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The Relationship between Allostatic Load and Psychosocial Characteristics among Women Veterans

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A B S T R A C T

Background: Allostatic load (AL) is a novel perspective for examining the damaging effects of stress on health and disease. Women veterans represent an understudied yet vulnerable subgroup of women with increased reports of traumatic stressors across their lifespan. AL has not been examined in this group. This study hypothesized that reports of sexual assault in childhood, civilian life, or in the military by women veterans was associated with AL and selected psychosocial measures. We also hypothesized that AL scores are positively associated with psychosocial characteristics.
Methods: Using a cross-sectional design, psychosocial and physiological data were obtained from women veterans ($n = 81$; 24–70 years old).
Findings: The AL score was 3.03 ± 2.36 and positively associated with age ($p = .001$). There was a trend for higher pain scores for women with an AL score of 2 or greater compared with those with an AL score of less than 2. There were significant differences in the Somatic Subscale of the Center for Epidemiological Depression Scale among the sexual assault categories with increasing scores among women reporting sexual assault in childhood, military, and civilian life ($p = .049$). The scores of the Profile of Mood States Depression/Dejection Subscale ($p = .015$), the Post-Traumatic Checklist- Military ($p = .002$), and the Pain Outcome Questionnaire ($p = .001$) were associated with sexual assault categories in a dose–response fashion.
Conclusions: AL was associated positively with age, and sexual assault categories were associated with increased somatization, depressed mood, posttraumatic symptoms and pain. Assessing both AL and sexual trauma are critical for preventing and managing the subsequent negative health consequences among women veterans.

More women than ever before are serving in the U.S. military with the number of women veterans exceeding 2 million (www.va.gov/vetdata/docs/SpecialReports/Women_Veterans_2013.pdf). Women veterans engage in duties during deployment leading to risks of combat trauma (Mattocks et al., 2012; Street, Gradus, Giasson, Vogt, & Resick, 2013). Women veterans who have experienced traumatic stressors in military or civilian life, such as military sexual trauma (MST), or adverse childhood experiences (ACEs) are at increased risk for cardiovascular disease (CVD), poor physical and mental health, and suboptimal quality of life (Boscarino, 2008; Der-Martirosian, Cordasco, & Washington, 2013; Lehavot, Hoerster, Nelson, Jakupcak, & Simpson, 2012; Rich-Edwards et al., 2012; Sumner et al., 2015; Wang, Lee, & Spiro, 2015). Hypertension, dyslipidemia, and diabetes are prevalent in midlife women veterans (Vimalananda et al., 2013). Childhood adversity is linked to heightened CVD risk in adulthood, with health behaviors and psychological factors partially mediating the relationship (Morton, Mustillo, & Ferraro, 2014; Roy, Janal, & Roy, 2010). Indeed, health behaviors and risk factors account for up to 80% of the link between ACEs and CVD incidence (Rich-Edwards et al., 2012). Negative health consequences of ACEs manifest through inflammatory cytokines (Matthews, Chang, Thurston, & Bromberger, 2014) with increased risk for metabolic dysregulation (Midei, Matthews, Chang, & Bromberger, 2013).

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ACEs and civilian sexual assault can exacerbate military deployment stressors of MST. Both childhood and MST are associated with posttraumatic stress disorder (PTSD), depression, and other physical and mental health disorders in women veterans (Carlson, Stromwall, & Lietz, 2013; Lehavot & Simpson, 2014). In the Women Veterans Cohort Study, exposure to multiple sexual assault and war-related traumas synergistically lead to PTSD symptoms (Cobb Scott et al., 2014). Both trauma exposure and PTSD symptoms were associated with poor cardiovascular health among nearly 50,000 nurses (Sumner et al., 2015). Prior trauma may propel women toward unhealthy behaviors that activate multisystem dysregulation and poor health.

Allostasis and allostatic load (AL) are useful concepts for examining the protective and damaging effects of stress and adaptation (McEwen, 1998a, 2015). Allostasis, the adaptive regulatory process that functions to maintain stability when exposed to toxic stress during predictable demanding life stages and unpredictable challenges (McEwen & Gianaros, 2010), is a novel integrative perspective for examining health disparities. AL is the consequence of regulatory deterioration that can result in disease (McEwen & Wingfield, 2003). The AL model highlights the powerful influences of the social environment, individual behaviors, and the importance of brain–body interactions (McEwen, 1998a). AL represents the cumulative, multisystem physiological dysregulation resulting from repeated cycles of activation and deactivation of allostasis over the life span in response to stressful life demands (McEwen & Stellar, 1993).

The hypothalamic–pituitary–adrenocortical (HPA) axis and the sympathetic–adrenal–medullary systems, cornerstones of allostasis, are activated with stress exposure, signaling changes in multiple physiological systems in a generalized stress response (McEwen, 1998a, 1998b). The central nervous system controls the stress response, with the brain serving as mediator between environment demands and physiological responses (Karatsoreos & McEwen, 2011) and influencing health behaviors that intensify or counteract AL (McEwen, 2007).

The allostatic process begins with what are termed *primary mediators*, the chemical messengers (e.g., epinephrine, cortisol) released in response to stress, that regulate each other in a nonlinear network, permitting rapid adjustments to compromising demands (McEwen, 2003; McEwen & Seeman, 1999). If these chemical mediators become dysregulated amidst chronic and unrelenting stress, they eventually produce *secondary outcomes* of multisystem physiological dysregulation (Juster, McEwen, & Lupien, 2010). Finally, *tertiary outcomes* of AL emerge with a plethora of negative consequences including pain syndromes, CVD, diabetes, and mortality (Beckie, 2012; McEwen & Seeman, 1999).

AL is typically operationalized using a battery of measures with higher scores reflecting greater multisystem dysregulation (McEwen, 2015; Seeman et al., 2010). The measures include blood pressure (BP), metabolic indicators (e.g., glucose, lipid profiles, waist circumference), inflammatory biomarkers (e.g., interleukin-6 [IL-6], C-reactive protein [CRP]), sympathetic nervous system activity (e.g., epinephrine) and HPA axis activity (e.g., cortisol). The predominant approach to analyzing AL involves dividing biomarker values into quartiles, scoring individuals with markers in the extreme quartiles, and summing across biomarkers for a total score (McEwen & Seeman, 1999). Women veterans are at risk for high AL if stress associated with childhood, military service or civilian life becomes additive or chronic.

Specific Aims

The conceptual logic model for examining women's health (Groer et al., 2010) served as a heuristic guide for examining AL among women veterans. Figure 1 depicts the hypothesized links between plausible allostatic challenges, allostatic load, and tertiary outcomes of AL. To our knowledge, AL has not been evaluated in women veterans. The following hypotheses were tested in the current study: 1) Reports of sexual assault in childhood, civilian life, or in the military by women veterans will be associated with AL, and selected measures of depressive symptoms, PTSD, pain, and perceived stress; and 2) AL scores will be positively associated with age and selected measures of depressive symptoms, PTSD, perceived stress, and pain among women veterans.

Methods

Design

Using an observational, cross-sectional design this study was approved by the university Institutional Review Board and the U.S. Army Telemedicine and Advanced Technology Research Center.

Recruitment, Consent, and Enrollment

In November 2011, a day of recognition was convened in West Central Florida with various community-sponsored activities celebrating women veterans at the venue. A site was designated for study recruitment where interested participants provided written informed consent. Participant recruitment continued after the event through snowball sampling methods. Women were eligible for study inclusion if they were 18 years of age or older, English speaking, able to read at an eighth-grade level, and a self-reported veteran of the U.S. Armed Services.

Procedures

Once written informed consent was provided, participants completed a battery of questionnaires online at computer kiosks during the day of recognition, or in some cases, at home or on university computers. Upon questionnaire completion, venous blood (15 mL) was drawn by research nurses, stored in heparinized tubes, transported on ice to the biobehavioral laboratory within 3 hours, and centrifuged at 1,200×*g* for 20 minutes. The plasma was aliquoted into Eppendorf tubes and frozen at −80°C until analysis. Hair samples closest to the roots were collected and the first 3 cm of hair preserved. Height, weight, waist circumference, and BP were also measured.

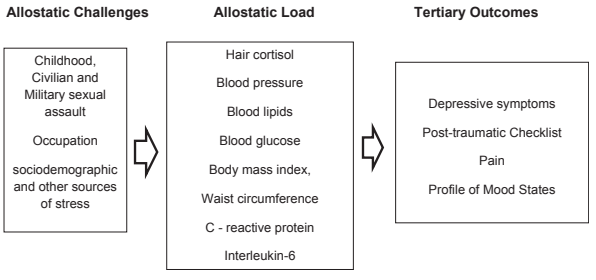

Figure 1. Model of hypothesized associations.