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Sociodemographic Influences on Hispanic-White Differences in Blood Pressure

SYNOPSIS

DATA ARE PRESENTED for 933 Hispanic and 7087 white men and women, ages 25 to 74, who participated in biennial cross-sectional surveys in California from 1979 to 1990. Using an unadjusted analysis, white women and men had significantly higher mean systolic blood pressures (123.4 mmHg versus 119.6 mmHg) and higher levels of hypertension (29.0% versus 22.9%) than Hispanic women and men (P values greater than 0.001).

To reduce bias from confounding, a subset of 702 Hispanics were matched to 702 whites on age, gender, education, city of residence, and time of survey. All ethnic differences in blood pressure became nonsignificant in this analysis. The mean systolic blood pressure for whites was 120.0 mmHg; for Hispanics, 120.7 mmHg (24.4% hypertension for both groups, P values greater than 0.10). These findings show the importance of taking sociodemographic factors into account when examining ethnic differences in blood pressure.

While past studies have compared blood pressure in Hispanic and white (non-Hispanic) populations, few have controlled for potential bias from sociodemographic factors in a rigorous manner (1-3). Furthermore, few have been conducted in California, whose population is 26% Hispanic (4-6). We had the opportunity to expand findings from previous blood pressure studies by using data from the Stanford Five-City Project, a community-based cardiovascular disease intervention study, conducted in northern California during the 1980s. In this analysis, we present comparative data for several blood pressure indicators for Hispanics and whites, sampled from four cities and representing a broad spectrum of educational levels (7).

Methods

The Stanford Five-City Project includes data from five separate cross-sectional surveys, conducted approximately biennially from 1979 to 1990. Households were randomly selected from two treatment and two control cities (in a fifth control city, only morbidity and mortality rates were monitored). All people ages 12 to 74 were eligible to participate and were invited to attend clinics located in the communities. Data from participants ages 25 to 74 are used for the current analysis.

Table 1. Sociodemographic and blood pressure data from two samples of Hispanic and white women and men ages 25 to 74, Stanford Five-City Project, 1979 to 1990

	Sample 1 Population-Based Unadjusted Data (n=933)	(n=7087)	P value ^b	Sample 2 Matched-Pairs Subgroup* (n=702)	(n=702)	P value ^b
Sociodemographic Factors						
Mean Age (years)	40.4	45.1	<0.001	40.7	41.3	0.002
Mean Education (years)	9.5	13.9	<0.001	10.5	12.0	<0.001
% Spanish-Speaking	40.6	0.2	—	34.0	2.8	—
% Mexican-American	90.1	0.0	—	88.4	0.0	—
Blood Pressure Indicators						
Mean Systolic Blood Pressure (mmHg)	119.6	123.4	<0.001	120.7	120.0	0.39
Mean Diastolic Blood Pressure (mmHg)	74.6	75.4	0.04	74.7	74.7	0.89
% with Hypertension	22.9	29.0	<0.001	24.4	24.4	1.00
Among Hypertensives, % Using Antihypertensive Medications	34.7	47.1	<0.001	44.9	52.2	0.35
Behavioral Factors						
Body Mass Index	27.6	25.5	<0.001	27.5	25.6	<0.001
Physical Activity (Kcal/kg/day) ^c	38.8	37.5	0.009	38.8	38.7	0.78
% of Calories from Fat ^d	33.1	36.4	<0.001	35.1	37.6	.04

* Hispanics matched to whites on gender, age, education, city of residence, and survey time period.

^b For sample 1, based on a two-sample t-test for continuous variables and a chi-square test for categorical data.

For sample 2, based on a paired t-test for continuous variables and McNemar's test for categorical data.

^c Based on 7-day total recall of work and leisure activities.

^d Obtained on a 40% random subsample of participants and based on standard 24-hour dietary recall data.

Each survey consisted of approximately 1800 to 2500 participants (response rates in successive surveys were 65%, 69%, 65%, 56%, and 61%). At each survey, approximately three-fourths of the nonrespondents answered a brief questionnaire, which showed that nonrespondents from both ethnic groups were less well educated than respondents. There were no significant differences in response rates between Hispanics and whites. Further details of the study design, field methodology, and results have been reported (8-10).

All questionnaire and physical measurement data were collected by health professionals at community survey centers. Although 90% of Hispanics in the Five-City Project sample are of Mexican-American origin, we did not restrict the analysis to Mexican Americans because we could not distinguish Mexican-American respondents from other Spanish-surnamed respondents in the fourth survey. However, results for the subset of 535 Mexican-American pairs that we could identify were almost identical.

We present data on mean systolic and diastolic blood pressure, prevalence of hypertension, and use of antihypertensive medications. Blood pressure was assessed using a semiautomatic blood pressure recorder to minimize observer bias. Three readings were taken after the participant had been seated for two minutes, and the mean of the second and third readings are used for analyses. Hypertension is defined as systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, current use of antihypertensive medications.

Blood pressure data are presented from two different samples. The first is the random population-based community sample of 933 Hispanic and 7087 white men and women ages 25 to 74. The second is a subgroup of the original sample in which 702 Hispanics are matched to

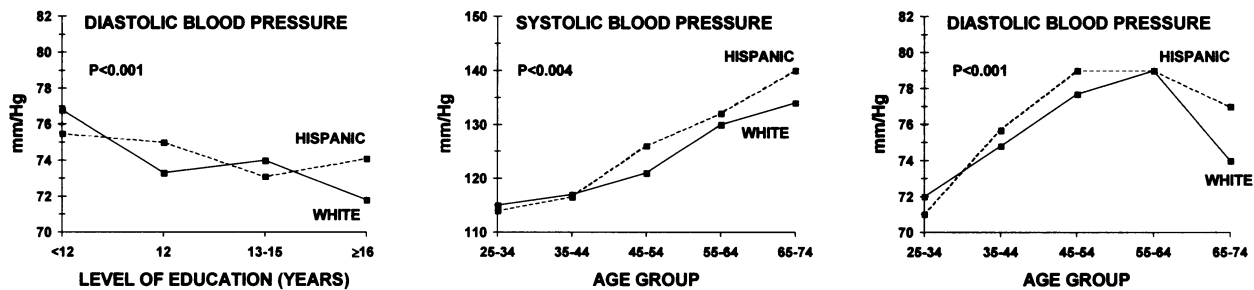
702 whites on gender, age (10-year age groups from 25 to 74), educational level (fewer than 12 years, 12 years, 13 to 15 years, 16 years, more than 16 years), city of residence (Salinas, Monterey, Modesto, San Luis Obispo), and survey time period (five periods from 1979 to 1990). This matched-pairs design reduces bias from confounding and problems associated with fitting mathematical models, such as equal variance assumptions and collinearity between variables (7). Multiple linear regressions of the ethnic risk factor difference scores were performed using data on the matched Hispanic-white pairs. For these analyses, we used the individual matching variables of gender, age group, educational level, city of residence, and survey time period as independent variables.

Results

Table 1 presents sociodemographic and blood pressure results for the two samples. Matching on age group almost eliminated age differences in the matched-pairs subgroup (mean age of 40.7 for Hispanics versus 41.3 for whites). Despite matching on five levels of education, Hispanics remained slightly less educated than their white counterparts (mean educational attainment of 10.5 years for Hispanics versus 12.0 for whites). Thus, we are not able to evaluate thoroughly environmental versus biologic explanations for any observed differences.

The analysis of the population-based unadjusted data showed that white women and men had significantly higher mean systolic blood pressures (123.4 mmHg versus 119.6 mmHg), higher levels of hypertension (29.0% versus 22.9%), and among people with hypertension, higher levels of antihypertensive medication use (47.1% versus 34.7%) than Hispanic women and men (P values <0.001).

Figure 1. Interactions between level of education and ethnicity for diastolic blood pressure, and between age group and ethnicity for systolic and diastolic blood pressure: the Stanford Five-City Project, ages 25 to 74, 1979 to 1990



All ethnic differences in blood pressure became non-significant in the matched-pairs subgroup analysis (P values >0.10). Mean systolic blood pressure was 120.0 mmHg for whites versus 120.7 mmHg for Hispanics; percent hypertension was 24.4% for both groups. After matching, Hispanics had a predominance of obesity; Hispanics and whites had similar levels of physical activity (as measured by 7-day total recall of work and leisure activities); and whites had higher total and saturated dietary fat intake (calculated from 24-hour dietary recall data) (7,11).

The multiple regression analysis of the matched-pairs sample showed several modest ethnic differences in blood pressure within specific educational and age subgroups (indicated by significant interactions between level of education and ethnicity for diastolic blood pressure, and between age group and ethnicity for systolic and diastolic blood pressure). These patterns are shown in Figure 1. Mean diastolic blood pressure decreased as level of education increased for both whites and Hispanics, but the decrease was steeper for whites than for Hispanics. This suggests that education exerts a stronger influence on white differences in blood pressure than on Hispanic differences (10).

The relationships between age and ethnicity for diastolic and systolic blood pressure show similar overall patterns for Hispanics and whites, with blood pressure levels increasing with age, but the associations are stronger for Hispanics. This stronger association between age and high blood pressure for Hispanics may be explained by poorer access to medical care and (or) lower antihypertensive medication use. Although Hispanics had higher levels of body mass index (BMI) at each age and educational level, the ethnic differences in BMI were similar for each sociodemographic subgroup, indicating that BMI did not confound these findings (data not shown).

Discussion

In this comparative analysis of Hispanics and whites, blood pressure was analyzed for two different samples. In the unmatched, unadjusted sample, whites had significantly higher levels of systolic and diastolic blood pres-

sure, higher levels of hypertension, and among hypertensives, higher levels of antihypertensive medication use than Hispanics. In the matched sample subgroup, average blood pressure measures were almost identical in the two ethnic groups, indicating that the results from the unadjusted data were confounded by the sociodemographic factors on which we matched. These findings show that ethnic comparisons of blood pressure can be biased if sociodemographic factors are not taken into account.

References

1. Franco, L. J., and others: Prevalence, detection, and control of hypertension in a biethnic community: the San Antonio Heart Study. *Am J Epidemiol* 121: 684-696 (1985).
2. Haffner, S. M., and others: Decreased prevalence of hypertension in Mexican-Americans. *Hypertension* 16: 225-232 (1990).
3. Sorel, J. E., Ragland, D. R., and Syme, S. L.: Blood pressure in Mexican Americans, whites and blacks: the Second National Health and Nutrition Examination Survey and the Hispanic Health and Nutrition Examination Survey. *Am J Epidemiol* 134: 370-378 (1991).
4. Stern, M. P., and others.: Affluence and cardiovascular risk factors in Mexican-Americans and other whites in three northern California communities. *J Chron Dis* 28: 623-636 (1975).
5. Kraus, J. F., Borhani, N. O., and Franti, C. E.: Socioeconomic status, ethnicity, and risk of coronary heart disease. *Am J Epidemiol* 111: 407-414 (1980).
6. Friis, R., and others: Coronary heart disease mortality and risk among Hispanics and non-Hispanics in Orange County, California. *Public Health Rep* 96: 418-422 (1981).
7. Winkleby, M. A., Fortmann, S. P., and Rockhill, B.: Health-related risk factors in a sample of Hispanics and whites matched on sociodemographic characteristics. *Am J Epidemiol* 137: 1365-1375 (1993).
8. Farquhar, J. W., and others: The Stanford Five-City Project: design and methods. *Am J Epidemiol* 122: 323-334 (1985).
9. Fortmann, S. P., and others: Effect of long-term community health education on blood pressure and hypertension control: the Stanford Five-City Project. *Am J Epidemiol* 132: 629-646 (1990).
10. Winkleby, M. A., Fortmann, S. P., and Barrett, D. C.: Social class disparities in risk factors for disease: eight-year prevalence patterns by level of education. *Prev Med* 19: 1-12 (1990).
11. Winkleby, M. A., and others: Dietary fat intake among low educated Hispanic and white adults and children. *Prev Med* 23: 465-473 (1994).