

# The Impact of Lifecourse Socioeconomic Position on Cardiovascular Disease Events in African Americans: The Jackson Heart Study

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**Background**—Few studies have examined the impact of lifecourse socioeconomic position (SEP) on cardiovascular disease (CVD) risk among African Americans.

**Methods and Results**—We used data from the Jackson Heart Study (JHS) to examine the associations of multiple measures of lifecourse SEP with CVD events in a large cohort of African Americans. During a median of 7.2-year follow-up, 362 new or recurrent CVD events occurred in a sample of 5301 participants aged 21 to 94. Childhood SEP was assessed by using mother's education, parental home ownership, and childhood amenities. Adult SEP was assessed by using education, income, wealth, and public assistance. Adult SEP was more consistently associated with CVD risk in women than in men: age-adjusted hazard ratios for low versus high income (95% CIs), 2.46 (1.19 to 5.09) in women and 1.50 (0.87 to 2.58) in men,  $P$  for interaction=0.1244, and hazard ratio for low versus high wealth, 2.14 (1.39 to 3.29) in women and 1.06 (0.62 to 1.81) in men,  $P$  for interaction=0.0224. After simultaneous adjustment for all adult SEP measures, wealth remained a significant predictor of CVD events in women (HR=1.73 [1.04, 2.85] for low versus high). Education and public assistance were less consistently associated with CVD. Adult SEP was a stronger predictor of CVD events in younger than in older participants (HR for high versus low summary adult SEP score 3.28 [1.43, 7.53] for participants  $\leq 50$  years, and 1.90 (1.36 to 2.66) for participants  $>50$  years,  $P$  for interaction 0.0846). Childhood SEP was not associated with CVD risk in women or men.

**Conclusions**—Adult SEP is an important predictor of CVD events in African American women and in younger African Americans. Childhood SEP was not associated with CVD events in this population. (*J Am Heart Assoc.* 2015;4:e001553 doi: 10.1161/JAHA.114.001553)

**Key Words:** adult SEP • African Americans • cardiovascular disease events • childhood SEP • epidemiology • lifecourse • socioeconomic position

A large body of work has documented the influence of lifecourse socioeconomic position (SEP) on cardiovascular disease (CVD) risk in later life.<sup>1–5</sup> Several models have been proposed for how factors operating over the lifecourse may affect CVD, including critical/sensitive periods (exposure at a critical time point having consequences regardless of subsequent exposures), accumulation of risk (exposures accumulating over time) and syner-

gistic effects (exposures later in life enhancing the effects of early exposures).<sup>1–4</sup> Lifecourse SEP may impact CVD through its effects on more proximal risk factors for CVD risk such as behavioral factors, psychosocial processes, or even infections acquired early in life.<sup>1,2,6,7</sup>

The majority of studies investigating the impact of childhood SEP on CVD in later life have been conducted in European<sup>8–10</sup> or US white populations.<sup>11–13</sup> It is possible that

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the role of lifecourse factors depends on the historical, economic, or social circumstances of different social groups. For example, African Americans are more likely than whites to experience adverse lifecourse SEP as the result of racial discrimination and segregation.<sup>14,15</sup> In addition, they may be more vulnerable to the effects of lifecourse SES due to the interaction of lifecourse SEP with other factors linked to race/ethnicity.

African Americans experience a disproportionate burden of CVD morbidity and mortality compared with whites.<sup>16</sup> Furthermore, the lifecourse SEP history of African Americans is quite different from that of US whites. However, there has been limited research on the association of lifecourse SEP with CVD risk in African Americans, and findings are mixed.<sup>17,18</sup> One study found childhood SEP predicted stroke risk in African Americans independent of adult SEP,<sup>17</sup> while another study reported no direct effect of early-life SEP on incident heart failure in African Americans.<sup>18</sup> To our knowledge, no studies have investigated the links between lifecourse SEP and CVD events in a large and economically diverse sample of African Americans. Understanding the lifecourse processes contributing to the development of CVD in African Americans may provide important insights into the causes of disparities in CVD risk.

We examined the associations of multiple measures of lifecourse SEP with CVD events in the Jackson Heart Study (JHS), a large population-based study of African Americans, with 10 years of follow-up. We also investigated whether CVD risk factors partially explain the associations between lifecourse SEP and CVD events. In addition, we examined whether sex and/or age modified associations between lifecourse SEP and CVD events.

## Materials and Methods

### Study Population

The JHS is a population-based study of the causes of CVD in African Americans. Between 2000 and 2004, a total of 5301 (3360 [63.4%] women and 1941 [35.6%] men) noninstitutionalized African Americans between the ages of 21 to 94 were recruited from Hinds, Madison, and Rankin counties in the Jackson Mississippi metropolitan area (MSA). The study design and recruitment protocol have been previously described.<sup>19–22</sup> Briefly, participants were recruited from 4 different sources: (1) 31% were recruited from prior Jackson participants of the Atherosclerosis Risk in Communities (ARIC) Study; (2) 17% were recruited randomly from the tricounty area; (3) 30% were volunteers recruited to be approximately representative of the Jackson MSA African American population in terms of age, sex, and socioeconomic characteristics; and (4) the remaining 22% were JHS family

members recruited to allow for future genetic studies. The JHS was approved by the institutional review boards of Jackson State University, Tougaloo College, and the University of Mississippi Medical Center. All participants provided written informed consent.

### Childhood SEP

Three measures of childhood SEP were derived from an interviewer-administered questionnaire during the first annual follow-up call. Participants were asked to think back on the time before they reached 16 years of age and select the number of years of schooling or highest academic degree attained by their father, mother, or primary caretaker. In the current study, the father's education was not used due to excessive missing data (41%). Mother's education was categorized into 3 groups: <high school (HS), HS/GED, and >HS. Participants' parental (or primary caretaker) housing tenure status before they reached age 10 was coded as 1 for owners and 0 for renters or other living arrangements. A childhood amenities score was derived based on access to 8 amenities (indoor plumbing, electricity, refrigerator, telephone, television, air conditioning, parental car ownership, and number of rooms) while growing up until age 10. Participants who had access to each amenity were coded as 1 and those with no access were coded as 0. The number of rooms was dichotomized at the median and coded into 0 (<5) or 1 (≥5). A summary score of childhood amenities was created by summing the points for these 8 amenities and subsequently categorized into tertiles of low, medium, and high (0 to 2). To examine the overall associations of childhood SEP with CVD risk independent of adult SEP, all childhood SEP measures (parental education [0 to 2], parental home ownership [0 to 1] and amenities [0 to 2]) were added together to generate a summary of childhood SEP score (range, 0 to 5). Then childhood SEP score was categorized into tertiles (low, medium, high) to allow for investigation of nonlinearity and to allow comparisons with adult SEP.

### Adult SEP

Adult SEP was assessed via questionnaire during the home induction interview at baseline. Education was measured as years of schooling completed and categorized into 4 groups: HS/GED or less, vocational certification/some college, associate/bachelor's degree, or postgraduate degree. Self-reported family income was measured from 13 brackets ranging from <\$5000 to ≥\$100 000. A continuous family income was calculated by taking the interval midpoint of each family income bracket of the participants. Those who reported total family income of <\$5000 were assigned a

value of \$2500 and those with >\$100 000 were assigned \$112 500 based on the US income distribution. Income was subsequently categorized into 4 groups (<\$25 000, \$25 000 to \$39 999, \$40 000 to \$74 999, or ≥\$75 000) for analysis. A score of wealth was created based on 3 assets: (1) whether the participant/family owned their home (yes/no), (2) whether the participant owned ≥1 cars (yes/no), and (3) liquid assets obtained by asking participants to select from 9 brackets ranging from \$0 to ≥\$200 000 indicating the total amount of money they could raise in an emergency by cashing in all of their (and spouses') checking, savings accounts, cars, jewelry, or other possessions and any stocks, bonds, or real estate. A continuous liquid asset measure was created by taking the interval midpoint of each liquid asset bracket of the participants. Those who reported liquid asset >\$200 000 were assigned a value of \$250 000 based on the US asset distribution. The continuous liquid asset was subsequently dichotomized at the median and coded into 0 (low) or 1 (high). The sum of home ownership (0 to 1), car ownership (0 to 1), and liquid asset (0 to 1) was used as a summary score of wealth (0 to 3). Wealth was then categorized as low (0 or 1 asset), medium (2 assets), and high (3 assets). Public assistance was constructed from 3 questions "In the past year, did you or anyone living in your household receive any income from the following sources (1) Food Stamps (yes/no)? (2) Other welfare program (yes/no)? (3) Supplemental Security Income (SSI) (yes/no)?" Participants on ≥2 types of assistance were assigned a 0 score; those on 1 type of assistance was assigned a score of 1, and participants with no assistance were assigned a score of 2. To examine the overall associations of adult SEP with CVD, a summary adult SEP score was generated by summing the participant's scores for education (0 to 3), income (0 to 3), wealth (0 to 2), and public assistance (0 to 2). The summary adult SEP score ranged from 0 to 10, and the score was categorized into tertiles (low, medium, high) to investigate nonlinearity and allow comparisons with childhood SEP.

## Covariates

Information on demographic (age [years] and sex [male/female]), behavioral risk factors (cigarette smoking, physical activity, and alcohol consumption), and biomedical risk factors (body mass index [BMI], low-density lipoprotein cholesterol [LDL], high-density lipoprotein cholesterol [HDL], triglycerides, hypertension, and type 2 diabetes) were derived from the baseline examination. Cigarette smoking status was classified as never, former, or current smoker. Physical activity was assessed based on a summary score of the intensity, frequency, and duration of activities associated with various aspects of life (active living, home

life, work, and sport) by using the JHS physical activity instrument.<sup>23,24</sup> Alcohol consumption (grams per day) was estimated from the frequency and portion sizes of beer, wine, and liquor ascertained from a food frequency questionnaire.<sup>25</sup> BMI (kg/m<sup>2</sup>) was calculated as weight in kilograms divided by height in meters squared. Fasting serum HDL (mg/dL) and triglycerides (mg/dL) were assayed by using standard techniques and were used as continuous measures.<sup>22</sup> Hypertension was defined as systolic pressure ≥140 mm Hg or diastolic pressure ≥90 mm Hg, taking antihypertensive medications within 2 weeks prior to the visit, or self-reported history of hypertension.<sup>26</sup> Type 2 diabetes was defined as fasting glucose ≥126 mg/dL, taking antidiabetic medications, or self-reported diabetes diagnosis.<sup>27</sup>

## CVD Events

The study outcome was CVD events and comprised incident and recurrent coronary heart disease (CHD) and stroke events. All participants were followed from the baseline examination in 2000–2004 to the date of CVD events, death, and loss to follow-up or otherwise through December 31, 2010. CVD events in the JHS were ascertained through a combination of active and passive surveillance by contacting the participants annually and identifying all hospitalizations and deaths during the prior year. In addition, discharge lists from local hospitals and death certificates from state vital statistics offices were surveyed for potential CVD events. If the death occurred out-of-hospital, interviews with the next-of-kin and completed questionnaires by physicians and medical examiners or coroners were used to obtain information on deaths. The abstracted information on hospitalizations and deaths was transmitted to the medical record abstraction unit who reviewed death certificates and hospital records for eligible CVD events in the cohort. Eligible events were classified as definite or probable fatal or nonfatal CHD and stroke events by a computer algorithm and follow-up review and adjudication by 2 independent physician reviewers. Any disagreements in diagnoses were adjudicated by another reviewer. Details on the quality assurance for ascertainment and classification of CVD events in JHS have been previously published<sup>28</sup> and follow those standardized ARIC protocols.<sup>29,30</sup>

### A CHD event

A CHD event was defined as a definite or probable myocardial infarction (MI), a definite fatal CHD, or cardiac procedure. The criteria for definite or probable MI were based on combinations of chest pain symptoms, ECG changes, and cardiac enzyme levels. The criteria for fatal CHD were based on chest pain symptoms, underlying cause of death from the death

certificate, and other associated hospital information or medical history. The criterion for cardiac procedure was based on receipt of angiography and any revascularization producers as indicated in the medical record.<sup>28,29</sup>

### A stroke event

A stroke event was defined as a definite or probable stroke on the basis of neuroimaging studies and autopsy according to criteria adapted from the National Survey of Stroke (NINCDS, 1981).<sup>31</sup> The minimum criterion for a definite or probable stroke was sudden or rapid onset of neurological symptoms lasting for >24 hours or leading to death. Any neurologic symptoms that did not last >24 hours or the lack of new neurologic symptoms seen before or during the hospital admission was not considered to be a stroke. Out-of-hospital stroke deaths not linked to a hospitalization or hospitalized events with no medical chart available were not included.<sup>28,30</sup>

### Missing Data Imputation

Our sample had substantial missing values for mother's education (27.1%), parental homeownership (8.6%), childhood amenities (10.0%), adult wealth (16.3%), income (15.1%), public assistance (2.5%), and education (0.4%). To reduce potential bias estimates and loss of statistical power due to missingness, we performed multiple imputations by using sequential multivariate regression imputation method (SMRI).<sup>32,33</sup> SMRI uses sequential regression models conditioned on all observed variables as predictors to provide less-biased estimates while accounting for uncertainty and improving efficiency compared with other methods such as the single imputation. SMRI was implemented by using IVEware software<sup>34</sup> to impute missing values and create 25 imputed datasets. The imputation model included all variables retained for the analysis. PROC MIANALYZE (SAS Institute) was used to combine the estimates across the imputed datasets and to obtain appropriate summary estimates and CIs.<sup>35</sup> We also performed sensitivity analyses by incorporating missing data as separate dummy variables in the original data. The results from the sensitivity analysis were generally similar to the imputation-based analysis, with unchanged overall patterns of associations and statistical significance.

### Statistical Analyses

Age- and sex-adjusted means and proportions were calculated by using linear and logistic regression, respectively, to compare baseline CVD risk factors across tertiles of summary childhood and adult SEP categories. To assess the patterns of CVD rates in men and women across categories of childhood and adult SEP, we calculated age-adjusted rates of CVD by

using Poisson regression. Linear trends across childhood and adult SEP categories were tested by including childhood and adult SEP measures as ordinal covariates.

Cox proportional hazards models were fitted to examine the associations between various lifecourse SEP measures and hazards of new or recurrent CVD events. Models were stratified by sex because descriptive analyses suggested different SEP patterning in men and women. Each adult SEP measure was first examined separately in age-adjusted models (model 1). We then included all adult measures together in the same model to determine if they had independent associations with CVD risks (model 2). Models were then adjusted for CVD risk factors (model 3). We also estimated age-adjusted associations with an overall adult SEP score and tested for interactions of this score with sex. We followed a similar modeling sequence for childhood SEP. A final model included the adult and childhood SEP summary score together in the same model in men and women separately. We also investigated whether associations of summary childhood and adult SEP with CVD were modified by age by using stratified analyses and by including appropriate interactions in the regression models.

We conducted several sensitivity analyses to test the robustness of our findings. We performed analysis with only incident CVD by excluding participants with recurrent events. Additionally, we also conducted sensitivity analysis to examine the impact of lifecourse SEP by type of CVD outcomes, separately for incident CHD and incident stroke. Last, we performed analysis with adult SEP and childhood SEP as continuous variables. Because there was evidence of a nonlinear relationship between lifecourse SEP and CVD events, the results from the tertiles of adult SEP and childhood SEP were presented.

The proportional hazards assumption was assessed by visual inspection of log-log plots and no significant violations were noted. All statistical analyses were performed with SAS (version 9.3; SAS Institute).<sup>35</sup>

### Results

During a median follow-up period of 7.2 years, 362 new or recurrent CVD events occurred in the sample of 3360 women and 1941 men. Of these events, 213 were in women and 149 in men.

Table 1 shows age- and sex-adjusted proportions and means of baseline demographic and CVD risk factors across tertiles of childhood and adult SEP categories. Participants with higher adult SEP and higher childhood SEP were younger and less likely to be women. Participants with higher adult SEP were also less likely to be current smokers and consume alcohol but had better dietary intake (ie, low energy, total fat,



**Table 1.** Selected Characteristics\* of the Study Sample by Tertiles of Adult and Childhood SEP Adjusted for Age and Sex,† JHS, 2000–2010

| Characteristics                    | Childhood SEP‡ (n=5301) |        |       |             | Adult SEP§ (n=5301) |        |       |             |
|------------------------------------|-------------------------|--------|-------|-------------|---------------------|--------|-------|-------------|
|                                    | Low                     | Medium | High  | P for Trend | Low                 | Medium | High  | P For Trend |
| Child SEP score                    | 0.7                     | 2.0    | 3.7   | —           | 1.6                 | 1.9    | 2.4   | <0.001      |
| Adult SEP score                    | 6.2                     | 7.3    | 7.8   | <0.001      | 3.9                 | 6.6    | 9.6   | —           |
| Age, y                             | 62.1                    | 53.8   | 46.1  | <0.001      | 58.3                | 53.9   | 52.8  | <0.001      |
| Female, %                          | 64                      | 66     | 60    | 0.022       | 64                  | 64     | 58    | <0.001      |
| Current smoker, %                  | 13                      | 13     | 12    | 0.004       | 13                  | 14     | 8     | <0.001      |
| Former smoker, %                   | 19                      | 20     | 19    | 0.515       | 19                  | 20     | 16    | <0.001      |
| Physical activity                  | 8.2                     | 8.5    | 8.5   | 0.007       | 7.6                 | 8.3    | 9.0   | <0.001      |
| Alcohol drinking, g                | 5.3                     | 5.4    | 5.5   | 0.835       | 7.3                 | 4.4    | 5.0   | 0.006       |
| Energy, kcal                       | 2250                    | 2234   | 2223  | 0.568       | 2517                | 2214   | 2055  | <0.001      |
| Total fat, g                       | 88.1                    | 87.9   | 88.0  | 0.973       | 97.6                | 87.3   | 81.7  | <0.001      |
| Total carbohydrate, g              | 281.3                   | 277.7  | 274.7 | 0.305       | 315.1               | 276.5  | 252.9 | <0.001      |
| Total dietary fiber, g             | 16.3                    | 16.4   | 16.6  | 0.333       | 17.7                | 16.0   | 15.9  | <0.001      |
| Body mass index, kg/m <sup>2</sup> | 31.6                    | 31.6   | 30.9  | 0.020       | 31.9                | 31.4   | 30.8  | <0.001      |
| Systolic blood pressure, mm Hg     | 127.4                   | 127.8  | 126.9 | 0.443       | 128.7               | 127.5  | 126.1 | <0.001      |
| Diastolic blood pressure, mm Hg    | 79.3                    | 80.4   | 78.8  | 0.333       | 78.7                | 79.7   | 79.5  | 0.056       |
| HDL cholesterol, mg/dL             | 50.1                    | 50.6   | 50.8  | 0.243       | 50.1                | 50.4   | 50.8  | 0.155       |
| LDL cholesterol, mg/dL             | 126.7                   | 128.0  | 127.0 | 0.813       | 125.7               | 127.1  | 128.0 | 0.094       |
| Fasting triglycerides, mg/dL       | 109.8                   | 110.4  | 107.1 | 0.413       | 109.7               | 110.7  | 106.8 | 0.253       |
| Diabetes, %                        | 17                      | 18     | 16    | 0.122       | 17                  | 18     | 14    | <0.001      |
| Hypertension, %                    | 65                      | 67     | 60    | 0.001       | 65                  | 66     | 61    | <0.001      |

SEP indicates socioeconomic position; JHS, Jackson Heart Study; HDL, high-density lipoprotein; LDL, low-density lipoprotein; CVD, cardiovascular disease.  
 \*All demographic and CVD risk factors were measured at the JHS baseline examination (2000–2004).  
 †Adjusted for age and sex means (continuous) and proportions (categorical) variables. Age was adjusted for sex only and female adjusted for age only.  
 ‡Childhood SEP was generated by summing points for mother’s education, parental home ownership, and childhood amenities and categorizing into tertiles of low, medium, and high childhood SEP.  
 §Adult SEP was generated by summing points for education, income, wealth and public assistance and categorizing into tertiles of low, medium, and high adult SEP.  
 ||P values for the tests for trend.

and carbohydrate intake) and higher levels of physical activity. Moreover, participants with higher adult SEP tended to have lower BMI, systolic blood pressure, and prevalence of hypertension and diabetes (Table 1). In contrast, fewer CVD risk factors were patterned by childhood SEP. Participants who had higher childhood SEP had lower mean BMI, lower prevalence of hypertension and current smoking, and higher levels of physical activity.

In women, higher education, income, and wealth and not being on public assistance were associated with lower rates of CVD (Table 2). Women not on public assistance had lower CVD rates than those on public assistance, but no trend was observed across public assistance categories. In men, higher SEP also tended to be associated with lower CVD rates, although patterns were less consistent than in women and trends were not statistically significant. Trends in CVD rates

by childhood SEP categories were not statistically significant in men or women.

Table 3 shows hazard ratios (HRs) and 95% CIs of CVD associated with adult SEP measures after adjustment for age, adjustment for each other, and adjustment for CVD risk factors. Among women, CVD rates were significantly higher with low education (HR 1.71 [95% CI 1.10 to 2.67] for ≤HS/GED versus postgraduate degree), low income (HR 2.46 [1.19 to 5.09] for <\$25 000 versus ≥\$75 000), and low wealth (HR 2.14 [1.39 to 3.29] for low versus high wealth). Being on public assistance was associated with higher CVD risk, but the association was not statistically significant (HR 1.41 [0.82 to 2.44] for ≥2 types of assistance versus no assistance). When adult SEP measures were simultaneously adjusted (model 2), low wealth remained associated with higher CVD risk (HR 1.73 [1.04 to 2.85]), but the associa-

**Table 2.** Age-Adjusted Rates of CVD Events by Lifecourse SEP in Men and Women, JHS, 2000–2010

| Lifecourse SEP                          | Women (n=3360) |                       |                          |           | Men (n=1941)  |                       |                         |           |
|---|----------------|-----------------------|--------------------------|-----------|---------------|-----------------------|-------------------------|-----------|
|   | No. of Events  | Total PY of Follow-up | CVD* Rate/1000 PY 95% CI | P Value   | No. of Events | Total PY of Follow-up | CVD Rate/1000 PY 95% CI | P Value   |
| Overall                                 | 213            | 23 475.0              | 6.30 (6.14 to 6.46)      |           | 149           | 12 873.0              | 8.76 (8.58 to 8.94)     |           |
| <b>Education</b>                        |                |                       |                          |           |               |                       |                         |           |
| <HS and GED                             | 118            | 8914.9                | 6.89 (6.64 to 7.14)      | 0.0200    | 71            | 4823.1                | 7.89 (7.58 to 8.20)     | 0.2169    |
| Vocational and some college             | 43             | 4923.9                | 8.44 (8.13 to 8.74)      | 0.0044    | 39            | 2941.1                | 13.16 (12.84 to 13.48)  | 0.0038    |
| Associate's and bachelor's degrees      | 28             | 5326.1                | 5.59 (5.22 to 5.97)      | 0.2539    | 21            | 3082.7                | 7.34 (6.91 to 7.77)     | 0.4233    |
| Postgraduate degree                     | 24             | 4310.1                | 4.07 (3.65 to 4.48)      | Reference | 17            | 2026.3                | 5.63 (5.14 to 6.13)     | Reference |
| P for trend                             |                |                       | 0.0184                   |           |               |                       | 0.2233                  |           |
| <b>Income</b>                           |                |                       |                          |           |               |                       |                         |           |
| <\$25 000                               | 137            | 10 328.0              | 8.04 (7.81 to 8.28)      | 0.0154    | 58            | 3664.0                | 9.35 (9.01 to 9.69)     | 0.1438    |
| \$25 000 to \$39 999                    | 27             | 3378.0                | 6.32 (5.91 to 6.74)      | 0.1093    | 24            | 1592.7                | 10.91 (10.45 to 11.37)  | 0.0804    |
| \$40 000 to \$74 999                    | 40             | 6939.3                | 5.37 (5.05 to 5.69)      | 0.1996    | 46            | 4532.2                | 8.77 (8.45 to 9.09)     | 0.2234    |
| ≥\$75 000                               | 9              | 2829.7                | 3.27 (2.58 to 3.96)      | Reference | 22            | 3084.3                | 6.24 (5.79 to 6.68)     | Reference |
| P for trend                             |                |                       | 0.0026                   |           |               |                       | 0.1758                  |           |
| <b>Wealth<sup>†</sup></b>               |                |                       |                          |           |               |                       |                         |           |
| Low                                     | 48             | 4092.0                | 8.64 (8.33 to 8.96)      | 0.0050    | 17            | 1793.3                | 8.87 (8.38 to 9.36)     | 0.8554    |
| Medium                                  | 123            | 12 008.0              | 7.25 (7.03 to 7.46)      | 0.0020    | 64            | 5366.9                | 8.56 (8.27 to 8.86)     | 0.9386    |
| High                                    | 42             | 7374.6                | 4.04 (3.71 to 4.37)      | Reference | 68            | 5713.0                | 8.44 (8.16 to 8.72)     | Reference |
| P for trend                             |                |                       | 0.0003                   |           |               |                       | 0.8675                  |           |
| <b>Public assistance<sup>‡</sup></b>    |                |                       |                          |           |               |                       |                         |           |
| >1 assistance type                      | 14             | 991.4                 | 8.53 (7.98 to 9.08)      | 0.2116    | 3             | 158.0                 | 17.87 (16.74 to 19.00)  | 0.1948    |
| 1 assistance type                       | 29             | 2313.1                | 8.69 (8.29 to 9.08)      | 0.0729    | 11            | 923.2                 | 8.35 (7.73 to 8.97)     | 0.9701    |
| No assistance                           | 170            | 20 170.0              | 6.02 (5.83 to 6.21)      | Reference | 135           | 11 792.0              | 8.45 (8.24 to 8.67)     | Reference |
| P for trend                             |                |                       | 0.0539                   |           |               |                       | 0.4229                  |           |
| <b>Adult SEP<sup>§</sup></b>            |                |                       |                          |           |               |                       |                         |           |
| Low                                     | 107            | 7153.5                | 8.72 (0.85 to 8.98)      | 0.0001    | 40            | 2730.7                | 8.63 (8.24 to 9.02)     | 0.2683    |
| Medium                                  | 73             | 8377.7                | 7.04 (6.79 to 7.30)      | 0.0056    | 67            | 4456.4                | 11.13 (10.84 to 11.41)  | 0.012     |
| High                                    | 33             | 7943.7                | 3.83 (3.47 to 4.19)      | Reference | 43            | 5686.2                | 6.61 (6.30 to 6.93)     | Reference |
| P for trend                             |                |                       | 0.0001                   |           |               |                       | 0.2082                  |           |
| <b>Mother's education</b>               |                |                       |                          |           |               |                       |                         |           |
| <12th grade                             | 154            | 14 376.0              | 6.30 (6.07 to 6.53)      | 0.7144    | 104           | 6716.7                | 9.43 (9.16 to 9.71)     | 0.5181    |
| 12th grade/GED                          | 37             | 4916.2                | 6.96 (6.60 to 7.33)      | 0.5133    | 25            | 3321.2                | 7.27 (6.81 to 7.73)     | 0.8788    |
| >12th grade                             | 22             | 4183.1                | 5.71 (5.23 to 6.18)      | Reference | 20            | 2835.3                | 7.69 (7.16 to 8.22)     | Reference |
| P for trend                             |                |                       | 0.8948                   |           |               |                       | 0.391                   |           |
| <b>Parental home ownership</b>          |                |                       |                          |           |               |                       |                         |           |
| Rent or other                           | 121            | 11 277.0              | 6.53 (6.29 to 6.76)      | 0.7190    | 77            | 5588.4                | 8.56 (8.27 to 8.85)     | 0.9859    |
| Own                                     | 92             | 12 197.0              | 6.19 (5.95 to 6.42)      | Reference | 72            | 7284.9                | 8.53 (8.27 to 8.79)     | Reference |
| P for trend                             |                |                       | 0.719                    |           |               |                       | 0.9859                  |           |
| <b>Childhood amenities<sup>  </sup></b> |                |                       |                          |           |               |                       |                         |           |
| Low                                     | 129            | 9014.4                | 6.06 (5.77 to 6.35)      | 0.6274    | 87            | 4940.1                | 7.90 (7.55 to 8.25)     | 0.2785    |
| Medium                                  | 72             | 10 207.0              | 6.62 (6.37 to 6.87)      | 0.8538    | 54            | 5248.5                | 9.98 (9.70 to 10.26)    | 0.2421    |

Continued

Table 2. Continued

| Lifecourse SEP                  | Women (n=3360) |                       |                          |           | Men (n=1941)  |                       |                         |           |
|---------------------------------|----------------|-----------------------|--------------------------|-----------|---------------|-----------------------|-------------------------|-----------|
|                                 | No. of Events  | Total PY of Follow-up | CVD* Rate/1000 PY 95% CI | P Value   | No. of Events | Total PY of Follow-up | CVD Rate/1000 PY 95% CI | P Value   |
| High                            | 13             | 4253.5                | 6.22 (5.63 to 6.81)      | Reference | 8             | 2684.6                | 6.28 (5.57 to 6.99)     | Reference |
| <i>P</i> for trend              |                |                       | 0.7277                   |           |               |                       | 0.7935                  |           |
| Childhood SEP <sup>¶</sup>      |                |                       |                          |           |               |                       |                         |           |
| Low                             | 138            | 10 910.0              | 6.43 (6.17 to 6.69)      | 0.7317    | 91            | 5455.7                | 8.89 (8.56 to 9.21)     | 0.3579    |
| Medium                          | 40             | 5000.4                | 6.71 (6.36 to 7.06)      | 0.6498    | 31            | 2455.6                | 10.86 (10.48 to 11.25)  | 0.1099    |
| High                            | 35             | 7564.3                | 5.92 (5.55 to 6.30)      | Reference | 27            | 4961.9                | 6.80 (6.38 to 7.22)     | Reference |
| <i>P</i> for trend <sup>#</sup> |                |                       | 0.8032                   |           |               |                       | 0.4933                  |           |

CVD indicates cardiovascular disease; SEP, socioeconomic position; JHS, Jackson Heart Study; PY, person-years; HS, high school.

\*CVD rates per 1000 PY were adjusted for age at baseline.

<sup>†</sup>Wealth was a composite of participant’s car and housing ownership and liquid asset.

<sup>‡</sup>Public assistance was a composite of Food Stamps, Supplemental Security Income, and other welfare program.

<sup>§</sup>Adult SEP was generated by summing points for education, income, wealth, and public assistance and categorizing into tertiles of low, medium, and high adult SEP.

<sup>||</sup>Childhood amenities was generated by summing points for indoor plumbing, electricity, refrigerator, telephone, television, air conditioning, parental car ownership, and number of rooms <5 or ≥5 and categorizing into tertiles of low, medium, and high childhood amenities.

<sup>¶</sup>Childhood SEP was generated by summing points for mother’s education, parental home ownership, and childhood amenities and categorizing into tertiles of low, medium, and high childhood SEP.

<sup>#</sup>*P* values for the tests for trend.

tions with income (HR 1.55 [0.68 to 3.41]) and education (HR 1.16 [0.70 to 2.04]) were weakened and became nonsignificant. Among men, those with vocational training/ some college education had higher CVD risk compared with those with postgraduate degree (HR 2.36 [1.33 to 4.20]). Inverse but nonsignificant associations were found with income (HR 1.50 [0.87 to 2.58] for low versus high income) and public assistance (HR 2.13 [0.69 to 6.60] for being on ≥2 types of assistance versus no assistance). When all adult SEP measures were simultaneously included in the same model, the associations were unchanged. In general, a strong inverse association of the summary adult SEP measure with CVD rates was observed in women but not in men (HR for low versus high adult SEP: 2.28 [1.50 to 3.47] for women and 1.31 [0.81 to 2.10] for men) and adjusting for CVD risk factors attenuated the associations, but wealth and summary adult SEP remained significantly associated with CVD events in women (model 3).

Table 4 shows HRs and 95% CIs for the association between various measures of childhood SEP and CVD events for women and men. Although childhood SEP was weakly inversely associated with CVD risk, associations were not statistically significant. Additional adjustment of childhood SEP measures for each other did not substantially alter the associations (model 2). There were no significant associations of the summary childhood SEP with CVD rates in women or men (HR for low versus high childhood SEP: 1.09 [0.68 to 1.74] for women and HR 1.30 [0.73 to 2.30] for men). Since the associations were not significant, no further adjustment for CVD risk factors was conducted.

Table 5 shows adjusted HRs and 95% CIs for the associations between summary measures of childhood and adult SEP and CVD events by sex and age groups. The association of summary adult SEP with CVD risk was stronger in women than in men (HRs for lowest versus highest tertile of summary adult SEP 2.38 [1.54 to 3.68] in women and 1.29 [0.80 to 2.09] in men, *P* value for interaction 0.0043). Associations of adult SEP with CVD risk were stronger in persons ≤50 compared with those >50 years at baseline although the interaction was not statistically significant (HR 3.28 [1.43 to 7.53] in ≤50 years and 1.90 [1.36 to 2.66] in >50 years, *P* value for interaction 0.0846). Associations of adult SEP with women and in persons ≤50 years at baseline were reduced after adjusting for CVD risk factors but remained statistically significant (model 2). However, childhood SEP was not associated with CVD risk independent of summary adult SEP in women or men. Lower childhood SEP appeared to be more strongly associated with CVD risk in persons ≤50 years at baseline than in persons >50 years, but this heterogeneity was not statically significant. A similar pattern was observed when analyses were stratified by age within sexes, but tests for interaction did not achieve statistical significance. Sensitivity analysis defining adult SEP and childhood SEP as continuous variables showed similar results (Table 6). Findings were similar in sensitivity analyses when we used only incident CVD and excluded participants with recurrent events (Table 7). Results were also generally similar for incident CHD and incident stroke as separate outcomes, although the CIs widened (Table 7).

**Table 3.** Adjusted Hazard Ratios of CVD Events by Categories of Adult SEP, JHS, 2000–2010

| Adult SEP                          | Women (n=3360)         |                        |                        | Men (n=1941)           |                        |                         | P for Interaction* |
|------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|--------------------|
|                                    | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 3<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 3<br>HR (95% CI)  |                    |
| <b>Education</b>                   |                        |                        |                        |                        |                        |                         | 0.4694             |
| ≤HS and GED                        | 1.71<br>(1.10 to 2.67) | 1.16<br>(0.70 to 1.94) | 1.29<br>(0.82 to 2.04) | 1.41<br>(0.83 to 2.40) | 1.23<br>(0.67 to 2.24) | 1.11<br>(0.64 to 1.92)  |                    |
| Vocational and some college        | 2.10<br>(1.27 to 3.47) | 1.63<br>(0.95 to 2.78) | 1.71<br>(1.03 to 2.83) | 2.36<br>(1.33 to 4.20) | 2.12<br>(1.15 to 3.89) | 1.99<br>(1.11 to 3.58)  |                    |
| Associate's and bachelors' degrees | 1.40<br>(0.81 to 2.41) | 1.17<br>(0.67 to 2.06) | 1.23<br>(0.71 to 2.14) | 1.31<br>(0.69 to 2.50) | 1.23<br>(0.64 to 2.38) | 1.11<br>(0.58 to 2.14)  |                    |
| Postgraduate degree                | Reference              | Reference              | Reference              | Reference              | Reference              | Reference               |                    |
| P for trend                        | 0.017                  | 0.6471                 | 0.3443                 | 0.2160                 | 0.9138                 | 0.7445                  |                    |
| <b>Income</b>                      |                        |                        |                        |                        |                        |                         | 0.1244             |
| <\$25 000                          | 2.46<br>(1.19 to 5.09) | 1.55<br>(0.68 to 3.41) | 1.83<br>(0.87 to 3.85) | 1.50<br>(0.87 to 2.58) | 1.44<br>(0.73 to 2.84) | 1.19<br>(0.69 to 2.07)  |                    |
| \$25 000 to \$39 999               | 1.96<br>(0.87 to 4.38) | 1.41<br>(0.60 to 3.27) | 1.56<br>(0.69 to 3.52) | 1.75<br>(0.93 to 3.28) | 1.70<br>(0.85 to 3.38) | 1.41<br>(0.75 to 2.65)  |                    |
| \$40 000 to \$74 999               | 1.64<br>(0.77 to 3.51) | 1.39<br>(0.65 to 3.00) | 1.54 (0.72 to 3.30)    | 1.40 (0.81 to 2.43)    | 1.32<br>(0.74 to 2.35) | 1.19<br>(0.69 to 2.06)  |                    |
| ≥\$75 000                          | Reference              | Reference              | Reference              | Reference              | Reference              | Reference               |                    |
| P for trend                        | 0.0026                 | 0.2177                 | 0.1014                 | 0.1752                 | 0.3702                 | 0.5943                  |                    |
| <b>Wealth†</b>                     |                        |                        |                        |                        |                        |                         | 0.0224             |
| Low                                | 2.14<br>(1.39 to 3.29) | 1.73<br>(1.04 to 2.85) | 1.68<br>(1.08 to 2.63) | 1.06<br>(0.62 to 1.81) | 0.88<br>(0.47 to 1.66) | 0.79<br>(0.45 to 1.39)  |                    |
| Medium                             | 1.79<br>(1.24 to 2.60) | 1.56<br>(1.03 to 2.36) | 1.61<br>(1.10 to 2.36) | 1.02<br>(0.70 to 1.47) | 0.88<br>(0.58 to 1.34) | 0.87<br>(0.60 to 1.27)  |                    |
| High                               | Reference              | Reference              | Reference              | Reference              | Reference              | Reference               |                    |
| P for trend                        | 0.0003                 | 0.0393                 | 0.0175                 | 0.8491                 | 0.3702                 | 0.3452                  |                    |
| <b>Public assistance‡</b>          |                        |                        |                        |                        |                        |                         | 0.814              |
| ≥2 assistance types                | 1.41<br>(0.82 to 2.44) | 1.17<br>(0.66 to 2.05) | 1.10<br>(0.63 to 1.93) | 2.13<br>(0.69 to 6.60) | 2.03<br>(0.63 to 6.50) | 2.06<br>(0.64 to 6.59)  |                    |
| 1 assistance type                  | 1.43<br>(0.96 to 2.14) | 1.24<br>(0.82 to 1.88) | 1.27<br>(0.84 to 1.90) | 0.99<br>(0.53 to 1.85) | 0.97<br>(0.51 to 1.86) | 0.87<br>(0.46 to 1.65)  |                    |
| No assistance                      | Reference              | Reference              | Reference              | Reference              | Reference              | Reference               |                    |
| P for trend                        | 0.0579                 | 0.5102                 | 0.4088                 | 0.4236                 | 0.5804                 | 0.6741                  |                    |
| <b>Adult SEP§</b>                  |                        |                        |                        |                        |                        |                         | 0.0544             |
| Low                                | 2.28<br>(1.50 to 3.47) |                        | 1.73<br>(1.11 to 2.67) | 1.31<br>(0.81 to 2.10) |                        | 1.034<br>(0.63 to 1.70) |                    |
| Medium                             | 1.86<br>(1.21 to 2.86) |                        | 1.57<br>(1.01 to 2.43) | 1.69<br>(1.12 to 2.53) |                        | 1.39<br>(0.91 to 2.10)  |                    |
| High                               | Reference              |                        | Reference              | Reference              |                        | Reference               |                    |
| P for trend                        | 0.0001                 |                        | 0.0212                 | 0.2060                 |                        | 0.8502                  |                    |

Model 1: adjusted for age and each adult SEP measure separately (eg, age+education; age+income; age+wealth; age+public assistance; age+adult SEP). Model 2: adjusted for age and joint effect of all adult SEP measures (education, income, wealth, and public assistance). Model 3: model 1+smoking, alcohol consumption, BMI, physical activity, HDL, LDL, triglycerides, hypertension, and type 2 diabetes. CVD indicates cardiovascular disease; SEP, socioeconomic position; JHS, Jackson Heart Study; HR, hazards ratio; HS, high school; BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

\*P values for the tests for interaction between adult SEP measures and sex.

†Wealth was a composite of participant's car and home ownership and liquid asset.

‡Public assistance was a composite of Food Stamps, Supplemental Security Income, and other welfare program.

§Adult SEP was generated by summing points for education, income, wealth, and public assistance and categorizing into tertiles of low, medium, and high adult SEP.

||P values for the tests for trend.



**Table 4.** Adjusted Hazard Ratios of CVD Events by Categories of Childhood SEP, JHS, 2000–2010

| Childhood SEP                          | Women (n=3360)         |                        | Men (n=1941)           |                        | P for Interaction* |
|--|------------------------|------------------------|------------------------|------------------------|--------------------|
|  | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) |                    |
| <b>Mother's education</b>              |                        |                        |                        |                        | 0.6888             |
| <12th grade                            | 1.11 (0.65 to 1.90)    | 1.12 (0.64 to 1.96)    | 1.22 (0.66 to 2.28)    | 1.28 (0.68 to 2.43)    |                    |
| 12th grade/GED                         | 1.24 (0.68 to 2.26)    | 1.24 (0.67 to 2.27)    | 0.94 (0.45 to 1.97)    | 0.97 (0.47 to 2.01)    |                    |
| >12th grade                            | Reference              | Reference              | Reference              | Reference              |                    |
| P for trend                            | 0.8846                 | 0.8543                 | 0.3978                 | 0.3353                 |                    |
| <b>Parental home ownership</b>         |                        |                        |                        |                        | 0.7659             |
| Rent or other                          | 1.06 (0.79 to 1.42)    | 1.07 (0.79 to 1.45)    | 1.00 (0.70 to 1.44)    | 0.99 (0.68 to 1.44)    |                    |
| Own                                    | Reference              | Reference              | Reference              | Reference              |                    |
| P for trend                            | 0.6939                 | 0.6274                 | 0.9828                 | 0.9675                 |                    |
| <b>Childhood amenities<sup>†</sup></b> |                        |                        |                        |                        | 0.6809             |
| Low                                    | 0.96 (0.48 to 1.93)    | 0.90 (0.43 to 1.89)    | 1.24 (0.53 to 2.90)    | 1.09 (0.45 to 2.67)    |                    |
| Medium                                 | 1.05 (0.54 to 2.04)    | 1.01 (0.51 to 1.99)    | 1.58 (0.73 to 3.44)    | 1.47 (0.67 to 3.25)    |                    |
| High                                   | Reference              | Reference              | Reference              | Reference              |                    |
| P for trend                            | 0.7062                 | 0.5957                 | 0.7695                 | 0.5429                 |                    |
| <b>Childhood SEP<sup>‡</sup></b>       |                        |                        |                        |                        | 0.9764             |
| Low                                    | 1.09 (0.68 to 1.74)    |                        | 1.30 (0.73 to 2.30)    |                        |                    |
| Medium                                 | 1.13 (0.66 to 1.94)    |                        | 1.60 (0.90 to 2.84)    |                        |                    |
| High                                   | Reference              |                        | Reference              |                        |                    |
| P for trend <sup>§</sup>               | 0.7941                 |                        | 0.5070                 |                        |                    |

Model 1: adjusted for age and each childhood SEP measure separately (eg, age+mother's education; age+parental home ownership; age+childhood amenities; age+childhood SEP); model 2: adjusted for age and joint effect of all childhood SEP measures (mother's education, parental home ownership, and childhood amenities). CVD indicates cardiovascular disease; SEP, socioeconomic position; JHS, Jackson Heart Study; HR, hazards ratio.

\*P values for the tests for interaction between childhood SEP measures and sex.

<sup>†</sup>Childhood amenities was generated by summing points for indoor plumbing, electricity, refrigerator, telephone, television, air conditioning, parental car ownership, and number of rooms <5 or ≥5 and categorizing into tertiles of low, medium, and high childhood amenities.

<sup>‡</sup>Childhood SEP was generated by summing points for mother's education, parental home ownership, and childhood amenities and categorizing into tertiles of low, medium, and high childhood SEP.

<sup>§</sup>P values for the tests for trend.

## Discussion

To our knowledge, this study is among the first to investigate the associations of various measures of SEP across lifecourse with CVD events in a large African American sample. Our study found significant and graded inverse associations between adult SEP measures and CVD rates in women; the associations were less consistent in men. In women, wealth appeared to be a stronger and more robust predictor than education, income, or being on public assistance. There was also evidence that the association of adult SEP with CVD events was stronger in the younger (≤50 years) than in the older age group (>50 years). Childhood SEP was not consistently associated with CVD risk in women or men.

Our findings that adult SEP is associated with CVD rates in African American women is consistent with prior studies that

reported inverse graded associations between adult SEP and incidence of CVD in developed countries.<sup>36–38</sup> Moreover, our findings are congruent with those from ARIC showing an inverse association between adult SEP and incidence of heart failure in African Americans.<sup>18</sup> One novel aspect of our study is that we used multiple measures of adult SEP compared with prior studies that relied on only few measures. In women, we found that wealth was the strongest predictor. In particular, low education was not consistently associated with CVD rates in women. One possible reason is that educational attainment may not translate proportionally into economic benefits in African Americans,<sup>16,39</sup> and economic factors may be the ones linked to CVD risk through processes affecting more proximal CVD risk factors.

Adult SEP measures were more consistently and strongly associated with CVD risk in African American women than in African American men. This finding is in agreement with

**Table 5.** Adjusted Hazard Ratios of CVD Events by Categories of Summary Childhood and Adult SEP by Sex and Age, JHS, 2000–2010

| Lifecourse SEP            | Women (n=3360)         |                        | Men (n=1941)           |                        | ≤50 y (n=2040)         |                        | >50 y (n=3261)         |                        |
|---------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
|                           | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) |
| <b>Childhood SEP*</b>     |                        |                        |                        |                        |                        |                        |                        |                        |
| Low                       | 0.87<br>(0.54 to 1.42) | 0.81<br>(0.50 to 1.32) | 1.18<br>(0.65 to 2.13) | 1.14<br>(0.64 to 2.05) | 1.48<br>(0.62 to 3.50) | 1.43<br>(0.57 to 3.57) | 0.85<br>(0.58 to 1.24) | 0.86<br>(0.58 to 1.26) |
| Medium                    | 1.03<br>(0.60 to 1.78) | 0.99<br>(0.56 to 1.72) | 1.52<br>(0.85 to 2.71) | 1.42<br>(0.80 to 2.55) | 1.47<br>(0.60 to 3.56) | 1.63<br>(0.64 to 4.14) | 1.02<br>(0.66 to 1.60) | 1.03<br>(0.65 to 1.62) |
| High                      | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              |
| <i>P</i> for trend        | 0.5128                 | 0.3310                 | 0.666                  | 0.7437                 | 0.3538                 | 0.3906                 | 0.3464                 | 0.3770                 |
| <i>P</i> for interaction  | 0.5767                 |                        |                        |                        | 0.2835                 |                        |                        |                        |
| <b>Adult SEP†</b>         |                        |                        |                        |                        |                        |                        |                        |                        |
| Low                       | 2.38<br>(1.54 to 3.68) | 1.83<br>(1.16 to 2.89) | 1.29<br>(0.80 to 2.09) | 1.02<br>(0.61 to 1.69) | 3.28<br>(1.43 to 7.53) | 3.03<br>(1.22 to 7.49) | 1.90<br>(1.36 to 2.66) | 1.42<br>(1.00 to 2.02) |
| Medium                    | 1.91<br>(1.23 to 2.96) | 1.62<br>(1.04 to 2.55) | 1.67<br>(1.10 to 2.52) | 1.36<br>(0.89 to 2.09) | 1.47<br>(0.63 to 3.43) | 1.05<br>(0.43 to 2.52) | 1.88<br>(1.36 to 2.60) | 1.56<br>(1.12 to 2.18) |
| High                      | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              |
| <i>P</i> for trend‡       | 0.0001                 | 0.0133                 | 0.2622                 | 0.9241                 | 0.0058                 | 0.0196                 | 0.0004                 | 0.1034                 |
| <i>P</i> for interaction§ | 0.0043                 |                        |                        |                        | 0.0846                 |                        |                        |                        |

Model 1: adjusted for age, childhood SEP, and adult SEP. Model 2: model 1+smoking, alcohol consumption, BMI, physical activity, HDL, LDL, triglycerides, hypertension, and type 2 diabetes. Sex was adjusted for models by age analysis (≤50 or >50). CVD indicates cardiovascular disease; SEP, socioeconomic position; JHS, Jackson Heart Study; HR, hazards ratio; BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

\*Childhood SEP was generated by summing points for mother’s education, parental home ownership, and childhood amenities and categorizing into tertiles of low, medium, and high childhood SEP.

†Adult SEP was generated by summing points for education, income, wealth and public assistance and categorizing into tertiles of low, medium, and high adult SEP.

‡*P* values for the tests for trend.

§*P* values for the tests for interaction between childhood SEP and sex and adult SEP and sex.

previous studies that reported sex differences in the social patterning of CVD-related outcomes.<sup>38,40–46</sup> One explanation of sex difference in social patterning CVD risk could be the stronger social patterning of obesity, hypertension, type 2

diabetes, and physical inactivity in African American women than in African American men. However, associations of wealth and summary adult SEP score with CVD events persisted after adjusting for CVD risk factors, suggesting that

**Table 6.** Sensitivity Analysis of Adjusted Hazard Ratios for CVD Events by Summary Scores of Childhood and Adult SEP (Continuous) and by Sex and Age, JHS, 2000–2010

| Lifecourse SEP | Women (n=3360)         |                        | Men (n=1941)           |                        | ≤50 y (n=2040)         |                        | >50 y (n=3261)         |                        |
|----------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
|                | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) |
| Childhood SEP* | 1.06<br>(0.93 to 1.21) | 1.08<br>(0.95 to 1.24) | 0.99<br>(0.84 to 1.16) | 1.00<br>(0.85 to 1.18) | 0.94<br>(0.72 to 1.23) | 0.91<br>(0.70 to 1.18) | 1.08<br>(0.97 to 1.20) | 1.07<br>(0.96 to 1.20) |
| Adult SEP†     | 0.89<br>(0.83 to 0.94) | 0.93<br>(0.67 to 0.99) | 0.96<br>(0.89 to 1.03) | 0.99<br>(0.92 to 1.07) | 0.83<br>(0.72 to 0.94) | 0.84<br>(0.71 to 0.98) | 0.91<br>(0.87 to 0.96) | 0.96<br>(0.91 to 1.01) |

Model 1: Adjusted for age, childhood SEP, and adult SEP; model 2: model 1+smoking, alcohol consumption, BMI, physical activity, HDL, LDL, triglycerides, hypertension, and type 2 diabetes. Sex was included in the models by age (≤50 or >50). CVD indicates cardiovascular disease; SEP, socioeconomic position; JHS, Jackson Heart Study; HR, hazards ratio; BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

\*Childhood SEP (continuous) was generated by summing points for mother’s education, parental home ownership, and childhood amenities.

†Adult SEP (continuous) was generated by summing points for education, income, wealth, and public assistance.

**Table 7.** Sensitivity Analysis of Adjusted Hazard Ratios for Incident CVD, CHD, and Stroke by Categories of Summary Childhood and Adult SEP by Sex and Age, JHS, 2000–2010

| Lifecourse SEP               | Women (n=3023)         |                        | Men (n=1681)           |                        | ≤50 y (n=1969)          |                         | >50 y (n=2735)         |                        |
|------------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|------------------------|------------------------|
|                              | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI)  | Model 2<br>HR (95% CI)  | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) |
| <b>Incident CVD</b>          |                        |                        |                        |                        |                         |                         |                        |                        |
| <b>Childhood SEP</b>         |                        |                        |                        |                        |                         |                         |                        |                        |
| Low                          | 0.87<br>(0.49 to 1.55) | 0.78<br>(0.50 to 1.21) | 1.14<br>(0.61 to 2.12) | 1.06<br>(0.56 to 2.00) | 1.68<br>(0.64 to 4.43)  | 1.70<br>(0.61 to 4.73)  | 0.81<br>(0.52 to 1.25) | 0.78<br>(0.50 to 1.21) |
| Medium                       | 1.02<br>(0.53 to 1.95) | 0.86<br>(0.49 to 1.50) | 1.17<br>(0.59 to 2.33) | 1.11<br>(0.55 to 2.22) | 1.56<br>(0.57 to 4.28)  | 1.74<br>(0.59 to 5.11)  | 0.87<br>(0.51 to 1.50) | 0.86<br>(0.49 to 1.50) |
| High                         | Reference              | Reference              | Reference              | Reference              | Reference               | Reference               | Reference              | Reference              |
| <i>P</i> for trend           | 0.5925                 | 0.2933                 | 0.6831                 | 0.8428                 | 0.2738                  | 0.4228                  | 0.3941                 | 0.2981                 |
| <b>Adult SEP</b>             |                        |                        |                        |                        |                         |                         |                        |                        |
| Low                          | 2.43<br>(1.46 to 4.03) | 1.29<br>(0.86 to 1.94) | 1.04<br>(0.59 to 1.83) | 0.80<br>(0.43 to 1.47) | 3.21<br>(1.26 to 8.17)  | 3.91<br>(1.38 to 11.04) | 1.69<br>(1.15 to 2.49) | 1.29<br>(0.86 to 1.94) |
| Medium                       | 1.92<br>(1.15 to 3.20) | 1.36<br>(0.93 to 2.00) | 1.29<br>(0.79 to 2.10) | 1.08<br>(0.66 to 1.78) | 1.53<br>(0.60 to 3.90)  | 1.06<br>(0.39 to 2.86)  | 1.61<br>(1.11 to 2.34) | 1.36<br>(0.93 to 2.00) |
| High                         | Reference              | Reference              | Reference              | Reference              | Reference               | Reference               | Reference              | Reference              |
| <i>P</i> for trend           | 0.0006                 | 0.0161                 | 0.8195                 | 0.5073                 | 0.0151                  | 0.0212                  | 0.0100                 | 0.3077                 |
| <b>Incident CHD</b>          |                        |                        |                        |                        |                         |                         |                        |                        |
| <b>Childhood SEP</b>         |                        |                        |                        |                        |                         |                         |                        |                        |
| Low                          | 0.84<br>(0.44 to 1.61) | 0.78<br>(0.41 to 1.51) | 1.65<br>(0.71 to 3.82) | 1.60<br>(0.69 to 3.71) | 1.61<br>(0.54 to 4.84)  | 1.60<br>(0.50 to 5.18)  | 0.93<br>(0.55 to 1.56) | 0.95<br>(0.56 to 1.61) |
| Medium                       | 0.91<br>(0.44 to 1.87) | 0.87<br>(0.42 to 1.83) | 1.98<br>(0.84 to 4.65) | 1.83<br>(0.79 to 4.27) | 1.52<br>(0.46 to 4.96)  | 1.58<br>(0.45 to 5.62)  | 1.04<br>(0.57 to 1.90) | 1.06<br>(0.58 to 1.94) |
| High                         | Reference              | Reference              | Reference              | Reference              | Reference               | Reference               | Reference              | Reference              |
| <i>P</i> for trend           | 0.5864                 | 0.449                  | 0.6783                 | 0.3209                 | 0.3797                  | 0.5158                  | 0.7644                 | 0.8214                 |
| <b>Adult SEP</b>             |                        |                        |                        |                        |                         |                         |                        |                        |
| Low                          | 1.74<br>(1.01 to 3.00) | 1.36<br>(0.77 to 2.40) | 1.12<br>(0.57 to 2.23) | 0.95<br>(0.46 to 1.96) | 2.97<br>(1.07 to 8.21)  | 3.78<br>(1.22 to 11.74) | 1.45<br>(0.91 to 2.31) | 1.12<br>(0.69 to 1.82) |
| Medium                       | 1.35<br>(0.78 to 2.35) | 1.15<br>(0.65 to 2.01) | 1.48<br>(0.83 to 2.63) | 1.28<br>(0.71 to 2.32) | 1.07<br>(0.36 to 3.20)  | 0.75<br>(0.24 to 2.34)  | 1.51 (0.98 to 2.32)    | 1.28<br>(0.82 to 1.61) |
| High                         | Reference              | Reference              | Reference              | Reference              | Reference               | Reference               | Reference              | Reference              |
| <i>P</i> for trend           | 0.0446                 | 0.2778                 | 0.2960                 | 0.9229                 | 0.0457                  | 0.0582                  | 0.1370                 | 0.7488                 |
| <b>Incident stroke</b>       |                        |                        |                        |                        |                         |                         |                        |                        |
| <b>Childhood SEP*</b>        |                        |                        |                        |                        |                         |                         |                        |                        |
| Low                          | 0.69<br>(0.31 to 1.53) | 0.63<br>(0.28 to 1.41) | 0.73<br>(0.32 to 1.68) | 0.64<br>(0.23 to 1.49) | 1.48<br>(0.62 to 3.50)  | 1.47<br>(0.34 to 6.44)  | 0.85<br>(0.58 to 1.24) | 0.57<br>(0.31 to 1.04) |
| Medium                       | 0.94<br>(0.41 to 2.20) | 0.90<br>(0.38 to 2.12) | 0.71<br>(0.26 to 1.94) | 0.64<br>(0.23 to 1.78) | 1.47<br>(0.60 to 3.56)  | 1.16<br>(0.24 to 5.63)  | 1.02<br>(0.66 to 1.60) | 0.70<br>(0.35 to 1.40) |
| High                         | Reference              | Reference              | Reference              | Reference              | Reference               | Reference               | Reference              | Reference              |
| <i>P</i> for trend           | 0.3553                 | 0.2461                 | 0.5064                 | 0.3291                 | 0.532                   | 0.8104                  | 0.1228                 | 0.1000                 |
| <b>Adult SEP<sup>†</sup></b> |                        |                        |                        |                        |                         |                         |                        |                        |
| Low                          | 3.22<br>(1.46 to 7.09) | 2.61<br>(1.17 to 5.91) | 1.61<br>(0.76 to 3.41) | 1.13<br>(0.50 to 2.54) | 8.23<br>(1.58 to 42.74) | 8.28<br>(1.42 to 48.12) | 1.90<br>(1.36 to 2.66) | 1.51<br>(0.85 to 2.68) |
| Medium                       | 3.39<br>(1.56 to 7.38) | 2.97<br>(1.34 to 6.55) | 1.35<br>(0.65 to 2.80) | 1.04<br>(0.49 to 2.21) | 2.52<br>(0.43 to 14.65) | 1.79<br>(0.29 to 11.22) | 1.88<br>(1.36 to 2.60) | 1.78<br>(1.04 to 3.06) |

Continued

Table 7. Continued

| Lifecourse SEP                  | Women (n=3023)         |                        | Men (n=1681)           |                        | ≤50 y (n=1969)         |                        | >50 y (n=2735)         |                        |
|---------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
|                                 | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) | Model 1<br>HR (95% CI) | Model 2<br>HR (95% CI) |
| High                            | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              | Reference              |
| <i>P</i> for trend <sup>‡</sup> | 0.0082                 | 0.0551                 | 0.2066                 | 0.7817                 | 0.0066                 | 0.0136                 | 0.0186                 | 0.2660                 |

Model 1: adjusted for age, childhood SEP and adult SEP. Model 2: model 1+smoking, alcohol consumption, BMI, physical activity, HDL, LDL, triglycerides, hypertension, and type 2 diabetes. Sex was adjusted for models by age analysis (≤50 or >50 y). CVD indicates cardiovascular disease; CHD, coronary heart disease; SEP, socioeconomic position; JHS, Jackson Heart Study; BMI, body mass index; HDL, high-density lipoprotein; HR, hazards ratio; LDL, low-density lipoprotein.

\*Childhood SEP was generated by summing points for mother's education, parental home ownership, and childhood amenities and categorizing into tertiles of low, medium, and high childhood SEP.

<sup>†</sup>Adult SEP was generated by summing points for education, income, wealth and public assistance and categorizing into tertiles of low, medium, and high adult SEP.

<sup>‡</sup>*P* values for the tests for trend.

these factors do not fully explain the sex differences in social patterning of CVD events. Alternatively, the social distribution of psychosocial stressors linked to CVD could also differ by sex.<sup>45–47</sup> It has also been posited that the behavioral and stress implications of higher SEP may be different in African American men.<sup>14,15,48</sup> In addition, African American women in this cohort may have received greater economic benefits from the civil rights laws and affirmative action legislation than African American men, which likely allowed them to take advantage of expanded higher education programs, the opening of service-sector jobs, and associated wage gains with consequent gains for physical and mental health. This may have allowed more-educated and higher-income African American women to derive more benefits from their higher social standing compared with less-educated and lower-income African American women, resulting in a stronger socioeconomic patterning of CVD in women.<sup>40,49</sup>

Our findings also revealed interesting differences in associations by age. Lower adult SEP was more strongly associated with CVD rates in younger than in older African Americans. This finding is consistent with previous studies that have documented inverse graded associations between SEP and CVD risk and related outcomes in young adults.<sup>7,50–52</sup> For example, Karlamangla et al<sup>51</sup> found strong inverse SES gradients in CVD risk in younger participants of the Coronary Artery Risk Development in Young Adults (CARDIA) study. This finding is also especially important given other work showing substantially higher CVD risks in young African Americans compared with young whites.<sup>53–55</sup> The reasons for a stronger association between lifecourse SEP and CVD risk in younger than in older African Americans are not clear. It is possible that a higher concentration of obesity, diabetes, hypertension, sedentary behaviors, and cholesterol in low SEP African Americans below the age of 50 could explain the strong association of CVD risk with low SEP in this age group,<sup>53–55</sup> although our results were robust to these CVD risk factors adjustments. This suggests that other factors might explain the higher

CVD risk among younger African Americans of low SEP, including stress, discrimination, depression, consumption of high fat foods, binge drinking, adverse physical and social neighborhood environments, as well as poor access to health care and health insurance.<sup>7,50–52,56–58</sup> The higher rates of CVD in older participants could also explain the relatively weaker HRs observed. Further research is needed to gain better insights into the factors that contribute to the strong SEP gradient in CVD risk among younger African Americans.

We found no associations of childhood SEP with CVD risk in adulthood. Only 2 studies of which we are aware have investigated the associations of childhood SEP with CVD events in African Americans, and those studies yielded mixed results. Contrary to our findings, Glymour et al<sup>17</sup> found that childhood SEP, measured by father's occupation, predicted stroke risk in African Americans independent of adult SEP by using the Health and Retirement Study. Our findings, however, are consistent with another study that found that childhood SEP was not significantly associated with incidence of heart failure after adjusting for adult SEP in African Americans in the ARIC Study.<sup>18</sup> The discrepant findings could be due to differences in the definition of childhood SEP. For example, Glymour et al<sup>17</sup> and Roberts et al<sup>18</sup> incorporated father's occupation into their study, but it was not available in our study. It is also possible that associations of childhood SEP are different for different types of CVD (as has been previously reported)<sup>5,59</sup>; however, our results did not show differences in the associations with incidence of CHD and stroke. It is also possible that misclassification errors due to recall bias and large missing items on our childhood SEP measures could explain the lack of association with CVD risk in our study.

Alternatively, it may be that traditional childhood SEP measures may not be good predictors in our sample or in African Americans. This is because African American childhood exposures may be very different from those in US whites; therefore, traditional childhood SEP measures may not

accurately reflect variability in the childhood social environments of African Americans. This suggests the need for additional lifecourse SEP measures beyond the traditional measures to better understand the lifecourse processes contributing to CVD risk in African Americans. Other social exposures (including those linked to discrimination and segregation), which also begin to act in childhood, need to be explored. Moreover, although we found no associations of childhood SEP with CVD risk, adverse childhood SEP may affect CVD risk indirectly through its impact on adult SEP.<sup>1–4,60</sup> These findings highlight the need for more research to clarify the impact of childhood SEP on CVD in African Americans, by using birth cohorts and measuring various SEP indicators over time.

Our findings should be interpreted with caution in light of the study's limitations. The first limitation is that our childhood measures were collected retrospectively, which likely resulted in substantial measurement error compared with adult SEP, which is reported more accurately. Several studies have shown that adult recall of childhood SEP is likely to result in underestimate of childhood SEP effects on adult health outcomes.<sup>6,61,62</sup> Another limitation is the large amount of missing data on childhood SEP. Although our analysis used multiple imputations to minimize bias and loss of power, it is difficult to check the validity of the assumption that the missing childhood SEP measures are missing at random.<sup>63</sup> Furthermore, our childhood SEP did not include father's education and occupation, which might have limited our ability to fully assess the effects of childhood SEP. The relatively small numbers of CVD events, especially in men and younger age groups limited the power of our analyses. Last, our results for childhood SEP could have been influenced by age cohort effects. Childhood SEP was strongly patterned by age, and it may therefore have been difficult to disentangle age and childhood SEP effects. Prior work has suggested that associations of childhood SEP may be different for different types of CVD events.<sup>5,59</sup> Our power to investigate differential associations for stroke and CHD was limited by power. In addition, heart failure, a common CVD event in African Americans, was not included in our analyses.

Although our findings cannot be generalized to all African Americans across the United States, our study uses data from the largest population-based studies of CVD in African Americans in the United States. Another strength was our ability to investigate a broad array of childhood and adult SEP measures. Finally, the prospective design of this study significantly contributes to the limited research on the impact of lifecourse SEP on CVD events in African Americans.

In conclusion, we found that adult SEP, especially wealth, was strongly inversely associated with CVD rates in African American women but that adult SEP was less consistently

associated with CVD rates in African American men. There was also evidence that adult SEP was a stronger predictor of CVD risk in younger than in older participants. In contrast, childhood SEP was not associated with CVD rates. These findings underscore the need for early detection and prevention of CVD in African American women of low SEP.

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## Disclosures

None.

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