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The role of material, psychosocial and behavioral factors in mediating the association between socioeconomic position and allostatic load (measured by cardiovascular, metabolic and inflammatory markers)

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ABSTRACT

Lower socioeconomic position (SEP), both accumulated across the life course and at different life-stages, has been found to be associated with higher cumulative physiological burden, as measured by allostatic load. This study aimed to identify what factors mediate the association between SEP and allostatic load, as measured through combining cardiovascular, metabolic and inflammatory markers. We explored the role of material, psychological and behavioral factors, accumulated across two periods in time, in mediating the association between SEP and allostatic load. Data are from the West of Scotland Twenty-07 Study, with respondents followed over five waves of data collection from ages 35 to 55 ($n = 999$). Allostatic load was measured by summing nine binary biomarker scores ('1' = in the highest-risk quartile) measured when respondents were 55 years old (wave 5). SEP was measured by a person's accumulated social class over two periods All mediators and SEP were measured at baseline in 1987 and 20 years later and combined to form accumulated measures of risk. Material mediators included car and home ownership, and having low income. The General Health Questionnaire (GHQ-12) was used as the psychosocial mediator. Behavioral mediators included smoking, alcohol consumption, physical activity and diet. Path analysis using linear regressions adjusting for sex were performed for each of the potential mediators to assess evidence of attenuation in the association between lower SEP and higher allostatic load. Analyses by mediator type revealed that renting one's home (approximately 78% attenuation) and having low income (approx. 62% attenuation) largely attenuated the SEP–allostatic load association. GHQ did not attenuate the association. Smoking had the strongest attenuating effect of all health behaviors (by 33%) with no other health behaviors attenuating the association substantially. Material factors, namely home tenure and income status, and smoking have important roles in explaining socioeconomic disparities in allostatic load, particularly when accumulated over time.

1. Background

Our bodies are often being challenged by changing and sometimes stressful environmental conditions that can alter the stability of our physiological systems. Allostasis is an active process where, given these challenges, our bodies attempt to maintain optimal physiological function by altering the operating set points or range ('moving the goalposts') of the physiological systems involved in adapting and reacting to these conditions (Sterling and Eyer, 1988). The wear and tear, or cumulative physiological burden, that occurs following the repeated activation of the allostatic response is known as allostatic load. Allostatic load is measured by combining several biomarker measures across an array of systems including the cardiovascular, metabolic and inflammatory systems, and has been shown to predict the risk of major health outcomes including heart disease and all-cause mortality (Seeman et al., 1997, 2004; Gruenewald et al., 2009; Karlamangla et al., 2006; Sabbah et al., 2008). Importantly, many of the individual components of allostatic load are not risk predictors for these same health outcomes, suggesting that the allostatic load construct could provide additional predictive power of disease risk over individual biomarkers. Assessing these biomarkers together as allostatic load helps us to understand the synergistic

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nature of the physiological burden on the body imposed by exposure to damaging environmental stressors. This could make allostatic load an important, early predictor of disease risk and improve our understanding of how physiological damage develops across the body.

There is growing evidence that allostatic load is socially patterned, with higher allostatic load associated with lower socioeconomic position (SEP), including SEP measured contemporaneously with allostatic load, as well as over time and during developmentally-important life stages such as childhood (measured distally to allostatic load) (Gruenewald et al., 2012; Gustafsson et al., 2011, 2012; Hawkley et al., 2011; Robertson et al., 2014). However, less is known about the potential pathways that link SEP and allostatic load. Three major mediating pathways have been suggested between SEP and *health*, namely material factors (e.g. income, employment status, ownership of material goods such as a car or home), psychosocial (e.g. stress)/psychological (e.g. distress) factors and health behaviors (e.g. smoking, alcohol consumption) (Fig. 1) Adler and Ostrove, 1999; Adler and Stewart, 2010. Given the evidence for links between SEP and health, SEP and allostatic load, and allostatic load and health, we propose that these same potential mediators could be involved in mediating the relationship between SEP and allostatic load. Given the theoretical links between the allostatic load concept and the stress response, and lower SEP and increased stressful environment (Baum et al., 1999; Brunner, 1997; Cohen et al., 2006), it would be expected that psychosocial/psychological factors would be important explanatory factors for the relationship between SEP and allostatic load (McEwen, 2001, 2006; Stewart, 2006). The socially patterned material factors linking SEP and allostatic load could relate to increased exposure to harmful conditions in the workplace, home and neighborhood, including toxins, damp, overcrowding, etc., as well as being interlinked to psychosocial factors (such as low control and high stress) that lead to psychological distress, which may play a role in both damaging and preventing repair to multiple physiological systems in the body. The carcinogens and health-damaging components in tobacco, alcohol, and some foods (and the lack of restorative efforts brought about by low physical activity) have the potential to impact on allostatic load, and are typically socially patterned. While these three pathways have distinct components, they are not mutually exclusive and are likely to combine in mediating the SEP–allostatic load association (Bartley, 2003). There has been evidence that some health behaviors, as well as a mix of psychosocial and psychological factors, explain some part of the SEP–allostatic load association (Gruenewald et al., 2012; Gustafsson et al., 2011, 2012; Hawkley et al., 2011). However, the number of studies are limited, the results inconsistent and material factors have had limited attention. The aim of this study was to examine the degree to which these material, psychological and behavioral factors explain the association between SEP and allostatic load, as measured through combining cardiovascular, metabolic and inflammatory markers. Given the strong links between stress and allostatic load, one would predict that psychosocial factors would play a major role in attenuating the SEP–allostatic load association. In this study we have used a measure of psychological distress, one mechanism linking psychosocial circumstances and health, and predicted that this psychological mediator would have the greatest attenuating effect, followed by material factors and then behavioral mediators.

2. Methods

2.1. Study sample

Data were from the West of Scotland Twenty-07 Study, a community-based, prospective study, with respondents aged approximately 35 in 1987 (wave 1/W1) and followed up in a further four waves over the next 20 years. This is an important stage in the life course for the early development of disease and therefore a key life stage to investigate allostatic load. A more detailed description of the study is available elsewhere Benzeval et al. (2009). Data, including blood samples at wave 5 (W5) (2007/8), were collected by trained nurses in the homes of the study participants when respondents were aged approximately 55. Ethical approval for the baseline study was granted in 1986 by the GP Sub-Committee of Greater Glasgow Health Board and the ethics sub-committee of the West of Scotland Area Medical Committees. Wave 5 was approved by the Tayside Committee on Medical Research Ethics.

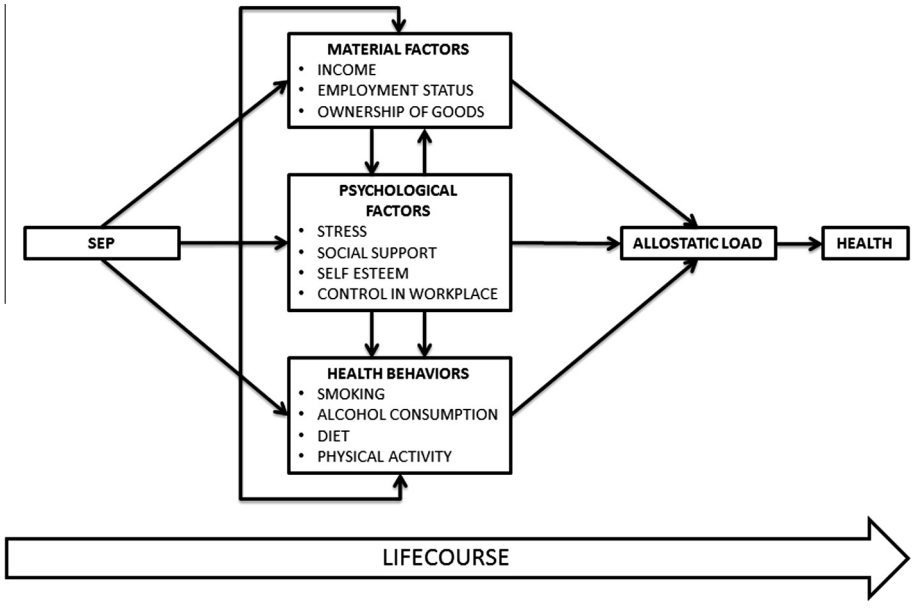

Fig. 1. Theoretical pathways linking SEP and health.