NIH-PA Author Manuscript
NIH-PA Author Manuscript

NIH Public Access
Author Manuscript
Am J Kidney Dis. Author manuscript; available in PMC 2011 June 1.

Published in final edited form as:
Am J Kidney Dis. 2010 June ; 55(6): 1001–1008. doi:10.1053/j.ajkd.2010.01.016.

Association of Socioeconomic Status and CKD among African Americans: The Jackson Heart Study

Marino A. Bruce, PhD,
Meharry Medical College

Bettina M. Beech, DrPH,
Wake Forest University School of Medicine

Errol D. Crook, MD,
University of South Alabama

Mario Sims, PhD,
University of Mississippi Medical Center

Sharon B. Wyatt, PhD, RN, FAAN,
University of Mississippi Medical Center

Michael F. Flessner, MD, PhD,
University of Mississippi Medical Center

Herman A. Taylor, MD,
University of Mississippi Medical Center

David R. Williams, PhD,
Harvard University

Ermeg L. Akylbekova, MS, and
University of Mississippi Medical Center

T. Alp Ikizler, MD
Vanderbilt University Medical Center

Abstract

Background—Socioeconomic status (SES) is recognized as a key social environmental factor because it has implications for access to resources that help individuals care for themselves and others. Few studies have examined the association of SES with CKD in high-risk populations.

Study Design—Single-site longitudinal population-based cohort

---

Corresponding Author: Marino A. Bruce, PhD, Meharry Medical College, Department of Family and Community Medicine, 1005 Dr. DB Todd Jr. Blvd, Nashville, TN 37208, telephone: 615-327-5853, fax: 615-327-5634, mabruce@mmc.edu.

Descriptive Text for Online Delivery
Hyperlink: Supplementary Table S1 (PDF)
About: Association of SES and Low eGFR in the Jackson Heart Study.

Financial Disclosures: the authors declare that they have no relevant financial interests.

Supplementary Material
Note: The supplementary material accompanying this article (doi:_______) is available at www.ajkd.org.

Setting and Participants—The data for this study were drawn from the baseline examination of the Jackson Heart Study. The analytic cohort consisted of 3,430 African American men and women living in the tri-county area of the Jackson, Mississippi metropolitan areas with complete data to determine CKD status.

Predictor—High SES (defined as having a family income at least 3.5 times the poverty level or having at least one undergraduate degree)

Outcomes and Measurements—CKD (defined as the presence of albuminuria or reduced estimated glomerular filtration rate (eGFR) <60 ml/min/1.73m2). Associations were explored through bivariable analyses and multivariable logistic regression analyses adjusting for CKD and cardiovascular disease risk factors as well as demographic factors.

Results—The prevalence of CKD in the Jackson Heart Study was 20% (865/3430 participants). The proportion of the Jackson Heart Study cohort with albuminuria and decreased eGFR was 12.5% (429/3430 participants) and 10.1% (347/3430 participants) respectively. High SES was inversely associated with CKD. The odds of having CKD were 41% lower for affluent participants than their less affluent counterparts. There were no statistically significant interactions between sex and education or income although subgroup analysis showed that high income was associated with CKD among male (OR 0.47, CI 0.23–0.97) but not female (OR 0.64, CI 0.40–1.03) participants.

Limitations—Models were estimated using cross-sectional data.

Conclusion—CKD is associated with SES. Additional research is needed to elucidate the impact of wealth and social contexts in which individuals are embedded, and the mediating effects of sociocultural factors.

INTRODUCTION

Kidney disease is one of the most pressing issues in health disparities research. African Americans require dialysis or transplant at younger ages and have greater incidence rates of end stage renal disease (ESRD) at each decade of life as compared to any other racial/ethnic group.[1, 2] These disparities have been generally thought to be a function of disproportionately high levels of chronic kidney disease (CKD) risk factors (i.e., diabetes, hypertension, and obesity). However, the presence of these co-morbidities does not fully explain the excess risks for CKD among African Americans. The evolving science in CKD research indicates that novel, non-biomedical factors can also have implications for CKD progression and complications.[3–6] Social science and social epidemiologic research have established that social environments may have important consequences for health outcomes, especially among at-risk populations such as African Americans. The accumulation of economic or social resources in an environment, referred to here as socioeconomic status (SES), is a key factor because it has implications for accessing the resources that can help individuals care for themselves and others. An emerging body of research has begun to consider the relationship between SES and CKD-related outcomes. Results from this line of work suggest that economic factors at the individual and community levels have implications for kidney disease.[5, 7–11]

Deprivation and disadvantage are often part of the social landscape for African Americans. Little research has examined the social patterning of CKD within high-risk populations such as African Americans. Analyses of the prevalence and awareness of CKD in the Jackson Heart Study suggested the social patterning of CKD.[12] This purpose of this study is to examine further the nuanced associations of individual SES and CKD in this cohort with high CKD prevalence comprised of African Americans of all SES strata. High SES participants are expected to be less likely to have CKD than their lower income and less educated counterparts. We further tested the hypothesis that the patterning of the association between high SES and CKD varies by sex.

METHODS

Study Population and Measurements

The data for this study were drawn from the baseline examination of the Jackson Heart Study -- a single-site, longitudinal population-based cohort study prospectively investigating the determinants of cardiovascular disease (CVD) among African Americans living in the tri-county area (Hinds, Madison, and Rankin counties) of the Jackson, MS metropolitan areas. Baseline data collection occurred between September 2000 and March 2004. Recruitment, sampling, and data collection methods have been described previously.[13–16] Recruitment limited the age range to 35 to 84 but allowed relatives <35 years and >84 years to enroll in order to increase the sample power of the family component of the study.[17] The total cohort consists of 5,301 African-American men and women between the ages of 21 and 94. The institutional review boards of the following participating institutions approved the study: the University of Mississippi Medical Center, Jackson State University, and Tougaloo College. All of the participants provided written informed consent.

The baseline examination had three components: a home interview, self-administered questionnaires, and a clinic visit. Individuals who had taken any medications two weeks prior to the examination were asked to bring them to the clinic to be coded by a pharmacist using the Medispan dictionary with classification according to the Therapeutic Classification System.[18] Participants were asked to fast overnight before their clinic visit where anthropometric and seated blood pressure measurements were to be obtained. Venipuncture/urine collections were performed according to the National Committee for Clinical Laboratory Standards.[13]

Study Variables

CKD was defined as the presence of albuminuria or reduced glomerular filtration rate (eGFR) <60 ml/min/1.73m^2. The presence of albuminuria was determined by urine albumin-creatinine ratio (ACR) based on spot or 24-hour urine values (ACR>30 mg/g). eGFR was estimated using the 4-variable Modification of Diet in Renal Disease (MDRD) Study equation [GFR = 186.0 · (serum creatinine) $^{-1.154}$ · age $^{-0.203}$ · (0.742 if female) · (1.212 if African American)]. The definition of CKD in this study was broader than other studies that defined CKD based solely on eGFR. Analyses published elsewhere indicate that characteristics of included participants were similar to those of participants with eGFR alone.[12]

SES was represented by educational attainment and annual family income. These indicators tend to have nonlinear relationships with health indices for African Americans; therefore, each of these variables was represented by a series of dummy variables.[19] Educational attainment was represented by a four-category variable: whether participants did or did not graduate from high school; attended or graduated from a community, technical, or junior college; or graduated from a four-year undergraduate institution or attained a post-baccalaureate education. Participants who did not complete high school made up the reference category. Annual family income was also a four-category variable classified into: low income (< poverty level), lower-middle income (1–1.6 times the poverty level), upper-middle income (1.6–3.5 times the poverty level), and affluent income (at least 3.5 times the poverty level). Classification was based on the year of visit, family size, and the number of resident children under 18. Following Smith[20] and Massey and Eggers,[21] income category boundaries were established by U. S. Census estimations. The low income classification was the reference category.

Select demographic factors including age, sex, and marital status (married/not married) were based on self-reporting during the baseline interview. Health care access was represented by a variable corresponding to a questionnaire item asking participants to rate difficulty of getting health care services as "not difficult at all" (coded 1), "not too hard" (coded 2), "fairly hard" (coded 3), or "very hard" (coded 4). CVD-related risk factors (CVD, hypertension, diabetes, hypercholesterolemia, or BMI) were also accounted for in this analysis. CVD status was defined as the presence of coronary heart disease (electrocardiogram-determined myocardial infarction or self-reported history of myocardial infarction or angioplasty) or cerebrovascular disease (self-reported history of stroke or carotid endarterectomy or angioplasty). Hypertension status was defined as a measured blood pressure ≥ 140/90 mmHg and/or use of antihypertensive medications.[22, 23] Presence of Type 2 diabetes mellitus (diabetes) was determined by a measured fasting glucose of ≥126 mg/dl or use of insulin and/or oral hypoglycemic agents. Presence of hypercholesterolemia was defined as an elevation in measured fasting total cholesterol (≥200 mg/dl), LDL-cholesterol (≥160mg/dl) and/or use of lipid-lowering medications. Hypertriglyceridemia was defined as elevated triglyceride levels (≥150 mg/dl) or/and treatment by fenofibrate or gemfibrozil while sex-specific limits (<50 mg/dl for women and <40 mg/dl for men) were used to define low HDL cholesterol levels.[24] BMI was derived by dividing participant weight in kilograms by participant height in meters squared.

Statistical Analysis

Study population characteristics were described overall by education and income strata, respectively, using mean and standard deviation for continuous variables and proportions for categorical variables. One-way ANOVA and Chi-square tests were used in descriptive analyses assessing how groups varied across key indicators. Multivariable logistic regression analysis was used to evaluate the relationship between high SES, co-morbid conditions, demographic factors, and CKD. "Education only" and "income only" models were also estimated to explore how the correlations between these components have implications for their respective relationships with CKD in the fully adjusted model. It also has been suggested that the social patterning of health outcomes for African-American men and women can vary considerably.[25–27] Group-specific logistic regression models were estimated to determine if the relationship between high SES and CKD varied by sex. All statistical analyses were conducted with StataSE Version 10 (www.stata.com).

RESULTS

As previously reported, 1,015 Jackson Heart Study participants completed 24-hour urine collections.[12] Spot urine collections were later added to the protocol (n=2,225); however, a substantial segment of the study population did not have sufficient urine data to determine CKD status (n=1,792). Other individuals were excluded if they did not have sufficient serum data to determine CKD status (n=56) or had restricted consent (n=23). The excluded participants were somewhat more likely to be older, not married, report more difficulty with healthcare access, and have lower education and income levels (data not shown). However, the analytic sample closely resembled the overall study sample.[12]

Table 1 describes the overall and SES-stratified characteristics of the sample. Most participants were female and married, and the mean age was 54. There was a high prevalence of hypertension, diabetes, dyslipidemia, and obesity. Approximately one-third of Jackson Heart Study participants had at least college degrees and one-fourth was affluent.

Higher SES participants were younger, more likely to married, and had easier access to health care services than their less educated and less affluent counterparts. The higher SES groups had substantially lower proportions of individuals with CKD and CKD risk factors than the corresponding proportions of sample members at lower levels of education and income. The patterns for education and income were strikingly similar with the notable exception of sex. The proportion of males was not statistically distinct across education levels. However, members of the higher SES groups were more likely to be male than their counterparts at lower levels of income.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 2 depicts the results from logistic models examining the association between the independent variables and CKD. Age, marital status, having CVD, diabetes, or hypertension, and being obese were associated with the likelihood of having CKD in each of the equations reported. In the "education only" and the "income only" models, being affluent and highly educated were inversely associated with the likelihood of having CKD. High income was the only statistically significant SES component in the fully adjusted model. The odds of having CKD were 41% lower for affluent participants than their poorer counterparts in the full model.

Our tests for interactions between sex and education ($p<.9$) or income ($p<.5$) did not yield statistically significant results. However, the findings from sex-specific logistic models presented in Table 3 suggest that sex has implications for the association between SES and CKD. Being affluent and attending college was inversely associated with the likelihood of having CKD for women as shown in the "education only" and the "income only" models. However, in the full model for female participants, neither of the SES measures was found to be statistically significant. In contrast, high income was the only SES-related factor found to be associated with CKD among men. The likelihood of having CKD was approximately 53% lower for affluent male participants compared to their poor male counterparts.

DISCUSSION

This study extends our initial analyses of indicators of CKD prevalence and awareness[12] and prior research that focuses on economic deprivation and its implications for the excess risks for outcomes such as CKD.[7–11, 28] Our research suggests that affluence also has implications for kidney disease among African Americans. As expected, affluent or highly educated African American participants in the Jackson Heart Study had lower risks for CKD relative to their poor or less educated counterparts. The results from this study also suggested that the patterns of association between high SES and CKD may differ by sex. Similar to other epidemiologic research showing that a lack of economic resources is associated with health outcomes such as hypertension, diabetes, and CVD,[29–38] CKD is socially patterned. Importantly, the findings from this study indicate that the relationship between SES and CKD may not be linear; while affluent and educated participants had lower risks of CKD, the likelihood of having CKD among middle-income participants was not significantly different from their poor counterparts. Similarly, high school and junior college graduates as well as college attendees did not have statistically distinct risks for CKD relative to study participants who did not graduate from high school. These results suggest that the relationship between SES and health outcomes may be complicated and require researchers to consider potential non-linear relationships between economic factors and health conditions such as CKD.

Sex-specific analyses suggested different patterns of CKD risk for men and women with varying SES. High income was associated with CKD among males but not in females although we found no statistically significant interaction between sex and SES. While speculative, high incomes may provide African American men with access to facilities (e.g., health clubs) or resources (e.g., private medical care) that substantially reduce their risk for CKD relative to low-income men. Additional research is required to determine how SES-related factors are associated with sex-related factors with regards to CKD.

The relationship between marital status and CKD was an unexpected finding worth notation. The likelihood of married participants having CKD was significantly lower than their unmarried counterparts. Classic social science asserts that social relationships affect individual well being.[39] The data are consistent with studies examining the impact of social relations on cardiovascular outcomes. For example, individuals who live alone or have minimal contact with friends, relatives, or acquaintances have been found to have higher rates of CVD and overall morbidity and mortality than do persons who are integrated in social networks.[40–42]

The relationship between social relations and kidney disease has not been pursued extensively.[43] Research has not determined the degree to which factors such as marriage have implications for the development and progression of CKD. It is not clear how social relationships combine with other environmental factors to impact the health and the development and progression of CKD among individuals at risk for CKD. Further research is needed to elucidate these patterns of association.

Despite its contributions to understanding SES patterning of CKD, this study is not without limitations. Our definition of CKD included both albuminuria and low eGFR. A sensitivity analysis was performed using the IVEware software.[44] For those missing urine values, albuminuria status was imputed for those with missing urine values using the Sequential Regression Imputation Method[45] and their CKD status was then determined based on both albuminuria and eGFR. Association of SES and CKD was then assessed using logistic regression models similar to the main analyses described in the paper. The results were very similar to the results reported in Table 2. Analyses of the cohort using low eGFR only (Table S1; available as online supplementary material associated with this article at www.ajkd.org) also yielded similar results to those combining albuminuria and eGFR (Table 2). Higher income levels correlated significantly with higher eGFRs. All of the usual limitations of cross-sectional studies apply.[12] The income and education measures used in the analyses were crude measures of SES and analyses utilizing more comprehensive measures of individual (e.g., wealth-oriented measures such as home ownership, investment income, or net worth) and neighborhood SES could produce more robust findings.

Some might consider the analysis of an exclusively African American sample to be a limitation arguing diminished usefulness without a comparison group. However, there is evidence that the factors associated with African American health outcomes can differ substantially from other groups.[25, 46–49] The results from this study provide deeper insight into CKD among a heterogeneous group of African Americans often masked in comparative studies in which race or ethnic group membership is represented by a single variable.

High SES was associated with lower risks for CKD among African Americans in the Jackson Heart Study though the results were not linear. As well, the results suggested there may be nuanced socioeconomic differences for men and women. Additional research incorporating measures of wealth and other social contextual factors may assist in developing culturally and context-specific interventions to help reduce disparities in CKD development and progression in the short term and eliminate them in the long term.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Support: This research was supported by National Institutes of Health (NIH) contracts N01-HC-95170, N01-HC-95171, and N01-HC-95172 that were provided by the National Heart, Lung, and Blood Institute (NHLBI), the National Center for Minority Health and Health Disparities, and the National Institute of Biomedical Imaging and Bioengineering and career development awards from NHLBI to Meharry Medical College (1 K01 HL88735-01; Dr Bruce) and the University of Mississippi Medical Center (1 K01 HL084682-01; Dr Sims).

References

1. Hsu C-Y, Lin F, Vittinghoff E, Shlipak MG. Racial differences in the progression from chronic renal insufficiency to end-stage renal disease in the United States. J Am Soc Nephrol 2003;14:2902–2907. [PubMed: 14569100]

2. Tareen N, Zadshir A, Martins D, Pan D, Nicholas S, Norris K. Chronic kidney disease in African American and Mexican American populations. Kidney Int 2005;68(Supplement 97):S137–S140.
3. Krieger N. The ostrich, the albatross, and public health: an ecosocial perspective--or why an explicit focus on health consequences of discrimination and deprivation is vital for good science and public health practice. Public Health Rep 2001;116(5):419–423. [PubMed: 12042606]
4. Krieger N. Theories for social epidemiology in the 21st century: an ecosocial perspective. Int J Epidemiol 2001;30(4):668–677. [PubMed: 11511581]
5. Norris K, Nissenson AR. Race, gender, and socioeconomic disparities in CKD in the United States. J Am Soc Nephrol Jul;2008 19(7):1261–1270. [PubMed: 18525000]
6. Powe NR. To have and have not: health and health care disparities in chronic kidney disease. Kidney Int 2003;64:763–772. [PubMed: 12846781]
7. Merkin SS, Coresh J, Roux Diez AV, Taylor HA, Powe NR. Area socioeconomic status and progressive CKD: The Atherosclerosis Risk in Communities (ARIC) Study. Am J Kidney Dis 2005;46(2):203–213. [PubMed: 16112038]
8. Rodriguez RA, Sen S, Mehta K, Moody-Ayers S, Bacchetti P, O'Hare AM. Geography matters: relationships among urban residential segregation, dialysis facilities, and patient outcomes. Ann Intern Med Apr 3;2007 146(7):493–501. [PubMed: 17404351]
9. Shoham DA, Vupputuri S, Diez Roux AV, et al. Kidney disease in life-course socioeconomic context: the Atherosclerosis Risk in Communities (ARIC) Study. Am J Kidney Dis 2007;49(2):217–226. [PubMed: 17261424]
10. Tarver-Carr ME, Powe NR, Eberhardt MS, et al. Excess risk of chronic kidney disease among African Americans versus White subjects in the United States: a population-based study of potential explanatory factors. J Am Soc Nephrol 2002;13:2363–2370. [PubMed: 12191981]
11. Volkova N, McClellan W, Klein M, et al. Neighborhood poverty and racial differences in ESRD incidence. J Am Soc Nephrol Feb;2008 19(2):356–364. [PubMed: 18057219]
12. Flessner MF, Wyatt SB, Akylbekova EL, et al. Prevalence and awareness of CKD among African Americans: the Jackson Heart Study. Am J Kidney Dis Feb;2009 53(2):238–247. [PubMed: 19166799]
13. Carpenter MA, Crow R, Steffes M, et al. Laboratory, reading center, and coordinating center data management methods in the Jackson Heart Study. Am J Med Sci Sep;2004 328(3):131–144. [PubMed: 15367870]
14. Fuqua SR, Wyatt SB, Andrew ME, et al. Recruiting African-American research participation in the Jackson Heart Study: methods, response rates, and sample description. Ethn Dis Autumn;2005 15(4 Suppl 6):S6-18–29. [PubMed: 16317982]
15. Payne TJ, Wyatt SB, Mosley TH, et al. Sociocultural methods in the Jackson Heart Study: conceptual and descriptive overview. Ethn Dis Autumn;2005 15(4 Suppl 6):S6-38–48. [PubMed: 16317984]
16. Taylor HA Jr, Wilson JG, Jones DW, et al. Toward resolution of cardiovascular health disparities in African Americans: design and methods of the Jackson Heart Study. Ethn Dis Autumn;2005 15(4 Suppl 6):S6-4–17.
17. Wilson JG, Rotimi CN, Ekunwe L, et al. Study design for genetic analysis in the Jackson Heart Study. Ethn Dis Autumn;2005 15(4 Suppl 6):S6-30–37.
18. Sketris I, Metge C, Ross J, MacCara M. The use of the WHO Health Organization anatomical theraputic chemical/defined daily dose methodology in Canada. Drug Inf J 2004;38:1–8.
19. Bruce MA, Thornton MC. It's my world?: exploring black and white perceptions of personal control. The Sociological Quarterly 2004;45(3):597–612.
20. Smith, JP. Poverty and the family. In: Sandefur, GD.; Tienda, M., editors. Divided Opportunities: Minorities, Poverty, and Social Policy. New York: Plenum; 1988. p. 141-172.
21. Massey DS, Eggers ML. The ecology of inequality: minorities and the concentration of poverty. American Journal of Sociology 1990;95(5):1153–1188.
22. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA May 21;2003 289(19):2560–2572. [PubMed: 12748199]

23. Wyatt SB, Akylbekova EL, Wofford MR, et al. Prevalence, awareness, treatment, and control of hypertension in the Jackson Heart Study. Hypertension Mar;2008 51(3):650–656. [PubMed: 18268140]

24. Taylor H, Liu J, Wilson G, et al. Distinct component profiles and high risk among African Americans with metabolic syndrome: the Jackson Heart Study. Diabetes Care Jun;2008 31(6):1248–1253. [PubMed: 18332154]

25. Bruce MA, Sims M, Miller S, Elliott V, Ladipo M. One size fits all? Race, gender and body mass index among U.S. adults. J Natl Med Assoc 2007;99(10):1152–1158. [PubMed: 17987919]

26. Courtenay WH, Keeling RP. Men, gender, and health: toward an interdisciplinary approach. J Am Coll Health May;2000 48(6):243–246. [PubMed: 10863867]

27. Griffiths S. Men's health. BMJ Jan 13;1996 312(7023):69–70. [PubMed: 8555922]

28. Merkin SS, Roux AV, Coresh J, Fried LF, Jackson SA, Powe NR. Individual and neighborhood socioeconomic status and progressive chronic kidney disease in an elderly population: the Cardiovascular Health Study. Soc Sci Med 2007;65(4):809–821. [PubMed: 17499411]

29. Collins CA. Racism and health: segregation and causes of death amenable to medical intervention in major U.S. cities. Ann N Y Acad Sci 1999;896:396–398. [PubMed: 10681933]

30. Diez-Roux AV. Investigating neighborhood and area effects on health. Am J Public Health 2001;91 (11):1783–1789. [comment]. [PubMed: 11684601]

31. Diez-Roux AV. Neighborhoods and health: where are we and were do we go from here? Revue d Epidemiologie et de Sante Publique 2007;55(1):13–21. [PubMed: 17320330]

32. Diez-Roux AV, Chambless L, Merkin SS, et al. Socioeconomic disadvantage and change in blood pressure associated with aging. Circulation 2002;106(6):703–710. [PubMed: 12163431]

33. Diez-Roux AV, Jacobs DR, Kiefe CI. Coronary Artery Risk Developoment in Young Adults S. Neighborhood characteristics and components of the insulin resistance syndrome in young adults: the Coronary Artery Risk Development in Young Adults (CARDIA) Study. Diabetes Care 2002;25 (11):1976–1982. [PubMed: 12401742]

34. Diez-Roux AV, Merkin SS, Arnett D, et al. Neighborhood of residence and incidence of coronary heart disease. N Engl J Med 2001;345(2):99–106. [see comment]. [PubMed: 11450679]

35. Diez-Roux AV, Nieto FJ, Muntaner C, et al. Neighborhood environments and coronary heart disease: a multilevel analysis. Am J Epidemiol Jul 1;1997 146(1):48–63. [PubMed: 9215223]

36. Williams DR. Black-white differences in blood pressure: The role of social factors. Ethn Dis 1992;2:126–141. [PubMed: 1467751]

37. Williams DR. Race, socioeconomic status, and health. the added effects of racism and discrimination. Ann N Y Acad Sci 1999;896:173–188. [PubMed: 10681897]

38. Williams DR, Collins C. Racial residential segregation: a fundamental cause of racial disparities in health. Public Health Rep 2001;116(5):404–416. [PubMed: 12042604]

39. Durkheim, E. Suicide. New York: Free Press; 1897.

40. Brummett BH, Barefoot JC, Siegler IC, et al. Characteristics of socially isolated patients with coronary artery disease who are at elevated risk for mortality. Psychosom Med 2001;63(2):267–272. [see comment]. [PubMed: 11292274]

41. Eng PM, Rimm EB, Fitzmaurice G, Kawachi I. Social ties and change in social ties in relation to subsequent total and cause-specific mortality and coronary heart disease incidence in men. Am J Epidemiol 2002;155(8):700–709. [PubMed: 11943687]

42. Kaplan GA, Salonen JT, Cohen RD, Brand RJ, Syme SL, Puska P. Social connections and mortality from all causes and from cardiovascular disease: prospective evidence from eastern Finland. Am J Epidemiol 1988;128(2):370–380. [PubMed: 3394703]

43. Bruce MA, Beech BM, Sims M, et al. Social environmental stressors, psychological factors, and kidney disease. J Investig Med 2009;57:583–589.

44. Raghunathan, T.; Solenberger, P.; Van Hoewyk, J. IVEware: imputation and variance estimation software. Ann Arbor, MI: Survey Methodology Program, Survey Research Center, Institute for Social Research, University of Michigan; 2002.

45. Raghunathan T, Lepkowski J, Van Hoewyk J, Solenberger P. A multivariate technique for multiply imputing missing values using a sequence of regression models. Survey methodology 2001;27(1): 85–96.

46. Bruce MA. Inequality and adolescent violence: an exploration of community, family, and individual factors. J Natl Med Assoc Apr;2004 96(4):486–495. [PubMed: 15101669]

47. Sims M, Sims TH, Bruce MA. Community income, smoking, and birth weight disparities in Wisconsin. J Natl Black Nurses Assoc Dec;2007 18(2):16–23. [PubMed: 18318327]

48. Sims M, Sims TL, Bruce MA. Urban poverty and infant mortality rate disparities. J Natl Med Assoc 2007;99(4):349–356. [PubMed: 17444423]

49. Sims M, Sims TL, Bruce MA. Race, ethnicity, concentrated poverty, and low birth weight disparities. J Natl Black Nurses Assoc Jul;2008 19(1):12–18. [PubMed: 18807774]

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 1

Characteristics of Jackson Heart Study Participants by SES components

	Analysis Sample	Education					Income				
		1	2	3	4	p^*	1	2	3	4	p^*
Age (y)	54.3± 13.1	65.1 ± 10.9	56.2 ± 12.8	49.3 ± 12.1	52.5 ± 11.7	<.001	55.1 ± 15.7	57.0 ± 13.8	52.4 ± 12.4	53.4 ± 11.1	<.001
Male (%)	37.3	35.9	35.9	38.2	37.9	.7	23.8	32.1	37.6	49.0	<.001
Married (%)	54.8	42.6	49.4	56.0	62.8	<.001	27.3	39.8	59.1	72.5	<.001
Health care access**	1.4 ± 0.8	1.5 ± 0.9	1.5 ± 0.9	1.5 ± 0.9	1.3 ± 0.6	<.001	1.9 ± 1.1	1.5 ± 0.9	1.3 ± 0.7	1.2 ± 0.5	<.001
CVD (%)	10.4	21.8	12.2	7.9	6.1	<.001	17.0	13.6	8.3	6.2	<.001
Diabetes (%)	17.9	28.8	17.9	16.4	14.1	<.001	24.1	20.3	18.1	11.6	<.001
Hypertension (%)	62.6	79.2	67.2	57.1	56.9	<.001	67.6	67.4	61.5	56.7	<.001
Hypercholesterolemia (%)	30.5	36.4	33.0	28.4	28.2	.001	30.0	30.1	31.5	30.4	.9
Hypertriglyceridemia (%)	6.7	7.6	6.5	8.7	4.5	.001	7.3	6.7	6.9	6.7	.9
BMI (kg/m^2)	31.7 ± 7.1	31.6 ± 7.1	31.7 ± 6.9	32.3 ± 7.5	31.3 ± 6.9	.006	32.8 ± 8.8	32.0 ± 7.4	31.9 ± 7.1	30.8 ± 6.2	<.001
Education (%)											<.001
< High School	16.1						34.1	27.0	9.0	2.8	
High School	19.9						27.7	27.5	18.3	9.9	
Some College	30.3						31.4	30.9	39.0	23.1	
College Degree	33.5						6.8	14.7	33.8	64.2	
Income (%)						<.001					
Low Income	12.0	32.9	20.8	14.5	2.9						
Lower Middle	19.7	42.7	22.8	23.5	10.0						
Upper Middle	25.7	18.5	29.4	38.8	30.0						
High Income	25.8	5.9	16.1	23.1	57.3						
eGFR distribution (%)***						<.001					<.001
>90	40.5 (1384)	29.0	38.1	49.1	39.8		39.1	38.4	42.7	40.0	
>60-<90	49.8 (1699)	49.8	51.5	43.8	54.1		42.9	50.3	48.8	55.0	
>30-<60	8.5 (291)	17.9	9.0	6.6	5.5		14.8	9.7	7.6	4.8	
<30	1.2 (41)	3.3	1.5	0.6	0.6		2.5	1.6	0.9	0.2	

NIH-PA Author Manuscript
NIH-PA Author Manuscript

	Analysis Sample	Education					Income				
		1	2	3	4	p*	1	2	3	4	p*
Albuminuria**** (%)	12.5 (429)	19.9	14.2	10.2	10.0	<.001	13.4	15.9	12.3	8.8	<.001
SCr (mg/dL)	1.1 ± 0.6	1.2 ± 0.9	1.1 ± 0.8	1.0 ± 0.5	1.1 ± 0.5	<.001	1.2 ± 1.0	1.1± 0.7	1.1 ± 0.5	1.1 ± 0.4	.02
CKD***** (%)	20.0 (685)	34.8	22.9	16.1	14.6		28.2	24.5	18.4	12.7	

Notes: **n=3,430.** Values expressed as percent, percent (no.), or mean ± SD. Education and Income levels (1, 2, 3, and 4) are defined in the left column.

* p trend

** Health care access is an ordinal variable with values denoting difficulty of getting health care services (1=not difficult at all, 2=not too hard, 3=fairly hard, 4=very hard)

*** eGFR expressed in units of mL/min/1.73 m^2

**** albumin-creatinine ratio > 30

***** eGFR<60 or ACR>30

Abbreviations: SCr, serum creatinine; CVD, cardiovascular disease; SES, socioeconomic status; CkD, chronic kidney disease; BMI, body mass index; eGFR, estimated glomerular filtration rate. Conversion factors for units: eGFR in mL/s/1.73 m^2, x0.01667; SCr in mg/dL to micromole/L, x88.4.

Table 2

Association of SES and CKD in the Jackson Heart Study

Variable	Education Only	Income Only	Full Model
Age (/1 y)	1.03 (1.02 – 1.04)	1.03 (1.02 – 1.04)	1.03 (1.01 – 1.04)
Male	0.96 (0.64 – 1.46)	1.24 (0.69 – 2.21)	1.10 (0.88 – 1.40)
Married	0.75 (0.62 – 0.91)	0.78 (0.62 – 0.97)	0.78 (0.63 – 0.98)
Healthcare Access*	1.04 (0.93 – 1.16)	1.03 (0.91 – 1.17)	1.03 (0.91 – 1.17)
CVD	1.82 (1.41 – 2.35)	1.71 (1.28 – 2.27)	1.70 (1.28 – 2.26)
Diabetes	2.53 (2.05 – 3.11)	2.39 (1.90 – 3.02)	2.40 (1.91 – 3.03)
Hypertension	2.43 (1.88 – 3.15)	2.99 (2.23 – 4.02)	2.99 (2.23 – 4.01)
Hypercholesterolemia	1.16 (0.95 – 1.41)	1.27 (1.02 – 1.57)	1.27 (1.02 – 1.57)
Hypertriglyceridemia	1.28 (0.91 – 1.79)	1.31 (0.91 – 1.90)	1.33 (0.92 – 1.92)
BMI (/1 kg/m^2)	1.03 (1.01 – 1.04)	1.02 (1.01 – 1.04)	1.02 (1.01 – 1.04)
Education			
< High School	1.00 (ref)		1.00 (ref)
High School	0.88 (0.60 – 1.17)		0.93 (0.68 – 1.29)
Some College	0.77 (0.53 – 1.05)		0.84 (0.61 – 1.17)
College Degree	0.68 (0.47 – 0.94)		0.94 (0.66 – 1.32)
p trend	.05		.8
Income			
Low Income		1.00 (ref)	1.00 (ref)
Lower Middle		0.88 (0.63 – 1.30)	0.88 (0.65 – 1.20)
Upper Middle		0.78 (0.52 – 1.08)	0.80 (0.57 – 1.11)
High Income		0.58 (0.41 – 0.83)	0.59 (0.40 – 0.87)
p trend		.01	.05
Education × Male p value	.9		.9
Income × Male p value		.5	.5

Note: All variables included in the analysis are listed in the table. Values shown are OR (95% CI).

BMI, body mass index; CI, confidence interval; OR, odds ratio; SES, socioeconomic status; CkD, chronic kidney disease; CVD, cardiovascular disease; ref, reference

*Health care access is an ordinal variable with values denoting difficulty of getting health care services (1=not difficult at all, 2=not too hard, 3=fairly hard, 4=very hard)

Table 3

Association of SES and CKD by Sex in the Jackson Heart Study

Variable	Education Only		Income Only		Full Model	
	Men	Women	Men	Women	Men	Women
Age (/1 y)	1.03 (1.02 –1.06)	1.03 (1.02 – 1.04)	1.04 (1.02 – 1.06)	1.03 (1.02 – 1.04)	1.04 (1.02 – 1.05)	1.03 (1.01 – 1.04)
Married	0.71 (0.50 – 1.01)	0.77 (0.61 –0.97)	0.70 (0.47 –1.04)	0.81 (0.62 – 1.05)	0.70 (0.47 –1.05)	0.81 (0.62 –1.06)
Healthcare access*	1.14 (0.92 –1.40)	1.00 (0.88 –1.15)	1.08 (0.86 –1.35)	1.00 (0.85 –1.16)	1.09 (0.87 –1.36)	1.00 (0.85 –1.16)
CVD	1.84 (1.20 –2.81)	1.81 (1.31 –2.51)	1.70 (1.05 –2.75)	1.67 (1.16 –2.40)	1.71 (1.05 –2.77)	1.66 (1.16 –2.38)
Diabetes	4.37 (3.03 –6.30)	1.95 (1.51 –2.52)	4.41 (2.93 –6.64)	1.78 (1.34 –2.37)	4.40 (2.92 –6.63)	1.78 (1.34 –2.37)
Hypertension	2.06 (1.34 –3.17)	2.65 (1.92 –3.64)	2.51 (1.54 –4.10)	3.28 (2.26 –4.76)	2.49 (1.52 –4.07)	3.29 (2.26 –4.79)
Hypercholesterolemia	1.12 (0.79 –1.59)	1.18 (0.93 –1.50)	1.15 (0.78 –1.70)	1.34 (1.03 –1.74)	1.17 (0.79 –1.73)	1.34 (1.03 –1.75)
Hypertriglyceridemia	1.50 (0.92 –2.45)	1.06 (0.65 –1.72)	1.33 (0.78 –2.26)	1.23 (0.73 –2.08)	1.35 (0.79 –2.32)	1.23 (0.73 –2.08)
BMI (/1 kg/m^2)	1.06 (1.03 –1.09)	1.02 (1.00 –1.03)	1.06 (1.03 –1.09)	1.01 (0.99 –1.02)	1.06 (1.03 –1.09)	1.01 (0.99 –1.03)
Education						
< High School	1.00 (ref)	1.00 (ref)			1.00 (ref)	1.00 (ref)
High School	1.00 (0.60 –1.67)	0.80 (0.57 –1.12)			0.90 (0.51 –1.61)	0.90 (0.61 –1.33)
Some College	0.78 (.47 –1.30)	0.73 (0.52 –1.04)			0.81 (0.45 –1.46)	0.85 (0.57 –1.26)
College Degree	0. 78 (0.47 –1.30)	0.62 (0.44 –0.87)			1.01 (0.55 –1.89)	0.85 (0.56 –1.31)
p trend	.6	.05			.8	.9
Income						
Low Income			1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Lower Middle			0.76 (0.39 –1.46)	0.87 (0.61 –1.24)	0.75 (0.39 –1.45)	0.88 (0.62 –1.27)
Upper Middle			0.81 (0.42 –1.55)	0.70 (0.49 –1.02)	0.80 (0.41 –1.56)	0.74 (0.50 –1.09)
High Income			0.49 (0.25 –0.96)	0.60 (0.40 –0.92)	0.47 (0.23 –0.97)	0.64 (0.40 –1.03)
p trend			.08	.08	.1	.3

Note: All variables included in the analysis are listed in the table. Values shown are OR (95% CI).

BMI, body mass index; CI, confidence interval; OR, odds ratio; SES, socioeconomic status; CkD, chronic kidney disease; CVD, cardiovascular disease; ref, reference

* Health care access is an ordinal variable with values denoting difficulty of getting health care services (1=not difficult at all, 2=not too hard, 3=fairly hard, 4=very hard)