



Multilevel socioeconomic differentials in allostatic load among Chinese adults

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ARTICLE INFO

Keywords:

China
Allostatic load
Socioeconomic status
Multilevel
Health transition

ABSTRACT

Capitalizing on the biomarker data from the 2009 wave of the China Health and Nutrition Survey (CHNS), this study examines the extent to which multilevel socioeconomic status (SES) gets “under the skin” to affect individuals’ health, measured by allostatic load (AL). Multilevel analyses suggest that in the context of China’s socioeconomic and health transitions, high income, prestigious but sedentary occupations, and high level of urbanization were independently associated with higher AL scores, or increased health risks of physiological dysfunction in cardiovascular, metabolic, inflammation, and urinary systems. Higher educational attainment was related to a decrease in AL, but the significant difference was only observed among the college-educated compared to lower levels of education.

1. Introduction

Socioeconomic inequalities in health have been well documented in both developed and developing countries (Bakkeli, 2016; Elo, 2009; Xu and Xie, 2017). What remains controversial is the underlying mechanism that relates socioeconomic status (SES) to specific health outcomes. The growing interest and efforts in collecting biomarker data in demographic surveys allow researchers to measure health status more accurately by using physiological indicators such as allostatic load (AL), compared to widely used respondents’ self-reports in the literature. This, in turn, provides a great opportunity to better identify the biological pathway through which SES may affect health (Seeman et al., 2001).

AL is designed as a measure of long-run health consequences resulting from a multi-system physiological response to chronic stresses in order to maintain internal homeostasis. The notion of AL was introduced by McEwen and Stellar (1993), based on the concept of allostasis, which describes the ability of physiological systems to adjust to environmental challenges. McEwen and Stellar (1993) proposed that a long-term deviation from the normal range of physiological parameters as a result of allostasis can impose unnecessary strains on physiological systems and predispose individuals to disease. AL measures such exposure and vulnerability to disease. In empirical studies, AL is often calculated as a summary score of high risks with respect to various biomarkers. Recent studies have demonstrated that it is an independent, powerful predictor of mortality, cardiovascular and metabolism-related chronic diseases, and overall decline in physical and

cognitive functioning (Kubzansky et al., 1999; Mattei et al., 2010; Seeman et al., 2004a, 2001; Singer and Ryff, 1999).

However, despite the widely held expectation about the protective effect of SES against AL, empirical evidence remains surprisingly scarce across diverse populations as detailed below. This study postulates that as a composite measure of cardiometabolic risks and other physiological dysfunctions, the SES determinants of AL are context-dependent (Link and Phelan, 1995). In particular, certain SES indicators, such as income and occupation, may operate in ways opposite to comparable indicators in Western societies, to affect AL in low- and middle-income countries where poverty triggers chronic daily stress, but affluence and prestigious occupations may also induce negative health consequences in light of the ongoing health transition. Informed by the mounting literature on community effects on health in the past decade (e.g. Diez Roux, 2001), this study further emphasizes a multilevel perspective in understanding the complex patterns of SES determinants of biological wear and tear (Bird et al., 2010; Merkin et al., 2009).

This study tests these conjectures in China because its experiences of dramatic economic growth, rapid social changes, and health transition can provide valuable insights to many other developing countries worldwide (Popkin, 2014). Capitalizing on the recently available biomarker data from the 2009 China Health and Nutrition Survey (CHNS), this study seeks to examine the extent to which multilevel SES gets “under the skin” to affect individuals’ health in terms of biological parameters among adult Chinese. More specifically, this study operationalizes the effect on AL of multilevel SES indicators, including education and occupation at the individual level, household income at

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<https://doi.org/10.1016/j.healthplace.2018.08.012>

the family level, and urbanization at the community level. To assess robustness, time-lagged models are estimated by regressing AL measured in 2009 on SES indicators measured in 2006 to assess the robustness of cross-sectional analyses. This study is among the first to systematically investigate the associations between multilevel SES factors and AL in China, the most populous country and the second largest economy in the world. Its empirical findings can enhance our understanding of the context within which different SES indicators operate, which is essential for designing intervention strategies that otherwise may be hopelessly ineffective (Link and Phelan, 1995).

2. Previous research

In the U.S., several similar studies drew on data from the Third National Health and Nutrition Examination Survey (NHANES III), but reached inconclusive findings. Seeman et al. (2008) found that both education and household income were negatively associated with AL in adults aged 20 and older. However, focusing on young women aged 17–30, Allsworth et al. (2005) reported that neither education nor income was a significant predictor of AL. Using samples of adults aged 20 and older from both NHANES III and NHANES 1999–2004, Crimmins et al. (2009) discovered higher levels of AL, without adjusting for other social and demographic characteristics, among people living in poverty or near poverty than among those with higher family incomes. Nonetheless, it is unclear whether the income gap would remain significant after controlling for other confounding variables. In a cohort study of community-dwelling men from the Greater Boston area, Kubzansky et al. (1999) found that the association between education and AL was no longer significant after controlling for a measure of psychosocial vulnerability.

Two cross-sectional U.S. studies (Bird et al., 2010; Merkin et al., 2009) have resorted to the NHANES III data to explore the independent effect of community SES on AL. Both studies approximated communities using the 1990 U.S. Census tracts and aggregated a community SES index across several domains (percent less than high school education, percent unemployment, median household income, etc.) from individual SES among those living in the community. This compositional approach leaves out other important measures of community characteristics that cannot be derived from individual level measures, such as urban development, environmental sanitation, and health-related resources, thereby subject to the risk of underestimating the community effect on AL. As a result, Bird et al. (2010) reported that community SES was inversely related to AL in adults aged 20 years or older; whereas Merkin et al. (Merkin et al., 2009) found that the inverse association between community SES and AL was significant only for non-Hispanic blacks, but not for non-Hispanic whites or Mexican Americans.

Researchers have also attempted to investigate the association between life course SES and AL in regional samples such as the Biomarker Substudy of the Study of Midlife in the U.S. (Gruenewald et al., 2011) and the subsample of the Wisconsin Longitudinal Study (Singer and Ryff, 1999). However, these studies did not fully control for important social and demographic confounders, which cast doubt on the robustness of their findings.

Several studies have expanded to a non-Western population by capitalizing on data from the Taiwan Social Environment and Biomarkers of Aging Study. Yet they yielded largely unfavorable results regarding the hypothesized protective effects of SES against AL. For example, Hu et al. (2007) reported significant bivariate associations of AL with education and family income, respectively; whereas in multiple regression models, neither of these associations remained significant in men or women aged 54 and older (Dowd and Goldman, 2006; Gersten,

2008). Nevertheless, Seeman et al. (2004b) found that husband's years of education was inversely related to AL for the nearly elderly women aged 54–70, but in terms of life course SES, a longitudinal measure of financial hardship did not predict AL in later life.

In light of the mixed results from high-income societies, this study seeks to contextualize health risk factors (Link and Phelan, 1995), that is, to identify the social conditions under which particular SES indicators are more or less consequential in predicting AL and in what directions among Chinese adults. It is expected that the association between SES and AL varies by the dimensions of SES (e.g., knowledge, material resources, and social capital), the hierarchy of resources (e.g., individual, family, and community levels), and broad societal contexts (e.g., Western vs. non-Western, developed vs. developing countries). China's ongoing economic, demographic, and health transitions are tightly interrelated, resulting in complex associations between SES and AL that are more dynamic than conventional wisdom would predict.

3. The Chinese context

Most Western countries have already entered the late stage of a health transition, which involves a shift to a diet high in fat, cholesterol, sugar, and energy, but low in fiber, as well as an increasingly sedentary lifestyle and hence reduced energy expenditure. As a result, these countries have been seriously confronted by obesity epidemics and a range of nutrition-related noncommunicable diseases, notably related to cardiovascular and metabolic systems (Popkin, 2015; Popkin and Gordon-Larsen, 2004). In other words, the predominant disease profile among Western populations coincides with the health risk factors summarized by AL. By contrast, fueled by its rapid economic growth, social development, and urbanization in the last few decades, China has only recently embarked on the chronic disease phase of the health transition, that is, in the midst of the alteration from a situation of significant undernutrition and infectious diseases to that characterized by obesity and associated degenerative disease (Du et al., 2002; Popkin, 2014). Overall, China's health transition has been proceeding faster than it did in the U.S. and many high income countries (Popkin, 2002). Among Chinese adults of 18 years and old, for example, the prevalence of overweight and obesity more than doubled from 16.4% in 1992 to 42% in 2012, the hypertension rate increased by 75% from 14.4% in 1991 to 25.2% in 2012, and the prevalence of diabetes nearly tripled from 2.6% in 2002 to 9.7% in 2012 (CNHFPC, 2015; Wang, 2005; Wang et al., 2007).

Today, China is a fast-developing middle-income country. Its GDP per capita rose from 1662.03 USD in 1960–7329.09 USD in 2017 (Trading Economics, 2018) and its Human Development Index increased from 0.499 in 1990–0.728 in 2015 at the ranked of 90 (UNDP, 2016). However, due to its enormous regional variations in baseline social conditions and the pace of economic reform (Xie and Hannum, 1996), China's economic and health transitions have been uneven both spatially and temporally. Epitomized by Deng Xiaoping's slogan, “let some of the people get rich first” (Hewitt, 2009), the urban population, especially those living in coastal provinces, have benefited disproportionately from the economic reform at the expense of their rural peers living inland. Consequently, despite overall improvements in living conditions and population health, the relatively affluent urban Chinese are undergoing a more accelerated health transition compared to their poor rural peers (Leow, 2014; Yang et al., 2013). For instance, the leading causes of mortality and morbidity have shifted to cancer, cardiovascular disease, cerebrovascular disease, and other types of chronic diseases in urban China, whereas infectious diseases, digestive diseases, and respiratory diseases still prevail in rural areas (Zhao, 2006). By 2010 the overall burden of disease for Chinese adults had

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