Sodium Intake and Cause-specific Mortality among Predominantly Low-Income Black and White Americans

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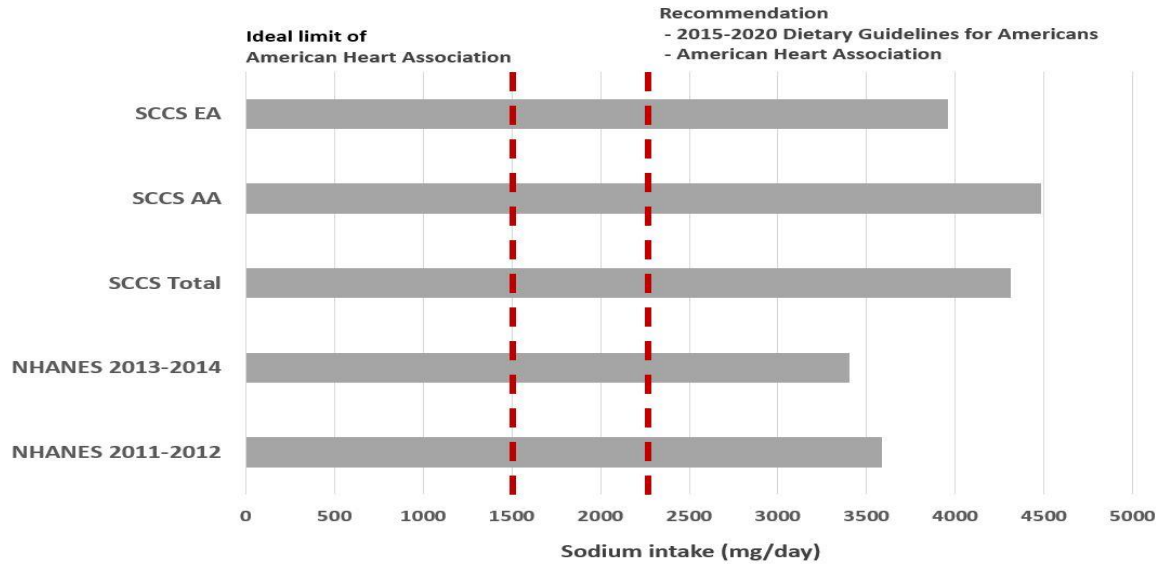
Background

- Sodium is an essential nutrient for normal physiologic function, but excessive intake is associated with adverse health outcomes
- Dietary patterns have changed dramatically over the last century, from plant-based to synthetic chemical nutrients
- Especially, sodium is widely used in food processing and manufacturing of processed foods
- Despite the *2020 to 2025 Dietary Guidelines for Americans* recommend **less than 2300mg of sodium per day**, most US adults consume **3400mg per day**, which far exceeds the body's needs

Sodium Intakes and Socioeconomic Status



4,512 mg/day for Black and 4,041 mg/day for Whites

The current evidence reported that sodium intake is closely associated with ***socioeconomic status***, as individuals with low socioeconomic status consume more sodium than those with high socioeconomic status

- **Approximately 500 to 1,000 mg/day more sodium intake**

Eating high sodium containing foods in accordance with one's socioeconomic status

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Study Aims

Limited evidence of sodium intake and mortality among Black Americans and/or low socioeconomic status population in the US

- To explore the socioeconomic differences in daily sodium consumption
- To investigate the associations of sodium intake with all-cause and cause-specific mortality (e.g. CVD and its subtypes, cancer, and other diseases)
- To estimate the burden of mortality attributable to excess dietary sodium among predominantly low-income Black and White Americans

Methods

- **Southern Community Cohort Study; Resource for health disparities research**
  - ✓ Recruited from 2002 to 2009, and Follow-up studies
  - ✓ 84,797 adults aged 40-79 years who were residing in 12 southeastern states of the US

- **Key Features of SCCS**
  - ✓ Collection of extensive baseline information and pre-diagnostic blood and urine samples (~75% of participants)
  - ✓ Routine follow-up to ascertain and update mortality, cancer incidence

- **This study included 64,329 participants,**
  - ✓ Mean (SD) age is 51.3 (8.6) years for Blacks, and 53.3 (9.3) years for Whites
  - ✓ 46,185 (71.8%) were Blacks, 18,144 (28.2%) were Whites

Methods

- **Exposure Assessment**
  - ✓ Food Frequency Questionnaire at baseline was developed to capture the usual diet for Black and White Americans living in the southeastern United States
  - ✓ **Dietary sodium intake** was classified into 5 categories: the recommended level (<2,300mg/d), above recommendation by up to 50% (2,300-3,450mg/d), more than 50% to 100% or less (3,451-4,600mg/d), more than 100% to 200% or less (4,601-6,900mg/d), and over 200% (>6,900mg/d)
- **Outcome Ascertainment**
  - ✓ Causes of death were defined using the ICD-10
- **Statistical Analysis**
  - ✓ Multivariable Cox proportional hazards regression was used to estimate hazard ratios (HRs) and 95%CIs for all-cause and cause-specific mortality
  - ✓ Potential nonlinear associations between sodium intake and mortality were assessed by using restricted cubic spline regression
  - ✓ Population attributable risks (PARs) and corresponding 95%CIs were calculated

Dietary Sodium Intakes by Educational Attainment and Annual Household Income

	Black Americans, N=46,185	White Americans, N=18,144
Education		
Less than 9 years of schooling	4,273 ± 2,500	4,062 ± 2,259
High school dropouts	4,653 ± 2,757	4,184 ± 2,366
Completed high school	4,603 ± 2,703	4,157 ± 2,339
Vocational or technical training	4,417 ± 2,514	3,835 ± 2,066
Some college or junior college	4,476 ± 2,505	3,939 ± 2,092
Graduated from college	4,206 ± 2,433	3,788 ± 1,886
Graduate school: master's degree	3,801 ± 2,047	3,499 ± 1,653
Beyond a master's degree	3,759 ± 2,310	3,563 ± 1,542
Annual household Income		
< $15,000	4,593 ± 2,695	4,145 ± 2,314
≥ $15,000 to < $25,000	4,486 ± 2,594	4,129 ± 2,266
≥ $25,000 to < $50,000	4,278 ± 2,409	3,848 ± 2,058
≥ $50,000	3,999 ± 2,314	3,471 ± 1,627

The population with **less educational attainment** and **lower annual household income** showed higher sodium intake regardless race/ethnicity

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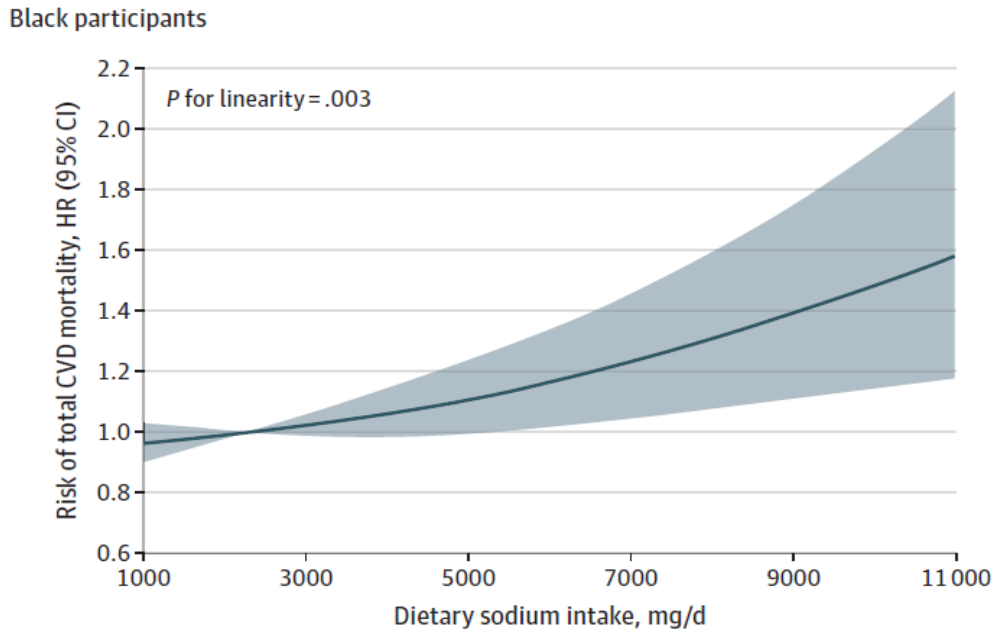
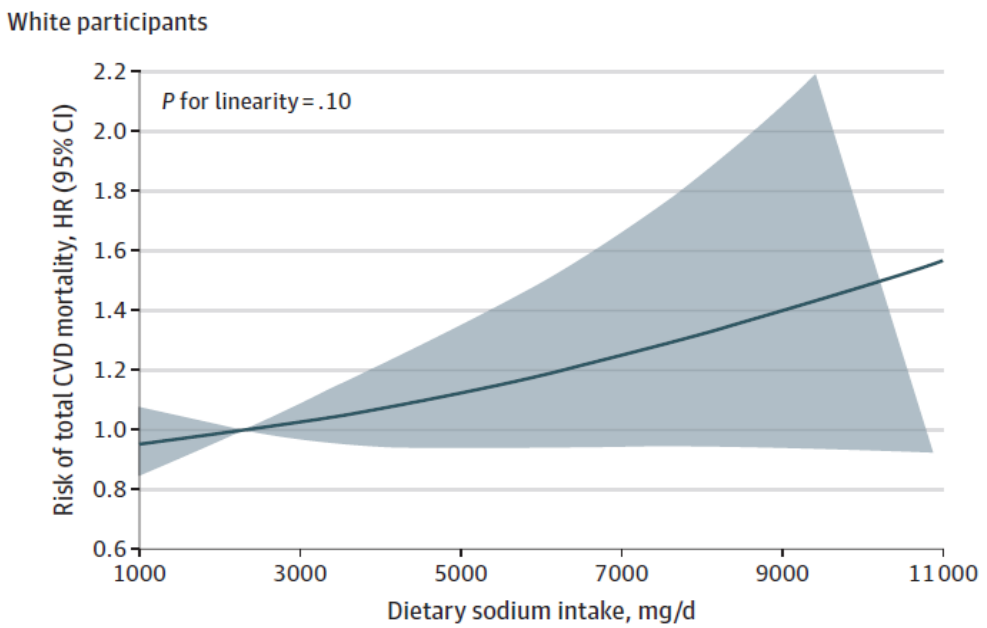
Dose-Response Association of Dietary Sodium Intake With Total Cardiovascular Disease Mortality





Restricted cubic spline analyses suggested that the association between **dietary sodium intake** and **total CVD mortality** follows a **linear dose-response pattern** in **Black individuals**

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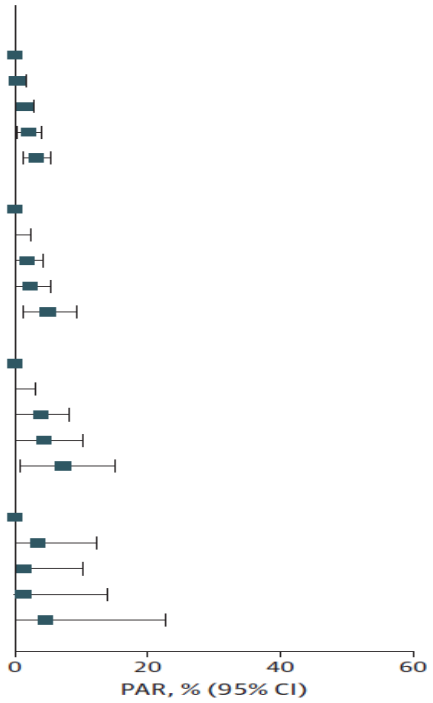
Population-Attributable Risk (PAR) for Cause-Specific Mortality by Dietary Sodium Intake

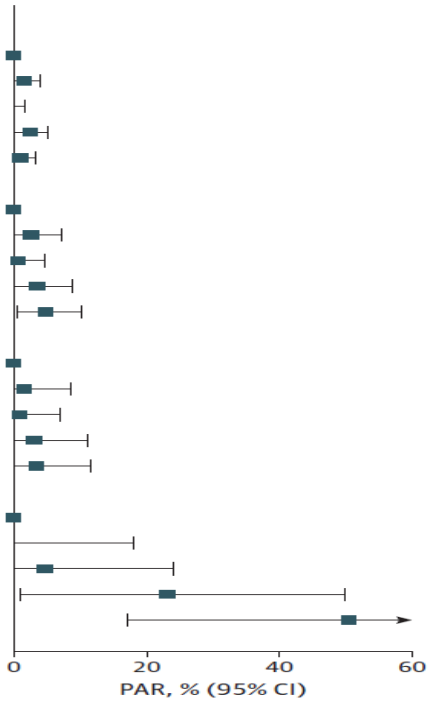
Black participants

Causes of death	PAR, % (95% CI)
All causes	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	0.38 (0.00-1.79)
3451-4600 mg/d	1.53 (0.19-2.90)
4601-6900 mg/d	2.05 (0.28-3.90)
>6900 mg/d	3.24 (1.13-5.52)
Total CVD	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	0.00 (0.00-2.26)
3451-4600 mg/d	1.86 (0.00-4.26)
4601-6900 mg/d	2.24 (0.00-5.52)
>6900 mg/d	4.97 (1.15-9.30)
CHD	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	0.00 (0.00-3.09)
3451-4600 mg/d	3.87 (0.00-8.18)
4601-6900 mg/d	4.44 (0.00-10.27)
>6900 mg/d	7.31 (0.79-15.16)
Heart failure	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	3.42 (0.00, 12.24)
3451-4600 mg/d	1.34 (0.00, 10.25)
4601-6900 mg/d	1.29 (0.00, 13.90)
>6900 mg/d	4.53 (0.00, 22.64)



White participants

Causes of death	PAR, % (95% CI)
All causes	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	1.58 (0.00-4.04)
3451-4600 mg/d	0.00 (0.00-1.75)
4601-6900 mg/d	2.46 (0.00-5.14)
>6900 mg/d	0.00 (0.00-3.21)
Total CVD	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	2.54 (0.00-7.27)
3451-4600 mg/d	0.55 (0.00-4.64)
4601-6900 mg/d	3.54 (0.00-8.87)
>6900 mg/d	4.71 (0.40-10.24)
CHD	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	1.49 (0.00-8.46)
3451-4600 mg/d	0.81 (0.00-6.98)
4601-6900 mg/d	3.07 (0.00-11.09)
>6900 mg/d	3.45 (0.00-11.66)
Heart failure	
<2300 mg/d	0 [Reference]
2300-3450 mg/d	0.00 (0.00-18.12)
3451-4600 mg/d	4.62 (0.00-23.94)
4601-6900 mg/d	26.16 (1.02-49.85)
>6900 mg/d	50.79 (17.40-80.01)



The overall Population-Attributable Risk associated with **exceeding 2300mg/day** of dietary sodium per day was approximately **10% for total CVD mortality**, **13% for CHD mortality**, and **about 30% for heart failure mortality**

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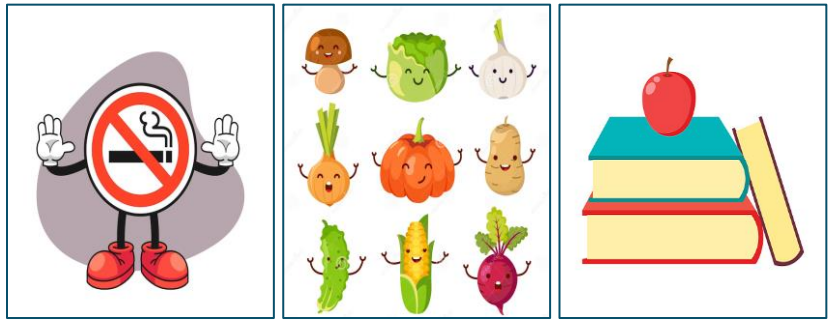
Conclusion and Future Efforts

- Despite substantial public health efforts to lower sodium intake in Americans during recent decades, ***over 80% of this underserved population did not adhere to the current dietary guidelines for sodium intake***

- High sodium intake appeared to account for about **10% to 30% of CVD-related deaths** among our study population

- Developing effective dietary modification strategies tailored to low socioeconomic status population is urgently needed to prevent health disparities in the US



- **Social supports for encouraging healthy eating**
- **Reducing the CVD burden due to excessive sodium intake**
- **Public health promotion via dietary modification**

Acknowledgement

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Sodium Intake and Cause-Specific Mortality Among Predominantly Low-Income Black and White US Residents

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Abstract

IMPORTANCE Epidemiologic evidence regarding the outcomes of dietary sodium intake on mortality remains limited for low-income individuals, particularly Black people.

OBJECTIVE To investigate the associations of excessive dietary sodium with all-cause and cause-specific mortality among predominantly low-income Black and White Americans.

DESIGN, SETTING, AND PARTICIPANTS This cohort study included participants aged 40 to 79 years from the Southern Community Cohort Study who were recruited at Community Health Centers in 12 southeastern states from 2002 to 2009. Analyses were conducted between March 2022 and June 2023.

EXPOSURES Dietary sodium intake was assessed using a validated food frequency questionnaire at baseline.

MAIN OUTCOMES AND MEASURES Multivariable-adjusted Cox regression was used to estimate hazard ratios (HRs) and 95% CIs for mortality outcomes (all-cause, cardiovascular disease [CVD], coronary heart disease [CHD], stroke, heart failure, cancer, and other) associated with sodium intake. Nonlinear associations and population-attributable risk (PAR) of the mortality burden associated with excess sodium were further assessed.

RESULTS Among the 64 329 participants, 46 185 (71.8%) were Black, 18 144 (28.2%) were White, and 39 155 (60.9%) were female. The mean (SD) age at study enrollment was 51.3 (8.6) years for Black participants and 53.3 (9.3) years for White counterparts. Mean (SD) dietary sodium intake was 4512 (2632) mg/d in Black individuals and 4041 (2227) mg/d in White individuals; 37 482 Black individuals (81.2%) and 14 431 White individuals (79.5%) exceeded the current dietary recommendations of 2300 mg/d. During a median (IQR) follow-up of 13.8 (11.3-15.8) years, 17 811 deaths were documented, including 5701 from CVD. After adjustment for potential confounders, in Black individuals, HRs per 1000-mg increase in daily sodium intake were 1.07 (95% CI, 1.03-1.10) and 1.08 (95% CI, 1.02-1.14) for deaths from total CVD and CHD, respectively; while in White individuals, the corresponding HRs were 1.08 (95% CI, 1.02-1.14) and 1.13 (95% CI, 1.03-1.23). No significant associations were found for cancer mortality. PAR estimates suggest that sodium intake above the recommended threshold may account for 10% of total CVD, 13% of CHD, and 30% of heart failure deaths in this low-income southern population.

CONCLUSIONS AND RELEVANCE In this cohort study of 64 329 low-income Americans, nearly 80% of study participants consumed sodium exceeding the current recommended daily amount,

Key Points

Question How is sodium intake associated with mortality outcomes among low-income Black and White Americans?

Findings This cohort study of 64 329 Americans from the Southern Community Cohort Study found that approximately 80% of low-income Black and White Americans exceeded the recommended daily intake of sodium, which was associated with 10% to 30% of cardiovascular disease mortality.

Meaning These findings suggest that approaches to lower sodium intake among underserved populations need to be established as the primary public health priority.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Thank You!

If you have any questions, please contact

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