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Original Research

Social and psychosocial determinants of racial and ethnic differences in cardiovascular health: The MASALA and MESA studies

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ABSTRACT

Background: Social and psychosocial determinants are associated with cardiovascular health (CVH).
Objectives: To quantify the contributions of social and psychosocial factors to racial/ethnic differences in CVH.
Methods: In the Multi-Ethnic Study of Atherosclerosis and Mediators of Atherosclerosis in South Asians Living in America cohorts, Kitagawa-Blinder-Oaxaca decomposition quantified the contributions of social and psychosocial factors to differences in mean CVH score (range 0–14) in Black, Chinese, Hispanic, or South Asian compared with White participants.
Results: Among 7,978 adults (mean age 61 [SD 10] years, 52 % female), there were 1,892 Black (mean CVH score for decomposition analysis 7.96 [SD 2.1]), 804 Chinese (CVH 9.69 [1.8]), 1,496 Hispanic (CVH 8.00 [2.1]), 1,164 South Asian (CVH 9.16 [2.0]), and 2,622 White (CVH 8.91 [2.1]) participants. The factors that were associated with the largest magnitude of explained differences in mean CVH score were income for Black participants (if mean income in Black participants were equal to White participants, Black participants' mean CVH score would be 0.14 [SE 0.05] points higher); place of birth for Chinese participants (if proportion of US-born and foreign-born individuals among Chinese adults were equivalent to White participants, Chinese participants' mean CVH score would be 0.22 [0.10] points lower); and education for Hispanic and South Asian participants (if educational attainment were equivalent to White participants, Hispanic and South Asian participants' mean CVH score would be 0.55 [0.11] points higher and 0.37 [0.11] points lower, respectively).
Conclusions: In these multiethnic US cohorts, social and psychosocial factors were associated with racial/ethnic differences in CVH.

1. Introduction

Differences in cardiovascular disease (CVD) risk factors and outcomes among racial and ethnic groups in the United States (US) are well documented. In the US population, age- and sex-adjusted levels of body mass index and hemoglobin A1c are higher in non-Hispanic Black and Hispanic adults compared with non-Hispanic White adults [1]. Several Asian American subgroups (e.g., Asian Indian, Filipino) also experience higher burden of diabetes and hypertension compared with adults of other race and ethnic groups [2]. The integration of these CVD risk factors (body mass index, cholesterol, blood glucose, and blood pressure) and health behaviors (smoking, physical activity, dietary quality) into a single composite score has been described by the American Heart Association as the cardiovascular health (CVH) score [3]. Differences in CVH among racial and ethnic groups in the US persist, with worse CVH factors observed among Black adults, Hispanic adults, and certain Asian

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subgroups compared with White adults [4]. Higher (better) CVH score in young adulthood to midlife is strongly associated with lower risks for CVD, multi-morbidity, and life expectancy. For example, a 1-point higher CVH score in young adulthood is associated was associated with a 27 % lower risk for incident CVD events over 30 years of follow-up in the Coronary Artery Risk Development in Young Adults (CARDIA) study [5]. Understanding the contributors to differences in CVH between groups is necessary to equitably promote optimal CVH.

Racial and ethnic differences in CVH and CVD are hypothesized to be due to differences in several interrelated individual-, environmental-, and structural-level factors. These underlying factors include social determinants of health (such as socioeconomic position, community and social context, and discrimination) [6] and psychosocial factors (including depression, anxiety, and chronic stress burden) [7]. It is important to note that racial and ethnic differences in CVH are not due to biological differences between groups, since race and ethnicity are social categorizations not determined by biology.

Findings from the CARDIA study demonstrated that differences in clinical CVH factors, neighborhood-level factors, and socioeconomic factors between Black and White participants fully explained the observed racial and ethnic difference in premature CVD in that sample [8]. Similarly, racial and ethnic differences in CVH likely have underlying social, psychosocial, and structural determinants. Quantifying the contribution of these factors to racial and ethnic differences in CVH can inform individual- and population-level strategies to mitigate racial disparities in CVH and CVD in the US. Therefore, among participants in the Multi-Ethnic Study of Atherosclerosis (MESA) and Mediators of Atherosclerosis in South Asians Living in America (MASALA) Studies, we evaluated the statistical contribution of social and psychosocial factors to differences in mean CVH among Black, Chinese, Hispanic, and South Asian compared with White adults.

2. Methods

2.1. Participants

We included 6814 Black, Chinese, Hispanic, and White adults who participated in the MESA Study Exam 1, and 1164 South Asian adults who participated in the MASALA Study Exam 1 and 1A. Inclusion criteria for MESA participants was age 45–84 years and for MASALA participants was age 40–84 years. Participants with a history of CVD were excluded. Race and ethnicity were self-reported from given categories. Detailed study data inclusion and exclusion criteria and data collection protocols have previously been described [9,10]. Briefly, MESA and MASALA Study participants were adults from multiple US sites (MESA: New York City, New York; Baltimore, Maryland; Chicago, Illinois; Los Angeles, California; Minneapolis-St. Paul, Minnesota; and Winston-Salem, NC; MASALA: San Francisco, California; and Chicago, Illinois). All participants were eligible for analysis. In the primary decomposition analysis, $n = 781$ participants (9.8 % of the total sample) were excluded due to missing data for one or more social or psychosocial factors. The MESA and MASALA Studies received institutional review board approval at all study sites. Participants provided written informed consent.

2.2. Dependent variable: cardiovascular health

The CVH score was based on the American Heart Association construct with poor (0 points), intermediate (1 point), and ideal (2 points) levels calculated for each of the CVH metrics: smoking, physical activity, dietary quality, body mass index, cholesterol, blood glucose, and blood pressure (**Supplemental Table** for definitions) [3,11]. The CVH score was calculated as the sum of points across all seven factors and behaviors, ranging from 0 to 14 (with 14 indicating optimal CVH).

2.3. Independent variables: social and psychosocial factors

Potential explanatory factors were selected by three criteria: first, based on published evidence demonstrating meaningful associations with CVH and CVD [6,7,12]; second, variables that were available in both the MESA and MASALA studies; and third, variables that had the same definition (i.e., data collected with the same instrument or measured in an equivalent way) in the MESA and MASALA studies. Selection of underlying factors for analysis was intended to reflect individual and neighborhood factors across multiple social determinants of health and psychosocial factors.

Social determinants included education, which was categorized as less than high school, high school or GED, some college, college graduate, or graduate/professional school. Annual family income was self-reported. Health insurance was categorized as no insurance, private insurance, or public or other insurance. Usual place for medical care was defined as having a usual source of care in a doctor's office or medical clinic, or in an emergency room or other location. Occupation was categorized as unemployed, retired, employed, or a stay-at-home role. Marital status was categorized as married, widowed, divorced or separated, or never married. Nativity was defined as born in the US or born outside the US.

Psychosocial factors included depression symptoms, defined by a score of 0–60 on the Center for Epidemiologic Studies Depression (CES-D) scale, with a higher score indicating more depression symptoms [13]. Anxiety was defined using the 10-item Spielberger anxiety scale with scores ranging from 10 to 40, with higher scores indicating more anxiety symptoms [14]. Emotional social support was characterized with the Enhancing Recovery in Coronary Heart Disease Patients Study Social Support Instrument, with scores ranging from 6 to 30 and lower scores indicating lower social support. Chronic stress burden was evaluated using a 5-item reporting scale measuring stress over the last 6 months in 5 domains (health of self, health of others, job or ability to work, finances, relationships), with a higher score indicating higher stress burden [15–17].

Neighborhood social cohesion was measured using a 5-item scale addressing participant-reported quality of relationships between neighbors in their location of residence (e.g., whether people are willing to help neighbors, trustworthiness of neighbors) [18–20]. Participant-reported characteristics of built environments were not evaluated since data were collected differently in the two studies. Individual-level discrimination was measured using the 9-item Everyday Discrimination Scale, which queries about experiences of unfair treatment in everyday life, without reference to race and ethnicity, age, sex, or other demographic characteristics [21,22].

2.4. Statistical analysis

Participant characteristics were described using mean (standard deviation, SD) and frequency (percent). The contribution of individual- and neighborhood-level factors to racial and ethnic differences in mean CVH score was evaluated using Kitagawa-Blinder-Oaxaca (KBO) decomposition. The KBO decomposition is a statistical method originally developed in economics to explain inequalities between groups [23–25]. This method has been used in health research to identify potential targets for intervention to prevent and reduce disparities [26–29], for example to characterize the factors that contribute to differences in CVH among non-Hispanic White, non-Hispanic Black, and Mexican American women in the US [30].

Details of the KBO statistical method are provided in the **Supplemental Methods**. We applied the KBO decomposition to quantify the amount of the difference in mean CVH between racial and ethnic groups that is due to [1] statistically "explained" differences, referring to the between-group differences in the levels of each factor (i.e., differences in mean CVH score due to observable differences between groups in the factors included in the regression models), and [2] "unexplained"

differences, which are the between-group differences in the magnitude of association (i.e., regression coefficient) of each underlying factor with the CVH score, attributed to unobserved factors. The KBO decomposition uses a counterfactual approach, by setting factor levels (for the explained component) and the regression coefficient (for the unexplained component) to the level or distribution of the reference group (White). The White group was set at the reference category so that the decomposition findings would address why minoritized groups may differ in mean CVH compared with the majority White American population. Interpretation of the quantitative results from KBO decomposition is further detailed in the **Supplemental Methods**. Analyses were conducted with Stata version 17. P-values <0.05 (two-sided) indicated statistical significance.

3. Results

3.1. Study population

Among 7978 total participants in the MESA and MASALA cohorts, there were 1892 Black adults (mean age 62 [SD 10] years, 56 % female), 804 Chinese adults (mean age 62 [10] years, 52 % female), 1496 Hispanic adults (mean age 61 [10] years, 52 % female), 1164 South Asian adults (mean age 57 [9] years, 48 % female), and 2622 White adults (mean age 63 [10] years, 52 % female). Table 1 shows participant characteristics. Mean (SD) CVH score in the total sample was 7.96 (2.1) in Black, 9.69 (1.8) in Chinese, 8.00 (2.1) in Hispanic, 8.67 (2.1) in South Asian, and 8.91 (2.0) in White participants.

In decomposition analysis, there was a −0.95-point net difference in mean CVH score in Black participants compared with White participants. KBO decomposition split this difference into −0.26 explained points, and −0.69 unexplained points. There was *a* + 0.78-point net difference in mean CVH score in Chinese participants compared with White participants, of which −0.04 points were the explained component and +0.82 points were the unexplained component. There was a −0.91-point net difference in mean CVH score in Hispanic participants compared with White participants, of which −0.69 points were the explained component and −0.23 points were the unexplained component. There was *a* + 0.25-point net difference in mean CVH score in South Asian participants compared with White participants, of which +0.51 points were the explained component and −0.26 points were the unexplained component.

3.2. Explained racial and ethnic differences in CVH

Individual- and neighborhood-level factors that contributed to the explained component of the racial and ethnic differences in mean CVH score are shown in the Fig. 1 and Table 2. For Black compared with White participants, income, marital status, and chronic stress burden contributed to the net difference in mean CVH score. Income contributed the largest magnitude (+0.14 points) to the Black-White net difference in mean CVH score. As shown in Table 2, if Black participants had the same income as White participants, the mean CVH score in Black participants would be +0.14 [SE 0.05] points greater ($p<0.05$). For Chinese compared with White participants, education, income, insurance, nativity, and chronic stress burden significantly contributed to the net difference in mean CVH score, with nativity contributing the largest magnitude (−0.22 [SE 0.10] points; $p<0.05$) to the net difference. For Hispanic compared with White participants, education and income significantly contributed to the net difference in mean CVH score, with education statistically contributing the largest magnitude (+0.55 [SE 0.11] points; $p<0.05$) to the net difference in mean CVH score. For South Asian compared with White participants, age, education, marital status, and chronic stress burden significantly contributed to the net difference in mean CVH score with education statistically contributing the largest magnitude (−0.37 [SE 0.11] points; $p<0.05$) to the net difference in mean CVH score.

Table 1
Participant characteristics in the MESA and MASALA cohorts.

	Black *N* = 1892	Chinese *N* = 804	Hispanic *N* = 1496	South Asian *N* = 1164	White *N* = 2622
Age, years	62.1 (10.1)	62.3 (10.3)	61.3 (10.3)	56.7 (9.4)	62.6 (10.2)
Female	1050 (55.5 %)	414 (51.5 %)	775 (51.8 %)	556 (47.8 %)	1362 (51.9 %)
CVH score	7.96 (2.1)	9.69 (1.8)	8.00 (2.1)	8.67 (2.1)	8.91 (2.0)
Education					
Less than high school	229 (12.2 %)	199 (24.8 %)	668 (44.7 %)	43 (3.7 %)	129 (4.9 %)
High school or GED	359 (19.1 %)	130 (16.2 %)	305 (20.4 %)	47 (4.0 %)	442 (16.9 %)
Some college	654 (34.8 %)	162 (20.2 %)	375 (25.1 %)	68 (5.8 %)	746 (28.5 %)
College graduate	325 (17.3 %)	182 (22.7 %)	83 (5.5 %)	355 (30.5 %)	581 (22.2 %)
Graduate/ professional	311 (16.6 %)	130 (16.2 %)	65 (4.3 %)	651 (55.9 %)	716 (27.4 %)
Annual income*	4.8 (5.7)	3.5 (6.8)	3.5 (3.9)	10.0 (3.3)	8.6 (7.0)
Insurance					
No insurance	119 (6.3 %)	151 (18.8 %)	266 (17.8 %)	99 (8.5 %)	72 (2.8 %)
Public or other insurance	420 (22.4 %)	270 (33.6 %)	418 (27.9 %)	192 (16.5 %)	449 (17.2 %)
Private insurance	1339 (71.3 %)	382 (47.6 %)	812 (54.3 %)	873 (75.0 %)	2094 (80.1 %)
Usual place for medical care**	1736 (93.1 %)	750 (93.5 %)	1261 (84.7 %)	1110 (95.4 %)	2531 (97.1 %)
Occupation					
Unemployed	50 (2.7 %)	18 (2.2 %)	51 (3.4 %)	36 (3.1 %)	37 (1.4 %)
Retired	857 (45.7 %)	276 (34.4 %)	511 (34.2 %)	187 (16.1 %)	940 (36.0 %)
Stay at home	124 (6.6 %)	135 (16.8 %)	242 (16.2 %)	155 (13.3 %)	283 (10.8 %)
Employed	846 (45.1 %)	374 (46.6 %)	692 (46.3 %)	786 (67.5 %)	1354 (51.8 %)
Marital status					
Married	848 (45.2 %)	655 (81.6 %)	890 (59.5 %)	1056 (90.7 %)	1726 (66.0 %)
Widowed	328 (17.5 %)	82 (10.2 %)	199 (13.3 %)	53 (4.6 %)	284 (10.9 %)
Divorced or separated	469 (25.0 %)	46 (5.7 %)	299 (20.0 %)	38 (3.3 %)	356 (13.6 %)
Never married	233 (12.4 %)	20 (2.5 %)	108 (7.2 %)	17 (1.5 %)	249 (9.5 %)
Nativity (US-born)	1699 (89.8 %)	82 (10.2 %)	578 (38.6 %)	22 (1.9 %)	2441 (93.1 %)
Social support index	25.0 (6.0)	24.0 (7.0)	26.0 (8.0)	26.0 (7.0)	25.0 (7.0)
Neighborhood social cohesion	18.0 (4.0)	17.0 (4.0)	17.0 (4.0)	17.0 (2.0)	18.0 (4.0)
CES-D depression score	6.0 (8.0)	5.0 (8.0)	7.0 (11.0)	6.0 (7.0)	5.0 (8.0)

(*continued on next page*)

Table 1 (*continued*)

	Black N = 1892	Chinese N = 804	Hispanic N = 1496	South Asian N = 1164	White N = 2622
Spielberger anxiety scale	14.0 (6.0)	16.0 (6.0)	15.0 (7.0)	15.0 (6.0)	15.0 (6.0)
Chronic stress burden	1.0 (2.0)	0.0 (1.0)	1.0 (2.0)	0.0 (1.0)	1.0 (2.0)
Discrimination	15.0 (9.0)	11.0 (6.0)	11.0 (7.0)	14.0 (7.0)	13.0 (7.0)

Data presented as mean (standard deviation), median (interquartile range), or n (%).

* Annual income is multiplied by $10,000 (i.e., $35,000 in Chinese participants).

** Frequency of usual source of care in a doctor's office or medical clinic.

3.3. Unexplained racial and ethnic differences in CVH

Individual- and neighborhood-level factors that significantly contributed to the unexplained component of the racial and ethnic differences in mean CVH score are shown in the Fig. 1 and Table 3. For Black compared with White participants, sex and occupation significantly contributed to the net unexplained difference in mean CVH score with sex statistically contributing to the largest magnitude (+0.35 [SE 0.13] points; $p<0.05$) to the net unexplained difference in mean CVH score. In Chinese, Hispanic, and South Asian participants compared with White participants, age statistically contributed the largest magnitude (+1.20 [SE 0.14] points, +1.23 [SE 0.28] points, and +1.70 [0.42] points, respectively; $p<0.05$ for all) to the net unexplained difference in mean CVH score for each group. This unexplained difference in CVH due to age represents the differences in the slope (or regression coefficient) for the associations of age with CVH score in these groups compared with White participants.

In Chinese participants, income, occupation, marital status, anxiety symptoms, and discrimination also significantly contributed to the net unexplained difference in mean CVH score. After age, the factor that contributed the next largest magnitude to the net difference in mean CVH score was anxiety symptoms. If Chinese participants had the same magnitude of association of anxiety symptoms with CVH score (i.e., slope of the regression line for association of anxiety symptoms with CVH score) as did White participants, the mean CVH score in Chinese participants would be significantly *higher* by 0.60 [0.28] points, $p<0.05$).

In Hispanic compared with White participants, sex, occupation, depression symptoms, and anxiety symptoms also significantly contributed to the net difference in mean CVH score. After age, the factor that contributed the next largest magnitude to the net difference in mean CVH score was anxiety symptoms. In South Asian compared with White participants, sex, education, and insurance also significantly contributed to the net difference in mean CVH score. After age, the factor that contributed the next largest magnitude to the net difference in mean CVH score was education.

4. Discussion

Social determinants (including education, income, and nativity) and psychosocial factors (including anxiety symptoms) contributed to the net explained differences in CVH in racial and ethnic minoritized groups compared with White participants, among approximately 8000 adult participants enrolled in two contemporary cohorts in the US. For Chinese, Hispanic, and South Asian participants, the higher magnitude of the regression coefficient between age and CVH in each of these groups compared with White participants also significantly contributed to net differences in mean CVH score. Additionally, several individual-level social and psychosocial factors contributed in smaller magnitude to net differences in CVH between groups. These findings demonstrate that population-level racial and ethnic differences in CVH score may be attributable to a range of social and psychosocial determinants, which are important targets because lower CVH is associated with a higher risk for incident CVD [5].

Decomposition analysis suggests the important role of socioeconomic factors, particularly education and income, in explaining racial and ethnic differences in CVH score. Black and Hispanic participants had lower overall educational attainment compared with White adults, and these findings demonstrated that if each group's distribution of educational attainment was similar to White participants, mean CVH score in each group would be higher. Conversely, South Asian participants enrolled in MASALA had higher educational attainment compared with White adults, and it was observed that if their distribution of educational attainment was similar to White participants, the mean CVH score would be lower. Notably, the MASALA Study enrolled South Asian participants who had relatively high socioeconomic position, so these findings may not represent all South Asian individuals in the US. Other South Asian communities (such as Pakistani and Bangladeshi) are known to have lower population-level socioeconomic position [31], so our findings are not intended to imply that socioeconomic position is not an important factor in the health of the South Asian American population. Lower educational attainment is associated with worse CVH and a higher lifetime risk of CVD [32,33], which may occur due to several interrelated socioeconomic factors including employment opportunity, literacy, and healthcare access, which likely all influence health status and outcomes, and have shared upstream systemic and structural determinants (i.e., structural racism).

Differences in the proportion of individuals born outside the US contributed to the net difference in mean CVH between Chinese and White samples. About 7 % of White participants were born outside the US, compared with 90 % of Chinese participants in the MESA cohort. The decomposition analysis demonstrated that if the percentage of the Chinese participant sample that was born outside the US was equal to the percentage in the White participant sample, the mean CVH score would be lower for Chinese participants. Such findings are consistent with a "healthy immigrant effect," which posits that selective immigration to the US of healthier individuals contributes to better population-level CVH among individuals who are immigrants in the US [34]. Place of birth is a complex social determinant that incorporates the influence of immigration, acculturation, and environmental exposures (among other factors), which each may influence CVH behaviors (such as diet) and socioeconomic status. Notably nativity did not significantly contribute to the net difference in mean CVH among Hispanic (61 % born outside the US) and South Asian (98 % born outside the US) participants, which may be due in part to the greater relative importance of other factors that are related to nativity in these groups, such as higher socioeconomic position and educational attainment that facilitate immigration among South Asian individuals. Although place of birth is not a modifiable factor per se, these findings underscore the importance of understanding how nativity and immigration may influence CVH within specific communities, since these factors likely operate differently among diverse populations.

It is notable that a substantial component of the differences in CVH score between groups were attributable to the unexplained component of net differences. This finding both suggests that there are additional unmeasured factors that likely contribute to differences in CVH between groups, and provides important evidence that the social and psychosocial determinants investigated operate differently between groups and so findings about the role of these factors in one racial and ethnic group should not be extrapolated to other groups. The contribution of age to the unexplained component of net differences in mean CVH between racial and ethnic groups suggests that Chinese, Hispanic, and South Asian adults may experience greater declines in CVH with aging compared with White adults. For each racial and ethnic group, their mean CVH score would have been 1.20, 1.23, and 1.70 points higher (respectively) if the magnitude of association of age with CVH in each

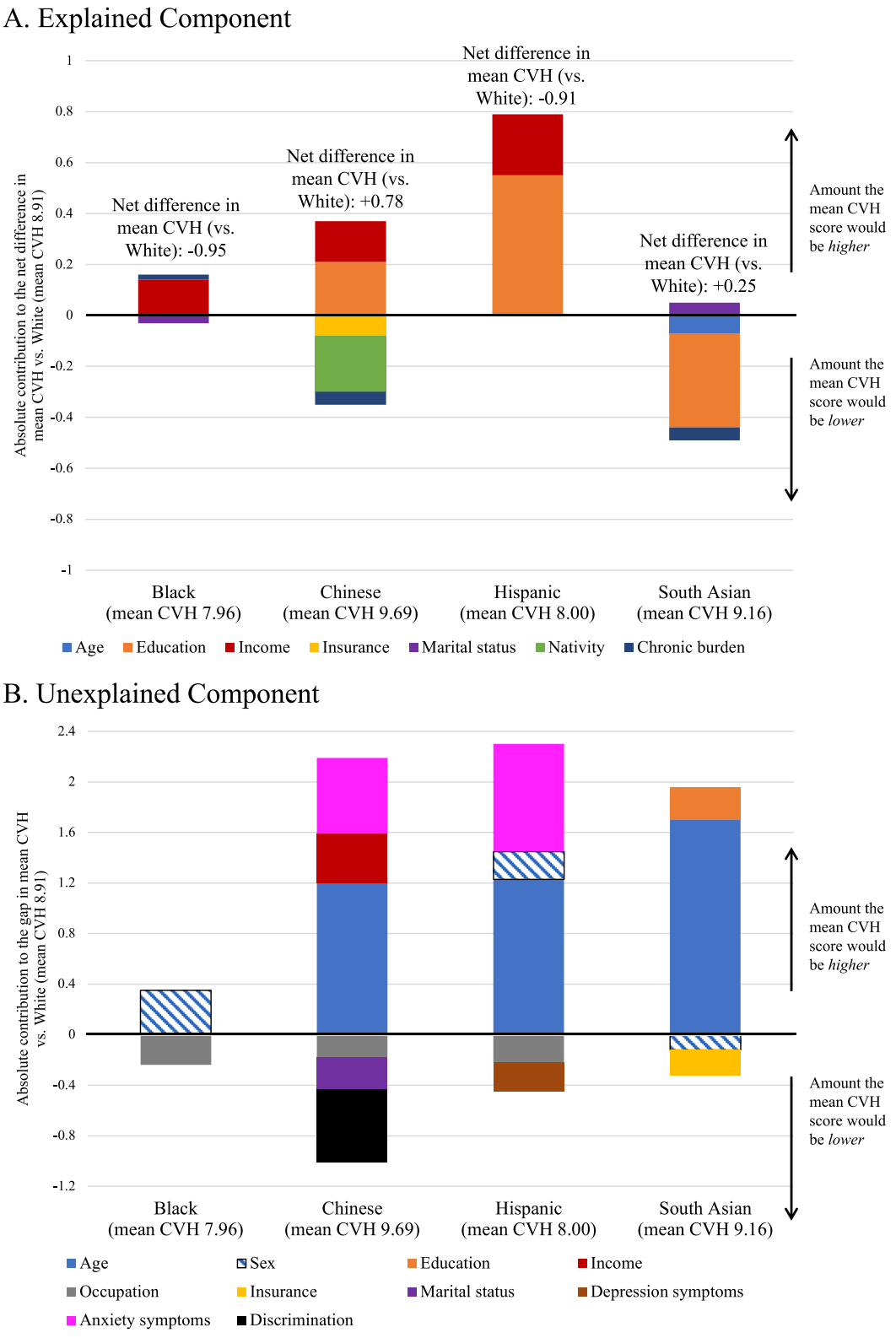

Fig. 1. Decomposition of net differences in mean cardiovascular health score between racial and ethnic groups
CVH: Cardiovascular health. (A) Values above/below 0 indicate the amount the mean CVH score would be higher/lower (respectively) if the distribution or level of the underlying factor was equivalent to that of White participants. Factors represented in the bar graphs statistically significantly contributed to the *explained* component of the net difference in mean CVH between racial and ethnic group compared with White participants ($p<0.05$). Factors not included in each respective bar did not significantly contribute to the explained component of the difference in mean CVH between groups. (B) Values above/below 0 indicate the amount the mean CVH score would be higher/lower (respectively) if the regression coefficient (i.e., magnitude of association) for the association of the factor with CVH score in the racial/ethnic group was equivalent to the regression coefficient for White participants. Factors represented in the bar graphs statistically significantly contributed to the *unexplained* component of the net difference in mean CVH between racial and ethnic group compared with White participants ($p<0.05$). Factors not included in each respective bar did not significantly contribute to the unexplained component of the difference in mean CVH between groups.

Table 2
Explained component of the decomposition of cardiovascular health differences between racial and ethnic groups in the MESA and MASALA cohorts.

	Black vs. White		Chinese vs. White		Hispanic vs. White		South Asian vs. White	
	Diff. in mean CVH	*SE*	*Diff. in mean CVH*	*SE*	*Diff. in mean CVH*	*SE*	*Diff. in mean CVH*	*SE*
Net explained component of CVH score	−0.26	0.11	−0.04	0.12	−0.69	0.17	0.51	0.20
Age	−0.00	0.00	0.00	0.00	−0.01	0.01	**−0.07***	**0.03**
Sex	−0.01	0.01	0.00	0.01	0.00	0.01	0.03	0.02
Education	0.14	0.08	**0.21***	**0.08**	**0.55***	**0.11**	**−0.37***	**0.11**
Income	**0.14***	**0.05**	**0.16***	**0.06**	**0.24***	**0.10**	−0.03	0.07
Occupation	0.01	0.01	−0.01	0.01	0.01	0.01	−0.00	0.02
Insurance	−0.00	0.01	**−0.08***	**0.03**	−0.00	0.02	0.02	0.01
Usual place for care	−0.00	0.01	−0.00	0.01	−0.02	0.02	−0.00	0.00
Marital status	**−0.03***	**0.01**	0.04	0.02	−0.01	0.01	**0.05***	**0.02**
Nativity	−0.01	0.01	**−0.22***	**0.10**	−0.08	0.06	−0.11	0.09
Social support	−0.00	0.00	0.00	0.01	−0.00	0.01	−0.00	0.01
Neighborhood social cohesion	0.01	0.01	0.01	0.03	−0.01	0.02	0.01	0.02
Depression symptoms	0.01	0.01	−0.01	0.03	0.02	0.02	0.01	0.01
Anxiety symptoms	0.02	0.01	−0.00	0.02	0.00	0.00	0.00	0.00
Chronic stress burden	**0.02***	**0.01**	**−0.05***	**0.02**	−0.00	0.01	**−0.05***	**0.01**
Discrimination	−0.01	0.02	−0.01	0.02	−0.00	0.01	0.01	0.01

CVH: Cardiovascular health, SE: Standard error. Mean [standard deviation] CVH scores in the decomposition analysis were: Black (7.96 [2.0]), Chinese (9.69 [1.8]), Hispanic (8.00 [2.1]), South Asian (9.16 [2.0]), White (8.91 [2.1]). Difference in mean CVH refers to the absolute difference in mean CVH score related to the explained component of racial and ethnic differences in CVH associated with each factor.
* $p<0.05$.

Table 3
Unexplained component of the decomposition of cardiovascular health differences between racial and ethnic groups in the MESA and MASALA cohorts.

	Black vs. White		Chinese vs. White		Hispanic vs. White		South Asian vs. White	
	Diff. in mean CVH	*SE*	*Diff. in mean CVH*	*SE*	*Diff. in mean CVH*	*SE*	*Diff. in mean CVH*	*SE*
Net unexplained component of CVH score	−0.69	0.07	0.82	0.18	−0.23	0.14	−0.26	0.10
Age	0.36	0.34	**1.20***	**0.14**	**1.23***	**0.28**	**1.70***	**0.42**
Sex	**0.35***	**0.13**	0.06	0.07	**0.22***	**0.11**	**−0.12***	**0.06**
Education	0.08	0.06	0.05	0.06	−0.05	0.04	**0.26***	**0.06**
Income	0.09	0.23	**0.39***	**0.14**	0.09	0.11	0.01	0.20
Occupation	**−0.24***	**0.05**	**−0.18***	**0.06**	**−0.22***	**0.07**	−0.03	0.07
Insurance	−0.06	0.10	0.09	0.09	−0.06	0.11	**−0.20***	**0.10**
Usual place for care	−0.27	0.44	−0.41	0.52	−0.05	0.44	−0.22	0.49
Marital status	0.00	0.04	**−0.25***	**0.03**	−0.03	0.06	−0.25	0.16
Nativity	−0.01	0.01	−0.26	0.27	−0.01	0.04	−0.37	0.44
Social support	0.44	0.30	0.29	0.50	−0.00	0.23	0.98	0.74
Neighborhood social cohesion	−0.24	0.59	−0.35	0.65	0.97	0.60	−0.62	0.62
Depression symptoms	−0.13	0.11	−0.12	0.09	**−0.23***	**0.10**	−0.07	0.09
Anxiety symptoms	0.20	0.37	**0.60***	**0.28**	**0.85***	**0.32**	0.44	0.33
Chronic stress burden	0.08	0.07	−0.08	0.06	−0.06	0.04	−0.02	0.05
Discrimination	−0.27	0.23	**−0.58***	**0.18**	−0.17	0.28	0.06	0.17

CVH: Cardiovascular health, SE: Standard error. Mean [standard deviation] CVH scores in the decomposition analysis were: Black (7.96 [2.0]), Chinese (9.69 [1.8]), Hispanic (8.00 [2.1]), South Asian (9.16 [2.0]), White (8.91 [2.1]). Difference in mean CVH refers to the absolute difference in mean CVH score related to the unexplained component of racial and ethnic differences in CVH associated with each factor.
* $p<0.05$.

group was equivalent to that of White participants. This finding may be consistent with the weathering hypothesis, which suggests that chronic exposure to disadvantageous conditions over time leads to accelerated declines in health and has been most well-studied among Black populations [35]. Such findings indicate that there may be benefit in optimizing social, psychosocial, and structural determinants of health beginning early in the life course to maintain optimal CVH and prevent deterioration. It is noted that age was not identified as a significant contributor to the unexplained component among Black participants, despite prior evidence that suggests the important role of weathering among Black individuals. This observation may arise because other factors not directly accounted for in our analysis, such as direct experiences of racism and discrimination, play a stronger role in differences in CVH compared with White participants. For South Asian, Chinese, and Hispanic participants, we hypothesize that the important role of age in the unexplained component of the CVH difference may more substantially be related to unmeasured factors associated with nativity and immigration, given the high proportion of non-US born individuals in these groups.

Several limitations to this analysis must be noted. First, these data are observational and cross-sectional, and may be subject to unmeasured confounders. These findings are intended to inform potential community-level interventions and policies to mitigate racial and ethnic differences in CVH. Second, the MESA and MASALA studies enrolled a multiethnic sample from several metropolitan areas in the US, but the studies' participant samples are not nationally representative. Variation in the contributions of social, psychosocial, and structural determinants to racial and ethnic differences in CVH may exist among populations in other regions. Third, other groups that may experience CVH disparities are not represented in these studies, including Native American, Middle Eastern and North African, Native Hawaiian, and other Asian subgroups. In addition, Hispanic subgroups are not separately identified in our analysis of the MESA study data, which may contribute to the observation that nativity did not significantly statistically contribute to the net difference in CVH score in Hispanic compared with White participants. Fourth, the decomposition analysis quantifies the contribution of determinants at the group-level to differences in group mean CVH. Personal contexts may result in variable contribution of underlying

determinants to individual-level CVH. Fifth, other multi-level factors beyond those studied (e.g., area-level deprivation, neighborhood segregation) have been associated with CVH and likely also contribute to differences in mean CVH but were not available in both datasets. Sixth, this analysis uses the Life's Simple 7 CVH score definition rather than the revised Life's Essential 8 CVH score, since measures of sleep duration are not available in the MESA and MASALA studies [36]. However, the two CVH scores are highly correlated [37]. Seventh, strain related to employment was not robustly evaluated in this participant sample which may contribute to chronic stress. Eighth, it is acknowledged that the social and psychosocial factors included in this analysis are likely interrelated, and that intervention focusing on one factor is likely to influence the experience of other factors. The complexity of the relationships between these factors is not fully represented using the KBO statistical methodology.

5. Conclusion

In this large, multiethnic sample of US adults, social and psychosocial determinants contributed statistically to racial and ethnic differences in mean CVH. These findings may guide the development of adapted community-level and policy interventions to mitigate differences in CVH between racial and ethnic groups.

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CRediT authorship contribution statement

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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Supplementary materials

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