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Subjective social status and psychosocial and metabolic risk factors for cardiovascular disease among African Americans in the Jackson Heart Study

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Abstract

Subjective social status has been shown to be inversely associated with multiple cardiovascular risk factors, independent of objective social status. However, few studies have examined this association among African Americans and the results have been mixed. Additionally, the influence of discrimination on this relationship has not been explored. Using baseline data (2000–2004) from the Jackson Heart Study, an African American cohort from the U.S. South (N = 5301), we quantified the association of subjective social status with selected cardiovascular risk factors: depressive symptoms, perceived stress, waist circumference, insulin resistance and prevalence of diabetes. We contrasted the strength of the associations of these outcomes with subjective versus objective social status and examined whether perceived discrimination confounded or modified these associations. Subjective social status was measured using two 10-rung "ladders," using the U.S. and the community as referent groups. Objective social status was measured using annual family income and years of schooling completed. Gender-specific multivariable linear and logistic regression models were fit to examine associations. Subjective and objective measures were weakly positively correlated. Independent of objective measures, subjective social status was significantly inversely associated with depressive symptoms (men and women) and insulin

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resistance (women). The associations of subjective social status with the outcomes were modest and generally similar to the objective measures. We did not find evidence that perceived racial discrimination strongly confounded or modified the association of subjective social status with the outcomes. Subjective social status was related to depressive symptoms but not consistently to stress or metabolic risk factors in African Americans.

Keywords

USA; African American; subjective social status; cardiovascular; risk factors

Introduction

Socioeconomic status (SES) shows robust inverse associations with cardiovascular disease (CVD) as well as with psychosocial, behavioral and biological risk factors for CVD (Kaplan & Keil, 1993). Among the many indicators of SES, subjective social status (SSS) has been posited to capture health-relevant dimensions that are not directly measured by objective social status (OSS) indicators such as income, and education (Adler et al., 2008). SSS is a measure of an individual's self-assessment of his/her position in a social hierarchy. It has been hypothesized that SSS may tap into the psychosocial consequences of relative position within a social hierarchy (Singh-Manoux et al., 2005), and may be more strongly associated with health outcomes linked to psychosocial characteristics than OSS measures.

SSS has been found to be inversely associated with cardiovascular risk factors such as obesity (Goodman et al., 2003), depression (Adler et al., 2008; Goodman et al., 2003), hypertension (Adler et al., 2008), increased heart rate (Adler et al., 2000), abdominal fat deposition (Adler et al., 2000), greater morning rise in cortisol (Wright & Steptoe, 2005), and metabolic syndrome (Manuck et al., 2009). Notably, these associations were independent of OSS. However, few studies have examined SSS and CVD risk factors among African Americans and the results have been mixed (Adler et al., 2008; Manuck et al., 2009;Ostrove et al., 2000). Adler et al. (2008) used data from the Coronary Artery Risk Development in Young Adults (CARDIA) study and found that lower SSS was associated with poor self-rated health and greater depression among both black and white individuals. However, the associations were weaker among blacks than among whites. Additionally, an inverse association between SSS and prevalence of hypertension was found among African American women but not African American men. These results correspond with the findings of Ostrove et al. (2000), who reported that SSS was not associated with self-rated health among African American women, while it was inversely associated with self-rated health for white and Chinese American women. On the other hand, Manuck et al. (2009) found that lower SSS was associated with higher prevalence of metabolic syndrome and this was not modified by race.

Few if any studies have investigated the influence of racial discrimination on the association of SSS and health. There are at least three ways in which SSS and discrimination could interrelate to affect health. The first relates to the incorporation of experiences and consequences of discrimination into the assessment of subjective social status. Research has suggested that individuals arrive at their SSS by taking into account OSS, as well as an assessment of their current and/or future socioeconomic prospects— an overall assessment, or cognitive averaging (Singh-Manoux et al., 2003). Adler et al. (2008) posited that experiences of racism might influence this assessment. Thus, among African Americans, assessments of SSS may tap into a person's assessments of what income and education may realistically ―buy‖ him/her in society in the presence of discrimination. It has been well established that for a given level of income and education African Americans experience

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lower social and economic returns compared to whites (Braveman et al., 2005; Krieger et al., 1997). As a result, among African Americans, SSS may actually better capture the material implications of social position. In addition, to the extent that discrimination affects perceptions of relative worth or standing, measures of SSS may also tap into the psychosocial consequences of discrimination. Both of these processes would result in SSS being an especially strong predictor of health outcomes in African Americans.

A second possibility is that discrimination is causally related to both perceptions of social status and health outcomes through separate pathways. This would result in discrimination confounding associations of SSS with health. If higher levels of perceived discrimination cause both lower rating of SSS and poorer health, then the association of SSS with health would be overestimated if discrimination is not adjusted for. A third possibility is that perceived discrimination modifies the association of SSS with health. For example, it is possible that the adverse health consequences of low SSS are magnified in the presence of the additional stress resulting from discrimination. To our knowledge, no study has examined the extent to which discrimination confounds or modifies the association of SSS with health. Furthermore, the few studies of SSS that have included African Americans have reported limited information about the relationships between subjective and objective measures of social status in this population.

We quantified the association between SSS and selected psychosocial and metabolic risk factors of CVD using data from the Jackson Heart Study (JHS), a large population-based study of African Americans. We also contrasted the strength of the associations of SSS and OSS with these risk factors. To address existing gaps in research, we examined whether the association between SSS and risk factors was independent of OSS. We also investigated whether this association was confounded or modified by perceived racial discrimination. Given the previous report of inverse association of SSS with hypertension among African-American women but not men (Adler et al., 2008), we tested whether gender modified the association of SSS with risk factors. We hypothesized that SSS would be negatively associated with depressive symptoms, stress, waist circumference, insulin resistance and diabetes, and that this association would be independent of OSS. We also expected a stronger association of SSS with these risk factors among individuals with higher versus lower levels of perceived racial discrimination. Additionally, we hypothesized that the associations of SSS with the risk factors would be stronger among women than men.

Methods

Data

We used baseline examination data (2000–2004) from the JHS, the largest single-site, population-based cohort study of CVD among African Americans. The study population consists of non-institutionalized African American adults aged 21–95 residing in the Jackson, MS metropolitan area (Taylor et al., 2005). Participants were recruited from the tri-county region: Hinds County (which includes the City of Jackson- the capital of Mississippi), Madison County, and Rankin County through four methods: 31% from the Jackson, MS site of the National Heart Lung Blood Institute's Atherosclerosis Risk in Communities study, 17% through random sampling of a commercially available database (Accudata) of households in the three counties, 30% as volunteers, and 22% as family members. The final sample size of the JHS cohort was 5301 (mean age = 55.6, s.d. = 12.7, 63.3% women), which is about 7% of the African American population aged 21–95 residing in Jackson, MS. (Fuqua et al., 2005). Details of the study design and recruitment protocol have been described elsewhere (Taylor et al., 2005; Fuqua et al., 2005; Payne et al., 2005; Dubbert et al., 2005).

Dependent variables

Because SSS measures relative social position, a concept hypothesized to influence CVD via psychosocial mechanisms; key dependent variables included psychosocial outcomes as well as selected metabolic factors hypothesized to be linked to CVD.

Depressive symptoms—The 20-item Center for Epidemiologic Studies Depression (CES-D) scale was used to measure depressive symptoms. The CES-D was developed for use in large epidemiologic studies involving the general public, and has been shown to have excellent psychometric properties in general (Radloff, 1977) as well as among African Americans (Naughton & Wiklund, 1993). Participants were asked to rate the frequency of occurrence of symptoms, and scores ranged from 0 to 3. The scores were summed, with higher scores denoting greater frequency of depressive symptoms, and used as a continuous variable. Because CES-D was part of a take-home packet given to participants at the end of the baseline clinic visit with a request to mail back the completed questionnaire, it is only available for 60 % of the total cohort.

Perceived stress—Developed for the JHS (Payne et al, 2005), perceived stress was measured using the Global Perceived Stress scale (GPSS). Modified from Kohn and MacDonald's (1992) Survey of Recent Life Experiences, Cohen et al.'s (1983) Perceived Stress Scale, and Sarason et al.'s (1978) Life Events Scale, the GPSS measured the perception of the severity of stress experienced over a prior period of twelve months in the eight domains of employment, relationships, related to one's neighborhood, caring for others, legal problems, medical problems, racism and discrimination, and meeting basic needs. Participants rated stress severity for each domain on a 4-point scale ranging from ―not stressful to ―very stressful, and the summary score was used as a continuous variable. Data on GPSS were available for 80% of the total cohort.

Waist circumference—Waist circumference was measured at the umbilicus in centimeters and operationalized as a continuous variable. Only 9 records were missing data on this variable.

Diabetes—Individuals with a fasting plasma glucose level ≥ 126 mg/dl and use of anti-diabetic medications within two weeks prior to clinic visit or a self-reported history of diabetes were classified as having diabetes. A binary indicator denoting the presence of diabetes was used in the analysis. About 97% of the cohort had data on diabetes.

Insulin resistance—Using the homeostasis model for insulin resistance (HOMA-IR) (Matthews et al., 1985), insulin resistance was measured using fasting insulin and fasting glucose: fasting insulin (μU/ml) × fasting glucose (mmol/l)]/22.5. HOMA-IR was natural log transformed to account for its skewed distribution and used as a continuous variable. The analysis for HOMA-IR was restricted to non-diabetics. Of the non-diabetics, 96% had data on HOMA-IR.

Primary independent variables

SSS was operationalized as the individual's self-reported position in the social hierarchy of two different reference groups: a) the entire United States (U.S.) and b) the community with which the individual identifies. The U.S. SSS was measured by showing the participants a picture of a 10 rung ladder and asking the single question ―Now, think of a ladder with 10 steps representing where people stand in the United States. At step 10 are the people who are the best off—those who have the most money, the most education and the most respected jobs. At step 1 are the people who are the worst off--who have the least money, least education, and the worst jobs or no job.‖ They were then asked to indicate which rung they would place themselves on. The question used for the community SSS was ―Think of this ladder with ten steps as representing where people stand in their communities. People define community in different ways. Please define it in whatever way is meaningful to you. At step 10 are people who have the highest standing in their community. At step 1 are people who have the lowest standing in their community.

For each of these reference groups, the sex-specific distribution of the ladder scores from 0–10 were standardized into *z* scores by subtracting the population mean and dividing by the population standard deviation (SD) and used as a continuous variable. These ladder measures have been found to be reliable among African Americans (Wolff et al., 2009). Previous research has also noted that African Americans tend to report higher community SSS at a given U.S. referent SSS, compared to whites (Wolff et al., 2009). Although both are measures of SSS, the two ladders differ slightly in that the U.S. ladder focuses on income, education and occupation with the U.S. society as a reference, while the community ladder emphasizes ―standing in the community without additional references. We therefore decided to use both SSS ladders to investigate if there were differences in the U.S. and community SSS-risk factor associations.

Secondary independent variables

OSS was measured using the individual's report of highest level of educational attainment, and annual family income. Information on these variables was obtained during an interview conducted by trained, ethnically-matched interviewers who administered a questionnaire to the participants, in their homes.

Using self-reported data on the years of schooling completed, we created a continuous education variable by using the actual number of years of schooling. We imputed the following values: 12 years for those with a high school diploma or a General Educational Development certificate, 13 years for those who had some/complete vocational schooling or some college education, 14 for those with associate degrees, 16 for a bachelor's degree, and 20 years for those with ―more than college education.‖ We used the *z* score of this continuous variable in our models.

Using self-reported data on annual family income (less than $5,000; $5,000 – 7,999; $8,000 – 11,999; $12,000 – 15,999; $16,000 – 19,999; $20,000 – 24,999; $25,000 – 34,999; $35,000 – 49,999; $50,000 – 74,999; $75,000 – 99,999; $100,000 or more) we created a continuous variable by imputing the median value of the category as the income for that individual. In cases where data on annual family income was missing, we imputed the value of the mode of income of people with the same education level as the participant with missing income data. We converted this continuous variable into a *z* score for inclusion in regression models.

Proposed effect modifiers

Perceived racial discrimination was operationalized as a) perceived lifetime discrimination and b) perceived everyday discrimination.

Lifetime discrimination—The perceived lifetime discrimination variable was created by counting the number of reports (yes/no) of unfair treatment across nine domains (at school, getting a job, at work, getting housing, getting resources or money, getting medical care, on the street or in a public place, getting services, other ways) over the lifetime. This count (0–9) was standardized by computing z scores which was used in the multivariable models. The scale used to measure lifetime discrimination was adapted from Krieger's discrimination scale (Krieger & Sidney, 1996; Krieger, 1990) and the scale developed by McNeilly et al. (1996) and had a Cronbach's alpha of 0.78 (Sims et al., 2009).

Everyday discrimination—Items from the Williams scale (Williams et al., 1997) were used to measure perceived everyday discrimination. The items questioned how often on a day-to-day basis the participant had the following experiences: ―You are treated with less courtesy…,You are treated with less respect…, You receive poorer service than others at restaurants…, People act as if they think you are not smart…, People act as if they are afraid of you…, People act as if they think you are dishonest…, People act as if they think you are not as good as they are…, You are called names or insulted…, You are threatened or harassed. Responses to this scale, which had a Cronbach's alpha of 0.88 (Sims et al., 2009), were scored from 1 (―never) to 7 (―several times a day) and the frequency of everyday discrimination was measured using the mean of these item scores. Similar to perceived lifetime discrimination, z scores of the summary score from the scale were computed and used in the multivariable models.

A binary indicator variable (male, female) was created to denote gender. The covariate age was measured in years and used as a continuous variable, centered on its mean.

Exclusions

We excluded any participant who was missing data on the outcomes or any of the covariates which resulted in the following analytic sample sizes (Table 1): 2458 (depressive symptoms), 3631 (stress), 4002 (waist circumference), 3939 (diabetes) and 3123 (insulin resistance). We examined whether those who were missing data on the outcomes differed from those with data on SSS, OSS and perceived discrimination (see below)

Analysis

Descriptive statistics (means and SD or proportions) of the outcome variables, SSS and OSS were calculated in order to describe the analytic samples. We also computed the gender-specific correlation of SSS and the linear versions of income, education, and both forms of perceived discrimination. Correlation of the U.S. ladder with the community ladder was also calculated.

We stratified our analyses by gender because previous research suggested gender differences in the association of SSS and CVD risk factors (Adler et al., 2008). In addition, we used pooled data (men + women) to test whether there was a statistically significant interaction between gender and each SSS ladder in models for all outcomes. Gender-specific multivariable regression models (linear for continuous outcomes and logistic for diabetes) were fit for each SSS measure in order to test our hypotheses, yielding four sets of models for each dependent variable. Each set of models were fit in stages: SSS and age (Model 1); age and income (Model 2); age and education (Model 3); and SSS, age, income, and education (Model 4). We added the main effects and interaction terms for discrimination to Model 4 to test whether the association between SSS and the dependent variable varied by levels of discrimination, fitting separate interaction models for lifetime discrimination (Model 5) and everyday discrimination (Model 6).

Because associations of SSS with outcomes could be confounded by general well-being, we added a variable denoting self-rated health to Model 4 for all the outcomes that were found to be significantly associated with SSS. Self-rated health was measured using a single item: ―Compared to other people your age, would you say that your health is excellent, good, fair or poor?‖ The four response options were collapsed to create a binary variable denoting fair/poor or good/excellent health. As a sensitivity test, we then compared the estimate for

SSS from models with and without self-rated health. Because self-esteem might affect an individual's SSS and their perception of discrimination, we also fit models that adjusted for four items of the Interpersonal Support Evaluation List (ISEL) (Payne et al., 2005) that measured ―self-esteem social support These items were: ――Most of my friends are more interesting than me, ―My friends are more successful in making changes in life, ―I am more satisfied with my life than most people, and, ―I have a hard time keeping pace with my friends. As additional sensitivity tests, we compared the estimates for SSS in models that additionally included a four category occupation variable (management, service, sales and manual). We also examined the final models stratified by levels of education to test whether the associations of SSS and the risk factors were consistent at every level of OSS.

Results

Description of the sample

The different analytic sample sizes available for each of the outcomes after excluding records with missing data on covariates are shown in Table 2. The average age among men ranged from 52.6 to 55.1 years and from 53.5 to 55.7 among women. The distribution of both measures of SSS, income and education did not vary to a great extent across the various analytic datasets. The CES-D sample had a greater proportion of men and women with at least a college degree than the full JHS dataset (Table 2). In general, those missing data on outcomes were significantly more likely to make less income and have lower levels of education than those not missing data (see Appendix A); but differences were not very large (mean differences: $9,000 and 1.5 years of schooling). There were no major differences in U.S. and community ladder scores and both forms of perceived discrimination between the sample included versus not included in the analyses.

SSS and OSS

The correlations between OSS and SSS were positive and mostly statistically significant, but weak in magnitude (Table 3). Among men, the correlations of SSS and income were 0.17 ($p<0.0001$) for the U.S. and 0.11 ($p<0.0001$) for the community ladder. The corresponding estimates for education were 0.16 ($p<0.0001$) for the U.S. and 0.05 ($p=0.0227$) for the community SSS. Among women we saw a similar pattern of stronger correlations with the U.S. than with the community ladder. Perceived everyday discrimination was negatively correlated with SSS in both men and women; however the strength of correlation was weak. Perceived lifetime discrimination had weak negative correlations with SSS among women but not men.

Associations with psychosocial and metabolic risk factors: SSS versus OSS

Associations of SSS and OSS with depressive symptoms, perceived stress, waist circumference, HOMA-IR and diabetes from age-adjusted models (column 1), and age, income and education adjusted models (column 2 for the US ladder and column 3 for the community ladder) are shown in Table 4 for men and Table 5 for women. The interaction of gender with both SSS ladders was not statistically significant in any instance. In order to allow comparisons across indicators, associations are shown for one SD difference in SSS and OSS. One SD difference is about 2 ―rungs on the SSS ladders.

Among men, higher levels of SSS (both ladders) and higher levels of income and education were significantly associated with lower depressive symptoms in age adjusted models. Associations were generally of similar magnitude across all four measures of social status (Table 4 column 1). Associations of SSS with depressive symptoms were slightly weakened but persisted after adjustment for OSS (Table 4 columns 2 and 3). A one SD higher U.S. SSS was associated with a 1.15($p<0.0001$) point lower depressive symptoms score, independent of age, income and education. This pattern was observed with community SSS as well. The SSS-depressive symptoms association persisted after additional adjustment for perceived discrimination (Table 4 columns 4–7). Across all models, associations of SSS with depressive symptoms were similar in magnitude for both ladders.

In contrast, stress was not consistently associated with any of the SSS measures in any of the models whereas income was inversely associated with stress levels (−0.50 points, $p < 0.01$) and education was positively associated with stress levels (+0.53 points, $p<0.01$). There were no statistically significant associations of SSS or OSS with waist circumference or HOMA-IR in men. Higher income was associated with lower odds of diabetes (OR = 0.72, 95% CI: 0.62, 0.86) but no other statistically significant associations of diabetes with OSS or SSS measures were observed.

There was no evidence of interaction between SSS and perceived discrimination except a statistically significant interaction between U.S. SSS and perceived everyday discrimination ($p = 0.01$ for the global test of interaction) in a model for depressive symptoms by which the association of SSS with depressive symptoms was stronger at higher levels of discrimination.

In women, OSS and SSS were inversely associated with depressive symptoms in age adjusted models (Table 5 column 1). These associations were mutually independent (Table 5 column 2) and persisted after adjustment for discrimination (Table 5 columns 4–7). Associations were generally stronger for OSS than for SSS and of approximately similar magnitude for the community and the US ladder. As in men, income was inversely, and education positively, associated with stress but no consistent associations of SSS with stress were observed. OSS measures were also inversely associated with waist circumference and with diabetes but no statistically significant associations of SSS with these outcomes were observed after adjustment for objective measures or after adjustment for discrimination. The U.S. ladder was independently associated with lower levels of HOMA-IR among women across all models (−0.03, $p<0.05$, Table 5 columns 4–5).

No statistically significant interactions between discrimination and SSS were observed in women.

Sensitivity analyses (see Appendix B)

Additional adjustment for self rated health slightly weakened but did not substantially modify the results for depressive symptoms in men or women. These results were also robust to the adjustment of each ISEL self-esteem social support item. Further adjustment for occupation did not change the results for depressive symptoms (men and women) and insulin resistance (women). The education-stratified models showed that SSS was associated with CESD (men and women) and HOMA-IR (women) even within strata of education although the smaller sample sizes resulted in loss of statistical significance.

Discussion

Using data from a large population-based cohort of African Americans, this study presents three important findings: SSS was associated with depressive symptoms (men and women) and insulin resistance (women) independent of OSS; the magnitude of the SSS-risk factor association was, on average, similar to that observed with OSS; and associations of SSS with the risk factors were generally not strongly confounded by and did not vary depending on levels of perceived racial discrimination. To our knowledge this is the first study to examine the influence of SSS on several selected CVD risk factors in a large African American sample which additionally takes account of perceived racial discrimination.

Subjective social status and psychosocial and metabolic risk factors

In gender-stratified models adjusted for age, income and education, higher SSS (U.S. and community) was independently associated with lower CES-D scores among both men and women. The results for CES-D were independent of OSS, two forms of discrimination, as well as self-rated health. These results correspond with the findings by Adler et al. (2008) who found that African Americans in the bottom fifth of the SSS scale, versus the top fifth, had greater odds of scoring >16 on the CES-D scale. Others have reported similar findings from samples of women, both multi-ethnic and white. Stewart et al. (2007) reported that one rung higher SSS was associated with a 0.17 ($p<0.001$) point lower CES-D score in a sample of 1802 pregnant women that was 18% African American. They also found that this association did not vary by race. Dennis et al. (2011) report similar findings in a sample of 1322 white women. In a sample of 92 middle-aged mostly white women Ghaed & Gallo (2007) report a 1.21 lower CES-D score with each rung higher SSS.

Additionally, we found a significant inverse association between the U.S. ladder and a biological measure of insulin resistance among women, independent of OSS and either form of discrimination. However we found no associations of SSS with waist circumference or diabetes, other outcomes also related to insulin resistance. In contrast, a study of 981 adults (16% African American) reported decreased odds of ―high waist circumference (OR = 0.83, 95% CI = 0.71, 0.91) with a 1.6 rung higher SSS (Manuck et al., 2010) although the association of SSS with continuous waist circumference was not statistically significant. Additionally, others have reported lack of statistically significant associations of SSS with related outcomes such as BMI (Ghaed & Gallo, 2007) and waist-hip-ratio (Adler et al., 2000) in predominantly white samples.

In general, this study found that SSS and OSS were similar in the strength of their association with depressive symptoms and insulin resistance, in models adjusted for both SSS and OSS. Among the handful of studies of SSS and health that include African Americans, a majority do not present results that enable a comparison of the effects of SSS versus OSS. One study of 129 African American pregnant women presented results from a multivariable model of the U.S. ladder and a self-rated health score, adjusted for income and education (Ostrove et al., 2000). In this model, one rung higher U.S. ladder score was associated with a 0.14 point lower self-rated health score, while one category difference in education (a 3 category variable) was associated with a 0.14 point difference in self-rated health and the estimate for income was 0.19 per point (7 point scale). Stewart et al. (2007) found that in mutually adjusted models, women with less than a high school degree scored 1.52 points higher on the CES-D than women with a graduate degree while each lower rung of SSS was associated with 0.17 points higher CES-D score, which is equivalent to a 1.7 points higher score if an individual’s SSS were to change from the lowest (1) to the highest (10). Evidence of similar strengths in the association of OSS and SSS with physical, and mental health have also been reported among low-income Mexican immigrants in Texas (Franzini et al., 2006).

In summary we found consistent evidence that SSS is related to mental health in African American men and women, but findings for the other risk factors and biological markers were not consistent. The presence of associations of SSS with depressive symptoms after adjustment for OSS suggests that SSS may be tapping into objective or subjective dimensions of social status relevant for mental health which are not routinely captured by commonly used objective measures. Others have observed that estimates of the association of SSS with health are more modest in magnitude among African-Americans than white populations (Adler et al., 2008; Manuck et al., 2009; Ostrove et al., 2000).Taken together with those of others, our results are not consistent with the hypothesis that SSS is an especially important predictor of health among African Americans.

Subjective versus objective social status

We found that SSS and OSS were positively correlated; however the strength of this correlation was weak, especially for education. This is congruent with the findings of Adler et al. (2008) and Ostrove et al. (2000).We are not aware of any other study of SSS and CVD risk factors among African Americans, which has used the community ladder. The measure of community SSS focuses on the ―standing in community instead of the emphasis on income, education and occupation reflected in the question on the U.S. ladder. This could explain the weaker correlations of the community ladder than the US ladder with income and education that we observed.

We found that persons tended to report higher community SSS than U.S. SSS, similar to Wolff et al. (2009). One explanation for this is that the community measure might be tapping into different constructs than the US ladder such as self-esteem or perceptions of self worth (Wolff et al., 2009). Because our sample included only African Americans we were unable to determine if this pattern is observed for other groups as well or is specific to the context of African American community. Despite these differences in the two ladders, associations of the psychosocial and metabolic risk factors with U.S. and community SSS appeared to be generally similar.

While previous studies have found evidence for the reliability of the SSS measures among African Americans (Wolff et al., 2009), research that maps the various domains being tapped by SSS in this population is limited. Wolff et al. (2009) found a weaker association between OSS and SSS among African Americans compared to whites, and that on average, African Americans reported higher SSS levels than whites. Drawing on evidence that self-esteem and a sense of self-efficacy are associated with perceived social class among African Americans, and that African Americans have significantly higher levels of self-esteem than whites, Wolff et al. (2009) surmise that OSS does not drive SSS ratings among African Americans. Our results and those of others, showing at least some independent associations of SSS with selected outcomes after controlling for OSS (Adler et al., 2008; Ostrove et al., 2000; Wolff et al., 2009), suggest that African Americans may incorporate other factors not captured by commonly used measures of OSS in the cognitive averaging process of rating their SSS. More research is needed to fully understand how African-Americans (and other race/ethnic groups) rate their SSS, what their ladder scores represent, and whether the factors driving the distribution of the SSS measures vary by social, cultural, or historical context.

SSS, psychosocial and metabolic risk factors, gender and discrimination

Although the stratified results for depressive symptoms (community ladder) and insulin resistance may suggest that the association of SSS with these risk factors is stronger among women than men, the tests of interaction of gender and SSS were not statistically significant. Others have reported gender differences in the association of social status and CVD risk factors. Adler et al. (2008) found that the inverse association of SSS and depressive symptoms was stronger among African American women (Relative Index of Inequality (RII) = 5.82) than African American men (RII=3.28). Stronger associations of OSS with CVD risk factors in African American women than African American men have also been reported by others (Boykin et al., 2011). Chichlowska et al. (2008) report similar findings in their study of metabolic syndrome and suggest that gender-differences in psychological response to the stress of lower SES might explain these findings. However more research is needed to understand whether these gender differences have causes specific to African Americans and whether the impact of gender is different on subjective versus objective measures.

In general we found no consistent evidence to support our hypothesis that the SSS-risk factor association varied depending on perceived racial discrimination. However in men the association of the U.S. ladder with depressive symptoms was stronger at higher than lower levels of perceived everyday discrimination. Also, there was some evidence that experiences of discrimination were weakly correlated with assessments of SSS and weakly confounded the associations of SSS with CESD based on the change in the estimates when discrimination was added to the models. However, the confounding effect was not large and adjustment for discrimination did not eliminate the association.

This study has a few limitations. The amount of missing data in these analyses is non- trivial (ranging from 40% for CESD to 0.1 % for waist circumference). A comparison showed that those missing data on outcomes were more likely to have lower income and education levels than those not missing data but differences were not large. It is unlikely that those excluded from the analyses were selected based on both SSS and the outcome, the conditions necessary for our estimates to be substantially biased, but given the large amount of missing data in some analyses we cannot categorically rule out an effect of selection on our results. Sensitivity analyses showed that the association of SSS with depressive symptoms and insulin resistance persisted even within strata of education, although the association of SSS and CESD was weaker among women with less than a high school education. This suggests that our findings are applicable to all SES groups. However, the greater proportion of missing data from persons with lower income and education needs to be borne in mind while interpreting our results. Since this is a cross-sectional study, we are unable to completely rule out reverse causation. It is possible that participants who reported greater number of depressive symptoms reported a lower SSS due to their depressed state of mind. However, we do not think the results are entirely explained by reverse causation because we did not find strong inverse association of SSS with stress, which is a self-reported score and we observed associations in the expected direction with insulin resistance (women), an objectively measured outcome. Results for depressive symptoms weakened slightly but persisted despite the addition of self-rated health to the models, indicating robustness these results.

Another limitation is the possibility that data from the Jackson, MS region are not representative of African Americans at the national level. However, our results correspond with studies using CARDIA (Adler et al., 2008) and the national HealthStyles survey (Wolff et al., 2009), thus increasing our confidence in them. It is also plausible that the relevant SES measures (whether subjective or objective) in this population are at the contextual level, such as area SES. However subjective status was measured only at the individual level in the JHS. The use of only two referent groups: the U.S. and the community with which the participants identify themselves, is a limitation. Including more referent groups might have provided a more nuanced picture of SSS in this population.

Strengths of this study include the use of data from a large African American sample to examine associations of SSS with selected CVD risk factors and the ability to account for discrimination. It also adds to the small body of work that has focused on SSS among African Americans and generates questions for further research. Further, this study focuses on multiple risk factors including both psychosocial and metabolic measures. Our results suggest that SSS may be of importance to mental health outcomes in African Americans, but do not support a stronger role of SSS versus OSS in African Americans. Additional work is needed to further understand the factors that affect assessments of SSS and the mechanisms linking SSS to health outcomes in this population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Analytic sample size for each outcome (Full JHS N = 5301)

Outcome	Missing outcome	Missing covariates	Analytic sample size
Depressive symptoms	2143	700	2458
Stress	656	1014	3631
Waist circumference	9	1290	4002
Diabetes	146	1216	3939
Insulin resistance*	268	942	3123

*Of the 4333 non-diabetics

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Table 2

Selected characteristics of the full JHS and the different analytic samples, baseline data from the Jackson Heart Study (2000–2004).

Characteristics	Men						Women					
Analytic sample **N**	**Full JHS** **1941**	**CESD** **887**	**Stress** **1344**	**Waist** **1472**	**HOMA-IR[c]** **1175**	**Diabetes[d]** **1448**	**Full JHS** **3360**	**CESD** **1571**	**Stress** **2287**	**Waist** **2530**	**HOMA-IR[c]** **1948**	**Diabetes[d]** **2491**
Outcome		9.55 (6.99)	4.45 (4.13)	101.44 (15.11)	1.09 (0.57)~	16.23⁺		11.52 (8.41)	5.58 (4.43)	100.51 (16.88)	1.18 (0.55)~	19.11⁺
SSS (community)[a]	7.61 (2.01)	7.53 (2.00)	7.51 (2.02)	7.56 (1.99)	7.56 (2.00)	7.56 (1.99)	7.61 (2.04)	7.54 (2.05)	7.65 (1.98)	7.56 (2.02)	7.52 (2.04)	7.56 (2.03)
SSS (U.S.)[a]	6.30 (2.14)	6.25 (2.04)	6.26 (2.18)	6.26 (2.11)	6.25 (2.04)	6.26 (2.11)	6.28 (2.25)	6.29 (2.15)	6.29 (2.20)	6.22 (2.22)	6.26 (2.17)	6.23 (2.21)
Age[a]	54.1 (13.0)	52.6 (12.5)	55.1 (12.6)	53.7 (12.8)	52.7 (12.9)	53.8 (12.7)	55.3 (12.8)	53.6 (12.2)	55.7 (12.6)	54.8 (12.6)	53.5 (12.8)	54.8 (12.5)
Income[b]												
Low	175 (10.64)	81 (9.13)	115 (10.11)	150 (10.19)	114 (9.70)	146 (10.08)	526 (18.54)	239 (15.21)	346 (18.00)	443 (17.51)	312 (16.02)	435 (17.46)
Lower-middle	365 (22.20)	159 (17.93)	229 (20.12)	316 (21.47)	240 (20.43)	308 (21.27)	766 (27.00)	390 (24.82)	497 (25.86)	668 (26.40)	491 (25.21)	655 (26.29)
Upper-middle	493 (29.99)	280 (31.57)	352 (30.93)	445 (30.23)	340 (28.94)	439 (30.32)	835 (29.43)	501 (31.89)	587 (30.54)	769 (30.40)	613 (31.47)	757 (30.39)
High	611 (37.17)	367 (41.38)	442 (38.84)	561 (38.11)	481 (40.94)	555 (38.33)	710 (25.03)	441 (28.07)	492 (25.60)	650 (25.69)	532 (27.31)	644 (25.85)
Z score of income[a]	0.22 (1.06)	0.44 (1.08)	0.28 ((1.07)	0.34 (1.08)	0.42 (1.09)	0.35 (1.07)	−0.13 (0.94)	−0.02 (0.96)	−0.10 (0.94)	−0.09 (0.95)	−0.03 (0.96)	−0.09 (0.95)
Education[b]												
Less than high school	370 (19.14)	112 (12.63)	239 (17.78)	250 (16.98)	176 (14.98)	245 (16.92)	603 (18.01)	173 (11.01)	372 (16.27)	395 (15.61)	255 (13.09)	384 (15.42)
High school grad	376 (19.45)	149 (16.80)	247 (18.38)	277 (18.82)	207 (17.62)	268 (18.51)	688 (20.55)	279 (17.76)	460 (20.11)	479 (18.93)	371 (19.05)	475 (19.07)
Some college	568 (29.38)	259 (29.20)	391 (29.09)	431 (29.28)	356 (30.30)	427 (29.49)	957 (28.58)	506 (32.21)	684 (29.91)	771 (30.47)	617 (31.67)	757 (30.39)
College and above	619 (32.02)	367 (41.38)	467 (34.75)	514 (34.92)	436 (37.11)	508 (35.08)	1100 (32.86)	613 (39.02)	771 (33.71)	885 (34.98)	705 (36.19)	875 (35.13)
Z score of education[a]	−0.06 (1.03)	0.16 (0.99)	−0.00 (1.00)	0.01 (1.02)	0.07 (1.00)	0.02 (1.02)	0.03 (0.99)	0.22 (0.94)	0.08 (0.97)	0.10 (0.97)	0.15 (0.93)	0.10 (0.96)
Lifetime discrimination score	3.27 (2.14)	3.47 (2.13)	3.28 (2.14)	3.32 (2.12)	3.41 (2.12)	3.33 (2.12)	2.93 (2.04)	2.98 (2.03)	2.95 (2.05)	2.96 (2.03)	2.99 (2.03)	2.96 (2.03)
Everyday discrimination score	2.20 (1.08)	2.21 (1.02)	2.20 (1.07)	2.21 (1.06)	2.23 (1.07)	2.21 (1.06)	2.06 (0.98)	2.05 (0.94)	2.07 (0.98)	2.07 (0.97)	2.08 (0.95)	2.06 (0.96)

[a]Mean (standard deviation)

[b]Frequency (percentages). Missing data in the JHS: 297 men, 523 women (income); 8 men, 12 women (education); 134 men, 248 women (lifetime discrimination); 128 men, 249 women (everyday discrimination)

[c]Logarithm of HOMA-IR

[d]Prevalence (%)

Table 3

Pearson correlation of income, education and perceived discrimination scores with subjective social status measures.

	Men		Women	
	USSS	**CSSS**	**USSS**	**CSSS**
Income	0.17***	0.11***	0.16***	0.03
Education	0.16***	0.05*	0.10***	0.01
Everyday discrimination	−0.10***	−0.13***	−0.12***	−0.16***
Lifetime discrimination	−0.03	−0.00	−0.06**	−0.07**

*** = p<0.0001,

** = p< 0.01,

* = p< 0.05

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Table 4

Mean differences in CESD, stress, waist circumference and log of HOMA, and odds ratios of diabetes associated with subjective and objective social status indicators among men in the JHS

	Age adjusted	Adjusted for age, income and education		Adjusted for age, income, education and discrimination			
				SSS (US)		SSS (Community)	
				Lifetime	Everyday	Lifetime	Everyday
CESD (N = 887)							
SSS (US)	−1.68 (0.25)***	−1.15 (0.25)***		−1.10 (0.25)***	−1.05 (0.25)***		
SSS(Community)	−1.45 (0.24)***		−1.06 (0.24)***			−1.10 (0.24)***	−0.91 (0.23)***
Income	−1.90 (0.21)***	−1.43 (0.24)***	−1.43 (0.24)***	−1.46 (0.24)***	−1.29 (0.24)***	−1.45 (0.24)***	−1.31 (0.24)***
Education	−1.58 (0.23)***	−0.52 (0.27)*	−0.65 (0.26)*	−0.60 (0.27)*	−0.48 (0.26)	−0.73 (0.26)**	−0.60 (0.26)*
Stress (N=1344)							
SSS (US)	0.14 (0.11)	0.13 (0.11)		0.12 (0.11)	0.13 (0.11)		
SSS(Community)	−0.18 (0.12)		−0.20 (0.12)			−0.18 (0.11)	−0.18 (0.11)
Income	−0.21 (0.11)*	−0.50 (0.13)**	−0.50 (0.13)**	−0.53 (0.13)***	−0.45 (0.12)**	−0.54 (0.13)***	−0.46 (0.12)**
Education	0.22 (0.11)	0.52 (0.14)**	0.53 (0.14)**	0.37 (0.14)**	0.37 (0.13)**	0.38 (0.14)**	0.38 (0.13)**
Waist circumference (N=1472)							
SSS (US)	−0.39 (0.41)	−0.53 (0.43)		−0.53 (0.43)	−0.45 (0.43)		
SSS(Community)	0.28 (0.41)		0.24 (0.42)			0.26 (0.42)	0.33 (0.42)
Income	0.11 (0.37)	−0.22 (0.43)	−0.32 (0.44)	−0.19 (0.44)	−0.13 (0.44)	−0.29 (0.44)	−0.22 (0.44)
Education	0.66 (0.40)	0.89 (0.47)	0.81 (0.46)	0.87 (0.47)	0.86 (0.47)	0.78 (0.47)	0.78 (0.46)
Log of HOMA-IR (N=1175)							
SSS (US)	−0.02 (0.02)	−0.02 (0.02)		−0.02 (0.02)	−0.02 (0.02)		
SSS(Community)	−0.006 (0.018)		−0.007 (0.018)			−0.007 (0.018)	−0.006 (0.02)
Income	0.004 (0.016)	0.001 (0.02)	0.0004 (0.018)	0.0003 (0.02)	0.0043(0.02)	−0.0008 (0.02)	0.003 (0.02)
Education	0.008 (0.017)	0.01 (0.02)	0.009 (0.020)	0.012 (0.02)	0.014 (0.02)	0.009 (0.02)	0.012 (0.02)
Diabetes (N=1448)							
SSS (US)	0.97 (0.84, 1.13)	1.04 (0.89, 1.21)		1.03 (0.89, 1.20)	1.04 (0.90, 1.21)		
SSS(Community)	0.87 (0.75, 1.01)		0.91 (0.78, 1.06)			0.91 (0.78, 1.06)	0.91 (0.78, 1.06)
Income	0.74 (0.64, 0.85)	0.72 (0.61, 0.85)	0.73 (0.62, 0.86)	0.72 (0.61, 0.85)	0.72 (0.60, 0.85)	0.73 (0.62, 0.89)	0.73 (0.62, 0.87)

	Age adjusted	Adjusted for age, income and education		Adjusted for age, income, education and discrimination			
				SSS (US)		SSS (Community)	
				Lifetime	Everyday	Lifetime	Everyday
Education	0.89 (0.78, 1.01)	1.04 (0.89, 1.22)	1.05 (0.89, 1.23)	1.05 (0.89, 1.23)	1.03 (0.88, 1.21)	1.06 (0.90, 1.24)	1.04 (0.89, 1.22)

*** = p<0.0001,

** = p< 0.01,

* = p< 0.05

Table 5

Mean differences in CESD, stress, waist circumference and log of HOMA, and odds ratios of diabetes associated with subjective and objective social status indicators among women in the JHS

	Age adjusted	Adjusted for age, income and education		Adjusted for age, income, education and discrimination			
				SSS (US)		SSS (Community)	
				Lifetime	Everyday	Lifetime	Everyday
CES-D (N=1571)							
SSS (US)	−1.59 (0.22)***	−1.18 (0.21)***		−1.08 (0.21)***	−1.04 (0.21)***		
SSS(Community)	−1.66 (0.21)***		−1.39 (0.21)***			−1.31 (0.21)***	−1.22 (0.20)***
Income	−2.31 (0.22)***	−1.44 (0.25)***	−1.49 (0.25)***	−1.47 (0.25)***	−1.43 (0.24)***	−1.51 (0.24)***	−1.46 (0.24)***
Education	−2.21 (0.22)***	−1.32 (0.25)***	−1.32 (0.25)***	−1.45 (0.25)***	−1.34 (0.24)***	−1.44 (0.25)***	−1.34 (0.24)***
Stress (N=2277)							
SSS (US)	0.11 (0.09)	0.09 (0.09)		0.07 (0.09)	0.13 (0.09)		
SSS(Community)	0.10 (0.10)		0.10 (0.10)			0.18 (0.09)*	0.13 (0.09)
Income	−0.11 (0.10)	−0.43 (0.12)**	−0.44 (0.12)**	−0.52 (0.11)***	−0.52 (0.11)***	−0.53 (0.11)***	−0.52 (0.11)***
Education	0.33 (0.10)**	0.56 (0.12)***	0.56 (0.12)***	0.31 (0.11)**	0.47 (0.11)***	0.31 (0.11)**	0.47 (0.11)***
Waist circumference (N=2530)							
SSS (US)	−1.09 (0.34)**	−0.62 (0.34)		−0.51 (0.34)	−0.56 (0.34)		
SSS(Community)	−0.53 (0.35)		−0.26 (0.35)			−0.19 (0.35)	−0.19 (0.35)
Income	−2.61 (0.26)***	−1.91 (0.41)***	−2.00 (0.41)***	−1.92 (0.41)***	−1.90 (0.42)**	−1.99 (0.41)***	−1.98 (0.41)***
Education	−2.15 (0.35)***	−1.13 (0.40)**	−1.15 (0.40)**	−1.27 (0.41)**	−1.13 (0.40)**	−1.29 (0.41)**	−1.14 (0.40)**
HOMA-IR (N=1948)							
SSS (US)	−0.03 (0.01)**	−0.03 (0.01)*		−0.03 (0.01)*	−0.03 (0.01)*		
SSS(Community)	−0.02 (0.01)		−0.01 (0.01)			−0.01 (0.04)	−0.02 (0.01)
Income	−0.04 (0.01)**	−0.02 (0.02)	−0.02 (0.02)	−0.01 (0.02)	−0.02 (0.02)	−0.02 (0.02)	−0.02 (0.02)
Education	−0.04 (0.01)**	−0.03 (0.02)*	−0.03 (0.02)*	−0.03 (0.02)*	−0.03 (0.02)	−0.03 (0.02)	−0.03 (0.02)
Diabetes (N=2491)							
SSS (US)	0.91 (0.82, 1.01)	0.94 (0.85, 1.05)		0.95 (0.86, 1.05)	0.95 (0.85, 1.05)		
SSS(Community)	1.00 (0.90, 1.12)		1.02 (0.92, 1.14)			1.02 (0.92, 1.14)	1.02 (0.92, 1.14)

	Age adjusted	Adjusted for age, income and education		Adjusted for age, income, education and discrimination			
				SSS (US)		SSS (Community)	
				Lifetime	**Everyday**	**Lifetime**	**Everyday**
Income	0.80 (0.71, 0.90)	0.85 (0.74, 0.97)	0.83 (0.73, 0.96)	0.84 (0.73, 0.97)	0.85 (0.74, 0.98)	0.83 (0.72, 0.96)	0.84 (0.73, 0.96)
Education	0.85 (0.77, 0.95)	0.92 (0.82, 1.04)	0.92 (0.82, 1.04)	0.92 (0.82, 1.04)	0.93 (0.83, 1.06)	0.92 (0.81, 1.04)	0.93 (0.83, 1.05)

*** = $p<0.0001$,

** = $p< 0.01$,

* = $p< 0.05$