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Subjective Social Status and Allostatic Load in Mothers One Year After Birth

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Abstract

Objective: Subjective social status (SSS) refers to an individual's perception of relative social rank. We tested associations between SSS and allostatic load, a multisystem index of physiological dysregulation, in a sample of women one year after the birth of a child.

Methods: Participants (*n* = 1168) in the Community Child Health Network study were recruited in five sites across the United States shortly after the birth of a child. SSS was assessed at 6 months after birth using the MacArthur Scale of Subjective Social Status. Participants also reported household income and years of education completed. Biomarkers were assessed and allostatic load was calculated by assigning one point for each of ten biomarkers above clinical cutoffs at a subsequent visit approximately 6 months later. Multiple linear regression analyses tested associations of SSS with allostatic load, adjusting for socioeconomic (SES) indicators of household income, years of education, and other covariates (race/ethnicity, relationship status, maternal age, and study site). We also tested interactions between each of the objective SES measures and SSS.

Results: Higher SSS predicted lower subsequent allostatic load independent of household income, education, and other covariates. Associations between SSS and allostatic load were strongest at higher levels of income and education.

Conclusions: Study findings demonstrate associations between perceptions of relative social standing and wear-and-tear on multiple physiological systems above and beyond indicators of

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objective SES, suggesting that psychosocial aspects of lower status may contribute to the gradient between social status and health.

Keywords

allostatic load; maternal health outcomes; subjective social status; socioeconomic status; socioeconomic position

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Lower socioeconomic status (SES) predicts adverse health outcomes (Braveman et al., 2010; WHO Commission on Social Determinants of Health, 2008). Because perceptions of status shape psychological processes relevant to health disparities, a growing number of studies include both subjective and objective measures of SES (income, education, and occupational prestige) in examining associations between status and health outcomes (MacArthur SES and Health Network, n.d.). Subjective social status (SSS) refers to perceptions of relative rank in a social hierarchy (Jackman & Jackman, 1973). It is typically measured by showing participants a picture of a ladder with ten rungs and asking them to rank themselves as compared to others in the U.S. (Adler et al., 2000). Previous studies find that participants ranking themselves lower on this ladder have poorer self-rated health (Singh-Manoux et al., 2005) and greater risk of adverse health outcomes including hypertension (Adler et al., 2008),viral infection (Cohen et al., 2008), and earlier mortality (Demakakos et al., 2018). A recent meta-analysis of 31 studies reported significant independent associations between SSS and physical health independent of objective markers of SES (Cundiff & Matthews, 2017).

In the context of maternal child health, women with lower SES experience higher rates of adverse birth outcomes such as preterm birth and low birth weight (Blumenshine et al., 2010). However, there is limited evidence connecting SSS to maternal health in the time surrounding the birth of a child, and a few studies suggest that further research is needed. For example, lower SSS has been linked to poorer selfreported health and greater emotional distress in pregnant and postpartum women over and above the effect of indicators of objective SES (Dennis et al., 2012; Ostrove et al., 2000; Stewart et al., 2007). Lower maternal SSS has also been associated with adverse health outcomes including higher levels of inflammatory markers during pregnancy (Scholaske et al., 2020) and high infant birth weight (Goplerud et al., 2021). To our knowledge, no prior studies conducted on SSS in the postpartum period have focused on prediction objective biological markers of maternal health.

In the present study, we test associations between SSS and allostatic load in a large and predominantly low-income sample of women from five sites in the U.S. Allostatic load (AL) is a summative measure of physiologic dysregulation across major regulatory systems including cardiovascular, autonomic, metabolic, neuroendocrine, and immune systems (Seeman et al., 1997). Previous studies have shown that higher levels of allostatic load predict greater risk of cardiovascular disease and all-cause mortality (Seeman et al., 1997). We sought to determine whether the relationship between SSS and AL persists after adjustment for objective SES (income and education) and other SESrelated covariates (maternal race/ethnicity, relationship status, maternal age, and study site). We also tested whether associations between subjective social status and allostatic load were moderated by income or education to determine whether perceptions of status are predictive of health outcomes across all SES levels, or whether these effects are specific to the middle- to high-SES samples in which they have been typically studied.

Methods

The data used in the present study were collected by the multisite Community Child Health Network (CCHN). The five study sites included three urban (Washington, DC; Baltimore, MD; Los Angeles County, CA); one suburban (Lake County, IL); and one rural area (seven counties in eastern North Carolina). For complete study details, see previous work by the CCHN (Guardino et al., 2017; O'Campo, Belue, et al., 2016; O'Campo, Dunkel Schetter, et al., 2016; Ramey et al., 2015; Shalowitz et al., 2019).

Participants

Participants in the larger CCHN study were 2510 women recruited and enrolled during their hospital stay following the birth of an index child (except in North Carolina where participants were recruited in clinics during pregnancy or after delivery). By study design, only women who identified as African American/Black, Latina/Hispanic or non-Hispanic White were eligible to enroll. The present sample excludes women who did not complete study visits at six months and one year after birth ($n = 1146$), those who were pregnant again by the time of the third visit when allostatic load was assessed ($n = 138$), those who had insufficient biomarker data to score allostatic load ($n = 55$), and those with missing data for SSS ($n = 3$). Thus, the final sample included 1168 participants.

Procedures

Structured interview and biomarker assessments were completed during in-home visits when babies were approximately 1 month, 6 months, and 12 months of age. Community members experienced or trained in community research or clinical service delivery conducted interviews in the participant's choice of English (chosen by 85% of the sample) or Spanish (15%). Data were collected between June 2008 and December 2011. All participants provided written informed consent and Institutional Review Boards at participating institutions approved the research protocol (see Acknowledgements for list of participating institutions).

Measures

Socioeconomic status.—During a home visit conducted at approximately one month after the birth of a child, participants reported their pre-tax household income in the previous calendar year using pre-specified categories (e.g., $10−20,000 per year, $50−75,000 per year). In scoring for analyses, we assigned the midpoint value for the response category as each person's household income (e.g., $62,500 as the midpoint for $50−75,000). To account for differences in household size, we used 2009 US Census data for poverty thresholds and calculated household income as a percentage of the federal poverty level (FPL) based on household size. As an example, the household income of $21,954 for a family of 4 is 100% of FPL. Observations three standard deviations above or below the sample mean were considered outliers. Scores on income were adjusted to three standard deviations above the sample mean (1212.81) for 14 participants (1% of the sample). To assess educational attainment, participants were also asked how many years of school they had finished.

Subjective social status.—Participants reported SSS using the MacArthur Scale of Subjective Social Status at 6 and 12 months postpartum (Adler et al., 2000). They were shown a picture of a ladder and asked to think of the ladder as representing where people stand in the U.S. and to indicate the number of the rung (1 being the lowest and 10 being the highest) that represents where they see themselves relative to others. This ladder has previously demonstrated test-retest reliability and predictive validity (Operario et al., 2004). As shown in Table 1, there was a moderate correlation between SSS measures completed approximately 6 months apart. Mean levels of SSS were slightly higher at 12 months postpartum, $M = 5.50$, $SD = 1.76$ than at 6 months postpartum, $M = 5.37$, $SD = 1.90$, $t(1206) = -2.06$, $p = .04$. Mean levels at both time points were slightly lower than the average of 6 that has been found in prior U.S. samples (Andersson, 2018; Operario et al., 2004). SSS measured at 6 months postpartum was used in all analyses.

Allostatic load.—Biomarkers were assessed at the 6 and 12 months postpartum home visits. Allostatic load was calculated by assigning one point for each of ten markers above established clinical cut-offs and then summing across biomarkers to generate a score with a possible range of 0 to 10. We used the following cut-offs to calculate this clinical AL index: Body Mass Index (BMI) of ≥30 kg/m2; Waist Hip Ratio (WHR) of ≥0.85; systolic blood pressure (SBP) of ≥125 mmHg; diastolic blood pressure (DBP) of ≥80 mmHg: pulse of ≥100 beats per minute: HS-CRP of ≥3 mg/L: HbA1c of ≥5.4%; HDL of ≤40 mg/dL; total cholesterol/HDL ratio ≥5.9; and diurnal cortisol slope of ≥ −0.01 μg/dL. For this last measure the top quartile was used as the cut-off, as there is no established clinical cutoff. This clinical cut-off approach to calculating allostatic load differs from the group-based top quartile approach to calculating allostatic load that has typically been reported in prior literature (Juster et al., 2010). In preliminary reports, CCHN found no major differences by race, ethnicity, or poverty between the two scoring methods (Shalowitz et al., 2019); therefore, to increase the clinical relevance of our work, CCHN chose to use the clinical cut-off scores in prior analyses (O'Campo, Dunkel Schetter, et al., 2016). In the present sample, there was a moderate correlation between clinical AL measures completed approximately 6 months apart (see Table 1). Mean levels of AL at 12 months postpartum ($M = 3.03$, $SD = 1.94$) were not significantly different than mean levels of AL at 6 months postpartum ($M = 2.98$, $SD = 1.92$), $t(1088) = 0.8985$, $p = .37$. AL measured at 12 months postpartum was used in all subsequent analyses.

Additional demographic variables.—Additional demographic variables included participants' self-reported racial/ethnic identification at the time of study enrollment, parity (live births including the study child), maternal age, current status of the relationship with the baby's father, and study site.

Data Analytic Plan

Pearson bivariate correlations and ANOVA were used to examine zero-order associations between study variables including AL, SSS, income, education, and demographic covariates. A series of multiple regression models were then used to test whether the association between AL and SSS held after adjustment for income, education, race/ethnicity, relationship status, study site, maternal age, and weeks since birth at the time of the biomarker assessment. An additional set of models tested the interaction of SSS with each of the objective SES variables; separate models were run for interactions of SSS with income and education. Significant interactions were probed using the PROCESS Procedure for SPSS Version 3.5.2 (Hayes, 2018), and the Johnson-Neyman technique was used to detect regions of significance for the moderator variable. The Johnson-Neyman technique is suitable for probing significant interactions when the moderator is a continuous variable (Hayes, 2018; Johnson & Fay, 1950). Regions of significance for the moderator were determined by examining 95% confidence intervals around the conditional effect of the predictor on the dependent variable (Bauer et al., 2005).

Results

Sample characteristics and descriptive characteristics for SSS are reported in Table 2. The median income as FPL was 140.87% and average years of education completed was 13 years. Forty-three percent of participants were living at or below the FPL; another 27% had incomes that fell between 100 and 200% FPL. Participants had an average of 3.01 markers of allostatic load that were above clinical cutoffs (SD = 1.95). As shown in Table 2, SSS was higher in White women than in Black women, who were in turn higher than Latina women. Mothers who were married to the baby's father and living in Baltimore were highest in SSS. Differences in mean SSS based on parity were not statistically significant. As shown in Table 1, higher SSS was correlated with higher income and more years of education completed.

A series of multiple regression models was used to examine associations between subjective social status and allostatic load. Table 2 shows results of multiple regression models predicting allostatic load. In Model 1, higher SSS was significantly associated with lower allostatic load. In Model 2, income and education were added to the model and SSS remained significantly associated with lower AL. In Model 3, SSS remained significantly associated with allostatic load after adjustment for race/ethnicity. In Model 4, the association remained after further adjustment for relationship status, study site, maternal age, and weeks since birth at the time of the biomarker assessment.

We also tested interactions of subjective SES with income and education and applied the Johnson-Neyman technique to identify regions of significance for moderation effects. There was a significant interaction between SSS and income in predicting allostatic load, $F(1, 1164) = 4.81$, p=.029. The Johnson-Neyman technique revealed that the association between SSS and allostatic load was significant only when household income was greater than 153.63% FPL (see Figure 1a and Supplementary Table 1). There was also a significant interaction between SSS and years of education in predicting allostatic load, $F(1, 1157) = 8.29$, p=.004. The Johnson-Neyman technique revealed that the association between SSS and allostatic load was significant only for participants with 11.96 years of education or more (see Figure 1b and Supplementary Table 2).

Discussion

In a multi-site study of 1168 women, participant reports of SSS predicted allostatic load six months later, after adjustment for income and education. Associations remained significant when additional covariates were entered in regression models. Thus, this study provides further evidence that SSS captures a unique dimension of social standing with important health implications independent from objective indices of SES. To our knowledge, this is the first study in mothers during the childbearing years showing that SSS predicts allostatic load, an index of cumulative risk which has been posited to contribute to adverse outcomes in subsequent pregnancies and shape health outcomes for women across the lifespan (e.g., Hogue & Bremner, 2005; Latendresse, 2009; Lu & Halfon, 2003). It also contributes to the broader literature demonstrating associations between SSS and objectively-assessed indicators of health status (for a review, see Cundiff & Matthews, 2017).

The present study also included participants representing the full range of the subjective status ladder. About 15% of the sample reported low SSS (1 to 3 on the 10-point scale) and 12% reported high SSS (8 to 10). This variability is of interest given that most participants (70%) had incomes that placed them at less than 200% of the federal poverty level. The strength of the correlations between SSS rankings and objective indicators of SES were low to moderate, demonstrating that these measures are not capturing the same constructs for the most part. The strength of the associations between objective SES measures and SSS is consistent with findings reported in recent meta-analyses by Cundiff and Matthews (2017) and Tan et al. (2020).

Mothers with higher income and more education had lower levels of allostatic load, which is consistent with prior research tying lower SES to poorer health outcomes. However, when comparing beta weights, the strength of the association of SSS with allostatic load was stronger than the association between income and allostatic load ($F(1,1147) = 5.49$. $p =$ .02), a result consistent with prior studies examining associations of SSS with self-reported maternal health outcomes during the period after the birth of a child (Dennis et al., 2012; Michelson et al., 2016). The association of SSS with allostatic load adjusted for objective SES suggests that material and educational differences alone do not entirely account for social patterning of health outcomes and suggests that psychological factors related to lower status play a role in the etiology of adverse health outcomes.

We also found that the association between SSS and allostatic load may vary depending on income and education. The association between SSS and allostatic load was strongest for those whose household incomes were higher than 153% of the federal poverty level (corresponding to an income of approximately $32,500 for a family of four at the time of data collection), and those who had completed high school or more education. One interpretation of these findings is that perceptions of status may be most health-relevant when basic needs are met and, for those living in poverty, perceiving higher social status may not shape social environments, interpersonal experiences, and stress processes to the

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same extent. Further research is needed to fully understand why SSS relates differently to allostatic load depending on objective SES markers.

There are strengths and limitations to the present study. CCHN sought to sample families in communities most affected by health disparities rather than a representative sample of individuals living in the U.S. The present sample includes participants who had given birth within the previous year and metabolic, cardiovascular, and neuroendocrine biomarkers included in the AL index may reflect continuing effects of the numerous physiological adjustments required during pregnancy, labor and delivery, and recovery after the birth of a child. Also, causal relationships between study variables cannot be established. There is evidence of a reciprocal relationship between SSS and health outcomes (Euteneuer et al., 2021). It is possible that those who are in poorer health as captured by the allostatic load index perceived lower social status due to limited employment opportunities or additional healthcare expenses. However, prior laboratory research experimentally manipulating SSS by asking college students to imagine themselves at either the top or the bottom of the ladder in five years provides evidence that low subjective status contributes to psychological processes that adversely affect well-being (Jackson et al., 2011). Third variable causation also remains possible. For example, those living in underserved neighborhoods may have higher health risk and lower SSS.

Overall, findings suggest that perceptions of socioeconomic disadvantage relative to others may contribute to wear-and-tear on multiple physiological systems and that subjective social status may be most health-relevant among those who are more educated and of higher income. Notably, the timing of the study was coincident with a major economic recession in 2008 and thus, may be particularly relevant to the present day as the U.S. faces pandemic-driven changes in employment and production. Awareness of the self-perceptions that contribute to socioeconomic patterning of health outcomes has implications for understanding and addressing health disparities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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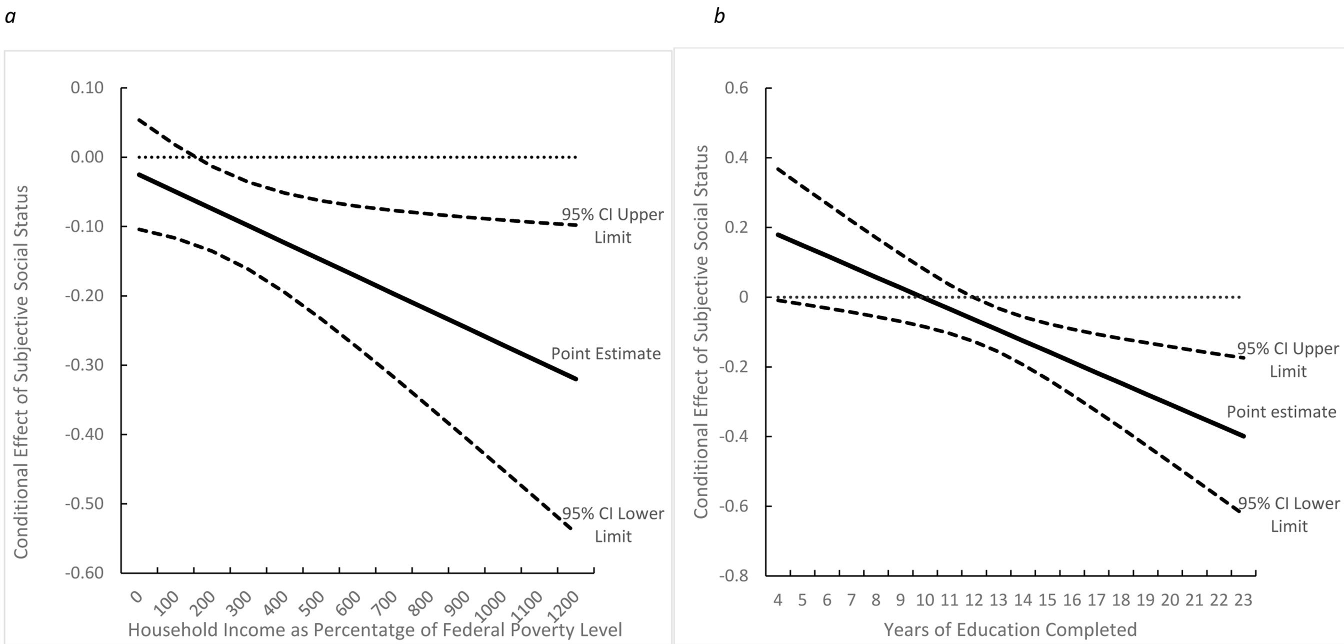

Figure 1.

Estimated effects of subjective social status on allostatic load moderated by household income and education with Johnson–Neyman confidence bands. Figure 1a displays conditional effect moderated by household income as percentage of Federal Poverty Level. Figure 1b displays conditional effect moderated by years of education completed.

Table 1.

Correlations between subjective social status, education, income, and allostatic load

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Subjective Social Status (6 months after birth)	1					
(2) Subjective Social Status (12 months after birth)	.54***	1				
(3) Years of Education Completed	.32***	.32***	1			
(4) Household Income (% FPL)	.29***	.28***	.44***	1		
(5) Maternal Age	.25***	.23***	.46***	.39***	1	
(6) Allostatic Load (6 months after birth)	−.06*	−.07*	−.08**	−.12***	−.04	1
(7) Allostatic Load (12 months after birth)	−.11***	−.12***	−.12***	−.13***	−.06*	.63***

* $p<.05$

** $p<.01$

*** $p<.001$

Table 2.

Characteristics of the study sample (n = 1168)

Categorical Variables	*n*	(%)	Mean SSS	(95% CI)
Race/ethnicity, $F(2, 1165) = 36.18$, $p < .0001$				
African American/Black	626	53.60	5.26	(5.11–5.40)
Non-Hispanic White	271	23.20	6.15	(5.93–6.37)
Hispanic/Latina	271	23.20	4.84	(4.62–5.06)
Relationship status, $F(2, 1165) = 30.88$, $p < .0001$				
Not married or cohabitating	421	36.04	5.06	(4.88–5.23)
Cohabitating, not married	362	30.99	5.08	(4.89–5.27)
Married	385	32.96	5.98	(5.79–6.16)
Site, $F(4, 1163) = 6.90$, $p < .0001$				
Baltimore	247	21.15	5.71	(5.47–5.94)
Lake County, IL	316	27.05	5.57	(5.36–5.78)
Los Angeles County	115	9.85	5.49	(5.15–5.83)
Eastern North Carolina	240	20.55	5.11	(4.87–5.35)
Washington, DC	250	21.40	4.97	(4.74–5.20)
Parity, $F(2, 1091) = 0.75$, $p = .471$				
1	501	45.80	5.44	(5.28–5.61)
2	406	37.11	5.36	(5.17–5.54)
>=3	187	17.09	5.25	(4.98–5.52)
Continuous variables	***M***	**(*SD*)**		
SSS (6 months after birth)	5.37	(1.90)		
Education (years completed)	12.97	(2.80)		
Household income (as % FPL)	233.03	(251.43)		
Maternal age	25.73	(5.73)		
AL (12 months after birth)	3.01	(1.95)		

Note. FPL=Federal Poverty Level. SSS=Subjective Social Status, AL=Allostatic Load

Table 3.

Multiple regression models predicting allostatic load at approximately 1 year after the birth of a child

	Model 1	Model 2	Model 3	Model 4
Subjective Social Status	−0.109**	−0.067*	−0.062*	−0.073*
Years of education completed		−0.069*	−0.051	−0.065
Household income (% FPL)		−0.077*	−0.043	−0.037
Maternal race/ethnicity				
Non-Hispanic White			Ref.	Ref.
African American/Black			0.199**	0.191**
Hispanic/Latina			0.056	0.117**
Relationship Status				
Not cohabitating or married				Ref.
Cohabiting, not married				−0.031
Married				−0.065
Site				
Baltimore				Ref.
Chicago				−0.127**
Los Angeles				−0.089*
North Carolina				−0.042
Washington DC				−0.136**
Age				0.112**
Time since birth				−0.028
R^2	0.01	0.03	0.05	0.07
N	1,168	1,161	1,161	1,161
F	14.09	10.26	13.00	7.15

Note. Standardized regression coefficients shown. FPL=Federal Poverty Level. Ref=Reference group coded as 0 in regression analysis.

* $p<0.05$

** $p<0.01$