Stress and the SES-Health Gradient: Getting Under the Skin

Jennifer Beam Dowd
Allison E. Aiello
Mary N. Haan

BACKROUND:

While the SES gradient in health is well established in many contexts, the physical mechanisms linking socioeconomic position and health outcomes are poorly understood. With the failure of health behaviors and access to health care to explain the gradient[1] [2], psychosocial stress has emerged as one of the most plausible pathways through which lower socioeconomic position can get "under the skin" and damage an individual's health. It is postulated that individuals of low socioeconomic position are more likely to experience both chronic and acute stressors in their lives, through their physical environment, financial/occupational environment, and their sociocultural environment. Crucial to the story that stress is making poorer people sick is research linking the body's physiological stress response to impaired immune function and other health risk factors**.** Studies of non-human primates have shown that lower status animals often show elevated basal cortisol levels, lower levels of HDL cholesterol, coronary heart disease pathology, and heightened susceptibility to infection, though the relationships with animal rank and risk factors are not straightforward. In humans, it is postulated that the experience of low social status elicits sustained activation of stress-related autonomic and neuroendocrine responses, with chronically elevated levels of cortisol the most commonly mentioned mechanism through which low socioeconomic position damages health.

Recent work attempting to link biomarkers such as cortisol or the broader measure of allostatic load to SES have had mixed results, and there is little consensus on how to measure cortisol effectively in populations, with measures from saliva, urine, and blood often showing low correlations within the same individual.[3] Thus far measures of SES have been inconsistently related to these biological markers, providing little direct evidence that stress explains the relationship between socioeconomic position and health outcomes.[4 5]

A promising alternative to examining neuroendocrine markers such as cortisol in the SES-stress relationship is to measure a more direct indicator of immune system functioning, such as the body's ability to keep latent herpesvirus antibody levels in a quiescent state. Research on the reactivation of herpesviruses is the strongest and most consistent experimental evidence of a relationship between stress and the immune system[6]. Exposure to many herpesviruses is nearly ubiquitous in early life. It is suggested that stress-induced viral reactivation later in life reduces the capacity of the immune system to respond to other challenges, and the latent herpesvirus known as cytomegalovirus (CMV) has been linked to inflammatory processes, cardiovascular and Alzheimer's disease. In this paper, we examine the relationship between socioeconomic position, as measured by education and income, and serum levels of antibodies to latent CMV infection. We will also test the extent to which antibody levels of CMV can account for the relationship between education, income, and cardiovascular disease outcomes in our sample**.**

STUDY POPULATION AND DESIGN:

The sample is a subset (1,554/1,789) of participants in the Sacramento Area Latino Study (SALSA) for whom a fasting blood sample was available. SALSA is a large, ongoing, prospective cohort study of Mexican Americans living in a community who were aged 60 to 100 at baseline.[7] Baseline data collection for SALSA began in 1998 with a two-hour interview at participants' homes. Each year, participants were re-interviewed and information on education, income, medical history and duration and date of diagnoses for 35 health conditions were gathered. Direct clinical evaluations were used to measure blood pressure, weigh/height and waist/hip ratios. Participants also responded to questions regarding the occurrence of cardiovascular events, such as heart attack, chest pains/angina, and congestive heart failure. Last, participants were screened for global cognitive functioning using the modified Mini-Mental State Examination (3MSE) and for episodic memory using a word list-learning test of delayed recall (DEL-REC).

METHODS:

Linear regression models will be used to test the relationship between education, income, baseline CMV antibodies, and health outcomes, controlling for age and sex. Cox-Proportional Hazards models will be used to look at the relationship between baseline education, income, CMV, and the onset of new cardiovascular disease in the follow-up period.

PRELIMINARY RESULTS:

97.0% of the study subjects showed signs of prior infection with CMV, demonstrating the wide prevalence of the virus in the population. Preliminary analysis shows that both

education and income are significantly associated with baseline levels of CMV controlling for age and gender (Figure 1). As previous work has linked CMV antibodies to cardiovascular disease, our next analysis will test whether and how much CMV antibody levels can account for the association between education, income, and cardiovascular disease in our sample, both cross-sectionally at baseline and prospectively in the follow-up period. Our analysis will control for a wide-range of other cardiovascular risk factors such as smoking, cholesterol levels, blood pressure, diabetes, and waist/hip ratio in order to measure the independent role of CMV antibodies in the relationships between education, income, and cardiovascular disease.

DISCUSSION

In this study, we attempt to uncover the stress-related biophysical mechanisms of the SES-health gradient . Pathways that seem plausible in theory from human experimental or other animal studies may not be generalizable at the population level, as the evidence from population-based studies of cortisol has recently suggested. This paper will make an important contribution to this literature by providing the most direct biological test currently available for the hypothesis that psychosocial stress, via stress-induced modulation of the immune system, contributes to socioeconomic inequalities in health outcomes.

Figure 1: CMV and Education

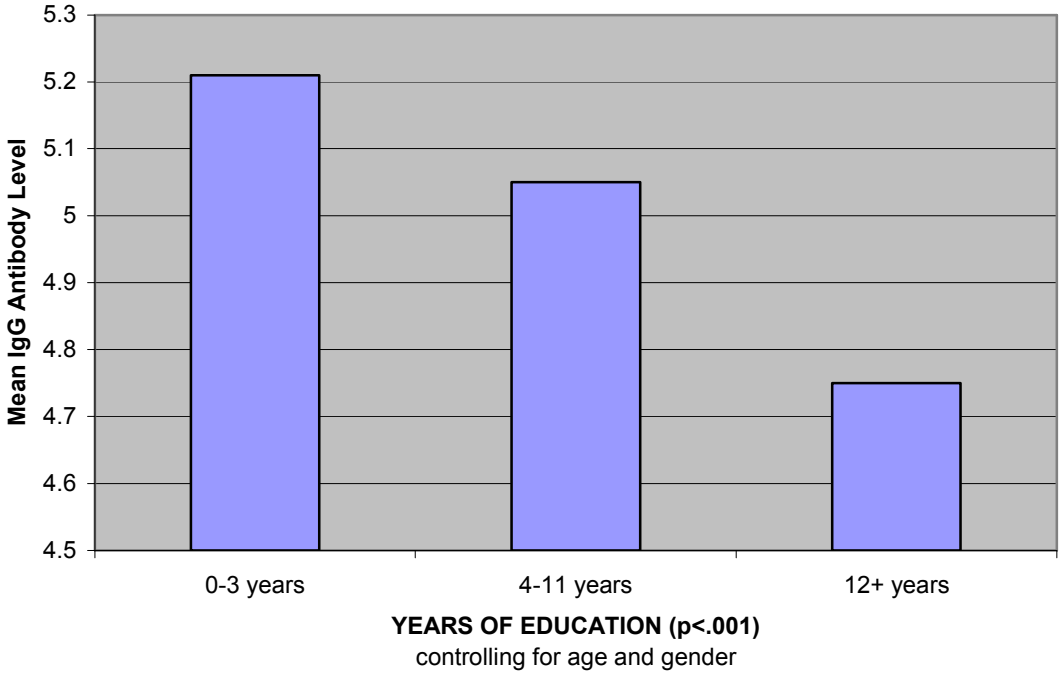
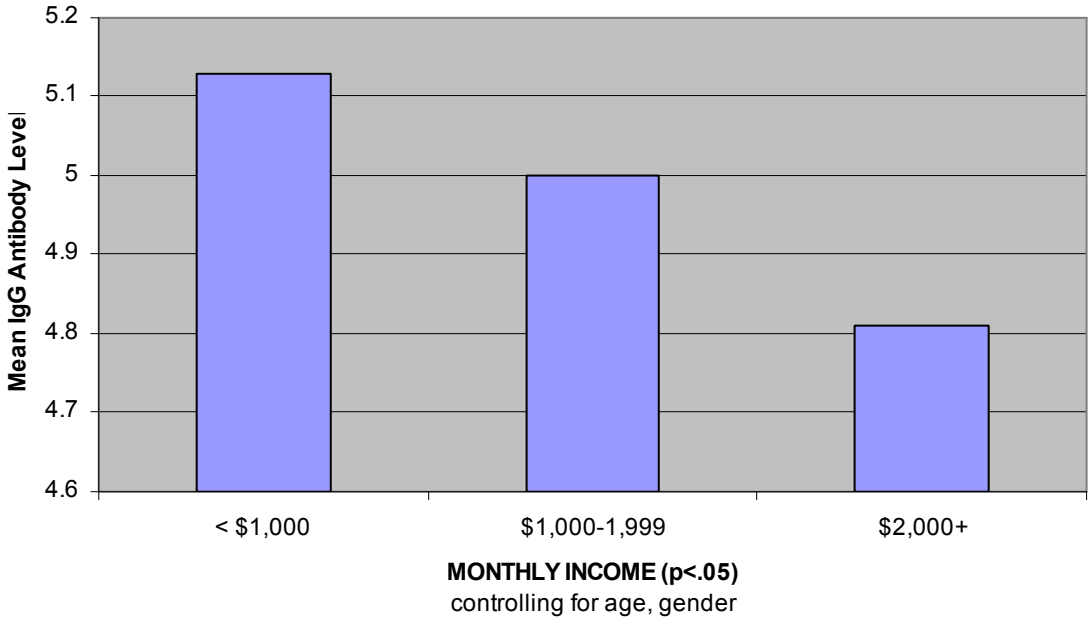


Figure 2: CMV and Income



[1] Adler NE, Boyce WT, Chesney MA, *et al*. Socioeconomic inequalities in health: no easy solution. *JAMA* 1993*;* **269**: 3140-5.

[2] Lantz P, House J, Lepkowski J, *et al*. Socioeconomic factors, health behaviours, and mortality. *JAMA* 1998; **279**: 1703-1708.

[3] Hruschka, DJ, Kohrt BA, Worthman CM. Estimating between-and within-individual variation in cortisol levels using multilevel models. *Psychoneuroendocrinology 2005*: **30**:698-714.

[4] Dowd JB, Goldman N. Do biomarkers of stress mediate the relation between socioeconomic status and health? *JECH* 2006*;* **60**:633-639.

[5] Steptoe A, Kunz-Ebrecht S, Owen N, *et al*. Socioeconomic Status and Stress-RelatedBiological Responses Over the Working Day. *Psychosom Med* 2003; **65**: 461-470.

[6] Herbert TB, Cohen, S. Stress and immunity in humans: a meta-analytic review. *Psychosom Med.* 1993;**55**(4):364-79.

[7] Haan MN, Mungas DM, Gonzalez HM, Ortiz TA, Acharya A, Jagust WJ. Prevalence of dementia in older latinos: the influence of type 2 diabetes mellitus, stroke and genetic factors. *J Am Geriatr Soc.* 2003;**51**(2):169-177.