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Allostatic load in an environmental riskscape: The role of stressors and gender

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ABSTRACT

Stressors are theorized to be associated with higher allostatic load (AL), a concept of physiological wear measured as a composite of physical biomarkers. Risk of high AL may vary by gender and may be intensified in places with significant environmental risks, otherwise known as 'environmental riskscapes'. Yet, no study has examined the relationship between stressors, gender, and allostatic load in an environmental riskscape. Using primary data collected in a sample ($N=1072$) exposed to various environmental and social stressors, we find that long-term residence in Texas City (30 or more years), residential proximity to petrochemical plants, perceived poor neighborhood conditions, and daily hassles are associated with higher allostatic load components. Variation in AL differs by gender and the types of biomarkers examined. Gender moderates the effect of length of residence in Texas City on cardiovascular health risk. We discuss our findings in light of current research on stressors, gender, allostatic load, and double jeopardy within environmental riskscapes.

1. Introduction

Conceptually, allostatic load (AL) refers to the body's ability to adjust physiologically to stressors. Operationalized as a measure of physiological homeostasis (Sterling and Eyer, 1988), AL is measured through a diverse set of biomarkers collected from blood, saliva, and other clinical means that reflect cardiovascular, metabolic, inflammatory, neuroendocrine, and immune-related risk (McEwen, 1998; McEwen and Seeman, 1999; Seeman et al., 2001). As the body adapts to its environment, it undergoes "wear and tear" that can accumulate, leading to systemic dysregulation manifested as higher AL (Dowd et al., 2009; Ganzel et al., 2010; Glei et al., 2007; Seeman et al., 1997). Although women report more stressors and higher perceived stress, no study has examined the relationship between stressors, gender, and AL. Further, we know little about how stressors and gender shape AL within an environmental riskscape—such as an area with substantial environmental health risks or poor neighborhood conditions (Morello-Frosch and Shenassa, 2006; Simandan, 2010). Thus, this study is one of the first to assess the relationship between stressors, gender, and AL in the context of an environmental riskscape. After describing further context for the study, methods, and findings, we discuss how our study supports a new understanding of the mechanisms that contribute to health disparity.

1.1. Stress processes and allostatic load risk

Stressful environments get "under the skin" to cause health problems (Taylor et al., 1997), yet there is still much unknown about how that process may work and how particular exposure to contextual conditions may shape the process. Chronic and acute exposure to stressors may yield long-term health consequences (Ganzel et al., 2010; McEwen, 1998). Stressors are theorized to be associated with neuroendocrine responses, which can have cascading effects on other systems of the body by increasing blood pressure, immune-responses, cancer, etc. (McEwen, 1998; Taylor et al., 1997). Theoretically, stressors such as dangerous situations, social instability, living in an "unpleasant neighborhood," negative life events, and daily hassles may be linked to elevated allostatic load (McEwen, 1998; McEwen and Seeman, 1999). In addition, health disparities literature posits gender differences in the stress process. Thus, there may be gender differences in AL and its components as well as gender differences in the association between stressors and AL.

In terms of the physical environment, stressors such as environmental hazards or poor-quality built environments, may be chronic or acute and are theoretically linked to poor health (Cutchin, 2007; Hill et al., 2009; Pearlin et al., 2005; Stronegger et al., 2010). Specifically, living in close proximity to an environmental hazard

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or having a high level of *perceived* exposure to environmental threats is associated with increased stress (Burby and Strong, 1997; Hallman and Wandersman, 1992; Luginaah et al., 2000; Yang and Matthews, 2010). Stress resulting from these types of environmental stressors may be associated with negative physiological outcomes. For example, a study of Three Mile Island in Pennsylvania finds elevated physiological risk factors, such as lower lymphocytes, higher cortisol, and higher levels of herpes simplex reactivation among residents living near the damaged nuclear reactor (McKinnon et al., 1989). In addition to environmental hazards, neighborhood conditions may operate as stressors. Evans (2003) reports that physical aspects of the neighborhood (household crowding, and quality) are associated with elevated AL among rural children. These studies provide preliminary empirical evidence of a link between environmental stressors and risk of elevated AL. Yet, it is unknown if exposure to environmental hazards, perceived risk from those hazards, or poor-quality neighborhoods are associated with elevated AL.

Stressors that are more psychosocial in origin – such as negative life events (e.g., divorce or death of a loved one) and daily hassles (e.g., family or financial worries) – are also theorized to be associated with AL (McEwen, 1998). Yet, the few studies to test the relationship between negative life events and AL or physiological dysregulation find little to no association (Clark et al., 2007; Glei et al., 2007). Further, no study has tested the link between daily hassles and AL. Daily hassles are weakly associated with poor immune flexibility (Peters et al., 2003), chest pain (Lau et al., 1996), and outpatient health care utilization (Williams et al., 1992)—all of which may indirectly reflect physiological dysregulation.

In addition to stressors *per se*, clinical classifications of high risk AL differ for men and women (Seeman et al., 2002), although no studies examine gender differences in stressors and AL. Women are typically classified as a disadvantaged group, yet this disadvantage does not always translate into poorer health (Macintyre et al., 1996; Rieker and Bird, 2005). Theoretical examinations of gender health disparities suggest that differences in the *effects* of stressors may not necessarily indicate that men and women are differentially *susceptible* to stressors (Aneshensel et al., 1991). Women may have more *exposure* to stressors (Rieker and Bird, 2005). Indeed, women report more negative life events (Turner and Avison, 2003) and higher stress levels (McDonough and Walters, 2001). However, some studies find that stressor exposure does not account for gender differences (McDonough and Walters, 2001; Turner and Avison, 2003). A study exploring concern over environmental risk reports that women have higher concern about risk than men in high quality neighborhoods but not in "stressed" neighborhoods (Greenberg and Schneider, 1995). Few studies, however, examine gender differences in the relationship between stressors and health in environmental riskscapes. Thus, it is unknown whether stressful environments get "under the skin" more for women than for men.

1.2. Stressors and allostatic load in environmental riskscapes

Overlapping risk factors may leave individuals vulnerable to double jeopardy. Morello-Frosch and Shenassa (2006) incorporate the concept of double jeopardy in a manner than considers local context and AL. The authors propose a framework that incorporates built environment, social environment, and psychosocial stressors as fundamental risks associated with allostatic load. They suggest that the combination of community-level and individual-level stressors creates a unique form of double jeopardy that can lead to health disparities, particularly among already disadvantaged groups such as women. This 'riskscape' framework explicitly suggests a strong relationship between place and physiological wear, as indicated by allostatic load. What the literature lacks, however, are studies that combine various community and individual-level measures of stressors together with gender to better understand place-based jeopardy for higher allostatic load.

Although the environmental riskscape is "driven by the distribution of power, privilege and economic resources" Morello-Frosch and Shenassa (2006, p. 1152), do not suggest processes that shape such distributions in particular places or identify analytical perspectives through which to recognize them. In contrast, Cutchin (2007) argues that there are several intertwined geographical processes at work in such risky and unequal places. Specifically, he describes historical and cultural processes materialized in the landscape of Texas City, Texas as a way to illuminate the agents and power that create unequal risk. Cutchin (2007) also invokes political ecology and territoriality perspectives to understand the intertwined local, state, national, and global scale processes that emerge in the local landscape and neighborhoods of Texas City. Those processes differentiate the risk experienced by various groups in Texas City. Other work by Cutchin et al. (2008) argues that at a smaller scale, the transactional process of stress and coping, theorized by Lazarus (1991, 1999), is relevant to understanding risky environments and individuals' relationship with them—a relationship that, in turn, influences health.

By taking these perspectives as a group and integrating them with allostatic load theory, we can begin to more thoroughly theorize an important health process—stressor exposure and the bodily response to it. The benefit of this approach is that it allows us to analytically combine processes at various scales of analysis. Therefore, these processes can be considered either upstream (more distal) or direct (more proximal) causes of AL and the poor health it indicates. Broader scale foci, such as the global reach and power of oil corporations, go well beyond the meso-scale conceptualizations of Ganzel et al. (2010) and Morello-Frosch and Shenassa (2006). Yet, those meso-scale understandings are essential to understand risk and health in particular places, particularly when combined with transactional stress and coping theory. Allostatic load theory completes the picture. The allostatic load perspective implicates specific physiological processes that reflect individuals' exposures and experiences within those broader geographical scales. This theoretical integration of allostatic load and geographical theory marks an initial step toward Simandan's (2010) recent call for allostatic load research that would unify explanation across geographical scales, ranging from the body to the global political economy. Moreover, this combined perspective stretches the understanding of a riskscape to encompass a broader range of processes. Although not all components of this integrated view can be included in this study, an awareness of a more holistic geographical understanding of process, place, and health facilitates an enhanced position for inference and explanation.

1.3. Hypotheses

In accordance with the allostatic load and health geography literature, we hypothesized that stressors are associated with higher overall AL and AL components. Drawing from gender and health literature, we hypothesized that the predictive power of stressors varies by gender and by the type of allostatic outcome examined. Finally, we hypothesized that gender moderates the relationship between stressors and AL, suggesting different processes by gender.

2. Data and methods

2.1. Data

We analyzed data from the Texas City Stress and Health Study collected between 2004 and 2006 in Texas City, Texas, a small