

Beyond the Gradient

An Integrative Anthropological Perspective
on Social Stratification, Stress, and Health

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The Social Gradient in Health

Socioeconomic deprivation is a fundamental form of adversity that leads to poor health by almost any measure. Indeed, socioeconomic status (SES) is among the most powerful predictors of health, yet it also among the least well understood. The terms *health disparities* (preferred in the US) and *health inequalities* (preferred in the UK) refer to the uneven population distribution of morbidity and mortality, with a particular emphasis on the disproportionate burden of disease endured by particular racial/ethnic groups and those at lower levels of SES. African-Americans, for example, suffer from cardiovascular disease, lung cancer, breast cancer, infant mortality, and total mortality at rates that are two to four times higher than those of other racial/ethnic groups in the United States (Keppel, Percy, and Wagener 2002). Similarly, a consistent socioeconomic gradient has been documented for cardiovascular disease, diabetes, gastrointestinal disease, arthritis, adverse birth outcomes, accidents, and many (but not all) forms of cancer (Adler and Ostrove 1999). For some in the biomedical research establishment, the social gradient in health is “the major unsolved public health problem of the industrialized world” (Marmot et al. 1997: 901).

Despite the fact that race/ethnicity and social class are often conflated (Williams 1999), research has demonstrated that SES alone cannot account for health disparities between ethnic groups and that associations of SES with health are not uniform across such groups (Farmer and Ferraro 2005; Ostrove et al. 2000; Nazroo 1998). It is notable that the social gradient in health has been found in almost every

industrialized population in which it has been studied and is not, therefore, unique to any particular system of health care. In addition, the effects of SES on health are not limited to conditions of poverty; incremental gains in socioeconomic position are associated with positive returns to health across the entire range of SES (Adler and Ostrove 1999).

Although race, class, and health are central concerns of many subfields of anthropology, relatively few anthropologists—with some notable exceptions—have contributed directly to understanding health disparities in the United States. Bioarchaeologists have uncovered the historical origins of health inequalities as a consequence of social stratification following agricultural intensification, sedentarism, and population growth (Armelagos, Brown, and Turner 2005; Cohen 1989). Recent work by human biologists has investigated child growth and nutritional status in the American South (Crooks 1999), the effects of environmental pollutants on growth and development in a Native American population (Schell and Tarbell 1998), and racial/ethnic differences in physical activity and obesity (Gordon-Larsen, Adair, and Popkin 2003). Recently, Dressler, Oths, and Gravlee (2005) have made an explicit attempt to construct a biocultural framework for advancing future research on race, stress, and health.

Recognizing the importance of SES to health, biomedical research typically uses standardized indicators of race/ethnicity and SES as “control” variables that may confound associations between exposures and outcomes of interest, but this approach cannot capture the complexity of important social processes linking SES and health, particularly across diverse cultural (and subcultural) groups. This chapter reviews evidence for the contribution of psychosocial stress to the social gradient in health, and draws on prior anthropological research to 1) demonstrate the value of minimally invasive biomarker methods for measuring health in community-based settings; and 2) highlight the importance of cultural factors in defining social status and its relevance to stress. Conceptual and methodological tools from cross-cultural research are equally useful in the United States and other Western settings, and they may suggest innovative new directions for research on stratification, stress, and health.

Psychosocial Stress and Human Health

There are several mechanisms contributing to the social gradient in health, including differential availability of material and social resources, exposure to noxious substances, access to health care, and negative health behaviors. Conversely, poor health may limit opportunities for economic achievement (Adler et al. 1994; Marmot et al. 1997). However, these factors cannot account for all of the health gradient, leading many scholars to consider psychosocial stress as an important mediator of SES effects on disease risk (Adler and Snibbe 2003; Seeman and Crimmins 2001; Siegrist and Marmot 2004).

What is stress? In the social/behavioral sciences, the term “stress” has been used to indicate adverse environmental circumstances, perceptions of discomfort or burden, reports of mental, behavioral, emotional and physical problems, or clinical and/or physiological assessment of biological outcomes. The vast majority of stress research draws on the early work of Hans Selye (1976), whose “General Adaptation Syndrome” provides an implicit framework for research in the behavioral, biological, and biomedical sciences. Although the terms have changed over the years, and different aspects of the stress process have received varying degrees of attention, the conceptual foundation remains largely the same (Elliott and Eisdorfer 1982; McEwen and Stellar 1993).

From this perspective, the term *stress* describes a process that incorporates the following elements: 1) stressor; 2) response; 3) consequences; and 4) moderators. A *stressor* is an environmental event or situation that disrupts normal functioning and poses an adaptive challenge to the individual. The reaction that follows is a *response*, representing an attempt by the individual to restore homeostasis, or maintain stability around a new baseline (also known as *allostasis*) (Sterling and Ayer 1988). Responses, while adaptive for coping with the immediate challenge, may nonetheless have deleterious *consequences* for an individual’s health, particularly if they are especially severe, frequent, or sustained for a prolonged period of time. *Moderators* include developmental, genetic, or situational factors that contribute to individual differences in the pathways linking stressors, responses, and/or consequences.

Psychosocial stressors initiate the activation of multiple physiological systems, including the sympathetic nervous system (SNS), the sympathetic adrenal medullary system (SAM), and the hypothalamic pituitary adrenocortical (HPA) axis. Epinephrine and norepinephrine (products of SNS and SAM activity), and cortisol (the end product of the HPA axis), are the primary hormonal products of the physiological stress response. It is through these neuroendocrine mechanisms that the adverse effects of stress on health are primarily mediated (Cacioppo et al. 2000; Johnson et al. 1992; McEwen 1998).

Stress represents a major means through which our physical and social environments affect our well-being, with demonstrated impact on mental and physical health throughout the life course. Prolonged or severe exposure to psychosocial stressors increases risk for cardiovascular disease, infectious disease, slowed wound healing, diabetes, impaired growth, poor birth outcomes, and reduced reproductive function (Sapolsky 2004). Recent research has employed the concept of “allostatic load” as a summary measure of dysregulation across multiple physiological axes resulting from stress (McEwen 1998; Seeman et al. 2001). Measures of low socioeconomic status have been associated with increased allostatic load in a number of community-based cohorts, and prospective research has associated baseline allostatic load with increased risk for all-cause mortality, cardiovascular disease, and declines in cognitive and physical function (Evans and English 2002; Seeman et al. 1997, 2001; Karlamangla et al. 2002).

Models and Methods for Research on Stratification, Stress, and Health: A Samoan Case Study

Current research into the contribution of psychosocial stress to health disparities faces two fundamental challenges. First, how do we measure health, particularly when conducting research in diverse cultural and ecological settings? How do we know when someone is “under stress,” and how can we identify individuals at risk for poor health outcomes? Second, how do we derive measures of social status that capture meaningful aspects of everyday experience? In particular, if we expect that stress is a *key pathway linking adversity and health*, then we have to think carefully about how our models represent these psychosocial processes. On both accounts, conceptual and methodological tools from biocultural anthropology may provide some innovative answers.

Methods: Minimally Invasive Tools for Community-Based Health Research

Disciplinary traditions are such that the vast majority of stress research in the social/behavioral sciences features in-depth analysis of psychosocial, economic, and/or cultural processes in diverse populations in conjunction with self-report measures of stress and health. In contrast, biomedical research employs sophisticated assessment of physiology but typically relies on small clinic-based samples and rarely evaluates social contexts beyond standard measures of socioeconomic status or self-reported health behaviors. However, the recent development and application of minimally invasive methods for measuring physiological function in field settings is helping to overcome these obstacles to integrative health research (Ellison 1988; McDade, Williams, and Snodgrass 2007; Worthman and Stallings 1997).

There are a number of well-validated and widely used self-report measures of stress and health (e.g., Cohen, Kessler, and Gordon 1997). These measures are administered through interviews or in writing and are easy to apply to large numbers of research participants with relatively minimal cost and effort. These methods are limited, however, by their potential for recall or reporting bias and by their lack of specificity with respect to revealing clinically relevant outcomes and underlying physiological processes (Panter-Brick et al. 2001). In addition, these methods are subject to the problem of “confounded measures,” where self-reports of stress are significantly correlated with self-reports of physical problems in the absence of underlying pathology (Dohrenwend et al. 1984; Watson and Pennebaker 1989). Lastly, the experience of stress is situated and constructed within specific social, cultural, and political-economic contexts (O’Neil 1986; Young 1980), and gaining access to this experience may be particularly difficult when working across linguistic or cultural settings. In other words, when someone reports being “stressed,” how can we be sure what that really means?

Biological indicators of health surmount many of these obstacles, and a growing number of social scientists are adapting methods from the biomedical sciences

Table 8.1. Measuring Stress: Advantages and Disadvantages of Using Physiological Indicators

Expanding knowledge of stress physiology presents new opportunities for measuring stress at multiple levels, and many studies have employed objective stress biomarkers such as cortisol, catecholamines, blood pressure, and EBV antibodies.

Advantages (in contrast to more common self-report methods)	Disadvantages
1. Objective data on stress that is not vulnerable to recall, reporting, or observer bias, that is valid across populations despite linguistic or cultural differences, and that provides information on individuals for whom self-report data may not be possible (e.g., infants, children).	1. Logistical challenges and ethical issues that increase the costs of data collection—in terms of time, money, and participant burden—that require that biomarkers be implemented only in the service of a well-articulated interdisciplinary research agenda.
2. Access to direct information on the mechanisms linking social and biological phenomena that are causally proximate to important health outcomes, and that can be used to identify individuals most at risk for current or future disease.	2. Epistemological questions regarding the definition of stress: Biomarkers rarely map neatly onto cognitive, self-report measures of perceived stress, leading some to question how they should be interpreted as representing “stress.”
3. Opportunities for measuring physiological function in community—rather than clinical or laboratory—settings that encourage the recruitment of more diverse, representative samples, thereby increasing the generalizability of research findings.	3. Possibility of confounding by factors other than psychosocial stressors, since physiological systems are responsive to a wider range of inputs (e.g., undernutrition, infection, and psychosocial stress, all of which upregulate the HPA axis).

to document the physiological impact of social contexts and processes (National Research Council 2001). A major advantage of these markers is their relative objectivity: Since they are beyond the conscious control of research participants they do not rely on participants' ability to access or recall relevant health information or their willingness to share this information. This may be particularly advantageous for research with children and for research in diverse populations where linguistic or cultural factors may contribute to variation in the perception, experience, and/or reporting of health (Hahn 1995; Kleinman 1986).

An additional advantage is the fact that biomarkers provide direct information on the physiological pathways that link social contexts, stress, and health. For example, biomarkers of cardiovascular function tend to “track” over time, such that an individual’s risk of developing disease compared to his or her peers remains consistent from childhood into adulthood (Berenson et al. 1995; Li et al. 2004). In other words, a child who has relatively high blood pressure early in life will also likely have high blood pressure later in life, even if his or her blood pressure in childhood does not exceed clinically defined thresholds for hypertension. The measurement of biomarkers can therefore provide insight into the predisease pathways that help identify individuals most at risk for the future development of disease.

Of course, requirements for sample collection and processing are major disincentives for implementing biomarkers into population-based health research. Clinical assays of endocrine or immune function typically require significant quantities of serum or plasma, and these samples must be centrifuged, separated, and promptly frozen or assayed to maintain sample integrity. In addition, venipuncture blood sampling, a relatively invasive procedure that requires the skills of a trained medical professional, may be unacceptable in certain cultural contexts and is particularly problematic with children. For these reasons, the vast majority of research on critical aspects of human physiology has been based in clinical or laboratory settings.

Biological anthropologists and human population biologists have long-standing interests in documenting the contributions of social, cultural, and ecological contexts to human biological variation (Stinson et al. 2000). To this end, methodological innovation has been central to the discipline as we seek to develop and implement tools that allow us to investigate human physiology and health in diverse populations around the world. These populations are often remote, and in many cases access to basic laboratory facilities, or even electricity, is limited.

Anthropometric measures of nutritional status (e.g., height, weight, body composition) have been, and continue to be, powerful tools for documenting the adverse short- and long-term effects of impoverished environments (Bielicki 1986; Bogin 1999). These measures are relatively easy to obtain in community-based research and are sensitive indicators of individual as well as population health (WHO 1995). More recently, anthropologists have turned their attention to investigating the direct physiological consequences of social contexts and to linking these contexts to health outcomes through specific physiological mechanisms (Panter-Brick 1998; Panter-Brick and Worthman 1999).

Much of this work has focused on physiological responses to stress. Saliva and urine are relatively easy to collect in field settings and can provide information on HPA and SAM axis activity, as well as measures of reproductive function, that have been linked to stressors across a wide range of cultural and ecological settings (Brown 1981; Ellison et al. 1993; Flinn and England 1995; Hanna, James, and Martz 1986; Pollard, Ungpakorn, and Harrison 1992). Unfortunately, the number of factors that can be measured in saliva or urine is limited since most analytes do not enter these

solutions from general circulation in a measurable form. As such, for many research questions, blood samples are still a necessity.

The relatively recent application of dried blood spot samples to population-based health research provides a viable option for circumventing limitations associated with collecting blood through venipuncture (McDade et al. 2007; Mei et al. 2001; Worthman and Stallings 1997). A sterile, disposable micro-lancet is applied to the participant's finger to stimulate capillary blood flow, and one to five drops of whole blood (about 50 μL each) are collected on standardized filter paper (Whatman #903) that is designed to diffuse and dry blood at a constant, uniform rate. Samples dry at room temperature for at least four hours and are then stacked and stored until analysis in the laboratory. The paper matrix stabilizes the sample, preserving its contents for an extended period of time (Figure 8.1).

The collection of whole blood on filter paper has several advantages over venipuncture that make it ideal for field-based research, namely: 1) collection is relatively painless and noninvasive; 2) samples do not need to be centrifuged, separated, or immediately frozen following collection (blood spots for most analytes are stable at ambient temperatures for up to two weeks and often longer); 3) samples are easily stored and transported; and 4) multiple assays can be performed from a single 50- μL drop of blood. Dried blood spots have been used to assay a growing number of analytes, including markers of infectious disease, stress, immune function, iron deficiency, metabolic activity, and reproductive function. They have been successfully collected in a wide range of cultural and ecological settings, including lowland Bolivia, Papua New Guinea, the Philippines, Kenya, Samoa, Nepal, and the United States.



Figure 8.1. Exemple of Blood spot collection



A primary advantage of dried blood spots is that they make feasible the collection of blood samples from large numbers of people in their homes or other local settings. This is a major boon to community-based research on adversity and health. It is now possible to combine rich measurement of social and cultural contexts with high-quality, objective physiological information to gain a better understanding of how social contexts “get under the skin” to shape health. By adapting clinical methods to field-based settings, we can draw larger, more diverse, representative samples that increase the generalizability of research findings and that may help us identify subgroups of individuals, or subsets of environments, that merit special attention. For these reasons, a number of large US-based health surveys (e.g., the National Longitudinal Study of Adolescent Health, the Health and Retirement Study) have recently incorporated the collection of biomarkers to complement their panel of psychosocial and demographic measures.

Models: Linking Stratification, Stress, and Health

Current health disparities research typically applies measures of income, education, and/or occupation as indicators of an individual's social position, and enters these measures into statistical models as simple linear predictors of various health outcomes (continuous variables are on occasion categorized to consider nonlinear or threshold effects). While this gradient approach has consistently demonstrated that SES is among the strongest predictors of health, its explanatory power is limited, and it fails to capture the more proximate processes linking stratification, stress, and health. For these reasons there is growing recognition of the need for additional, more meaningful measures and models of social status and health (Dressler and Bindon 2000; Kaplan 1996; Ostrove et al. 2000; Nazroo 1998; Krieger, Williams and Moss 1997).

A welcome innovation is the recent development of a subjective SES measure, in which individuals are presented with a drawing of a ladder and asked to mark the rung that corresponds to their position in society (Adler et al. 2000). Subjective SES is moderately correlated with objective SES measures and is an independent predictor of a number of health-related variables (Adler et al. 2000; Ostrove et al. 2000). While the ladder moves beyond income/education/occupation to tap directly into the personal, perceived experience that may mediate associations among SES and health, it continues to work within the classic gradient framework that expects direct, linear associations with health.

Culture is a foundational concept for anthropology, and although it has been repeatedly contested within the discipline, few anthropologists would deny that it is a defining attribute of the human species that provides a framework for meeting subsistence and other material needs, structuring social and economic relations, and creating systems of meaning that motivate behaviors and beliefs. Just as we investigate how cultural and ecological factors contribute to human biological variation, we recognize that these factors shape variation in individual psychosocial experience. In particular, the significance of specific social status markers—and their relevance to

stress and health—will vary across time and space. It is therefore critical that we develop models of social status and stress that are informed by the cultural and political-economic contexts within which they operate.

In this section I discuss my attempt to do just that in a study of adolescent stress in Samoa. The islands of Samoa have served as an important testing ground for evaluating the relationships among culture change, stress, and health (e.g., Baker 1986; Bindon 1997; James et al. 1987; McGarvey and Baker 1979; Pearson, James, and Brown 1993). Historically, Samoans have lived primarily in small seaside villages, surrounded by extended family and engaging in subsistence cultivation of family-owned lands, with some cash-cropping of copra and cocoa (Mead 1928; Shore 1982).

Increasingly, Samoans are taking advantage of new opportunities for employment, commerce, and education as Western institutions and lifestyles become an increasingly visible part of the islands. More children are attending Western-style schools for longer periods of time, consumer goods and services are increasingly available and desired, and sons and daughters are frequently traveling to American Samoa, New Zealand, and Hawaii for education or to earn money to send back to the family (Macpherson 1994; Mageo 1988; O'Meara 1990). But despite these intrusions, Samoans have managed to maintain a strong cultural identity that values the *fa'aSamoa*, or the "Samoan way."

These shifting cultural and economic environments make Samoa an ideal location to investigate the adaptive challenges and opportunities associated with globalization, and a major research effort launched in the 1970s by Baker and colleagues (Baker, Hanna, and Baker 1986) established this as an important area of inquiry in biological anthropology. It was in this tradition that I sought to investigate social status and adolescent stress in the context of cultural transitions in Samoa. A recent suicide epidemic among adolescents and young adults—with rates two to four times higher than in the United States—lends a certain urgency to understanding the underlying causes of psychosocial stress in Samoa, and suggests an uneasy interface between the *fa'aSamoa* and encroaching Western lifestyles (Bowles 1985; McDade 2002).

The study included 352 individuals between the ages of 10 and 20 recruited from nine villages and five neighborhoods, representing the full range of articulation with Western lifestyles in Samoa. Each participant was interviewed to gather demographic and psychosocial information, followed by the collection of standard anthropometric measurements and a finger prick blood spot sample for subsequent biomarker analysis (McDade, Stallings, and Worthman 2000).

I measured antibodies against the Epstein-Barr virus (EBV) in blood spot samples as a biomarker of chronic psychosocial stress (McDade et al. 2000). A ubiquitous herpes virus, EBV takes up residence permanently following infection, and cell-mediated immune processes are primarily responsible for maintaining the virus in a latent state (Henle and Henle 1982). Stress-induced immunosuppression allows EBV to reactivate and release viral antigens into circulation, to which a second-tier, humoral antibody response may emerge (Glaser et al. 1991). As a result, levels of antibodies

against EBV antigens provide an indirect measure of an aspect of cell-mediated immune function, such that increased EBV antibody titers indicate lower cell-mediated immunity (Glaser 1987; 1993).

Psychoneuroimmunologists have demonstrated the utility of the EBV antibody model in cross-sectional as well as prospective studies. Increased antibody titers have been associated with a wide range of naturalistic stressors, including negative life events, academic stress, strained social relationships, and emotional distress (Esterling et al. 1992, 1993; Glaser et al. 1993; Kiecolt-Glaser et al. 1987, 1987, 1988; Lutgendorf et al. 1994; McDade et al. 2000; McDade 2001, 2002, 2003). Furthermore, in comparison with other measures of immunity, meta-analysis has identified EBV antibodies as among the strongest and most consistent correlates of chronic stress (Herbert and Cohen 1993).

Since the duration of time elapsing between a stressor and EBV antibody response is on the order of days or weeks, EBV antibody levels are not subject to short-term fluctuation, acute context effects, or diurnal variation, and a single sample can thus be used as an immunological measure of chronic stress. This is an advantage over other stress biomarkers, which require multiple samples or are sensitive to the time of day or circumstances under which they are collected. And, as mentioned, using a physiological indicator of chronic stress surmounts many of the shortcomings associated with self-reports. A shortcoming of this method is that results may be confounded by nutritional status or the presence of infection, both of which were controlled for in all analyses with objective measures (McDade et al. 2000).

The gradient, part I: Is household SES related to stress?

According to the gradient approach to health disparities, low socioeconomic status should be associated with higher burdens of stress. The challenge in the Samoan case is to derive a meaningful household-level measure of socioeconomic resources. A household-level measure is particularly appropriate in this case since children and adolescents have yet to complete their schooling and establish households independent of their parents. Furthermore, in Samoa, one's social status is intimately tied to that of the family, and children and adolescents are expected to serve their elders and contribute to the household economy (O'Meara 1990; Shore 1982).

Since information on household income was not directly available, each household's socioeconomic position was estimated by the occupational rank of the father and mother as follows: 1=planter/housewife (no cash income); 2=unskilled wage labor (domestic help, factory work, security, etc.); 3=skilled labor/professional (teacher, government employee, engineer, etc.) (McDade 2001). The relatively low number of individuals with wage-earning jobs (35.9 percent) precluded a finer level of distinction. In addition, remittances from relatives working overseas make important contributions to the Samoan economy (O'Meara 1990), and information was collected on the number of family members regularly sending money home. A summary score of household socioeconomic status was obtained by summing the remittances sent

home by wage earners, mother's occupational rank, and father's occupational rank (mean SES=4.1, range 2–9).

Figure 8.2 presents the association between socioeconomic status and EBV antibody level. A linear effect is evident, in which lower economic status is associated with higher EBV antibody level, indicating reduced cell-mediated immune function and—according to the EBV model—a higher burden of psychosocial stress. This result is consistent with prior work using the gradient approach, but the effect of economic status is small and of marginal statistical significance.

The gradient, part II: Is *matai* absence a source of stress?

An alternative approach is to use a locally defined, historically significant marker of social status specific to the Samoan cultural context. One might expect such a marker to be more meaningful for the everyday lives of Samoan adolescents, and therefore be a stronger predictor of stress. The logic behind this ethnographically informed gradient approach is similar to that of recent work by Dressler and colleagues that uses “cultural consonance” as a tool for assessing the degree to which individuals conform to locally defined cultural models for a “successful” lifestyle (Dressler and Bindon 2000).

The *matai* system of village political organization is a central feature of the *fā'a Samoa* (O'Meara 1990; Shore 1982). Extended families each elect by consensus a *matai* to represent them at the council of chiefs (*fono*) and to exert authority over the family land, property, and labor. The council of chiefs meets frequently to act as

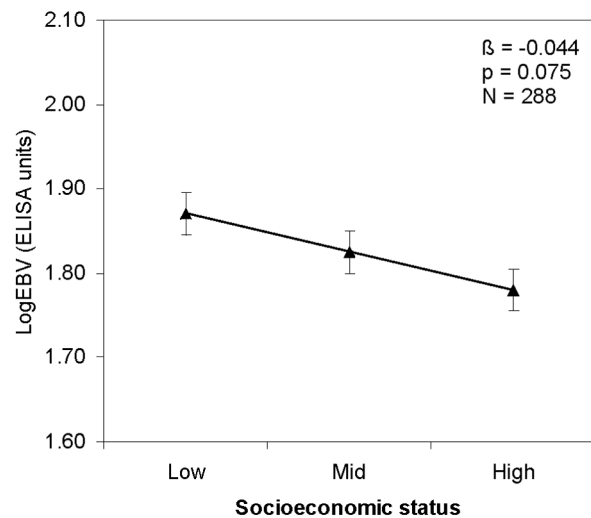


Figure 8.2. Association between household economic status (tertiles, based on parental occupation) and log-transformed EBV antibody level (mean \pm SE) in Samoan adolescents (10 to 20 years), controlling for age, sex, region of residence, BMI, and current infection.

the legislative, executive, and judicial bodies of local governance (Shore 1982). While the *matai* system is currently in flux and chiefs increasingly face emerging sources of power that circumvent the *matai* system, considerable honor and respect continue to be conferred upon individuals who possess a *matai* title in all regions of Samoa (O'Meara 1990; Shore 1996). Members of their household also command a certain respect in daily life, and achieve significant social standing due to their affiliation with a *matai*.

This raises the question as to whether *matai* presence may be an important local marker of social status that is related to adolescent stress. In this study, 47 percent of the adolescents lived in households with a *matai* titleholder present. Not surprisingly, *matai* households scored significantly higher on the SES scale than non-*matai* households (N=157 and 172, respectively; 4.3 vs. 3.8, $p < 0.01$). Regardless of whether SES is controlled for in a regression model, adolescents from *matai* and non-*matai* households have virtually identical EBV antibody levels, suggesting that *matai* status is not related to adolescent stress in Samoa. This was the case across all regions and all age groups, and for boys as well as for girls.

The gradient, part III: Is familiarity with Western lifestyles related to stress?

A weak association between SES and stress, and a lack of association between *matai* absence and stress, may reveal limitations of the gradient approach to understanding adolescent stress in Samoa, or it may indicate that these are not meaningful markers of social status for adolescents in this cultural context. In observing and interacting with youth in Samoa, it is striking the degree to which many are attracted to aspects of Western lifestyles: Western-style media (English-language newspapers, radio, television programming) are ubiquitous, older kids travel more frequently to American Samoa, New Zealand, and Hawaii for education, to visit family, or to earn money for remittance to the family (Macpherson 1994; O'Meara 1990). A trip to McDonald's (recently opened in the capital city Apia) is considered a major treat, and it is not unusual to see school uniforms with the Nike "swoosh" drawn on the sleeve with permanent marker. According to a mother in Apia, children in Samoa now "grow up in a least developed economy where nearly every family has a car, TV, video, and better meals, unlike the past. . . . So children do not realize what it was like to try and make ends met. They are too materialistic, want more sophistications, and what-nots" (McDade 2002).

Similar themes are echoed in the work of Sia Figiel (1996), a Samoan author whose fictional account of coming of age in a contemporary Samoan village reinforces the social significance of Western lifestyles and material goods. For example, Alofa, the adolescent narrator reflects:

Two coloured TVs. Mu's family had two coloured TVs—one on the first floor of the fale, and the other on the second floor in Pola and Lalogi's room—and all the kids and some adults went there to watch Little House on the Prairie, Charlie's Angels, and Dallas.

Plus a video machine, too. . .with Rambo, and Mickey Mouse, and men and women without clothes...

Yes, we were envious of Mu and tried desperately by association to be her friend. If not that, then just to be seen with her, to sleep over at her house... (pp. 26–27).

In an effort to explore familiarity with Western lifestyles as a potentially important source of social status for Samoan adolescents, I asked participants a series of questions regarding their exposure to and engagement with nontraditional lifestyles through travel outside Samoa, siblings living overseas, frequency of television viewing, and friendships with Westerners. Responses were scored and summarized such that a higher score indicates a higher level of familiarity. Items for this scale were chosen based on my own observations while conducting fieldwork as well as prior work investigating the impact of cultural transitions on health in Samoa (James et al. 1987; McDade 2002). The average score for the sample was 3.6, ranging from 0 to 9.

As with *matāi* status, an adolescent's westernization experience was positively associated with household SES (Pearson $R=0.28$, $p<0.001$). When considered as a predictor of EBV antibody level, a nonlinear association emerged such that adolescents with mid levels of westernization experience had the lowest levels of EBV antibodies, and levels were elevated for those with low, as well as high, levels of familiarity with Western lifestyles (Figure 8.3). While previous work has reported nonlinear asso-

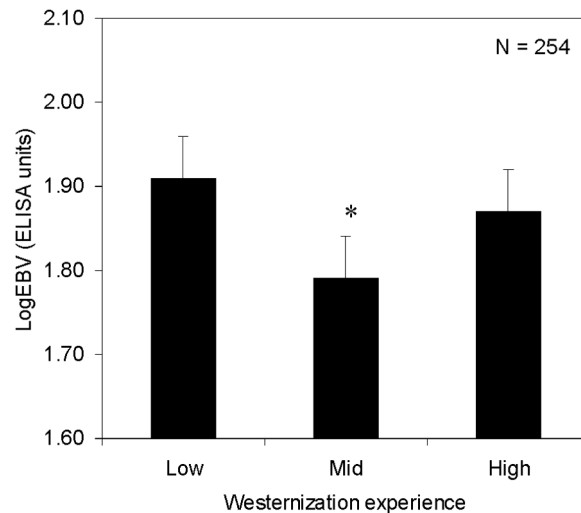


Figure 8.3. Association between westernization experience (tertiles) and EBV antibody level in Samoan adolescents, controlling for age, sex, region, BMI, current infection, and SES.

* indicates $p<0.05$ for contrast between Low and Mid levels of westernization experience.

ciations between measures of acculturation and stress (e.g., Brown 1982), these results are inconsistent with a dose-response, gradient model of stratification and stress. They suggest that low as well as high levels of engagement with Western lifestyles are sources of stress, and point toward a more complicated set of dynamics linking social status and health.

Beyond the gradient in Samoa: Models of status incongruity.

The analyses to date have provided some insight into sources of stress for Samoan adolescents, but they are ultimately unsatisfying in that I feel that they fail to capture important aspects of adolescents' lives. The gradient approach assumes that individual markers of social status are related to health in an additive fashion, but my observations of youth in Samoa suggest a more complicated set of social dynamics. It is clear that in the context of globalization and local cultural diversification, new markers of social status have begun to emerge in Samoa and that tensions and uncertainties associated with reconciling multiple status markers can be an important source of stress. I have therefore drawn on the concept of status inconsistency in an attempt to model interaction across multiple dimensions of social position.

Models of status inconsistency assume that an individual derives his or her social status from multiple sources to advertise a certain style of life or social worth. Consistency across these domains leads to the projection of a coherent social identity, but inconsistency can lead to ambiguity and tension in everyday social encounters, resulting in psychosocial stress (Dressler 1988; Hope 1975; Hornung 1977). Dressler and colleagues have seized on this concept to develop models of "lifestyle incongruity" that have been linked to elevated blood pressure in adults in a wide range of cultural settings (Bindon et al. 1997; Chin-Hong and McGarvey 1996; Dressler 1990; Dressler et al. 1987, 1987).

In defining a status inconsistency model, the challenge is to identify meaningful markers of social standing in a given sociocultural context and to operationalize them in such a way as to make it possible to relate them quantitatively to outcome measures of stress (Hartman 1974). For youth in Samoa, I hypothesized that the presence or absence of a *matai* titleholder in the household, and an adolescent's level of familiarity with Western lifestyles, were two significant social status markers. I constructed a measure of status incongruity by assigning adolescents into "low Western" or "high Western" groups based on their score on the westernization experience scale, and then defining individuals as incongruent (*matai* titleholder in the household, but low westernization status; no *matai* and high westernization status) or congruent (*matai* and high Western; no *matai* and low Western). Summary social status variable was also constructed to control for the direct effects of *matai* status and westernization experience on stress, thereby allowing the status incongruity measure to represent an independent discrepancy effect (Whitt 1983).

Note that in contrast to the gradient models evaluated above, in this formulation social status itself is not assumed to be associated with stress; rather, it is the social

and/or psychological *dissonance* associated with being high on one status dimension but low on another that results in stress. The model does not assume an additive association between status and stress, and it explicitly tests for interactive, nonadditive effects across two dimensions of social position. As such, this approach provides a more dynamic measure of individual experience that may be particularly useful for capturing the struggles facing adolescents in the context of cultural transition.

It is important to point out that this model is an intentional simplification of a complex set of social processes in Samoa. Binary categorizations discount dynamic and shifting sets of relationships and local meanings that define the *matai* system, as well as the emerging importance of Western lifestyles. However, “thick description” is beyond the scope of this analysis, and a certain degree of informed reductionism is necessary in order to analyze aspects of the sociocultural environment as predictors of stress in a quantitative framework.

Overall, I found a significant effect of status incongruity on EBV antibody level, with the association most pronounced for adolescents living in Apia: adolescents in situations of incongruence had significantly higher EBV antibody levels than congruent individuals, indicating lower cell-mediated immune function and higher psychosocial stress (Figure 8.4). The summary measure of social status was not significantly related to EBV antibody level (McDade 2002).

These findings suggest that for the youth of Samoa, discrepancy in two meaningful dimensions of social status—one old (the presence of a *matai* title in the house-

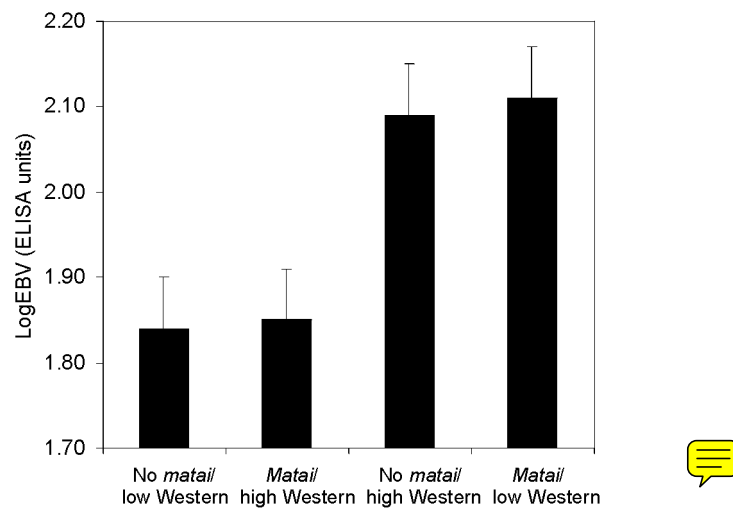


Figure 8.4. Association between status incongruity and EBV antibody level in the capital city of Apia, Samoa, controlling for age, sex, region, BMI, current infection, and overall social status. (Redrawn from McDade 2002.) Situations of status incongruity are indicated in boldface.

hold) and one relatively new (familiarity with western lifestyles through siblings, friends, travel, and television)—is a significant source of stress. It is worth noting that the direction of incongruity made no difference: adolescents with a *matai* present and low westernization experience, and those with high westernization experience but no *matai*, had virtually identical EBV antibody levels. This pattern supports the assumption that incongruity itself is a source of stress, perhaps through everyday interactions that challenge one's self-image or one's claim to a certain standing within the community.

These results are difficult to explain in terms of access to economic resources. As noted above, both *matai* presence and westernization experience are positively associated with household economic status in Samoa. If economic resources were driving the association between status incongruity and stress, then one would expect the lowest EBV antibody levels in the *matai* present/high Western group, and the highest levels in the *matai* absent/low Western group. However, these groups both had low, and virtually identical EBV antibody levels, further underscoring the importance of interactive—rather than directly additive—effects of social status on stress.

Independently, *matai* presence/absence and familiarity with Western lifestyles provide little insight into the contribution of social status to adolescent stress in Samoa. However, in interaction a more complicated picture emerges, suggesting that new and old markers of social status are becoming inextricably linked as adolescents attempt to negotiate a shifting sociocultural landscape (McDade 2002). Are analogous processes at work in the United States and other Western societies struggling with the problem of health disparities?

Beyond the Gradient in the United States: Socioeconomic Status, Skin Color, and Blood Pressure among African-Americans

Results from Samoa suggest that we should think more creatively about how to define and model social status, and also that we consider moving past income, education, and occupation as our primary indicators of social position. Recent work in the United States underscores the point that the meaning of social status measures varies across context: in a large multiethnic sample of American women, occupational rank was the strongest predictor of self-rated health for Latinas (Pearson $R=0.46$), while subjective SES (the “ladder” measure discussed above) was most important for Caucasians ($R=0.37$). Among African-American women, subjective SES was relatively unimportant, while their partner's occupational status was the strongest predictor of health ($R=0.43$) (Ostrove et al. 2000).

In the United States, the rate of essential hypertension (systolic/diastolic blood pressure above 140/90 mmHg) is nearly double in African-Americans compared to European Americans (American Heart Association 2004). This disparity in hypertension is the single most important contributor to racial/ethnic differences in all-cause mortality in the US (Wong et al. 2002). Because African-Americans are overrepre-

sented in lower strata of SES, concentrated disadvantage may account in large part for this disparity (Williams 1999). However, in many studies racial differences in health remain even after accounting for population differences in SES, and others point to the fallacy of “controlling for” SES when race is itself a major determinant of economic opportunity (Cooper and David 1986). In addition, recent research has demonstrated that the effects of SES on health may not be uniform across racial groups: for European Americans there is a strong gradient in self-reported health associated with SES, whereas for African-Americans a pattern of diminishing returns is evident such that economic success does not provide the same level of benefits to health (Farmer and Ferraro 2005). These results emphasize the complexity of interactions among race and class in our society, and suggest that we consider additional markers of social experience.

Skin color may represent just such a marker. Among African-American and other African Diaspora populations, darker skin has been associated with higher average blood pressure, fueling speculation that skin color provides a measure of African admixture that can serve as a proxy for underlying genetic predispositions toward high blood pressure (Boyle 1970; Harburg et al. 1978). However, these associations are rarely straightforward and are often modified by socioeconomic status (Gravlee and Dressler 2005; Krieger and Sidney 1998). In addition, skin color is a poor proxy for proportional genetic ancestry in multiracial societies (Parra et al. 2003; Parra, Kittles, and Shrivvers 2004), and genetic factors cannot explain population-level differences in hypertension (Cooper, Kaufman, and Ward 2003; Madrigal et al., this volume).

More promising is a consideration of skin color as a social variable; an attribute that may be particularly salient in a color-conscious society with a history of oppression and discrimination directed at individuals of African descent. Prior work has revealed that African-Americans with darker skin have lower average incomes and less prestigious occupations than those with lighter skin (Hill 2000; Hughes and Hertel 1990). Darker skin has also been associated with reports of discrimination, although this relationship may be mediated by gender and class (Krieger and Sidney 1998). Recent anthropological research in the United States, Brazil, and Puerto Rico has highlighted the complex dynamics linking skin color, SES, and health (Dressler 1991; Gravlee and Dressler 2005).

We sought to investigate skin color in interaction with SES as a predictor of blood pressure in self-identified African-Americans, using existing data in an ongoing, longitudinal study of cardiovascular disease in young adults (Sweet et al., 2007). The Coronary Artery Risk Development in Young Adults study (CARDIA) collected traditional measures of income, educational attainment, and occupation and measured skin reflectance as an objective indicator of skin color (Friedman et al. 1988). We found evidence for a significant interaction between skin color and income in predicting systolic blood pressure (Figure 8.5). For African-Americans with relatively light skin, there is a strong negative association between income and blood pressure, a result that is consistent with prior work documenting the social gradient in health. In

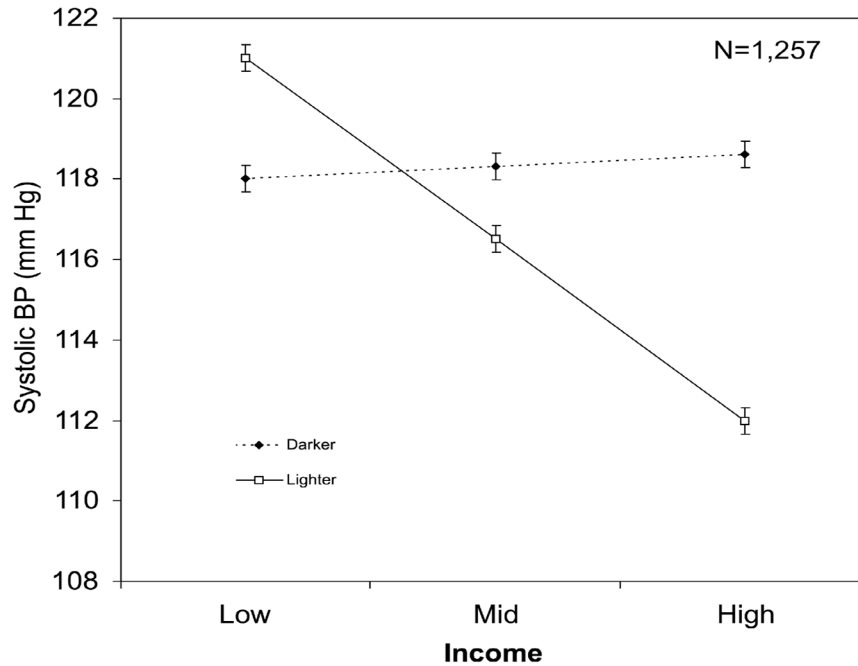


Figure 8.5. Interaction between skin color and income in predicting systolic blood pressure in African-Americans in the United States (age 33 to 45 years), controlling for age, sex, BMI, smoking, and use of anti-hypertensive medication. (Redrawn from Sweet et al., under review.)



contrast, for individuals with darker skin, we found no pay-off associated with higher income: rather than the expected decline in blood pressure with higher income, there is, in fact, a slight increase. The difference in adjusted blood pressure between individuals with darker and lighter skin is greatest at high incomes, and at low incomes, lighter skin color is associated with higher blood pressure.

It is difficult to interpret these results within a simple genetic framework, and the evaluation of skin color as a moderator of the association between income and blood pressure reveals considerable heterogeneity within the African-American population. For those with lighter skin, lower economic resources may be a significant source of chronic stress, in agreement with previous work highlighting the contribution of stress to the social gradient in health (Adler and Snibbe 2003; Seeman and Crimmins 2001; Siegrist and Marmot 2004).

Why, then, are increases in income not associated with lower blood pressure for those with darker skin? If skin color and income are both socially meaningful dimensions of status for African-Americans, then perhaps inconsistency across these dimensions may result in stress, analogous to the Samoan situation. African-Americans with

relatively higher incomes and darker skin may be in just such a position. Dressler (1991) has reported comparable results in the US and Brazil, and suggests that darker skin may serve as a criterion of social exclusion that limits access to the privileges and opportunities that are otherwise afforded individuals with substantial economic resources. Such individuals may have had to overcome more barriers on the path to economic success than those with lighter skin, and they may be exposed to more daily experiences of discrimination in a social world dominated by whites.

The point here is not to refocus all our efforts on skin color but, rather, to suggest that there are additional cues to social status that merit consideration and, moreover, that these cues may be uniquely salient in particular cultural and political economic settings. To the extent that we can think more critically about how to measure and model markers of social status in ways that capture meaningful experiences of individuals in their everyday lives, we will be more successful in teasing out the complex pathways that link social stratification, stress, and health.

Conclusions

Socioeconomic status is a major—if not *the* major—determinant of health, but only recently has the problem of health disparities gained the attention of policy makers and public health researchers in Western nations. Anthropologists have played central roles in uncovering the historical origins of health inequalities and in documenting the impact of adversity in diverse cultural and ecological settings around the world. Relatively few, however, have contributed to current debates regarding pathways linking social stratification and health. This is unfortunate, since conceptual and methodological tools from anthropology are particularly well suited for a more multidimensional, integrative approach to this complex problem.

The vast majority of what we know about human physiology and health is based on research with animal models or samples drawn from affluent Western populations. In an explicit effort to complement this work, and to explore the full range of human phenotypic variation, biological anthropologists often collect biological data in remote settings that are beyond the reach of basic laboratory or clinical facilities. This has encouraged considerable methodological innovation, and minimally invasive methods for community-based research now present exciting new opportunities for integrative research on health, risk, and adversity. Recent developments in immunoassay technology will continue to expand the range of analytes that can be quantified in small volumes of whole blood and saliva, and will further enrich our understanding of how social, cultural, and ecological variation shapes human physiological function and health.

Biomarkers are typically conceptualized within an epidemiological framework as physiological endpoints that identify individuals at risk for current or future disease. However, biomarkers can also offer insights into hidden sociocultural dynamics as well as access to experiences that cannot be readily observed or communicated. This

is evident in the results from Samoa, where EBV antibody levels pointed toward inconsistency between old and new dimensions of social status as significant sources of stress in adolescence. This unanticipated result highlights the utility of biomarkers as ethnographic tools that can reveal meaningful aspects of individual psychosocial experience that warrant further investigation. Biomarkers certainly do not represent the final word on these issues, nor do they represent a higher standard of evidence; but they provide a novel way to overcome barriers in communication, observation, and interpretation that may lead to new insights into the complex associations among social contexts, stress, and health. Our analyses of blood pressure in relation to skin color and income among African-Americans suggest productive directions for further research along these lines.

Links between psychosocial stress and morbidity and mortality are well established, but the proportional contribution to explaining the social gradient in health remains to be determined. A major challenge here is to develop constructs that successfully capture meaningful aspects of everyday experience and that can be modeled within a quantitative statistical framework. A large body of research clearly demonstrates that SES matters to health, but we have yet to capture the complexity of this relationship, particularly as it relates to psychosocial stress. Individuals are socialized into, and help construct, shared cultural environments that define the experience of stress as well as the meaning of social status. Ethnography, social theory, and methods for locating individuals with respect to cultural processes will be essential if we are to move beyond the gradient approach and push health disparities research in innovative new directions (Dressler 1995; Dressler et al. 2005).

An additional challenge to integrative research on stratification, stress, and health derives from the fact that the majority of current research occurs within distinct disciplinary traditions—traditions that, for example, measure mental but not physical health (or vice versa), that consider the effects of stress on health behaviors but not on physiology, or that focus exclusively on a single physiological system (e.g., the HPA axis but not cardiovascular function). If we are to understand the overall impact of psychosocial stress on population health, then future studies need to consider a more comprehensive range of outcomes and the possibility of interactions across physiological systems.

Similarly, we should consider expanding our models of stress to include psychosocial as well as material stressors. Physiological systems integrate information across a number of environmental inputs, making it difficult to isolate the unique effects of psychosocial factors. For example, cortisol plays a critical metabolic role in mobilizing energetic resources, and concentrations of cortisol increase in response to undernutrition and infection as well as to exposure to a psychosocial stressor (Sapolsky 2004). Most stress research avoids this issue by conceptualizing material stressors as nuisance factors that need to be controlled by focusing exclusively on healthy individuals.

This approach, however, misses an opportunity to consider the effects of exposure to stressors across multiple domains. There is no a priori reason why population-level

analyses cannot model the simultaneous effects of multiple *material* as well as *psychosocial* stressors on human physiology. The nature of interaction across these domains then becomes an interesting empirical question. For example, does undernutrition obscure the immunosuppressive effects of psychosocial stress, or are their joint effects additive or multiplicative? While this complicates efforts to identify specific causal pathways, it better reflects the ecology of human experience, with implications for understanding health at the level of the individual and population (McDade 2005).

Lastly, we should be wary of approaches to investigating the contribution of psychosocial stress to health disparities that privilege cognitive appraisal and/or self-reported measures of stress. An exclusive focus on perception may divert attention from the broader material, cultural, and political-economic factors that structure the subjective experience of stress, and it runs the risk of blaming the victim for perceiving these factors as stressful (Lynch et al. 2000; Young 1980). Biomarker measures of stress sidestep some of these issues, as does the development of theoretically and ethnographically informed models that operationalize stressful circumstances independently of subjective appraisal. This is an exciting time for integrative approaches to stratification, stress, and health, and anthropology is well positioned to contribute theoretical and methodological expertise that promotes innovative directions for future research.

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