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ORIGINAL RESEARCH

Association of Socioeconomic Status With Life's Essential 8 in the National Health and Nutrition Examination Survey: Effect Modification by Sex

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BACKGROUND: Higher scores for the American Heart Association Life's Essential 8 (LE8) metrics, blood pressure, cholesterol, glucose, body mass index, physical activity, smoking, sleep, and diet, are associated with lower risk of chronic disease. Socioeconomic status (SES; employment, insurance, education, and income) is associated with LE8 scores, but there is limited understanding of potential differences by sex. This analysis quantifies the association of SES with LE8 for each sex, within Hispanic Americans, non-Hispanic Asian Americans, non-Hispanic Black Americans, and non-Hispanic White Americans.

METHODS AND RESULTS: Using cross-sectional data from the National Health and Nutrition Examination Survey, years 2011 to 2018, LE8 scores were calculated (range, 0–100). Age-adjusted linear regression quantified the association of SES with LE8 score. The interaction of sex with SES in the association with LE8 score was assessed in each racial and ethnic group. The US population representatively weighted sample (13 529 observations) was aged ≥20 years (median, 48 years). The association of education and income with LE8 scores was higher in women compared with men for non-Hispanic Black Americans and non-Hispanic White Americans (*P* for all interactions <0.05). Among non-Hispanic Asian Americans and Hispanic Americans, the association of SES with LE8 was not different between men and women, and women had greater LE8 scores than men at all SES levels (eg, high school or less, some college, and college degree or more).

CONCLUSIONS: The factors that explain the sex differences among non-Hispanic Black Americans and non-Hispanic White Americans, but not non-Hispanic Asian Americans and Hispanic Americans, are critical areas for further research to advance cardiovascular health equity.

Key Words: equity ■ health disparities ■ Life's Essential 8 ■ sex ■ socioeconomic status

Cardiovascular disease (CVD) is the leading cause of death in the United States among men and women.[1] Age-adjusted CVD mortality rates declined for many years, then hit an inflection point in 2011, and have since remained stable for premature CVD (age, <65 years).[2,3] There are disparities in incident premature CVD among Black women and men compared with White women and men, with the former having a 144% and 59% higher risk, respectively.[4] The disparities in incident CVD disappeared after

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CLINICAL PERSPECTIVE

What Is New?

- The association of socioeconomic status with cardiovascular health is of greatest magnitude among non-Hispanic White and Black American women compared with non-Hispanic White and Black American men, with few sex differences among non-Hispanic Asian Americans and Hispanic Americans.

What Are the Clinical Implications?

- Improving socioeconomic status is beneficial for both men and women of all races and ethnicities, but women of some races and ethnicities may have a greater association of socioeconomic status with cardiovascular health than men; thus, multifaceted approaches may be required to advance sex-based cardiovascular health equity.

Nonstandard Abbreviations and Acronyms

CVH	cardiovascular health
HA	Hispanic American
LE8	Life's Essential 8
NHAA	non-Hispanic Asian American
NHANES	National Health and Nutrition Examination Survey
NHBA	non-Hispanic Black American
NHWA	non-Hispanic White American

adjustment for clinical, lifestyle, depression, socioeconomic, and neighborhood factors.[4] In women, clinical factors (eg, blood pressure, glucose, lipids, cardiometabolic medications, and forced vital capacity) contributed to 87% of the disparity between Black and White women, followed by neighborhood (32%) and socioeconomic (23%) factors, when examining these factors individually. Similarly, in Black and White men, clinical factors contributed to 64% of the disparity, followed by socioeconomic (50%) and lifestyle (34%) factors, when examining these factors individually. Thus, to eliminate disparities in premature CVD across racial and ethnic groups, it is critical to advance our understanding of socioeconomic status (income, education, and occupation) and clinical and lifestyle factors across racial and ethnic groups. It is also important to consider the role of sex, given the sex-based variance in CVD prevalence in the United States.[1]

In 2010, the American Heart Association developed Life's Simple 7, which consisted of 7 factors that are critical in cardiovascular health (CVH), including diet, physical activity, smoking, body mass index, cholesterol, blood pressure, and blood glucose,[5] and in 2022, the American Heart Association revamped the scoring and added an eighth metric, sleep.[6] This new group of risk factors, Life's Essential 8 (LE8), has disparate attainment across racial and ethnic and sex groups, with non-Hispanic Black Americans (NHBAs; Americans used to mean US residents) and men having the lowest (worst) CVH scores.[7,8]

Socioeconomic status (SES) has been posited as a potential explanatory factor for the racial and ethnic disparities in CVH, as SES is associated with attainment of CVH, although we have previously shown that these associations may be limited in some populations, including Black men.[9] The objective of the current analysis was to quantify the association of SES (income, education, insurance status, and employment) with CVH (using the updated LE8 definition) among men and women, stratified by self-reported racial and ethnic group. On the basis of our prior work,[9] we hypothesized that SES would have a greater magnitude of association on CVH in women compared with men, across racial and ethnic groups.

METHODS

Sample Characteristics

The National Health and Nutrition Examination Survey (NHANES) is a multistage, cross-sectional, stratified, clustered probability sample of US civilian, noninstitutionalized residents organized by the National Center for Health Statistics of the Centers for Disease Control and Prevention. All data and guidance on analytical approaches are freely and publicly available from the US Centers for Disease Control and Prevention's National Center for Health Statistics and can be found at https://www.cdc.gov/nchs/nhanes/index.htm. The analyzed NHANES data were gathered in 4 waves from 2011 to 2018 (2011–2012, 2013–2014, 2015–2016, and 2017–2018). These waves involved oversampling of non-Hispanic Asian Americans (NHAAs). The included waves were combined and sample weights were transformed following National Center for Health Statistics guidelines.[10] Participants answered questions and underwent physical examination, including blood draws. For this investigation, we included adults aged ≥20 years who self-identified as Asian, Black, Hispanic, or White and who were not missing any metrics of the LE8 score, SES variables, or covariates (n=13 529; Figure S1). All participants gave written informed consent. The NHANES study protocol was approved by the National Center for Health Statistics

Institutional Review Board. This analysis of secondary data was exempted from approval by The Ohio State University Institutional Review Board, because the use of deidentified secondary data is not human subjects research.

SES Variables (Exposures)

The categorization of the exposures, the scoring of the outcome, and analysis of the data were conducted in a similar manner to previously published work.[11] These methods are described in detail below.

Educational Level

NHANES published data on education status, with levels: less than 9th grade, 9th to 11th grade (includes 12th grade with no diploma), high school graduate/general educational development or equivalent, some college or associate's degree, and college graduate or above. Because of the small number of observations, and consistent with our prior publications,[9] the lower levels of education were combined. The 3 categories used in this analysis were high school graduate/general educational development or less, some college or associate's degree, and college graduate or above.

Income

Annual family income divided by the applicable (based on family size) poverty line was the formula used to calculate the income/poverty line ratio. In NHANES, income/poverty line ratio is reported continuously, ranging from 0 (no income) to 5 (≥5 times the poverty line). Regression models featured continuous income/poverty line ratio.

Employment

Employment status options were student, retired, employed, unemployed, homemaker, and unable to work for health reasons/disability.

Health Insurance Status

Health insurance options were private, uninsured, Medicare, Medicaid, military, combination, and other. Combination insurance is any combination of insurance types.

LE8 Scoring (Outcome)

LE8 score (on a scale from 0 to 100) was the average of the scores for the 8 individual health behaviors and factors explained below.[6] Low CVH is an average score of 0 to 49, moderate CVH is a score of 50 to 79, and high CVH is a score of 80 to 100.[6] In regression analyses, LE8 score was modeled continuously.

Body Mass Index

For non-Asian participants, body mass index (BMI) of <25 kg/m^2 received a score of 100 points, BMI of 25 to 29.9 kg/m^2 received a score of 70 points, BMI of 30 to 34.9 kg/m^2 received a score of 30 points, BMI of 35 to 39.9 kg/m^2 received a score of 15 points, and BMI of ≥40 kg/m^2 received a score of 0 points. NHAA participants were scored as shown in Table 1.

Blood Pressure

Blood pressure was measured ≥3 times. The mean of all measurements was used in this analysis, after excluding implausible values. Blood pressure scores ranged from 0 to 100, as shown in Table 1.

Smoking

Current tobacco users received 0 points. If participants reported quitting, they received a score of 25 to 75 points, depending on how long it had been since quitting, as shown in Table 1. Participants who never smoked received 100 points. For the 2013 to 2017 cycles, e-cigarette use decreased the score by 20 points (if the score was ≥20). E-cigarette use was not measured in the 2011 cycle, but e-cigarette use was rare at that time.

Physical Activity

Self-reported physical activity was measured via the NHANES Physical Activity Questionnaire. Number of weekly leisure moderate and vigorous physical activity bouts were multiplied by mean bout duration in minutes. The product was weekly physical activity minutes. A total of ≥150 weekly physical activity minutes received a score of 100 points, and 0 weekly physical activity minutes was scored as 0 points. Values in between 0 and 150 minutes received scores between 0 and 100, as shown in Table 1.

Diet

Two days' (averaged) 24-hour recall data were transformed into the Dietary Approaches to Stop Hypertension score, as described by Fung et al.[12] The 24-hour recall from day 1 was collected at the Mobile Examination Center using the automated multiple pass method. The recall from day 2 was collected over the telephone 3 to 10 days later with the same method. Ounce and cup equivalents for the required Dietary Approaches to Stop Hypertension food groups were downloaded from the US Department of Agriculture Agricultural Research Service.[13] Consumption levels were then adjusted on the basis of caloric targets for each age/sex group (Table S1–S5). The US Department of Agriculture did not separate low-fat dairy, so total

Table 1. Measurement and Scoring of LE8

CVH metric	Method of measurement	Scoring	
Diet	Two 24-h recalls, intakes averaged	Points	Quantile of DASH score
		100	≥95th Percentile
		80	75th–94th Percentile
		50	50th–74th Percentile
		25	25th–49th Percentile
		0	1st–24th Percentile
Physical activity	NHANES Physical Activity Questionnaire	Points	Minutes
		100	≥150
		90	120–149
		80	90–119
		60	60–89
		40	30–59
		20	1–29
		0	0
Smoking	NHANES Smoking and Tobacco Use Questionnaire	Points	Status
		100	Never smoker
		75	Quit ≥5 y
		50	Quit 1 to <5 y
		25	Quit <1 y, or current NDS use
		0	Current smoker
		Subtract 20 (if score ≥25) for living with active indoor smoker	
Sleep	2011 and 2013 cycles: average sleep per night 2015 and 2017 cycles: average weekday sleep per night	Points	Hours of sleep
		100	7 to <9
		90	9 to <10
		70	6 to <7
		40	5 to <6 or ≥10
		20	4 to <5
		0	<4
Body mass index	Weight in kg/height in m squared	Points	Body mass index, kg/m^2
		Non–Asian Americans	
		100	<25
		70	25.0–29.9
		30	30.0–34.9
		15	35.0–39.9
		0	≥40.0
		Asian Americans	
		100	<23.0
		70	23.0–24.9
		50	25.0–29.9
		25	30.0–34.9
		0	≥35.0
Non–HDL-C	Enzymatically measured total cholesterol minus HDL-C	Points	Non–HDL-C, mg/dL
		100	<130
		60	130–159
		40	160–189
		20	190–219
		0	≥220
		If drug-treated level, subtract 20 (if score ≥20)	
Blood glucose	Glycated hemoglobin	Points	Glycated hemoglobin, %
		100	<5.7, No diabetes
		60	5.7–6.4, No diabetes
		40	<7.0, With diabetes
		30	7.0–7.9, With diabetes
		20	8.0–8.9, With diabetes
		10	9.0–9.9, With diabetes
		0	≥10.0, With diabetes
Blood pressure	Appropriately measured systolic and diastolic blood pressure	Points	Blood pressure, mm Hg
		100	<120/<80
		75	120–129/<80
		50	Systolic 130–139 or diastolic 80–89
		25	Systolic 140–159 or diastolic 90–99
		0	Systolic ≥160 or diastolic ≥100
		If drug-treated level, subtract 20 (if score ≥20)	

(*Continued*)

Reproduced from Williams et al[11] with permission. Copyright ©2023, John Wiley and Sons. CVH indicates cardiovascular health; DASH, Dietary Approaches to Stop Hypertension; HDL-C, high-density lipoprotein cholesterol; LE8, Life's Essential 8; NDS, nicotine delivery system; and NHANES, National Health and Nutrition Examination Survey.

dairy was used. The US Department of Agriculture did not report sugar-sweetened beverage intake, so kilocalories from sugar-sweetened beverages were calculated and then averaged from the 2 days' recall. Quantile cutoff points for the Dietary Approaches to Stop Hypertension score were used to calculate the LE8 diet score, as described in Table 1.

Cholesterol

Total cholesterol was measured enzymatically by hydrolyzing cholesterol esters and producing H_2O_2, which was then quantified chromatically with paraquinone. Total cholesterol, high-density lipoprotein cholesterol, and self-reported prescription of hypercholesterolemia medications were used to calculate the cholesterol score. Total cholesterol minus high-density lipoprotein cholesterol (non– high-density lipoprotein cholesterol) <130 mg/dL without hypercholesterolemia medication received a score of 100 points. Non– high-density lipoprotein cholesterol of ≥220 mg/dL received a score of 0 points. Values in between 130 and 220 mg/dL received scores between 0 and 100, as shown in Table 1.

Blood Glucose

The glycemia score was based on diabetes status (self-reported diagnosis, hemoglobin A1c [HbA1c]

≥6.5, or use of diabetes medication) and HbA1c. High-performance liquid chromatography was used to measure HbA1c. An HbA1c of <5.7% in the absence of diabetes received a score of 100 points. For participants with diabetes, the highest score possible was 40 points (HbA1c <7.0%). Participants with an HbA1c ≥10.0% received a score of 0 points. Values of HbA1c between 7.0% and 10.0% received scores between 0 and 40, as shown in Table 1.

Sleep

Self-reported hours of average weekday sleep were used for cycles 2015 and 2017, and self-reported mean hours of sleep per night were used for cycles 2011 and 2013. A total of 7 to <9 hours of sleep per night received a score of 100 points, and 0 points were awarded for sleep <4 hours per night. Other sleep durations received points between 0 and 100, as shown in Table 1.

Demographic Variables (Covariates)

Race and Ethnicity

Race and ethnicity were self-reported from the available categories of non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, non-Hispanic other, Mexican American, and other Hispanic. For this assessment, participants who identified as non-Hispanic other were excluded (n=1646), and participants who identified as other Hispanic or Mexican American were combined into the Hispanic American (HA) group. The 4 included groups were HA, NHAA, NHBA, and non-Hispanic White American (NHWA).

Age

Age at time of data collection was calculated in years from the participant's self-reported or imputed date of birth. Participants aged >80 years were coded as 80 to minimize risk of identification.

Sex

Sex was self-reported at the time of the survey, with male or female being the only options.

Statistical Analysis

Linear regression was used to quantify the association of SES variables (exposure) with LE8 score (outcome). An interaction term was included in the model to test the interaction of sex with SES variables in the association with LE8 score among men and women of each racial and ethnic group (see conceptual model, Figure S2). Univariate models contained only the sex×SES variable interaction term describing LE8 score (the software automatically adds the main effects of SES and sex to the model).

$$LE8 = \beta_0 + \beta_1(SES) + \beta_2(sex) + \beta_3(SES * sex) + \epsilon$$

Age-adjusted models contained the interaction term, main effects, and age. Multivariable models were adjusted for age and all SES variables not included in the interaction term. Statistical analyses were performed in R, version 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria). All analyses were performed accounting for NHANES sample weights, primary sampling units, and strata, in R, using the survey package.[14–18] Models were computed using the glm function of the survey package, and predicted LE8 scores were extracted from these models with the predict function of the stats package. Statistical significance for all analyses was defined as 2-sided α <0.05 for main effects of the models, and a 2-sided α<0.1 for interaction terms, as in previous studies.[19]

RESULTS

Sample Characteristics

The overall weighted sample (n=13 529) was 15% HA, 11% NHBA, 5% NHAA, 69% NHWA, 49% men, and representative of the US population. Median age was 48 years. In all racial and ethnic groups, there was a greater proportion of women in the high CVH category than men, with the most prominent difference being among HAs, where only 36% of participants with high CVH are men (Table 2).

Predicted LE8 Scores

Figure 1 shows that at lower levels of education and income, predicted LE8 scores were not appreciably different between men and women among NHBAs and NHWAs, holding age constant. Appreciable sex differences among NHBAs and NHWAs appeared at higher income and education levels, with women having the higher scores. Among HAs and NHAAs, women generally had higher LE8 scores than men at all levels of SES. One notable exception is the higher scores of NHAA men compared with women when retired or with Medicare insurance.

Education and LE8 Scores

Among NHBAs and NHWAs, women had a greater magnitude of positive association of college degree or more (compared with high school or less) with LE8 scores than men after adjusting for age (interaction *P*=0.013 among NHBAs and *P*=0.006 among NHWAs). There was no difference between HA or NHAA men and women in this association in age-adjusted models (Figure 2 and Table S2).

Table 2. Sample Characteristics of Male and Female Adult Participants by Race and Ethnicity

Characteristics	Hispanic Americans						Non-Hispanic Asian Americans						Non-Hispanic Black Americans						Non-Hispanic White Americans					
	Male			Female			Male			Female			Male			Female			Male			Female		
	Obs.	N	%	Obs.	N	%	Obs.	N	%	Obs.	N	%	Obs.	N	%	Obs.	N	%	Obs.	N	%	Obs.	N	%
Age, y																								
20–30	269	4033	51	323	3933	49	167	1408	54	161	1212	46	268	2392	47	297	2743	53	443	11 888	52	450	10 784	48
31–50	512	6106	51	583	5805	49	303	2023	51	287	1979	49	414	3140	43	544	4173	57	882	21 107	51	912	20 605	49
51–65	459	2775	49	496	2908	51	192	1082	45	186	1320	55	464	2484	46	518	2925	54	673	19 136	49	731	20 129	51
66+	241	1015	45	280	1253	55	80	429	41	94	618	59	297	1055	45	267	1285	55	875	13 153	46	861	15 183	54
Income/poverty line ratio																								
0–1.00	390	3153	45	509	3847	55	82	635	48	87	689	52	317	2060	39	454	3176	61	429	5558	43	486	7255	57
1.01–2.00	464	4345	51	513	4212	49	108	724	51	101	704	49	375	2392	44	445	3081	56	785	11 007	47	797	12 591	53
2.01–3.00	241	2287	53	261	2043	47	99	679	49	105	695	51	242	1447	46	258	1674	54	417	9979	51	443	9704	49
3.01–4.00	155	1839	55	155	1530	45	111	729	47	111	835	53	179	1075	48	166	1185	52	310	7923	46	344	9432	54
4.01–5.00+	231	2305	50	244	2266	50	342	2174	50	324	2205	50	330	2097	51	303	2010	49	932	30 816	53	884	27 720	47
Employment																								
Disability	130	947	48	140	1025	52	8	67	36	19	116	64	168	972	46	176	1120	54	262	4009	46	285	4641	54
Employed	1012	10 658	57	852	7970	43	573	3852	55	441	3140	45	805	5680	46	933	6723	54	1614	44 588	55	1434	36 822	45
Homemaker	12	70	3	302	2200	97	12	88	10	112	765	90	11	54	9	84	553	91	21	447	7	252	5860	93
Retired	198	854	42	220	1174	58	77	427	43	83	557	57	273	995	42	265	1364	58	772	12 732	46	783	14 760	54
Student	13	216	37	32	373	63	34	287	58	30	204	42	36	281	56	28	217	44	35	619	39	35	953	61
Unemployed	116	1185	51	136	1157	49	38	221	39	43	345	61	150	1089	49	140	1148	51	169	2888	44	165	3666	56
Educational level																								
HS	930	8061	52	975	7384	48	130	939	48	134	1013	52	704	4292	50	633	4280	50	1084	20 583	51	1002	19 515	49
Some college	356	3834	47	477	4367	53	134	942	44	167	1223	56	475	3202	42	638	4336	58	941	20 569	47	1112	23 165	53
College+	195	2035	49	230	2147	51	478	3061	51	427	2892	49	264	1578	39	355	2509	61	848	24 131	50	840	24 021	50
Insurance																								
Combination	149	833	50	158	820	50	36	242	45	47	292	55	213	862	44	213	1096	56	655	10 757	48	637	11 715	52
Medicaid	94	731	30	200	1744	70	38	305	53	43	267	47	111	914	32	267	1942	68	134	2161	40	211	3236	60
Medicare	136	578	50	129	588	50	40	210	42	41	284	58	143	528	43	133	700	57	280	4449	45	306	5384	55
Military	17	132	50	11	131	50	4	34	24	10	109	76	62	379	66	24	196	34	81	1265	55	38	1047	45
Other	79	713	39	135	1112	61	50	409	56	39	323	44	86	573	40	117	868	60	117	2734	47	150	3114	53
Private	519	5807	52	566	5318	48	469	3022	49	457	3190	51	519	3543	46	621	4237	54	1194	35 810	50	1283	35 908	50
Uninsured	487	5135	55	483	4186	45	105	721	52	91	663	48	309	2272	52	251	2086	48	412	8107	56	329	6296	44
LE8																								
Low	337	2746	61	275	1767	39	70	411	57	41	316	43	420	2462	50	402	2485	50	651	11 676	54	552	9814	46
Moderate	1012	9379	51	1109	8982	49	486	3293	53	422	2966	47	906	5702	43	1057	7443	57	1862	43 168	53	1769	38 755	47
High	132	1804	36	298	3149	64	186	1238	40	265	1846	60	117	907	43	167	1198	57	360	10 439	37	633	18 133	63

% Indicates weighted percentage; HS, high school or less; LE8, Life's Essential 8; N, weighted number (in 1000s); and Obs., number of participants (observations).

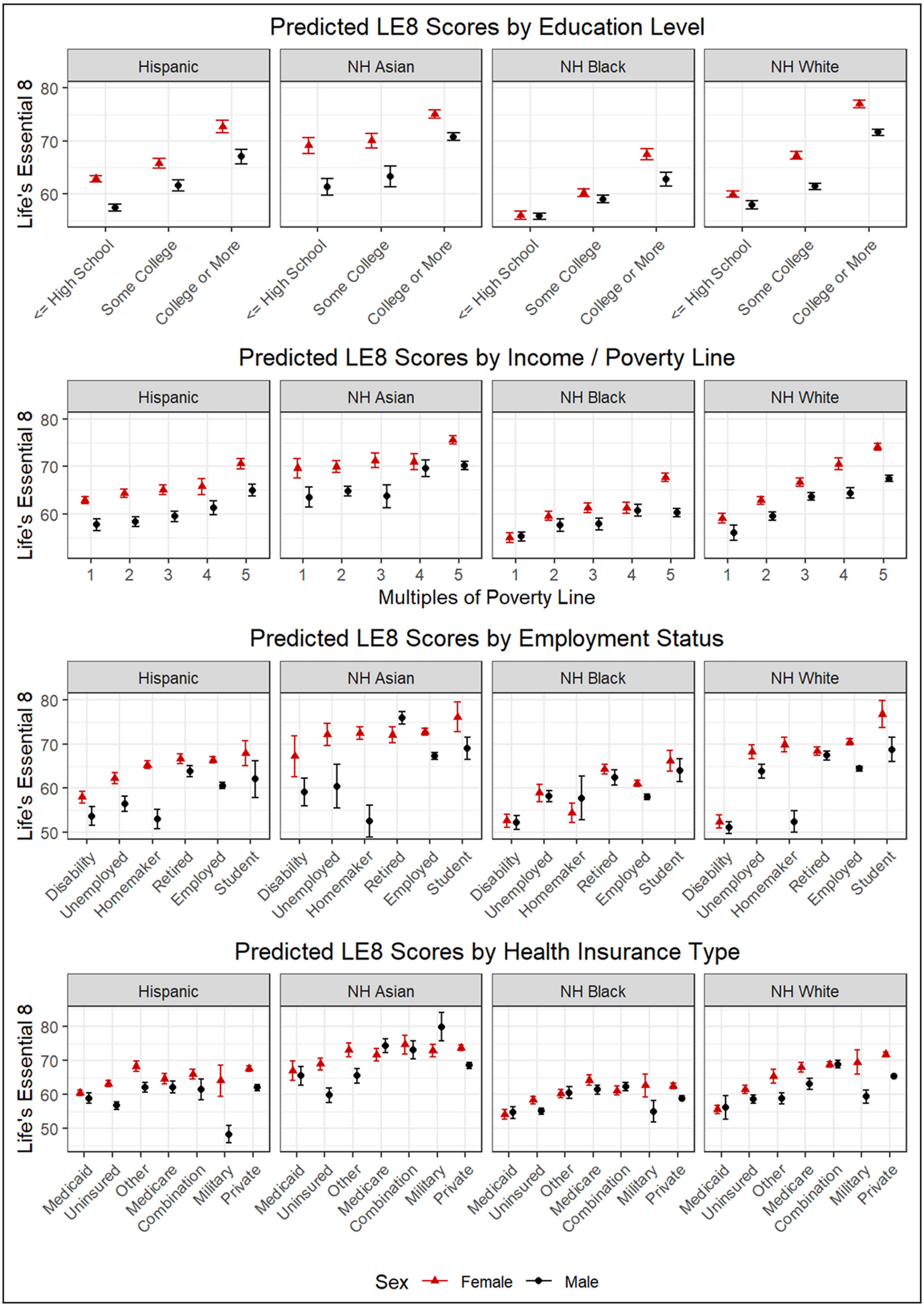

Figure 1. Predicted Life's Essential 8 (LE8) values for each level of socioeconomic status by sex and race and ethnicity, with age held constant at the median (48 years).
Predicted LE8 scores for women are in red, and scores for men are in black. Radio masts indicate SE of the predicted scores. NH indicates non-Hispanic.

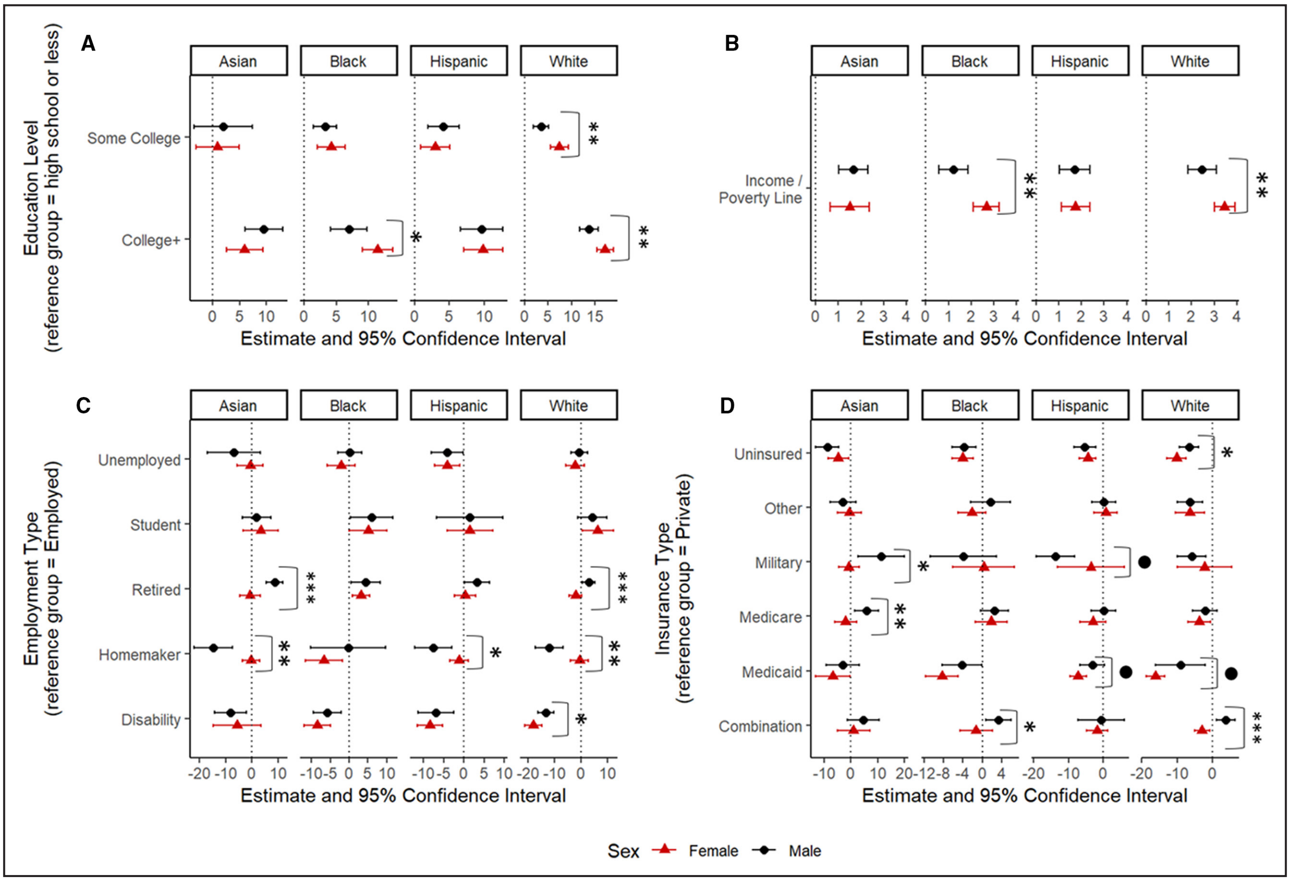

Figure 2. Association of socioeconomic status measures with Life's Essential 8 scores by race and ethnicity and sex, with sex interaction *P* values indicated.

Estimates represent the difference in Life's Essential 8 score for the indicated group compared with the reference group of the same sex, race, and ethnicity. Error bars are 95% CIs of this difference. Interaction *P* values are indicated by the following symbols: ● indicates *P*<0.1, **P*<0.05, ***P*<0.01, ***P*<0.001. Estimates are from models adjusted for age. **A**, The association of educational level with Life's Essential 8 score. **B**, The association of income/poverty line ratio with Life's Essential 8 score. **C**, The association of employment type with Life's Essential 8 score. **D**, The association of insurance type with Life's Essential 8 score. Interpretation: Black women have a greater magnitude of association of college or more education (compared with high school or less education) with cardiovascular health than Black men (12 vs 7 LE8 points; *P*=0.01). White women have a greater magnitude of association of income/poverty line ratio with cardiovascular health than White men (3.4 vs 2.5; *P*=0.002). Asian women have a negative association of Medicare health insurance (compared with private insurance) with cardiovascular health, and Asian men have a positive association (–2 vs 6; *P*=0.005). Hispanic men have a greater magnitude of association of homemaker employment status (compared with employed) with cardiovascular health score than Hispanic women (–8 vs –1; *P*=0.02).

Income/Poverty Line Ratio and LE8 Scores

Among NHBAs and NHWAs, women had a greater magnitude of positive association of income/poverty line ratio with LE8 scores than men after adjusting for age (interaction *P*=0.001 among NHBAs and *P*=0.002 among NHWAs). Among HAs and NHAAs, there was no difference between men and women in this age-adjusted association (Figure 2 and Table S3).

Insurance

The most common combination of insurances was Medicare and private insurance. Among NHWAs and NHBAs in age-adjusted models, men with a combination of insurances had numerically higher LE8 scores than men with private insurance only, whereas women with a combination of insurances had lower scores than women with private insurance only. These sex differences resulted in significant interaction term *P* values (*P*=0.011 among NHBAs and *P*<0.001 among NHWAs). Among NHAAs and HAs, there were no significant sex differences in the association of combination insurance with LE8 scores; however, the same pattern of higher scores among men and lower scores among women was seen among NHAAs with Medicare insurance compared with private insurance (*P*=0.005; Figure 2 and Table S4).

Employment

Among NHAAs and NHWAs, men who were retired had higher LE8 scores than men who were employed, whereas women who were retired had lower scores than women who were employed after adjusting for age. These sex differences resulted in significant interaction term *P* values ($P<0.001$ for NHAAs and NHWAs; Figure 2 and Table S5).

DISCUSSION

Summary

In this US representative sample, NHBA and NHWA populations had a greater magnitude of association of education and income with LE8 in women compared with men. The greater magnitude was a reflection of higher LE8 scores in women in higher education and income categories while having similar LE8 scores to men at the lowest education and income categories. The current analysis shows that there are greater sex differences as income and education increase in NHWA and NHBA populations. In general, women had higher LE8 scores than men in HA and NHAA populations. Thus, no sex disparity existed when comparing higher with lower levels of SES with LE8. Potential explanations for the sex differences in the NHWA and NHBA populations include sex norms around seeking health care, caregiver burden, survivor bias, perceived discrimination, the sex-based pay gap, and the glass ceiling, which are explained below.

Greater Willingness to Visit a Physician: A Potential Factor Leading to Higher LE8 in Women With High SES Compared With Men

A study of Medical Expenditure Panel Survey data from 1996 found that 60% of men and 77% of women visited a physician in that year.[20] In addition, 26% of men compared with 16% of women did not have a usual source of health care. These trends exist despite men in Medical Expenditure Panel Survey having higher SES and being more likely to work ≥40 h/wk than women. These patterns are not isolated to this sample; others have found women have higher health care use than men, even after adjusting for services like gynecologic examinations.[21] Higher health care use among high SES women compared with high SES men may contribute to women having better preventive care and control of chronic medical conditions than men, leading to higher LE8 scores at higher SES.

Potential Factors Leading to Lower LE8 With Low SES in NHBA and NHWA Women

Caregiver Burden

Women, particularly low SES women, are more likely than men to be caregivers.[22] Caregiver burden is a stress, and stress is associated with poor CVH scores.[23] Among NHBAs and NHWAs, caregiver burden may affect low SES women more than higher SES women, who may be able to afford to reduce caregiver burden through additional paid resources. This difference in caregiver burden may contribute to the lower LE8 scores experienced by lower SES women compared with higher SES women. Among NHAAs and HAs, caregiving may not be a task predominantly performed alone, and instead, a task performed by the entire (extended) family.[24] This may partially explain why no sex differences by income or education were found among NHAAs and HAs.

Perceived Discrimination

Ample research has described the association between perceived discrimination and poorer mental and physical health, but much of it has been focused on race- or ethnicity-based discrimination.[25] Research on sex-based discrimination is scarcer and often focuses on workplace discrimination. Some studies report similar general discrimination scores by sex,[26,27] but studies measuring sex-specific discrimination have found the opposite.[28,29] One may conclude that women experience more sex-based discrimination, but experience overall discrimination similarly to men. In addition, women may experience poor health outcomes related to discrimination at lower levels of discrimination than men.[27] Limited evidence suggests that perceived race- and sex-based discrimination increases as SES increases among women.[30,31] If discrimination leads to poorer health, and women perceive more discrimination as SES increases, one would expect women of high SES to have worse CVH than men of high SES and there to be little difference between men and women of low SES. Instead, this analysis showed men of high SES had lower CVH than women of high SES. More research is needed to explain sex differences in perceived discrimination (or lack thereof) and their relationship to sex differences in CVH by SES.

Sex-Based Pay Gap and the Glass Ceiling

This and previous analyses show that women earn less income than men, even when adjusting for education and occupation.[32] In addition, women are underrepresented in higher-paying occupations, like C-suite level executives, suggesting the existence of what is termed the "glass ceiling."[32] There are many factors that may explain these gaps, including sex-based discrimination, career and educational field choice differences, sex differences in risk aversion, and sex-related norms around nonmarket work.[32] In light of the sex-related pay gap that persists within education and occupation strata, one would expect women to have lower LE8 scores than men within each stratum of education and occupation, but this analysis revealed the opposite, especially in higher SES strata among NHBAs and NHWAs.

Toxic Stress of Poverty

Poverty, in childhood and in adulthood, is associated with toxic stress, whose effects in children manifest as chronic illnesses in adulthood.[33] The lack of difference in LE8 in the lowest educational attainment, the highest poverty level, and Medicaid as insurance among NHBAs and NHWAs may reflect a more toxic effect of poverty among NHBAs and NHWAs than NHAAs and HAs, and may reflect similar lived experiences and effects of poverty on male and female children that extend into adulthood. More research is needed to understand these observations and relationships.

Survivor Bias

One explanation for the sex differences in LE8 among those who are retired and have Medicare insurance among NHAAs could be survivor bias. It is possible that NHAA men with low scores die at greater rates than NHAA women with low scores. Indeed, men in all age groups have higher rates of myocardial infarction or fatal coronary heart disease than women in those age groups,[34] although there is a dearth of data on sex differences in CVD mortality among NHAAs. In this analysis, 20- to 30-year-old NHAAs are 54% men, whereas NHAAs aged ≥66 years are only 41% men. This discrepancy is the greatest difference between proportion of men and women at ≥66 years among the studied racial and ethnic groups. This evidence, however, cannot address the question of survivor bias, as it is cross-sectional. Thus, more longitudinal research is needed.

Factors that influence men's lower LE8 scores than women's in higher strata of SES need to be further explored. We have previously shown that the associations of SES with CVH may be limited in men, particularly in Black men, where education and employment status were not associated with higher attainment of CVH.[9] Mechanistic evaluation of drivers and inhibitors of CVH in men with increasing SES may provide targets for interventions to improve CVH in men.

Strengths and Limitations

The strengths of this study include census-based definitions of race and ethnicity, the use of a nationally representative sample, gold standard ascertainment of diet (two 24-hour recalls on nonconsecutive days), a validated physical activity questionnaire, and reliably measured laboratory values. Results should be considered in light of a few limitations. Participants were able to choose only between male or female sex. The study is cross-sectional in design, so causation and temporality can neither be ascertained nor inferred. For employment status, the employed category was not further subdivided in this analysis, as there was no clear SES gradient among the industry codes supplied by NHANES. Participants who identified themselves as Indigenous or multiracial were not included in this analysis. As is convention, self-reported data were used for sleep, diet, physical activity, and smoking. Limited overlap in ages between Medicare and private insurances may lead to residual confounding attributable to age, even after adjustment. Multiple models were fit to generate these results, which increases the probability of false-positive results. Finally, participants of different national origin and immigration statuses are grouped together within the racial and ethnic groups described. These groups could not be further subdivided because of power considerations.

CONCLUSIONS

CVH scores were greater in higher SES strata than in lower strata for all sex, race, and ethnicity groups. Women have the greatest magnitude of association of SES with LE8 scores among NHBAs and NHWAs, but not NHAAs and HAs. Improving SES may improve CVH in all groups; however, given the greater magnitude of difference in NHBA and NHWA women compared with men and the higher overall CVH at higher levels of SES in women across racial and ethnic groups, interventions focused on addressing inequities in men's health should consider the intersectional role of SES.

ARTICLE INFORMATION

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Disclosures
None.

Supplemental Material
Tables S1–S5
Figures S1–S2

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