. Influence of nativity on cancer mortality among black New Yorkers. *Cancer*. 1997;80(1):129–135.
7. Richardus JH, Kunst AE. Black-white differences in infectious disease mortality in the United States. *Am J Public Health*. 2001;91(8):1251–1253.
8. Howard G, Howard VJ. Ethnic disparities in stroke: The scope of the problem. *Ethn Dis*. 2001;11(4):761–768.
9. Merrill RM, Lyon JL. Explaining the difference in prostate cancer mortality rates between white and black men in the United States. *Urology*. 2000;55(5):730–735.
10. Flaws JA, Newschaffer CJ, Bush TL. Breast cancer mortality in black and in white women: A historical perspective by menopausal status. *J Womens Health*. 1998;7(8):1007–1015.
11. Kennedy BS, Kasl SV, Brass LM, Vaccarino V. Trends in hospitalized stroke for blacks and whites in the United States, 1980–1999. *Neuroepidemiology*. 2002;21(3):131–141.
12. Keil JE, Loadholt CB, Weinrick MC, Sandifer SH, Boyle E Jr. Incidence of coronary heart disease in blacks in Charleston, South Carolina. *Am Heart J*. 1984;108(3 Pt 2):779–786.
13. Park H, Safdar N, Schmidt H. Decline in mortality of coronary heart disease among whites and blacks in Wisconsin 1979–1998. *WMJ*. 2002;101(3):23–27.
14. Liao Y, Cooper RS. Continued adverse trends in coronary heart disease mortality among blacks, 1980–91. *Public Health Rep*. 1995;110(5):572–579; discussion 570–572.
15. Traven ND, Kuller LH, Ives DG, Rutan GH, Perper JA. Coronary heart disease mortality and sudden death among the 35–44-year age group in Allegheny County, Pennsylvania. *Ann Epidemiol*. 1996;6(2):130–136.
16. Haywood LJ. Hypertension in minority populations. Access to care. *Am J Med*. 1990;88(3B):17S–20S.
17. Barnett E, Armstrong DL, Casper ML. Evidence of increasing coronary heart disease mortality among black men of lower social class. *Ann Epidemiol*. 1999;9(8):464–471.
18. Liu K, Ruth KJ, Flack JM, Jones-Webb R, Burke G, Savage PJ, et al. Blood pressure in young blacks and whites: Relevance of obesity and lifestyle factors in determining differences. The CARDIA Study. Coronary Artery Risk Development in Young Adults. *Circulation*. 1996;93(1):60–66.
19. Cowie CC, Harris MI, Silverman RE, Johnson EW, Rust KF. Effect of multiple risk factors on differences between blacks and whites in the prevalence of non-insulin-dependent diabetes mellitus in the United States. *Am J Epidemiol*. 1993;137(7):719–732.
20. Urbina EM, Srinivasan SR, Tang R, Bond MG, Kieltyka L, Berenson GS. Impact of multiple coronary risk factors on the intima-media thickness of different segments of carotid artery in healthy young adults (The Bogalusa Heart Study). *Am J Cardiol*. 2002;90(9):953–958.
21. Smith EA. Cultural and linguistic factors in worker notification to blue collar and no-collar African-Americans. *Am J Ind Med*. 1993;23(1):37–42.
22. Kennedy BP, Kawachi I, Lochner K, Jones C, Prothrow-Stith D. (Dis)respect and black mortality. *Ethn Dis*. 1997;7(3):207–214.
23. Chin MH, Zhang JX, Merrell K. Diabetes in the African-American Medicare population. Morbidity, quality of care, and resource utilization. *Diabetes Care*. 1998;21(7):1090–1095.
24. Davey Smith G, Neaton JD, Wentworth D, Stamler R, Stamler J. Mortality differences between black and white men in the USA: Contribution of income and other risk factors among men screened for the MRFIT. MRFIT Research Group. Multiple Risk Factor Intervention Trial. *Lancet*. 1998;351(9107):934–939.
25. Sorlie P, Rogot E, Anderson R, Johnson NJ, Backlund E. Black-white mortality differences by family income. *Lancet*. 1992;340(8815):346–350.
26. Palloni A, Morenoff JD. Interpreting the paradoxical in the Hispanic paradox: Demographic and epidemiologic approaches. *Ann N Y Acad Sci*. 2001;954:140–174.
27. Yu PN. Heart disease in Asians and Pacific-Islanders, Hispanics, and Native Americans. *Circulation*. 1991;83(4):1475–1477.
28. Goff DC Jr, Ramsey DJ, Labarthe DR, Nichaman MZ. Acute myocardial infarction and coronary heart disease mortality among Mexican Americans and non-Hispanic whites in Texas, 1980 through 1989. *Ethn Dis*. 1993;3(1):64–69.
29. Abraido-Lanza AF, Dohrenwend BP, Ng-Mak DS, Turner JB. The Latino mortality paradox: A test of the “salmon bias” and healthy migrant hypotheses. *Am J Public Health*. 1999;89(10):1543–1548.
30. Hunt KJ, Williams K, Resendez RG, Hazuda HP, Haffner SM, Stern MP. All-cause and cardiovascular mortality among diabetic participants in the San Antonio Heart Study: evidence against the “Hispanic Paradox”. *Diabetes Care*. 2002;25(9):1557–1563.
31. Franzini L, Ribble JC, Keddie AM. Understanding the Hispanic paradox. *Ethn Dis*. 2001;11(3):496–518.
32. Fang J, Madhavan S, Alderman MH. Cancer mortality of Chinese in New York City 1988–1992. *Int J Epidemiol*. 1996;25(5):907–912.
33. Yu TS, Wong SL, Lloyd OL, Wong TW. Ischaemic heart disease: Trends in mortality in Hong Kong, 1970–89. *J Epidemiol Community Health*. 1995;49(1):16–21.
34. Tao SC, Huang ZD, Wu XG, et al. CHD and its risk factors in the People’s Republic of China. *Int J Epidemiol*. 1989;18(3 suppl. 1):S159–S163.
35. Young RP, Thomas GN, Critchley JA, Tomlinson B, Woo KS, Sanderson JE. Interethnic differences in coronary heart disease mortality in 25 populations: Association with the angiotensin-converting enzyme DD genotype frequency. *J Cardiovasc Risk*. 1998;5(5–6):303–307.
36. Marmot MG, Syme SL, Kagan A, Kato H, Cohen JB, Belsky J. Epidemiologic studies of coronary heart disease and stroke in Japanese men living in Japan, Hawaii and California: Prevalence of coronary and hypertensive heart disease and associated risk factors. *Am J Epidemiol*. 1975;102(6):514–525.
37. Tsugane S, Gotlieb SL, Laurenti R, Souza JM, Watanabe S. Mortality and cause of death among first-generation Japanese in Sao Paulo, Brazil. *Int J Epidemiol*. 1989;18(3):647–651.
38. de Souza RK, Gotlieb SL. [Mortality among Japanese migrants living in the State of Parana, Brazil]. *Rev Saude Publica*. 1999;33(3):262–272.
39. Fujiura Y, Adachi H, Tsuruta M, Jacobs DR Jr, Hirai Y, Imaizumi T. Heart rate and mortality in a Japanese general population: An 18-year follow-up study. *J Clin Epidemiol*. 2001;54(5):495–500.
40. Yano K, Grove JS, Chen R, Rodriguez BL, Curb JD, Tracy RP. Plasma fibrinogen as a predictor of total and cause-specific mortality in elderly Japanese-American men. *Arterioscler Thromb Vasc Biol*. 2001;21(6):1065–1070.
41. Sekikawa A, Satoh T, Hayakawa T, Ueshima H, Kuller LH. Coronary heart disease mortality among men aged 35–44 years by prefecture in Japan

- in 1995–1999 compared with that among white men aged 35–44 by state in the United States in 1995–1998: Vital statistics data in recent birth cohort. *Jpn Circ J*. 2001;65(10):887–892.
42. Tan AT, Emmanuel SC, Tan BY, Teo WS, Chua TS, Tan BH. Myocardial infarction in Singapore: A nationwide 10-year study of multiethnic differences in incidence and mortality. *Ann Acad Med Singapore*. 2002;31(4):479–486.
 43. Nazroo JY. South Asian people and heart disease: An assessment of the importance of socioeconomic position. *Ethn Dis*. 2001;11(3):401–411.
 44. McKeigue PM, Shah B, Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. *Lancet*. 1991;337(8738):382–386.
 45. Mather HM, Keen H. The Southall Diabetes Survey: Prevalence of known diabetes in Asians and Europeans. *Br Med J (Clin Res Ed)*. 1985;291(6502):1081–1084.
 46. Markovitz JH, Kulkarni K, Goldschmidt-Clermont P, Kiefe CI, Rustagi P, Sekar P, et al. Increased platelet activation and fibrinogen in Asian Indians. Potential implications for coronary risk. *Eur Heart J*. 1998;19(5):720–726.
 47. Deepa R, Velmurugan K, Saravanan G, Dwarakanath V, Agarwal S, Mohan V. Relationship of tissue plasminogen activator, plasminogen activator inhibitor-1, and fibrinogen with coronary artery disease in South Indian male subjects. *J Assoc Physicians India*. 2002;50:901–906.
 48. Chuang CZ, Subramaniam PN, LeGardeur BY, Lopez A. Risk factors for coronary artery disease and levels of lipoprotein(a) and fat-soluble antioxidant vitamins in Asian Indians of USA. *Indian Heart J*. 1998;50(3):285–291.
 49. Rosenberg HM, Maurer JD, Sorlie PD, Johnson NJ, MacDorman MF, Hoyert DL, et al. Quality of death rates by race and Hispanic origin: A summary of current research, 1999. *Vital Health Stat*. 1999;2(128):1–13.