

# Healthy Lifestyle Index is Associated with Lower Allostatic Load in Young Women

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# Introduction

- Allostatic load (AL) is a measure of cumulative biological across multiple physiological systems (McEwen 1998; Seeman et al., 1997)
- Allostatic load has been shown to be a stronger predictor of all-cause mortality than single markers (Karlamanla et al., 2006)
- Thus, AL can be a useful “early warning” index for subsequent health conditions



# Introduction

- Most prior allostatic load research, appropriately, has focused on characterizing the socio-demographic, psychosocial, and lifestyle factors that are associated with *higher* AL
- While there is still much work to do in that area, there is also increased interest in better understanding factors that might be associated with *lower* AL (Upchurch, Rainisch & Chyu, 2015)
- Additionally, the bulk of prior research has studied AL in midlife and older populations, although there is increasing evidence that differences in AL emerge early in the life course (Evans et al., 2007; Rainisch & Upchurch, 2013)



# Introduction

- Emerging epidemiologic research is demonstrating the utility of using a constructed measure summarizing the number of “healthy behaviors” individuals engage in, sometimes called a “healthy index” (HI) (Akesson et al., 2014)
- Several large, longitudinal studies have found associations between greater HI and lower risk for stroke and myocardial infarction (Akesson et al., 2014; Larsson et al., 2014)



# The Current Study

- With these considerations in mind, the purpose of the current study is to assess the relationship between a composite healthy index score and level of AL among a nationally representative sample of young adult women
- We use data from the National Longitudinal Study of Adolescent to Adult Health, Wave IV



# National Longitudinal Study of Adolescent to Adult Health

- Study Design
  - The Add Health study started with a stratified, random sample of all high schools in the US and selected adolescents in grades 7-12 during the 1994-1995 school year in the first wave (Harris, 2009)
  - Since then, three more waves have been conducted
  - A fourth in-home interview was conducted in 2008 and 2009 with the original Wave I respondents (Wave I n= 20,745, Wave IV n=15,701)
  - The Wave IV study was designed to be a follow-up of the adolescents first interviewed in 1994 and 1995



# National Longitudinal Study of Adolescent to Adult Health

- Add Health – Wave IV
  - Unique to Wave IV is the inclusion of a battery of biomarkers which can be used to construct a measure of AL
  - Trained and certified field interviewers in the Add Health study completed anthropometric assessment and blood spot collection
  - Whole blood spot samples were obtained from a finger prick and collected using a 7-spot capillary whole blood collection card (Entzel et al., 2009)



# National Longitudinal Study of Adolescent to Adult Health

- Analytic Sample
  - Analytic sample included women who had sample weights, had valid data on all biomarkers used in the analysis, and had complete age information
    - Individuals classified as “Other” races were excluded
    - Pregnant women were excluded
  - The final sample size was  $n = 6071$



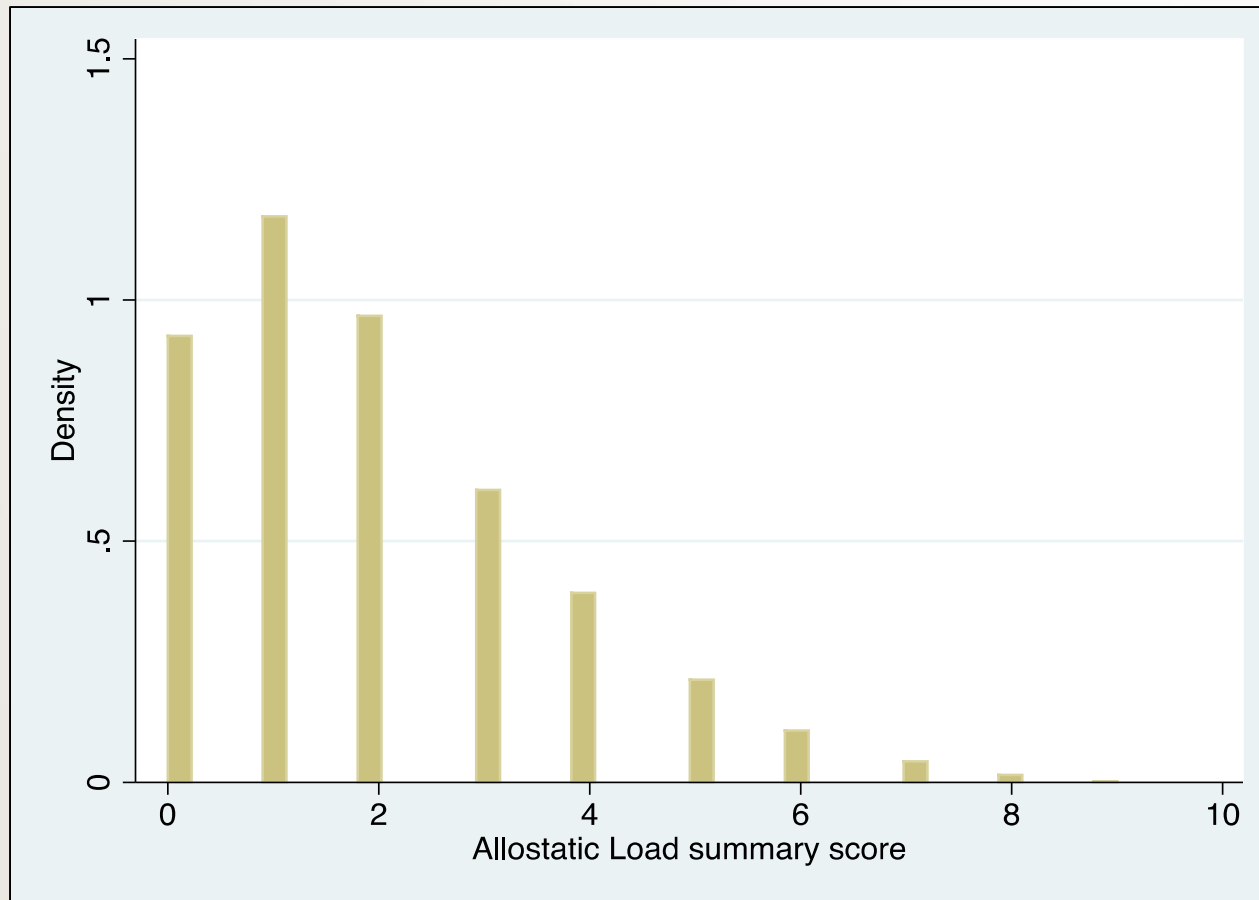


# Biomarkers Included in AL Score

- Allostatic load summary score (0-9) composed of empirical cutoffs (0/1) for:
  - Cardiovascular markers:
    1. Systolic blood pressure (SBP),
    2. Pulse rate,
    3. Pulse pressure
  - Metabolic markers:
    4. Waist circumference,
    5. Body mass index (BMI),
    6. Glycated hemoglobin (HbA1c),
    7. Total cholesterol, high-density lipoprotein (HDL)
  - Inflammatory markers:
    8. High-sensitivity C-reactive protein (hsCRP),
    9. Epstein-Barr viral (EBV) capsid antigen IgG



# Distribution of AL Summary Score



# Healthy Index

- Health Index (0-7) based on healthy/unhealthy (coded 0/1):
  - Sleeping patterns,
  - Smoking behavior,
  - Alcohol consumption,
  - Sweetened beverage consumption,
  - Diet beverage consumption,
  - Physical activity,
  - Hours spent watching television



# Covariates

- Demographics: age, race/ethnicity, education, household income
- Health conditions (0-9): count of total chronic health conditions
- Medication Use:
  - Anti-inflammatory medication
  - Anti-diabetic medication
  - Anti-hyperlipidemia medication



# Analysis

- Bivariate analysis:
  - Design-based Wald F-test
- Multivariate analysis:
  - Negative binomial regression
  - Investigating the effects of demographics, health conditions, and the health index, controlling for medication use on AL
- All analyses were weighted



TABLE 1

**DISTRIBUTION OF DEMOGRAPHIC, HEALTH, AND LIFESTYLE FACTORS, WOMEN 24-32, ADD HEALTH WAVE 4 2008**

Females (n=6071)

**Demographic Characteristics**

Age (mean)	28.7
Education Level (%)	
Less than HS	8.1
HS/GED	24.3
Some College	35.6
4 Year College Degree	19.5
More than College	12.6
Race/Ethnicity (%)	
Non-Hispanic White	69.0
Hispanic	12.1
Non-Hispanic Black	15.8
Non-Hispanic Asian	3.1
Household Income (%)	
< \$25,000	20.2
\$25,000 - \$49,999	31.9
\$50,000 - \$74,999	23.2
\$75,000 +	24.7
Nativity Status	
US Born	96.1
Non-US Born	3.9

**Health and Lifestyle Factors**

Health Index (mean)	3.3
Health Conditions (mean)	1.2

**Medication Use**

Anti-inflammatory Medication Use (%)	34.6
Hypertension Medication Use (%)	0.8
Diabetes Medication Use (%)	1.7

*Note: Weighted Proportions*

TABLE 2

## MEAN AL OVER POPULATION CHARACTERISTICS, WOMEN 24-32, ADD HEALTH WAVE 4, 2008 (N=6071)

	Mean AL
<b>Overall Mean AL</b>	<b>1.9</b>
<b>Demographic Characteristics</b>	
Age	
24-26	1.9
27-29	2.0
30-32	2.1
Education Level ***	
Less than HS	2.1
HS/GED	2.0
Some College	2.0
4 Year College Degree	1.6
More than College	1.6
Race/Ethnicity ***	
Non-Hispanic White	1.9
Hispanic	1.9
Non-Hispanic Black	2.2
Non-Hispanic Asian	1.6
Household Income ***	
< \$25,000	2.1
\$25,000 - \$49,999	2.0
\$50,000 - \$74,999	1.9
\$75,000 +	1.8
Nativity Status ***	
US Born	1.9
Non-US Born	1.7
<b>Health and Lifestyle Factors</b>	
Health Index ***	
0	3.9
1	2.7
2	2.1
3	2.0
4	1.8
5	1.6
6	1.3
Health Conditions	
0	1.8
1	2.0
2	2.2
3+	2.3

Design-based Wald F-test, \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\*  $p < 0.001$ 

Table 3

**NEGATIVE BINOMIAL REGRESSION RESULTS, WOMEN 24-32, ADD  
HEALTH WAVE 4, 2008 (N=6071)**

	<b>Coefficient</b>	<b>IRR</b>	<b>95% Confidence Intervals on IRR</b>
<b>Demographics</b>			
Age	0.019 *	1.019	1.000 - 1.039
Education Level			
Less than HS	---	1.000	---
HS/GED	0.092	1.097	0.962 - 1.250
Some College	0.030	1.022	0.894 - 1.169
4 Year College Degree	- 0.045	0.955	0.826 - 1.105
More than College	- 0.153 *	0.858	0.746 - 0.987
Race/Ethnicity			
Non-Hispanic White	---	1.000	---
Hispanic	0.120	1.127	0.976 - 1.159
Non-Hispanic Black	0.256 ***	1.292	1.201 - 1.390
Non-Hispanic Asian	- 0.272 **	0.761	0.631 - 0.920
Household Income			
< \$25,000	---	1.000	---
\$25,000 - \$49,999	0.062	1.064	0.976 - 1.159
\$50,000 - \$74,999	0.030	1.031	0.939 - 1.131
\$75,000 +	- 0.116	0.891	0.791 - 1.002
Nativity Status			
US Born	0.257 **	1.292	1.061 - 1.575
Non-US Born	---	1.000	---
<b>Health and Lifestyle Factors</b>			
Health Index	- 0.089 ***	0.914	0.892 - 0.938
Health Conditions	0.058 ***	1.059	1.039 - 1.080

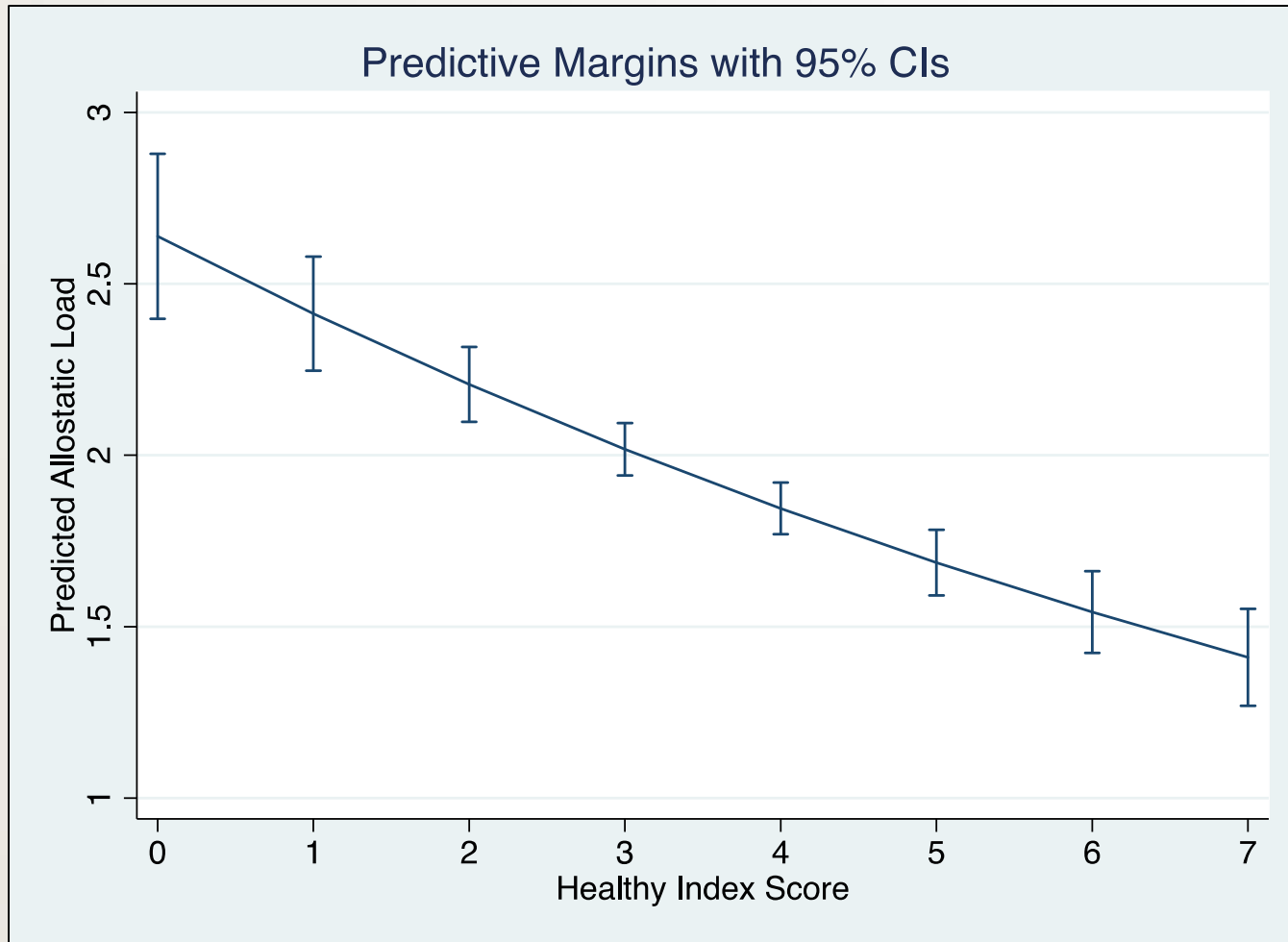
*Note: model also included medication use*

*Weighted regression, \*p<0.05, \*\*p<0.01, \*\*\* p<0.001*





# Health Index and AL

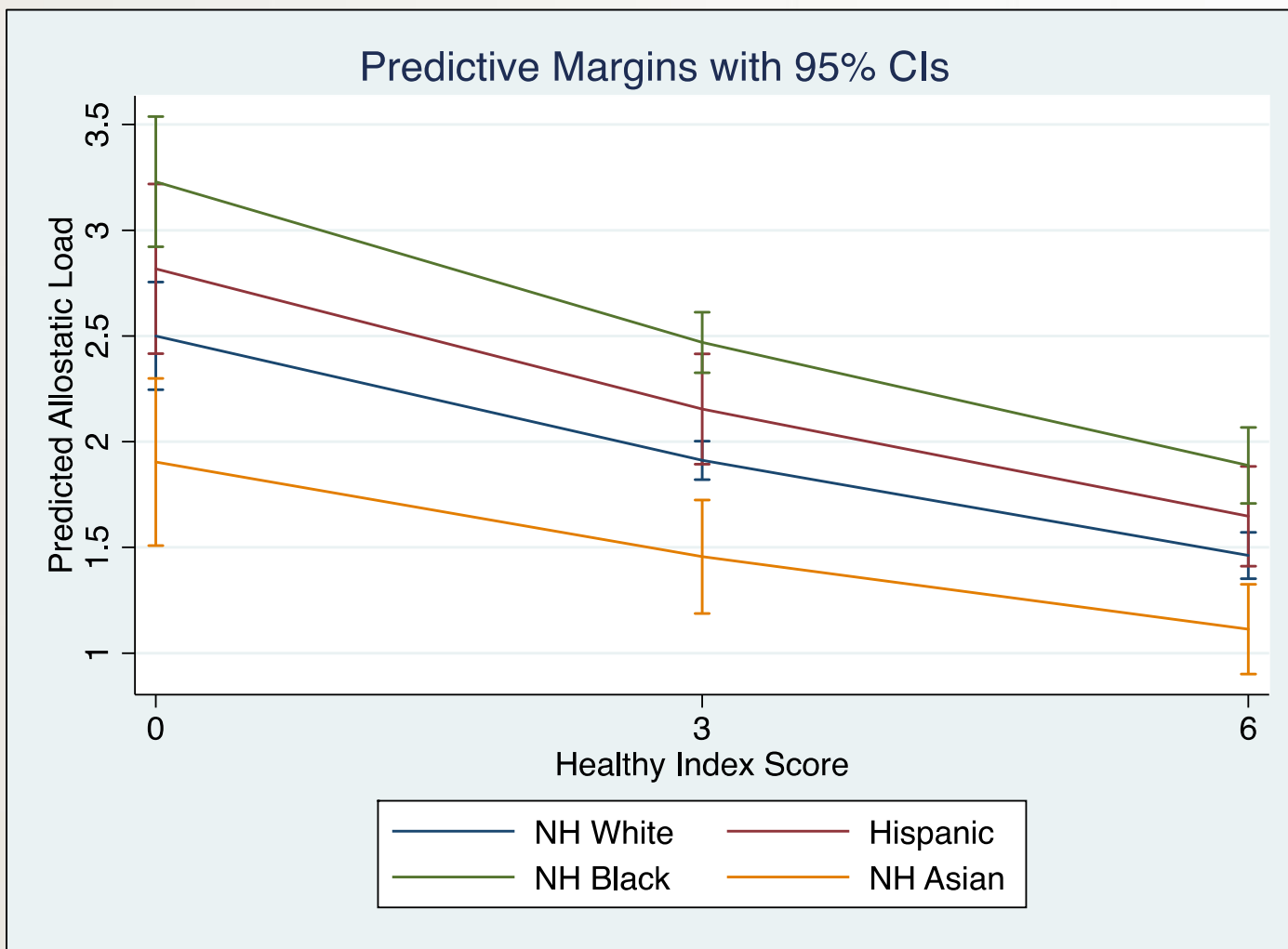


# Summary of Results

- Controlling for age, race, income, education, nativity status, and number of health conditions, the HI continues to have a strong, negative association with allostatic load
- Additionally, HI explains the variation seen in AL due to income level and education
- Although there were no significant race interactions with the variables in the model, we can see some race differences as main effects in the model



# Racial/Ethnic Differences in Predicted AL by Healthy Index Score



# Conclusions

- We find that the health index is a useful way to examine the combined association of several lifestyle factors with AL
- Here we have identified modifiable lifestyle factors that have a discernable effect on AL early in the life course
- This provides targets for health behavior interventions that could potentially reduce the burden of disease later in life



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# Thank you!

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