The Longitudinal Implications of Stress Dissipation on Pathophysiological Mechanisms

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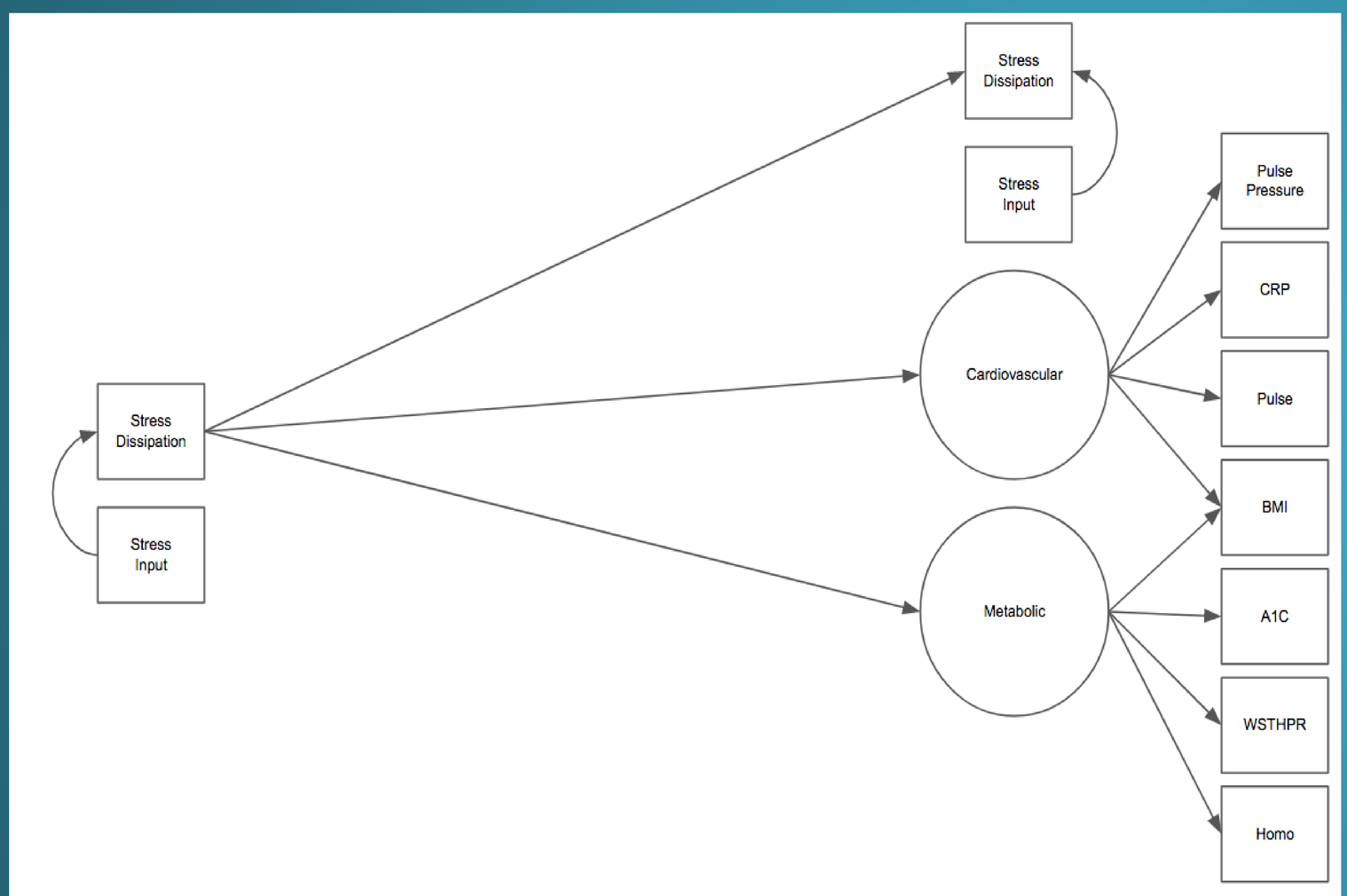
Introduction

- The experience of stress stimulates the HPA axis, inducing a cascade of hormonal responses and the production of glucocorticoids (Cohen, 1996).
- Research suggests that acute stress may be beneficial since it increases memory consolidation (Wolf, 2008) and enhances physical performance (Wolf, 2009) until the stress response downregulates and returns to baseline (Abercrombie et al., 2006).
- Longitudinal maladaptive stress response patterns and overexposure to glucocorticoids exhaust bio-mediators and predict a cohort of negative health outcomes, known as allostatic load (AL) (McEwen, 1998).
- The AL model partitions stress-induced physiological mechanisms into cardiovascular, metabolic, immune, and endocrine categories (De Kloet et al., 1998). Despite this, there is no clear consensus on a biomarker panel that can assesses stress-induced pathology in older adults.
- Stress accumulates unless resources are allocated to mediate stressful situations. Stress dissipation mathematically describes the efficiency of this process (Beregeman and Deboeck, 2014).
- Due to the ambiguity around AL literature in older adults, the following study sought to examine: 1) The interrelationship of biomarkers and physiological systems in an older population; 2) The relationship between stress dissipation and pathophysiology 3) Whether the ability to dissipate stress affects AL outcomes.

Method

- Participants (N=95, M_{age}=67.37, SD=5.48) were recruited from Northern Indiana for the Notre Dame Study of Health & Wellbeing.
- All participants completed 56-day diary bursts in years (Y) 1, 3, and 5, annual questionnaires, and an in-person health evaluation after year five.
- Using standardized protocols, a phlebotomist and nurse conducted a total health workup, including blood samples and physiology assessments.
- Stress dissipation, stress input, and global stress measures were computed for each wave of daily diary bursts.
- Blood samples were assessed for Interleukin-6, DHEA-S, hemoglobin A1C, homocysteine (Homo), ratio of total cholesterol to high density lipoprotein, low density lipoprotein, triglycerides, C-reactive protein (CRP). Body mass index (BMI), pulse, pulse pressure(PPRESS), and waist to hip ratio (WSTHPR) were measured by the nurse.



Results

- We tested biomarker interrelationships in the structural equation modeling (SEM) framework in M-plus, assessing the factor structure of the indicators of AL. Only two factors, representing cardiovascular and metabolic health, of the expected four factors emerged and were composed of seven of the twelve biomarkers, respectively.
- The metabolic factor consisted of BMI (β =1.80, p=0.02), Homo (β =0.85, p=0.08), A1C (β =0.68, p<0.001), and WSTHPR (β = 0.02 , p<0.011). The cardiovascular factor was composed of PPRESS (β = 1.43, p=0.46), pulse (β = 4.67, p=0.09), CRP (β =2.53, p=0.08), and BMI (β = 0.90, p=0.48). The cross loading of BMI onto both cardiovascular and metabolic factors produced a good fitting model, χ^2=14.43, p=0.27.
- SEM was used for the two factor model for stress dissipation at Y1 on cardiovascular disease and metabolic health at Y5 (controlling for stress input at Y1 & 5 and stress dissipation at Y5).
- Results of the SEM analysis indicate that stress dissipation, controlling for stress input at Y1, predicting cardiovascular health, and controlling for Y5 variables fits the model adequately (χ^2=5.98, p=0.74). The predictive value of stress dissipation at time one on cardiovascular health was not significant (β=0.28, p=0.19).

Discussion

- The results suggest that the two health factors are indicative of the physiological systems activated in this population. Since this sample consists of older adults, it is a viable notion that particular biomarkers are indicative of another aging process, such as frailty or medication use, instead of health integrity.
- Every model, involving the metabolic factor, was either non-convergent or produced inadequate model fit indices due to negative variance. Since we did not control for medication or diagnosis and over 25% of the United State's population over the age of 65 is diagnosed with diabetes, it is possible that accurate estimates for models with the metabolic factor can be calculated in the SEM framework after controlling for diagnosis and medication (Center for Disease Control, 2011).
- The post-hoc finding of a causal relationship between hardiness/ perceived stress at Y5 with CRP needs more exploration. For example, individuals with remarkable cardiovascular health may embody more hardiness due to the vitality of their physical systems. Additionally, resilient older adults may have better cardiovascular health and control variables, such as blood pressure, due to this trait-like characteristic.
- The results may suggest that the accurate notion of allostatic load as the present literature understands it is not applicable to aging individuals.

Post Hoc Analyses

- Hardiness (χ^2=10.48, p=0.23) and perceived stress (χ^2=8.11, p=0.42) at Y1 separately predict cardiovascular health controlling for hardiness and perceived stress at Y5.
- Hardiness at Y1 was not indicative of cardiovascular health at Y5 (β=0.01, p=0.54),
- Hardiness at Y5 was significantly related to cardiovascular health at Y5 (β=-0.05, p=0.02).
- Hardiness significantly correlated with perceived stress at Y1 (r=-0.53, p<0.001) and Y5 (r=-0.55, p<0.001)
- Perceived stress at Y5 moderately correlated with C-reactive protein (r=0.28, p<0.001).

Future Directions

- Since the sample consists of older adults, future investigations are needed to differentiate age-related from stress-induced physiology.
- Models that included hemoglobin A1C resulted in negative variance, controlling for medications and analyzing a middle life sample are necessary to adequately evaluate the model.
- Future research should continue to examine the longitudinal relationship between stress parameters and pathophysiology given the limited sample size (N=95) and health assessment at one point in time.

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