Women's Health Issues xxx-xx (2017) 1–9

ELSEVIER

WOMEN'S HEALTH ISSUES

www.whijournal.com

Original article

A Longitudinal Analysis of Allostatic Load among a Multi-Ethnic Sample of Midlife Women: Findings from the Study of Women's Health Across the Nation

Laura Chyu, PhD [a,*], Dawn M. Upchurch, PhD, LAc [b]

[a] *Public Health Program, Santa Clara University, Santa Clara, California*
[b] *Department of Community Health Sciences, UCLA Fielding School of Public Health, Los Angeles, California*

Article history: Received 17 March 2017; Received in revised form 25 October 2017; Accepted 6 November 2017

A B S T R A C T

Objectives: We examined longitudinal patterns and sociodemographic correlates of allostatic load (AL), a measure of cumulative biological risk and aging, in a sample of midlife women consisting of non-Hispanic White, African American, Chinese, and Japanese women.
Methods: Longitudinal cohort data from the Study of Women's Health Across the Nation were used to examine AL patterns in midlife women ages 42–53 (n = 1,932). AL measures were created using 10 biomarkers representing cardiovascular, inflammatory, neuroendocrine, and metabolic system functioning. We used longitudinal random effects Poisson regression models to assess change in AL over the 7-year follow-up period and associations between sociodemographic factors and AL.
Results: On average, a woman's AL score increased 2% each year over the course of the study. Baseline measures of African American race, low family income, older age, and ability to read and speak only in English were significantly associated with higher levels of AL over the study period. We did not observe significant differences in rates of change in AL by race/ethnicity or socioeconomic status.
Conclusions: This study demonstrates that AL increases in a cumulative manner as women age. Midlife is an especially important time in women's life course with respect to health maintenance and healthy aging. AL can be an early warning indicator of subsequent disease burden, pointing to subclinical conditions and the need for implementation of medical and public health interventions earlier in the disease process.

Midlife is a significant period in women's life course marked by changing social roles, increases in prevalence of chronic conditions, and transition through menopause (Hardy & Kuh, 2002; Kaeberlein, Rabinovitch, & Martin, 2015; Kuh, Wadsworth, & Hardy, 1997). Midlife is also when racial and socioeconomic disparities in chronic disease, impairments, and disability widen (House, Lantz, & Herd, 2005; House et al., 1994). By 2020, more than 35% of the U.S. population will be age 50 and over; therefore, it is imperative that medical and public health professionals address the physical, mental, and social well-being of this growing demographic group. A better understanding of the ways in which health differentials emerge during midlife can inform possible interventions and policies to impact healthy aging.

Allostatic load (AL), a measure of cumulative biological risk and aging, assesses the impact of environmental and social stressors on multiple physiological systems in the body, and elucidates possible pathways by which these stressors translate into health outcomes and disparities (Crimmins & Seeman, 2004; McEwen, 1998, 2002, 2004; Seeman, Crimmins, et al., 2004; Seeman, McEwen, Rowe, & Singer, 2001; Seeman, Singer, Rowe, Horwitz, & McEwen, 1997; Singer, Ryff, & Seeman, 2004). As individuals age, AL generally increases as the functioning and adaptability of physiological systems decline (Crimmins,

Funding statement: This study received funding from the National Institute on Aging and the Office of Research on Women's Health AG038467, awarded to Dr. Upchurch, and the University of California Dissertation Year Fellowship awarded to Dr. Chyu. The Study of Women's Health Across the Nation (SWAN) has grant support from the National Institutes of Health (NIH), DHHS, through the National Institute on Aging (NIA), the National Institute of Nursing Research (NINR) and the NIH Office of Research on Women's Health (ORWH) (Grants U01NR004061; U01AG012505, U01AG012535, U01AG012531, U01AG012539, U01AG012546, U01AG012553, U01AG012554, U01AG012495).
* Correspondence to: Laura Chyu, PhD, 500 El Camino Real, Santa Clara, CA 95053. Phone: +408-551-3176.
E-mail address: lchyu@scu.edu (L. Chyu).

1049-3867/$ - see front matter © 2017 Jacobs Institute of Women's Health. Published by Elsevier Inc.
https://doi.org/10.1016/j.whi.2017.11.002

Johnston, Hayward, & Seeman, 2003). Furthermore, cumulative exposure to social, psychological, or environmental stressors is posited to increase the risk for chronic degenerative health problems via disruption of physiological regulatory systems involved in the generalized physiological stress response (McEwen, 1998; McEwen & Stellar, 1993). Increases in AL are associated with health deterioration, accelerated aging, and shortened longevity (Geronimus, Hicken, Keene, & Bound, 2006; Karlamangla, Singer, & Seeman, 2006).

AL often reflects subclinical dysregulation, and as such, can potentially be used as an early warning indicator of disease risk. AL is associated with increased risk for mortality, cardiovascular disease, diabetes, higher pain scores, and decreased physical and cognitive function (Beckie, Duffy, & Groer, 2016; Karlamangla, Singer, McEwen, Rowe, & Seeman, 2002; Karlamangla et al., 2006; Mattei, Demissie, Falcon, Ordovas, & Tucker, 2010; Sabbah, Watt, Sheiham, & Tsakos, 2008; Seeman, Crimmins, et al., 2004; Seeman et al., 2001; Seeman et al., 1997; Seplaki, Goldman, Weinstein, & Lin, 2004), and is a better predictor of subsequent cardiovascular disease than the single biomarkers that comprise it (Karlamangla et al., 2005). Thus, conceptualizing AL in the context of primary and secondary prevention strategies can provide opportunities to prevent or slow chronic disease development in high-risk groups, reduce disease burden in the long term, and promote healthy aging.

Prior research on AL has typically combined men and women when identifying empirical cutpoints for AL, despite evidence of gender variation in distributions of individual biomarkers and cumulative biological risk (Goldman et al., 2004). Rather than incorporating gender simply as a control variable, we focus on a sample of women in this study to explicitly characterize gender-specific patterns of AL and to account for biological makeup, social factors, and health trajectories unique to women. Moreover, midlife is a dynamic stage in the life course of women, marked by physiological changes, social transitions, and the menopausal transition (Hardy & Kuh, 2002; Kuh et al., 1997). It is also during midlife when chronic health problems emerge and health disparities at the population level are most pronounced (House et al., 2005). With women spending one-third or more of their lives in postmenopause, understanding and promoting healthy aging in midlife has important implications for health in later years. To this end, AL can be a useful composite indicator of subclinical health risks and aging trajectories.

Socioeconomic differences in AL have been widely reported such that individuals who have lower socioeconomic status (SES) have higher AL relative to their more affluent counterparts (Gustafsson, Janlert, Theorell, Westerlund, & Hammarström, 2011; Karlamangla et al., 2005; Kuzbansky, Kawachi, & Sparrow, 1999; Seeman, Crimmins, et al., 2004; Seeman et al., 2008). Moreover, there is a SES gradient of AL, such that, at incrementally lower levels of SES, AL proportionately increases (Seeman et al., 2008). SES is seen as a fundamental cause of health differentials, whereby individuals of lower SES have fewer flexible resources, such as financial resources, power, social networks, and access to services, that can be leveraged to promote health and reduce disease (Link & Phelan, 1995; Phelan, Link, & Tehranifar, 2010).

Racial differences persist when SES is taken into account (Adler & Rehkopf, 2008; Kawachi, Daniels, & Robinson, 2005; Lillie-Blanton & LaVeist, 1996; Williams & Collins, 1995). African Americans have higher AL compared with Whites; chronic exposure to social and economic adversity and racial and ethnic discrimination is thought to accelerate the aging process, or weathering, among African Americans and other people of color (Geronimus, 1992, 2001; Geronimus et al., 2006).

Although several studies have identified and characterized African American and White differences, few studies have investigated AL among Asians and Asian Americans (Seeman, Glei, et al., 2004; Upchurch, Stein, et al., 2015). In this study, our sample includes women who identified as Chinese and Japanese. As the fastest growing racial group in the United States, Asian Americans comprise a heterogeneous population, characterized by diverse cultures and representation at both extremes of socioeconomic and health measures (Barnes, Adams, & Powell-Griner, 2008; Hoeffel, Rastogi, Kim, & Shahi, 2012). The common practice of aggregating Asian subgroups in health research masks distinct disease patterns and health inequities among Asians (Ro & Yee, 2010). Nationally representative data have shown that Chinese and Japanese adults are significantly less likely to report fair or poor health, be obese, or have multiple chronic conditions in comparison to other U.S. adults (Barnes et al., 2008; Bloom & Black, 2016). There are also differences in health behaviors, with Chinese women in California reporting less alcohol binge drinking and smoking than their White counterparts (Maxwell, Crespi, Alano, Sudan, & Bastani, 2012). As a predisease indicator, AL can provide insight into underlying cumulative biological risk patterns that may lead to better or worse health outcomes among certain Asian subgroups. This study helps to fill a gap in the literature on AL among Asians, and specifically among Asian subgroups of Chinese and Japanese women in the United States.

A central tenet of AL and physiological dysregulation is that these changes are cumulative as individuals age, reflecting both antecedent and current biopsychosocial challenges (Beckie et al., 2016; Crimmins et al., 2003; Crimmins & Seeman, 2004). However, a significant limitation of much of the prior research is the use of cross-sectional data or only a few longitudinal time points to characterize AL. We use longitudinal biomarker data from the Study of Women's Health Across the Nation (SWAN), measured annually at more time points than available in other datasets, to examine AL patterns among midlife women as they transition through menopause. Leveraging biomarker data collected annually over 7 years, we are able to examine within-woman changes in AL over time and quantify estimated change per year, as well as investigate AL differences between women in different sociodemographic groups. This is one of a few studies to examine the magnitude of change in AL over an extended period of time, a novel contribution to understanding how multisystemic physiological dysregulation accrues.

The objectives of this study are to examine how AL changes over time among midlife women and investigate sociodemographic correlates of AL, with a specific focus on racial and SES differentials. We hypothesize that within-woman values of AL will increase over time, reflecting health declines and physiological aging over the study period for each woman. We also hypothesize that lower SES, as measured by education and household income, will be associated with higher AL in a stepwise gradient pattern. We expect African American women to exhibit higher AL and Japanese and Chinese women similar or lower AL, relative to their White counterparts.

Methods

SWAN is a community-based, multisite, prospective study that examines biopsychosocial changes during the